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Using Prompting and Modeling to Teach Imitation Skills and Eye Contact to Syrian Children with Autism Spectrum Disorder

Wissam Mounzer ^a, Donald M. Stenhoff ^b, Jamal M. Alkhateeb ^c, Amal J. Al Khatib ^d, Muna S. Alhadidi ^e, and Tristan T. Lyle ^b

^aDepartment of Special Education, Stockholm University, Stockholm, Sweden; ^bDepartment of Psychology, Arizona State University, Tempe, USA; ^cDepartment of Special Education, The University of Jordan, Amman, Jordan; ^dDepartment of Early Childhood Education, Queen Rania Faculty for Childhood, Hashemite University, Zarqa, Jordan

ABSTRACT

Lack of eye contact and imitation deficits are frequently targeted in behavioral interventions for children with autism spectrum disorder (ASD). In this study, we examined the effects of prompting and modeling on the imitation skills and eye contact of three Arabic-speaking young children with ASD in Syria. A multiple baseline design with a withdrawal component was used to evaluate the effects of the intervention in a clinical setting, at a center for children with special needs, and in follow-up sessions conducted in the participants' homes. All participants' imitative responses and eye contact increased when prompting and modeling were used. Our findings support the effectiveness of prompting and modeling on imitation skills.

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KEYWORDS



ASD; eye contact; imitation; modeling; prompting

Researchers report that imitation is crucial for acquiring numerous new skills, including daily living and social skills,^{1–4} For example, Silva and Fiske compared the effects of varying levels eye contact during discrete trial instruction (DTI) sessions.⁴ They found that the three participants who were diagnosed with autism spectrum disorder (ASD) acquired tacting skills faster when required to make eye contact during 100% of trials compared to 67% of trials. While several researchers studied treatment fidelity of DTI, including requiring eye contact (e.g., see refs.^{2,3}), Silva and Fiske's study further supported a functional relation between eye contact and skill acquisition.⁴

Imitation is also a prerequisite for the development of communication, implementation of many commonly used instructional practices, and effectiveness of observational learning.^{2,3,5,6} Imitation, which plays an important role in social interactions, is modulated by social signals such as eye contact.⁷ According to the Diagnostic and Statistical Manual of Mental Disorders, lack of eye contact is an early indicator of ASD.⁸ Eye contact is a vital skill required for communication and facilitating meaningful social interactions.⁹ Sustained eye contact may increase the probability of attending to necessary instructional stimuli and the rate of acquisition of skills.^{10,11} A substantial number of children with ASD have significant social, communication, and behavioral challenges, including lack of eye contact,^{12–17} This can significantly limit the skills these children can acquire through the process of observational learning. Therefore, extensive research over the past three decades has investigated the effectiveness and efficiency of several behavioral interventions in teaching eye contact responses and developing imitation in children with ASD.

Research has demonstrated that both least-to-most and most-to-least prompting strategies are effective in helping children with ASD learn a variety of new skills.¹⁸ However, currently, there is no established best practice prompting strategy to evoke eye contact with another individual; furthermore, using physical guidance to make eye contact may be overly intrusive.¹⁰ Silva and Fiske used a least-to-most prompting procedure to obtain eye contact in their study in which they stated the participant's name and waited 10 s.⁴ If the participant did not respond the researcher repeated the participant's name and provided a gestural prompt. In the present study, least-to-most prompting procedure was used because it: (a) is effective and easy to implement with single behaviors in a typical classroom environment (refs.^{19,20} and (b) allows the child a brief opportunity to respond independently on each training trial (ref.²¹ Additionally, the therapists in this study were most familiar with the least-to-most prompting procedure. The same prompt was used throughout the intervention with all participants. This prompting procedure may have exposed participants to intrusive or aversive procedures.¹⁰ Avoidance of intrusive prompts may function as negative reinforcement for unprompted responding.²²

Both prompting and modeling have been used for teaching a variety of skills to children with ASD, including eye contact (refs.^{12,23–25} and imitation.^{9,26,27} However, stimulus prompts may have certain disadvantages, such as being time-consuming and difficult to fade.⁹ Additionally, previous studies have reported mixed results, indicating that the effectiveness of different prompting procedures varies across participants.^{18,28,29} Therefore, it is suggested that the

CONTACT Wissam Mounzer  wissam.mounzer@specped.su.se  Department of Special Education, Stockholm University, Albanovägen 28, Stockholm 106 91, Sweden

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prompting procedure be dependent on the assessment of each individual child.³⁰ Markham et al. concluded that available research shows that prompting procedures may need to be individualized for the child and the task, and that no prompt type is universally effective across children.³¹

Previous studies have indicated that modeling can improve the effectiveness of prompts in teaching skills to children with developmental disabilities, including ASD (e.g., refs.^{6,20,32,33}). The benefits of modeling and prompting as methods to promote skill acquisition for children with ASD include immediate feedback, repetition of instruction, and cost efficiency,^{34–36} While modeling can be implemented independently to assess its effect on the acquisition of skill, it is commonly used with other strategies, such as prompting, reinforcement, scripting, and peer-mediated procedures.³⁷

Although ASD research has been growing globally in recent years, little research has been conducted on this disorder in Arab countries.³⁸ For example, Alallawi et al. conducted a review in which they found 70 studies conducted in Arab countries related to individuals with ASD.³⁹ Of the 70 studies, 59 were quantitative. However, only six studies evaluated interventions for children. This study aims to bridge this gap in research on interventions for children diagnosed with ASD in these countries. It also intends to illuminate the cultural aspects of ASD, which have been largely ignored thus far.⁴⁰

The World Health Organization reported that across Arab countries there is a lack of sufficient data and evidence on the different aspects of ASD.⁴¹ In these countries, there are tremendous challenges in the provision of effective interventions for children with ASD, such as the stigma associated with the disorder, critical shortages of special education and behavioral interventions, and shortages of qualified personnel and facilities.⁴² Given that very little research has been conducted on children with ASD in Syria or other Arab countries, this study evaluated the effectiveness of prompting in combination with modeling in teaching skills to children with ASD in Syria. While the techniques applied may be similar across different countries, the setting in the current study is distinctly unique, as the region has been engaged in civil war since 2011. This offers a distinct challenge in that the children who live in Syria may be separated from their family, experienced trauma due to the brutality of war, and face barriers to services.^{43,44} The purpose of the current study was to increase the empirical research originating from Arab countries, and to assess the extent to which prompting and modeling procedures are effective in increasing eye contact and imitation skills in Syrian children diagnosed with ASD. The following research questions were addressed: (a) to what extent does modeling with least to most prompting increase eye contact in Syrian children diagnosed with ASD?, and (b) to what extent does modeling with least to most prompting increase imitation skills in Syrian children diagnosed with ASD?

Method

Participants

Three Arabic-speaking children, who were referred by their parents, participated in the study. All participants were diagnosed with ASD and were rated low (a score below 70) across

all domains (communication, daily living skills, socialization, and adaptive behavior composite) of the Vineland Adaptive Behavior Scales.⁴⁵ The participants' parents and therapists were interviewed individually to collect demographic information (e.g., age, sex, and imitation skills).

Hamza was a 3-year-old male with a Vineland Adaptive Behavior Composite (ABC) score of 64 (low). His parents and therapists reported that he had no functional communication skills but made sounds such as “ba” and “ma.” He was able to play independently, but did not play with other children and avoided eye contact with others. Hamza engaged in self-injurious behavior (SIB; i.e., picking and biting his fingertips) and stereotypy (i.e., staring at his hands, hand flapping, and rocking). His care providers reported that he cried and ran away when he heard loud sounds or when they touched him.

Hala was a 4-year-old female with a Vineland ABC score of 55 (low). According to her care providers, her vocal repertoire was similar to Hamza's but she also engaged in humming, and avoided eye contact with others. She displayed ritualistic behavior patterns, including watching objects fall, arm flapping, spinning objects, turning light switches on and off, and toe walking.

Ali was a 5-year-old male with a Vineland ABC score of 45 (low). His care providers reported that he did not display any vocal repertoire at all. He did not play with other children but engaged in solitary play, consisting mainly of repetitive acts. Ali avoided social interactions and averted eye contact. His care providers reported that he did not respond when normally painful stimuli were present (e.g., bumping into things or getting a vaccine shot), and he engaged in biting clothing and a sponge, and in SIB, including banging his head on the table.

Setting

The study was conducted at a center for children with special needs, located in a large metropolitan area in Syria. All sessions were conducted in 4 × 5-meter (13 × 16 feet) rooms with a window and balcony. The rooms contained child-sized tables, chairs, a small wardrobe, a visual schedule listing the daily routine, and were equipped with video cameras that recorded the sessions. Follow-up sessions were conducted in the participants' homes.

Response Definitions and Interobserver Agreement

Percentage of Correct Imitative Responses

The first dependent variable was the percentage of correct independent imitative responses per session (prompted responses were not scored as correct). A correct response was scored if the participant imitated the therapists' model within five seconds and sustained the response for two seconds. The first author, and two therapists at the center, implemented the intervention. All participants' therapy goals included increasing imitation skills and eye contact. Participants' imitation and eye contact skills were evaluated at intake. Prior to the onset of the study, each participant's parent reported their child's level of imitation and eye contact skills and whether these should be addressed in their clinical program as a goal. Thus, the

imitation skill goal was developed in their program and used for the study.

The participants' parents and therapists selected the targeted imitation skills from a list of target responses. Hamza's targeted imitation skills were smiling, puckering lips, and imitating vocal sounds (e.g., "ba ba"); Hala's targeted imitation skills were raising and clapping hands; and Ali's were knocking on the table and raising thumbs.

Eye Contact

The second dependent variable was eye contact. While there is a lack of a consistent and uniform definition of eye contact (ref.⁴⁶ for purposes of this study, correct eye contact was defined as the participant's eyes were oriented toward the therapist's face within five seconds of the therapist's request, "look at me," and was sustained for five seconds (ref.²³ Eye contact was calculated as the number of times that the participant looked at the therapist following the therapist's request for them to do so.

Data were collected from the first author's video recordings and then compared with the therapists' data on 100% of the sessions for interobserver agreement (IOA). IOA on the percentage of correct imitative responses was calculated trial-by-trial by dividing the number of trials with agreement by the total number of trials and multiplied by 100.⁴⁷ During baseline, mean agreements were 100% for Hamza, 98% (range, 88% to 100%) for Hala, and 93% (range, 88% to 100%) for Ali. During treatment sessions, mean agreements were 82% (range, 69% to 94%) for Hamza, 91% (range, 69% to 100%) for Hala, and 90% (range, 88% to 100%) for Ali. IOA on eye contact was assessed through live observation. The first author and a therapist observed the child's eye contact for each trial and independently coded each response as correct or incorrect based on the definition of the target behavior. IOA for the percentage of eye contact per session was 100%.

Experimental Design

A multiple baseline design across participants was used to evaluate the effects of imitation training on imitative skill acquisition. A withdrawal design was embedded within the multiple baseline design to minimize threats to internal validity.⁴⁸ During withdrawal phases, sessions were conducted until stable responding was achieved. Two therapists, who have been working in the special education field for 10 years, implemented the sessions. To ensure correct implementation of procedures, the first author monitored the therapists' behaviors in each session and provided corrective feedback. We aimed to use this design because it provides a greater degree of control for our target skills and ends the experiment with treatment instead of an absence of an intervention. In addition, it would allow us to demonstrate the functional relation between the use of least-to-most prompt and an increase of eye contact, etc.)

Baseline

During baseline, there were 10 trials per session, and all sessions were conducted in Arabic. The therapist and participant

sat across from each other at a table, and the session began when the therapist said, "Look at me." If the participant's eyes did not orient toward the therapist's face, or if the participant tried to leave the table after sitting down, the therapist would block the response and say, "First play, then take a break." This phrase was used in the study since it was commonly used during therapy sessions at the center. The therapist then said, "Do this." If no response occurred within five seconds, the therapist repeated the statement and waited an additional five seconds. If the participant responded correctly, the therapist provided a statement of affirmation (e.g., "good job" or "bravo"). Based on prior observation, reinforcers, such as vocal praise and access to preferred stimuli, were used. Varied reinforcers were used for participants in the study: Hamza received praise, play, and plastic toys; Hala received praise, popcorn, and videos; and Ali received praise, a phone, and toy cars.

Prompting and Modeling

Prompting and live modeling sessions were conducted five days per week for 30 to 45 minutes. Following baseline, prompting and live modeling were provided for eye contact and imitative responses. Following the "look at me" direction, if the participant did not make eye contact, a least-to-most prompting procedure was used, in which therapists modeled eye contact, provided a prompt using a light (the therapist would say, "Look at me," and then shine the light toward his own eyes), snapped their fingers, and finally helped the participant to move their head toward the therapist. During the 10 prompting and modeling trials, the therapist first modeled the target behavior. If the participant did not imitate the model, a least-to-most prompting hierarchy was used (i.e., vocal, partial-physical, and full physical prompting). To verify treatment effects, a second baseline phase was added.⁴⁹ Subsequently, the intervention (i.e., prompting and live modeling) was reinstated. The therapist then repeated the model and checked for an imitative response. An error correction was not provided if the participant's response was incorrect. However, as with baseline, reinforcers were provided immediately following a correct independent response, while no reinforcers were provided for prompted correct responses. The mastery criterion was 80% correct responses over three consecutive sessions.⁵⁰ Generalization checks of the target behavior were assessed in other areas of the clinic (e.g., sitting on the floor or standing away from the table) and with other therapists; a total of five generalization trials were presented per week. Prompt fading was implemented to help participants gain independence, and when they began to respond correctly, the prompt level gradually faded.

Follow-Up

Follow-up sessions occurred two and five weeks after the final prompting and modeling session at the center and at the participants' homes, respectively. The participants' home therapist conducted generalization trials two and five weeks

after the participants fulfilled the mastery criteria. The same baseline procedures were used during the follow-ups.

Procedural Fidelity

As mentioned earlier, two therapists working in the field of special education for 10 years implemented the sessions. To ensure the correct implementation of the procedures, the first author monitored the therapists' behaviors during each session and provided corrective feedback. The first author could select "Yes" or "No." The checklist provided space for the assessor to record details verbatim from the intervention record that would require either evidence of where the component had been delivered or why the part was not deliverable. To calculate procedural fidelity, we addressed a list of the steps involved in performing the procedures for both eye contact and non-verbal imitation, Figures 1 and 2. Moreover, we record whether each step was being performed correctly. Then, divide the number of correctly performed steps by total number of steps in the task to get a percentage of procedural fidelity. The first author also collected fidelity data on the therapists' procedures during 26% of baseline sessions and for 26% of training sessions. Using a checklist, procedural fidelity data were calculated as the percentage of steps performed correctly and were scored out of 100%.

Social Validity

A social validity questionnaire was administered to the participants' parents ($N = 6$ parents). They were asked questions about: (a) whether they felt the intervention was socially acceptable; (b) whether the intervention produced socially important outcomes; (c) whether the intervention was effective; (d) which prompting procedures they preferred; and (e) whether they were satisfied with the results. These questions were developed specifically for this study, and the parents responded to them on a 5-point Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree) Table 1.

Results

In the current study, the effects of prompting and modeling on eye contact and correct imitative responses were assessed. The percentage of eye contact improved across participants (Figure 3, Table 2).

For all participants, eye contact occurred in nearly 0% of the opportunities at baseline; however, once the prompting and modeling were introduced, there was an immediate change in level to a mean percentage of opportunities in which eye contact occurred immediately increased to 48% for Hamza (range, 50% to 90%), 44% for Ali (range, 30% to 50%), and 43% for Hala (range, 40% to 50%). Once prompting and modeling were withdrawn, the participants' eye contact levels dropped to near baseline levels, with no overlap with the previous prompting and modeling condition data. Once prompting and modeling were reintroduced, Hamza's mean

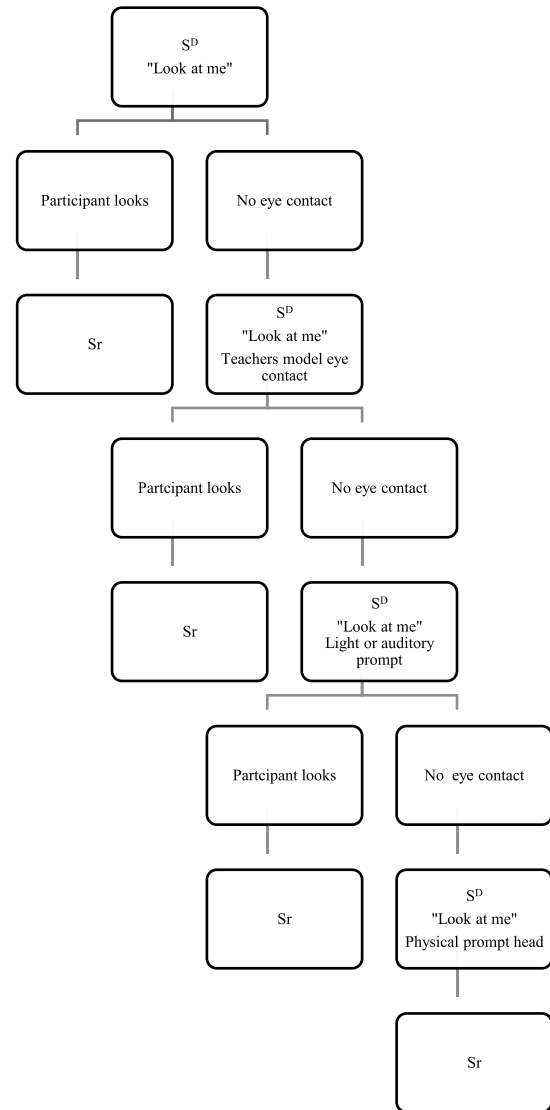


Figure 1. Eye contact prompting procedure.

eye contact increased to 77% (range, 50% to 90%), Ali's to 67% (range, 40% to 90%), and Hala's to 74% (range, 50% to 90%), with all participants showing an increasing trend. Of note, from the first baseline to the modeling and prompting condition, there were no overlapping data. This was also observed between the second baseline and treatment phase. When eye contact was assessed at follow-up, all participants' percentages of eye contact were maintained at levels similar to that at the end of the final prompting and modeling condition.

Similarly, the results indicated that prompting and modeling increased participants' imitative responses (Figure 4, Table 3). During baseline, all three participants scored correctly in less than 20% of the sessions. Once the prompting and modeling conditions were introduced, there was an immediate increase in the level of correct imitation with no overlapping data points compared to the baseline for Hamza ($M = 42%$; range, 30% to 50%), Ali ($M = 43%$; range, 30% to 50%), and Hala ($M = 44%$; range, 40% to 50%). Once the baseline was

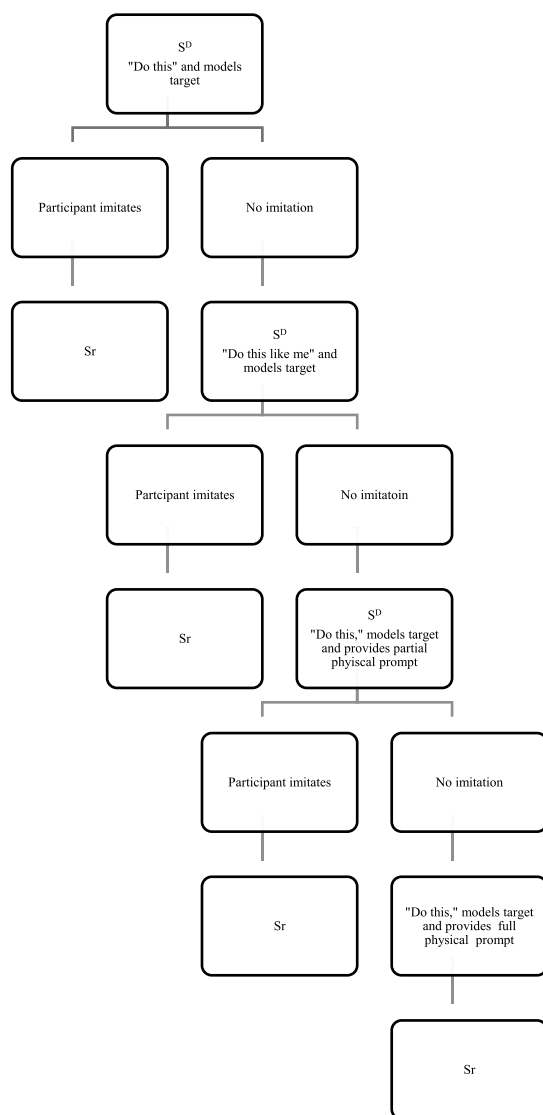


Figure 2. Nonverbal imitation prompting Procedure.

reinstated, there was an immediate decrease in the level with no overlap between the initial model and the prompting condition. When the prompting and modeling phase were reinstated, Hamza's percentage of correct imitative responses increased to a mean of 73% (range, 60% to 90%), Ali's increased to a mean of 68% (range, 50% to 80%), and Hala's increased to a mean of 68% (range, 40% to 80%), with no overlapping data points from the second baseline to the final modeling and prompting phase.

All three participants' percentages of correct imitative responses increased during the prompting and modeling conditions with no overlap with the adjacent baseline

condition, and all three participants met the 80% mastery criteria. During follow-up at two and five weeks after the final prompting and modeling session at the clinic, the participants' percentage of correct imitative responses-maintained outcomes similar to the final prompting and modeling condition.

Discussion

The findings of this study are similar to those of Logan et al., in that prompting and modeling were effective for teaching imitation skills to children diagnosed with ASD.⁵¹ The findings are also consistent with Kleeberger and Miranda (ref.²⁷ and Cardon (ref.⁵² who found that imitation skills were maintained and generalized when compared to baseline levels.

The results of our study are promising. While the use of modeling has been successful in Early Intensive Behavioral Intervention (EIBI) programs (e.g., refs.^{24,53} there has been no research in regions in which trauma-inducing situations are prevalent due to civil war (e.g., Syria). Barr reported that early trauma could hinder skill development in children.⁵⁴ While the current study did not directly examine that aspect, our results demonstrated that children are able to learn with modeling and maintain the skills learned at least one month after the end of the intervention, regardless of the civil conflict in their country. Additionally, the participants were able to learn a range of skills, including raising hands, knocking on a table, clapping hands, raising thumbs, smiling, puckering lips, sticking out tongues, and imitating vocal sounds (e.g., saying "ba ba") from the modeling procedures.

The current study demonstrated the effectiveness of a combination of least-to-most prompting and video modeling in increasing eye contact and imitation skills in children with ASD in a specific cultural context (i.e., Middle Eastern culture) that differed from cultures considered in most prior studies. The results of this study are consistent with previous studies that revealed the effectiveness of presenting least-to-most prompting together with video modeling in teaching skills to children with ASD (e.g., refs.^{20,55} Participants in the current study also maintained eye contact skills during follow-up checks. This is encouraging, because we were able to demonstrate these outcomes in the Syrian context, where prolonged eye contact is expected during interaction with individuals of the same age, gender, or status.⁵⁶

All the participants' parents scored high on the social validity questions ($M = 4.6$; range, 4 to 5) and reported that they preferred model prompting and physical prompts to gestural and verbal prompts. Parents were also asked about the intervention effects, and all replied favorably (e.g., they thought the intervention was effective and they enjoyed seeing a less intrusive prompt).

Table 1. Social validity questionnaire.

	N	Min	Max	Mean	Std. Deviation
I felt that the program was socially acceptable	6	4	5	4.67	.52
The program produced socially important outcomes	6	4	5	4.67	.52
The program fit well the child program instructional style	6	3	5	4.17	.75
The intervention was effective	6	4	5	4.67	.52
I was satisfied with the results	6	4	5	4.67	.52
Total	6	4.2	5	4.57	.37

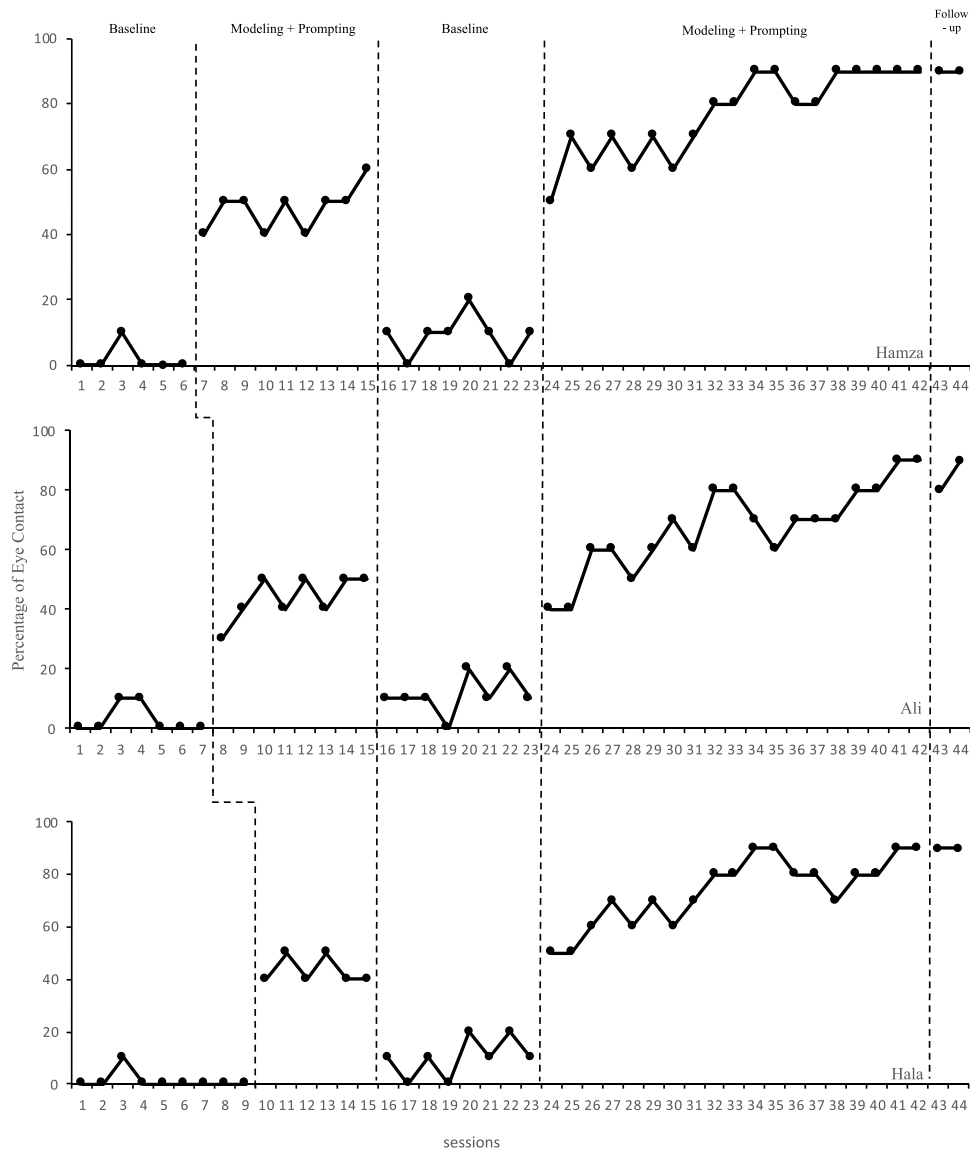


Figure 3. Percentage of eye contact by session.

Table 2. Eye contact descriptive statistics.

Participant	Mean (range) PND			
	Baseline	Modeling + Prompting	Baseline	Modeling + Prompting
Hamza	1.7% (0–10%)	48% (50–90%) PND = 0	8.8% (10–20%)	77% (50–90%) PND = 0
Ali	2.9% (0–10%)	44% (30–50%) PND = 0	11.3% (10–20%)	67% (40–90%) PND = 0
Hala	1.1% (0–10%)	43% (40–50%) PND = 0	10% (0–20%)	74% (50–90%)
Mean	1.9%	45%	10%	72.7%

While the results of the study were favorable, a few limitations should be noted. First, the therapists’ implementation of the intervention was overseen by the first author; however, intervention fidelity data were not collected in this study. Therefore, caution should be exercised when interpreting and generalizing outcomes of the intervention implemented in the current study.⁵⁷ Second, the results of this study should

be interpreted with caution because it was conducted on three young children with ASD. This limits the generality of the findings to other young children with ASD, and not to older children. Therefore, researchers should examine the external validity of these findings with a more diverse age group and with other non-English languages, except for Arabic. Third, while generalization in the clinic was checked and was directly

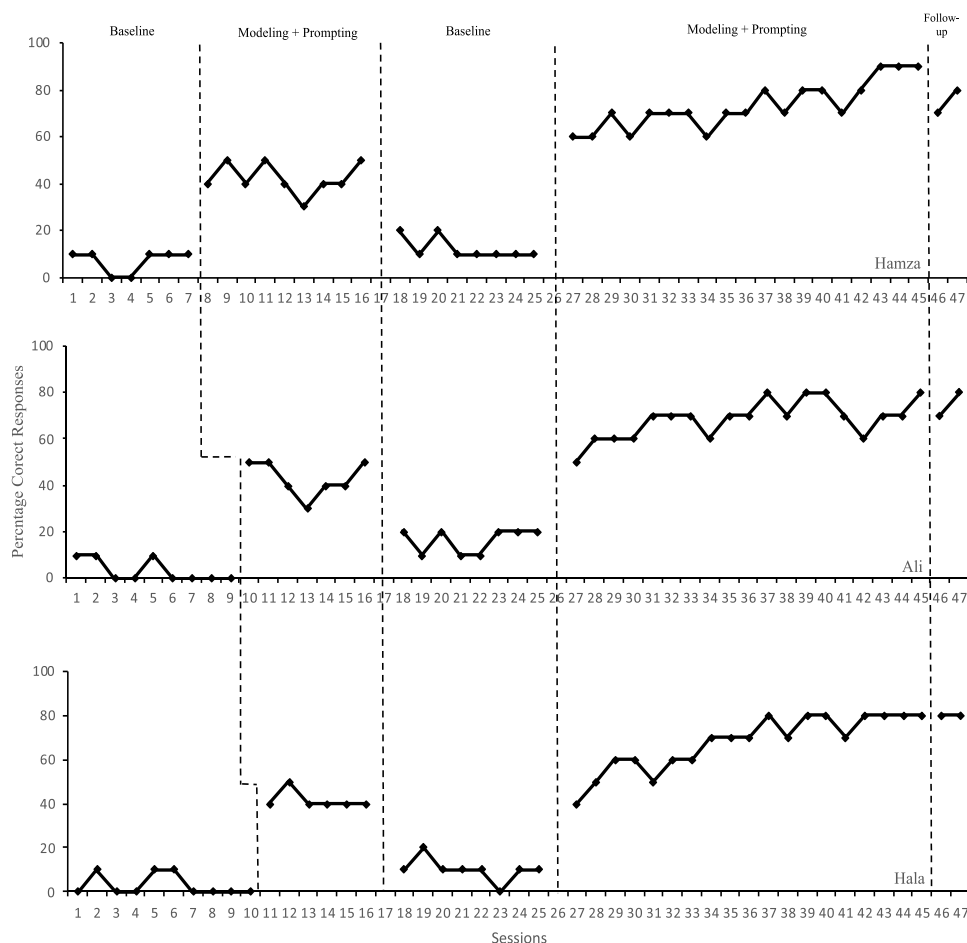


Figure 4. Percentage of correct imitative responses by session.

Table 3. Correct imitative responses descriptive statistics.

Participant	Mean (range) PND			
	Baseline	Modeling + Prompting	Baseline	Modeling + Prompting
Hamza	7.1% (0–10%)	42% (30–50%) PND = 0	12.5% (10–20%)	73% (60–90%) PND = 0
Ali	3.3% (0–10%)	43% (30–50%) PND = 0	16.3% (10–20%)	68% (50–80%)
Hala	3% (0–10%)	44% (40–50%) PND = 0	10% (0–20%)	68% (40–80%),
Mean	4.5%	43%	12.9%	69.7%

assessed during follow-up, it was not directly measured during the prompting and modeling conditions. Finally, while social validity was assessed with the parents, the study did not assess social validity of the therapists. Researchers should address this in future studies.

There were limitations in the design of the study that should be addressed. First, the purpose of introducing this intervention (live modeling plus least-to-most prompting) with these three children was to achieve the final goal of increasing imitative responses and eye contact as quickly as possible. However, the lack of rigorous experimental control is a major limitation. Future research could evaluate each component of this treatment package. Additionally, the study did not include the percentage of trials in which least-to-

most prompting was used. Future research should include this measure.

Second, intervention with Ali and Hala started too early, without first waiting for a treatment effect for the participants that preceded them. The intervention with Ali started after collecting only two data points during the intervention with Hamza, and the intervention with Hala started after only one data point was collected with Ali. It is typical in a multiple-baseline design to wait until dependent measure stability in the preceding participant's data is established.⁵⁸ In addition, a withdrawal was embedded in the multiple-baseline design to demonstrate sound experimental control. Withdrawal is not usually used if acquired skills cannot be unlearned. However, all participants emitted

lower correct imitative and eye contact responses when baseline conditions were reinstated. While this phenomenon was not assessed, it is possible that the participants were not fluent in either skill during the return to baseline but were fluent during follow-up, thus explaining the decrease in correct responses during the return to baseline. Finally, the ability of children to imitate novel movements and behaviors was not assessed in the present study. Despite these limitations, this study offers potentially useful teaching procedures that can be used effectively to support learning in children with ASD in low-income underserved communities.

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ORCID

Wissam Mounzer  <http://orcid.org/0000-0001-9133-7618>
 Donald M. Stenhoff  <http://orcid.org/0000-0003-4703-0621>
 Jamal M. Alkhateeb  <http://orcid.org/0000-0002-1667-5710>
 Amal J. Al Khatib  <http://orcid.org/0000-0003-3585-6872>
 Muna S. Alhadidi  <http://orcid.org/0000-0001-6272-4352>
 Tristan T. Lyle  <http://orcid.org/0000-0002-3841-5928>

Authors' Contributions

All authors contributed to the study design and material preparation. WM was responsible for the literature review, data collection, data analyses, and completed the initial and final drafts. DS, JK, and AK added additional narrative and revised the first draft of the manuscript. MSA and TT joined the research group and assisted with revision and development of the final manuscript. All authors commented on previous versions of the manuscript, and read and approved the final manuscript.

Consent

Informed consent was obtained from all parents and teachers of children included in the study.

Data Availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Approval

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

This work was carried out following the Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans and its later amendments or comparable ethical standards. According to national and international regulations, the protocol was approved by the Ethics Committee from Damascus University, Department of Psychology. Due to the affiliation change for the first author from Damascus University to Stockholm University, the Swedish

Ethical Review Authority approved a new ethics review application (approval number 2022–01262–01).

The integrity of the participants was assured. The families were asked permission to collect the relevant information for the study. Informed consent was obtained from all parents and/or legal guardians for participating children. Parents could interrupt their children's participation at will. Furthermore, parents had access to the data and were able to select what data could be used or not without penalties. The written consent form was presented and explained to clarify any doubts. Data protection has been considered.

References

- Carroll RA, Kodak T, Adolf KJ. Effect of delayed reinforcement on skill acquisition during discrete-trial instruction: implications for treatment integrity errors in academic settings. *J App Behav Anal.* 2016;49(1):176–81. doi:10.1002/jaba.268.
- Greer RD, Ross DE. Verbal behavior analysis: inducing and expanding new verbal capabilities in children with language delays. Boston: Allyn & Bacon; 2008.
- Lovaas OI. Teaching individuals with developmental delays. Austin: Pro-Ed, Inc; 2003.
- Silva DP, Fiske KE. Evaluating the effects of establishing eye contact on the skill acquisition of individuals with autism. *J Behav Educ.* 2021;30(4):708–23. doi:10.1007/s10864-020-09391-5.
- Ledford JR, Wolery M. Teaching imitation to young children with disabilities: a review of the literature. *Topics Early Child Spec Educ.* 2011;30(4):245–55. doi:10.1177/0271121410363831.
- McDowell LS, Gutierrez A, Bennett KD. Analysis of live modeling plus prompting and video modeling for teaching imitation to children with autism. *Behav Intervent.* 2015;30(4):333–51. doi:10.1002/bin.1419.
- Wang Y, Newport R, Hamilton AF. Eye contact enhances mimicry of intransitive hand movements. *Biol Lett.* 2011;7(1):7–10. doi:10.1098/rsbl.2010.0279.
- American Psychiatric Association. Diagnostic and statistical manual of mental disorders (DSM-V). Washington, DC: American Psychiatric Association; 2022.
- Carbone VJ, O'Brien L, Sweeney-Kerwin EJ, Albert KM. Teaching eye contact to children with autism: a conceptual analysis and single case study. *Educ Treat Children.* 2013;36(2):139–59. doi:10.1353/etc.2013.0013.
- Conine DE, Vollmer TR, Barlow MA, Grauerholz-Fisher E, Dela Rosa CM, Petronelli AK. Assessment and treatment of response to name for children with autism spectrum disorder: toward an efficient intervention model. *J App Behav Anal.* 2020;53(4):2024–52. doi:10.1002/jaba.737.
- Fonger AM, Mallott RW. Using shaping to teach eye contact to children with autism spectrum disorder. *Behav Anal Pract.* 2018;12(1):216–21. doi:10.1007/s40617-018-0245-9.
- Cook JL, Rapp JT, Mann KR, McHugh C, Burji C, Nuta R. A practitioner model for increasing eye contact in children with autism. *Behav Modif.* 2017;41(3):382–404. doi:10.1177/0145445516689323.
- Jeffries T, Crosland K, Miltenberger R. Evaluating a tablet application and differential reinforcement to increase eye contact in children with autism. *J App Behav Anal.* 2016;49(1):182–87. doi:10.1002/jaba.262.
- Ingersoll B. The social role of imitation in autism: implications for the treatment of imitation deficits. *Infant Young Child.* 2008;21(2):107–19. doi:10.1097/01.IYC.0000314482.24087.14.
- Rogers SJ, Hepburn SL, Stackhouse T, Wehner E. Imitation performance in toddlers with autism and those with other developmental disorders. *Child Psychol Psychiatry.* 2003;44(5):763–81. doi:10.1111/1469-7610.00162.
- Stewart HJ, McIntosh RD, Williams JHG. A specific deficit of imitation in autism spectrum disorders. *Autism Res.* 2013;6(6):522–30. doi:10.1002/aur.1312.
- Van Etten HM, Carver LJ. Does impaired social motivation drive imitation deficits in children with autism spectrum disorder? *Rev*

- J Autism Dev Disord. 2015;2(3):310–19. doi:10.1007/s40489-015-0054-9.
18. Cengher M, Shamoun K, Moss P, Roll D, Feliciano G, Fienup DM. A comparison of the effects of two prompt-fading strategies on skill acquisition in children with autism spectrum disorders. *Beh Anal Pract.* 2015;9(2):115–25. doi:10.1007/s40617-015-0096-6.
 19. Ferguson JL, Cihon J, Leaf JB. The utility of a least-to-most prompting procedure on the acquisition of multisymbol messages for children with autism spectrum disorder. *Evidence-Based Comm Assess Inter.* 2017;11(1–2):1–6. doi:10.1080/17489539.2017.1319016.
 20. Murzynski NT, Bourret JC. Combining video modeling and least-to-most prompting for establishing response chains. *Behav Intervent.* 2007;22(2):147–52. doi:10.1002/bin.224.
 21. Libby ME, Weiss JS, Bancroft S, Ahearn WH. A comparison of most-to-least and least-to-most prompting on the acquisition of solitary play skills. *Behav Anal Practice.* 2008;1(1):37–43. doi:10.1007/BF03391719.
 22. Karsten AM, Carr JE. The effects of differential reinforcement of unprompted responding on the skill acquisition of children with autism. *J App Behav Anal.* 2009;42(2):327–34. doi:10.1901/jaba.2009.42-327.
 23. Rapp JT, Cook JL, Nuta B, Crouchman K, Jenkins C, Karim S, Watters-Wybro C, Watters-Wybro C. Further evaluation of a practitioner model for increasing eye contact in children with autism. *Behav Modif.* 2019;43(3):389–412. doi:10.1177/0145445518758595.
 24. Steinbrenner JR, Hume K, Odom SL, Morin KL, Nowell SW, Tomaszewski B, Szendrey S, McIntyre NS, Yucesoy-Ozkan S, Savage MN. Evidence-based practices for children, youth, and young adults with autism. Uni North Carolina Chapel Hill, Frank Porter Graham Child Dev Inst, Nat Clearinghouse Autism Evidence Practice Rev Team. 2020. <https://files.eric.ed.gov/fulltext/ED609029.pdf>.
 25. Wong C, Odum SL, Hume KA, Cox AW, Fettig A, Kucharczyk S, Schultz TR, Plavnick JB, Fleury VP, Schultz TR. Evidence-based practices for children, youth, and young adults with autism spectrum disorder: a comprehensive review. *J Autism Dev Disord.* 2015;45(7):1951–66. doi:10.1007/s10803-014-2351-z.
 26. Cardon T, Wilcox M. Promoting imitation in young children with autism: a comparison of reciprocal imitation training and video modeling. *J Autism Dev Disord.* 2011;41(5):654–66. doi:10.1007/s10803-010-1086-8.
 27. Kleeberger V, Miranda P. Teaching generalized imitation skills to a preschooler with autism using video modeling. *J Posit Behav Interv.* 2010;12(2):116–27. doi:10.1177/1098300708329279.
 28. Neitzel J, Wolery M. Steps for implementation: least-to-most prompts. Chapel Hill, NC: National Professional Development Center on Autism Spectrum Disorders, Frank Porter Graham Child Development Institute, The University of North Carolina; 2009.
 29. Schnell LK, Vladescu JC, Kisamore AN, RM D, Kahng S, Marano K. Assessment to identify learner-specific prompt and prompt-fading procedures for children with autism spectrum disorder. *J Appl Beh Anal.* 2020;53(2):1111–29. doi:10.1002/jaba.623.
 30. Foran-Conn D, Hoerger M, Kelly E, Cross RR, Jones S, Walley H, Lauren Firth L. A comparison of most to least prompting, no-no prompting and responsive prompt delay procedures. *Behav Intervent.* 2021;36(4):1024–41. doi:10.1002/bin.1808.
 31. Markham V, Giles A, May R. Evaluating efficacy and preference for prompt type during discrete-trial teaching. *Behav Modif.* 2020;44(1):49–69. doi:10.1177/0145445518792245.
 32. Cannella-Malone HI, Miller O, Schaefer JM, Jimenez ED, Page EJ, Sabelny LM. Using video prompting to teach leisure skills to students with significant disabilities. *Except Child.* 2016;82(4):463–78. doi:10.1177/0014402915598778.
 33. Tetreault AS, Lerman DC. Teaching social skills to children with autism using point-of-view video modeling. *Educ Treat Children.* 2010;33(3):395–419. doi:10.1353/etc.0.0105.
 34. Gardner S, Wolfe P. Use of video modeling and video prompting interventions for teaching daily living skills to individuals with autism spectrum disorders: a review. *Res Pract Pers Sev D.* 2013;38(2):73–87. doi:10.2511/027494813807714555.
 35. Kellems RO, Frandsen K, Hansen B, Gabrielsen T, Clarke B, Simons K, Clements K. Teaching multi-step math skills to adults with disabilities via video prompting. *Rsrch In Dev Disabilities.* 2016;58:31–44. doi:10.1016/j.ridd.2016.08.013.
 36. Park J, Bouck E, Duenas A. The effect of video modeling and video prompting interventions on individuals with intellectual disability: a systematic literature review. *J Spec Educ Technol.* 2019;34(1):3–16. doi:10.1177/0162643418780464.
 37. Quigley J, Griffith AK, Kates-McElrath K. A comparison of modeling, prompting, and a multi-component intervention for teaching play skills to children with developmental disabilities. *Behav Anal Pract.* 2018;11(4):315–26. doi:10.1007/s40617-018-0225-0.
 38. Alnemery F, Alnemery FM, Alamri Y. Autism research: where does the Arab world stand? *Rev J Autism Dev Disord.* 2017;4(2):157–64. doi:10.1007/s40489-017-0104-6.
 39. Alallawi B, Hastings R, Gray GA. A systematic scoping review of social, educational, and psychological research on individuals with autism spectrum disorder and their family members in Arab countries and cultures. *Rev J Autism Dev Disord.* 2020;7(4):364–82. doi:10.1007/s40489-020-00198-8.
 40. Kang-Yi CD, Grinker RR, Mandell DS. Korean culture and autism spectrum disorders. *J Autism Dev Disord.* 2013;43(3):503–20. doi:10.1007/s10803-012-1570-4.
 41. World Health Organization. Summary report on the first stakeholders' meeting for developing an Arab report on disability; 2012; https://applications.emro.who.int/docs/IC_Meet_Rep_2013_EN_14926.pdf.
 42. Al Khateeb JM, Kaczmarek L, Al Hadidi MS. Parents' perceptions of raising children with autism spectrum disorders in the United States and Arab countries: a comparative review. *Aut: The Inter J Res Pract.* 2019;23(7):1645–54. doi:10.1177/1362361319833929.
 43. Mounzer W, Stenhoff DM, Alkhateeb JM, Khatib AJ. A follow-up study of early intensive behavioral intervention program for children with autism in Syria. *Sci Rep.* 2023 13;13(1). doi:10.1038/s41598-022-27198-4.
 44. United Nations Children's Emergency Fund. Syrian Crisis Rep. 2019. <https://www.unicef.org/emergencies/syrian-crisis>.
 45. Sparrow SS, Cicchetti DV, Saulnier CA. Vineland adaptive behavior scales. 3rd. San Antonio: Pearson; 2016.
 46. Jongerius C, Hessels RS, Romijn JA, Smets EMA, Hillen MA. The measurement of eye contact in human interactions: a scoping review. *J Nonverbal Behav.* 2020;44(3):363–89. doi:10.1007/s10919-020-00333-3.
 47. Cooper JO, Heron TE, Heward WL. Applied behavior analysis. 2nd. Upper Saddle River, New Jersey: Pearson; 2007.
 48. Coon JC, Rapp JT. Application of multiple baseline designs in behavior analytic research: evidence for the influence of new guidelines. *Behav Intervent.* 2018;33(2):160–72. doi:10.1002/bin.1510.
 49. Michiels B, Onghena P. Randomized single-case AB phase designs: prospects and pitfalls. *Behav Res Methods.* 2019;51(6):2454–76. doi:10.3758/s13428-018-1084-x.
 50. McCormack J, Arnold SA, Elliffe D. The differential outcomes effect in children with autism. *Behavioral Intervent.* 2017;32(4):357–69. doi:10.1002/bin.1489.
 51. Logan SM, Anibal G, Kyle DB. Analysis of live modeling plus prompting and video modeling for teaching imitation to children with autism. *Behavioral Intervent.* 2015;30(4):333–51. doi:10.1002/bin.1419.
 52. Cardon TA. Teaching caregivers to implement video modeling imitation training via iPad for their children with autism.

- Research in Autism Spectrum Disorders. 2012;6(4):1389–400. doi:[10.1016/j.rasd.2012.06.002](https://doi.org/10.1016/j.rasd.2012.06.002).
53. National Autism Center. Findings and conclusions: national standards project, phase 2. Author; 2015.
54. Barr DA. When trauma hinders learning. *Phi Delta Kappan*. 2018;99(6):39–44. doi:[10.1177/0031721718762421](https://doi.org/10.1177/0031721718762421).
55. Ulke-Kurkcuoglu B. A comparison of least-to-most prompting and video modeling for teaching pretend play skills to children with autism spectrum disorder. *Edu Sci Theory Pract*. 2015;15(2):499–517. doi:[10.12738/estp.2015.2.2541](https://doi.org/10.12738/estp.2015.2.2541).
56. Al-Krenawi A, Graham JR. Culturally sensitive social work practice with Arab clients in mental health settings. *Health Soc Work*. 2000;25(1):9–22. doi:[10.1093/hsw/25.1.9](https://doi.org/10.1093/hsw/25.1.9).
57. Capin P, Walker MA, Vaughn S, Wanzek J. Examining how treatment fidelity is supported, measured, and reported in K-3 reading intervention research. *Educ Psychol Rev*. 2018;30(3):885–919. doi:[10.1007/s10648-017-9429-z](https://doi.org/10.1007/s10648-017-9429-z).
58. Kazdin AE. *Single-case research designs: methods for clinical and applied settings*. 2nd. New York, NY: Oxford University Press; 2010.