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BRIEF PRACTICE

Using Shaping to Teach Eye Contact to Children with Autism Spectrum Disorder

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Abstract

The current study used a shaping procedure to teach three preschool-aged children diagnosed with autism spectrum disorder to make eye contact with the instructor for a duration of 3 s. Then, eye contact was taught during breaks in instruction. Following the initial intervention, the frequency of reinforcement was decreased while training for generalization across instructors and locations. All three children acquired quick and sustained eye contact, which maintained after 1 month without the need for prompting. This study provides an alternative method for teaching young children diagnosed with autism spectrum disorder to make eye contact without the need for prompting; outlines an approach for teaching eye contact when baseline levels of eye contact are severely low and/or the child is actively avoiding eye contact; describes a successful method for thinning the schedule of reinforcement and introducing instructional demands; and recommends a practical technique for gaining attention before delivering an instructional demand.

Keywords Eye contact · Shaping · Early intervention · Autism spectrum disorder

Eye contact avoidance has become synonymous with autism spectrum disorder (ASD) and social impairment (Ninci et al., 2013), making it a common goal of interventions for children with ASD (Carbone, O'Brien, Sweeney-Kerwin, & Albert, 2013; Foxx, 1977; Weiss & Zane, 2010). Sustained eye contact may increase the probability of attending to necessary instructional stimuli (e.g., observing modeled behavior of the instructor or instructional materials), thus increasing the probability of compliance with instructions and potentially increasing the rate of acquisition of such skills as manding and simple motor imitation (Carbone et al., 2013; Cook et al., 2017; Kraus, Hanley, Cesana, Eisenberg, & Jarvie, 2012; Tiegerman & Primavera, 1984).

In spite of its social validity and prominence as a target for early intervention, there are few empirical demonstrations of and little agreement on appropriate procedures to effectively teach eye contact to young children with ASD. In some studies, "eye contact" has been described as looking at a person spontaneously while it has been defined in others as looking at a person in response to a name or an instruction (e.g., "look at me") (Ninci et al., 2013). Beyond this distinction, eye contact has been targeted both directly and indirectly (Ninci et al., 2013). Few studies have utilized the same prompting strategies, varying from none, to physical, to visual/modeling (Carbone et al., 2013). Only a few studies have considered and programmed for long-term maintenance and generalization in their investigations (Cook et al., 2017; Ninci et al., 2013).

Levin, Lee, Korneder, Bauer, and Evans (2009) used shaping and differential reinforcement to teach eye contact during pauses in instruction. The instructor removed a preferred item until the child made eye contact and used differential reinforcement to decrease latency to eye contact. If the child made eye contact within 5 s, they received a reinforcer for 40–60 s. If eye contact occurred after 5 s, the instructor delivered the item for only 10–30 s. Once the children made eye contacts within 5 s following the removal of the reinforcer, the instructor no longer immediately gave the reinforcer and instead

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would require a previously mastered response (e.g., a high-five) and a second eye contact before giving the reinforcer.

Based on procedures recommended by Levin et al. (2009) and O'Reilly and Leslie (1999) and later adopted for our classroom by Shane, Lichtenberger, Michelin, Mrljak, and Malott (2016), the present study used shaping without prompting to increase eye contact during pauses in instruction. A duration of 3 s was selected because it is approximately the length of time required to observe any necessary instructional components of a discrete trial (e.g., the modeled behavior of the instructor during a discrete trial of imitation training). Given the present skill level of the participants, who engaged in few listener responses and who did not make spontaneous eye contact, a shaping-only approach was selected to increase eye contact as a prerequisite for discrete trial training.

Method

Three 2-and-1/2-year-old children participated: Isabella, Natalie, and Gavin. Isabella was an African American/Asian female, Natalie was a Caucasian female, and Gavin was a Hispanic male. The children were enrolled in an early childhood special education (ECSE) preschool classroom where they received 3 h of discrete trial training (DTT), 5 days a week, and had received an educational diagnosis of ASD by the program's evaluation team consisting of a social worker, school psychologist, occupational therapist, and speech therapist. Both the preliminary evaluations (consisting of a structured observation, home visit, and caregiver interviews) and initial Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP) indicated that eye contact and responding to name were notable deficits and goals for intervention. Gavin scored a 1.5 on the initial VB-MAPP and did not demonstrate any verbal behavior, listener responses, imitation. A VB-MAPP was not able to be conducted with Natalie due to challenging behavior. or visual perceptual match-to-sample skills. Isabella scored an 18 with no verbal behavior and limited listener responses and imitation. Additionally, each child avoided direct eye contact (e.g., used only peripheral vision), turned their head away from the instructor, or closed their eyes and engaged in other forms of problem behavior (e.g., flopped out of their seats and attempted to elope). This made it difficult for instructors to ensure that the children were attending before delivering an instruction and ultimately interfered with the implementation of the children's DTT programming. Informed consent was obtained from all individual participants included in the study.

Sessions were conducted in the children's typical work areas (i.e., small cubicles), the playroom, at a group table in the classroom, and the hallway in a classroom in a specialized center in the Midwest. Items used in the study included procedure-specific data sheets, pencils, timers, and a camera for recording sessions.

Experimental Design and Procedures

In a non-concurrent multiple-baseline across-participants design, eye contact was taught during 5-min sessions, ranging from one to six sessions each day. This design was non-concurrent in the sense that baseline for Natalie and Isabella began after Gavin's fourth baseline session. First, we shaped orientation to the instructor's body, then orientation to the instructor's face, and finally, duration of eye contact.

Baseline

During baseline, at the beginning of each trial, we removed a preferred item, waited 30 s before returning it, and recorded whether the child made eye contact and the latency to any instance of eye contact. Baseline sessions ranged from four to six trials. Eye contact was defined similarly to Carbone et al. (2013), as any duration of the children's eyes looking directly at the instructor's eyes. The instructor in all phases (excluding phases targeting transfer to novel instructors) was the first author.

Intervention: General Method

During intervention, at the beginning of each trial, the instructor removed a preferred item and waited until the child made the appropriate orienting response before returning it. If the orienting response occurred within 5 s of the removal of the item, we provided an edible reinforcer and 15-s access to the preferred item and the trial was recorded as correct. A latency longer than 5 s resulted in 5-s access to the preferred item and the trial was recorded as incorrect. The instructor silently counted the duration of eye contact in seconds. Sessions during intervention ranged from 3 to 20 trials. We increased the response requirement after three consecutive sessions of performance at 80% or greater, or two consecutive sessions at 90% or greater (see Table 1 for a description of each numbered phase).

Phases A–B Initially, any orientation of the child's eyes to the instructor's body was reinforced. Once body orientation became reliable (i.e., within 5 s of the removal of the preferred item), the reinforcer was provided only when the child's eyes oriented to the instructor's face.

Phases 1–4 After the children reliably oriented to the instructor's face, eye contact shaping began. First, any instance of eye contact within 5 s of the removal of the preferred item was reinforced. Once eye contacts of < 1-s duration were occurring within 5 s following the removal of the preferred item, the duration of eye contact was shaped to 3 s by reinforcing successive approximations. Initially, any instance of eye contact

Table 1 Description of phases in Fig. 1

Phase label	Description of graphic results
A	Percentage of correct eye contacts during body orientation shaping
B	Percentage of correct eye contacts during facial orientation shaping
1	Any instance of eye contact
2	1-s duration
3	2-s duration
4	3-s duration
5	Eye contact, high-probability response, eye contact
6	Eye contact, high-probability response, eye contact, high-probability response, eye contact
6a	Differential reinforcement of eye contact without other behaviors (i.e., pointing for Natalie and open mouth for Isabella)
6b	Differential reinforcement of eye contact without pointing and visual prompt for Natalie
7	Generalization across instructors
8	Generalization across locations
NE	Edibles unavailable as a consequence
E	Reinstate edibles as a consequence
MC	Randomization of phases 4–6
Follow-up	Once weekly for 3–4 weeks

was reinforced, then 1-s duration, 2-s duration, and finally 3-s duration.

Phases 5–6 After eye contacts became quick (occurring within 5 s of the removal of the tangible item) and sustained (3-s duration), high-probability responses were interspersed to teach the children to make eye contact during breaks in instruction. For example, the instructor removed the preferred item, waited for eye contact, provided an instruction involving an unreinforced, high-probability response (e.g., high-five, imitation, echoic, listener response), and waited for a second eye contact. This method served to decrease the frequency of the added reinforcement for eye contact and also attempted to make the training environment more similar to the child's typical instructional environment.

Reliability of Data Recording and Procedural Integrity

Procedural integrity and interobserver agreement (IOA) data were collected in 58% of the shaping sessions. IOA was assessed on a trial-by-trial basis by dividing the number of agreements by the total number of trials for that session. Procedural integrity was evaluated by dividing the number of correct steps by the total number of steps of the intervention procedure. IOA averaged 98% across all sessions with a range of 71–100% and procedural integrity averaged 97% with a range of 80–100%.

Results

During the seven sessions of baseline, Gavin did not make eye contact in six of the seven sessions. During the second baseline session, he only made eye contact on 20% of the trials. Following two sessions of shaping body orientation and 28 sessions of shaping facial orientation, shaping the duration of eye contact began. But then, he quickly met the mastery criterion for increasing duration of eye contact to 3 s, and when the instructor interspersed high-probability responses, eye contact remained at the mastery criterion with some variability when an additional high-probability response and a third eye contact was required. After introducing novel instructors, Gavin met the mastery criterion in three of the four sessions before a 2-week vacation. When he returned, it was anticipated that his performance might regress; therefore, a progressive phase was implemented that began by reinforcing 3-s eye contacts. After each session of performance at 80% or greater, he progressed to the next phase of the original teaching procedure (i.e., one high-probability response and two eye contacts and then two high-probability responses and three eye contacts). After seven additional sessions, Gavin demonstrated generalization across five novel instructors and two novel environments. One month later, maintenance was assessed once a week for 3 weeks, and responding had increased to 100% (see Fig. 1 for results).

Natalie's baseline began after Gavin's fourth baseline session. During the eight sessions of baseline, Natalie never made eye contact, but after nine sessions of shaping body orientation and 12 additional sessions of shaping facial orientation, she was making fleeting eye contacts. When the response duration requirement increased to 1 s, responding increased initially, became variable, and then increased once more until the mastery criterion was met. After interspersing high-probability responses, the instructor observed that she was pointing at the instructor's face while making eye contact, and began blocking pointing and differentially reinforcing eye contacts without pointing. After two sessions of blocking, a visual cue was introduced (i.e., hovering our hands over hers

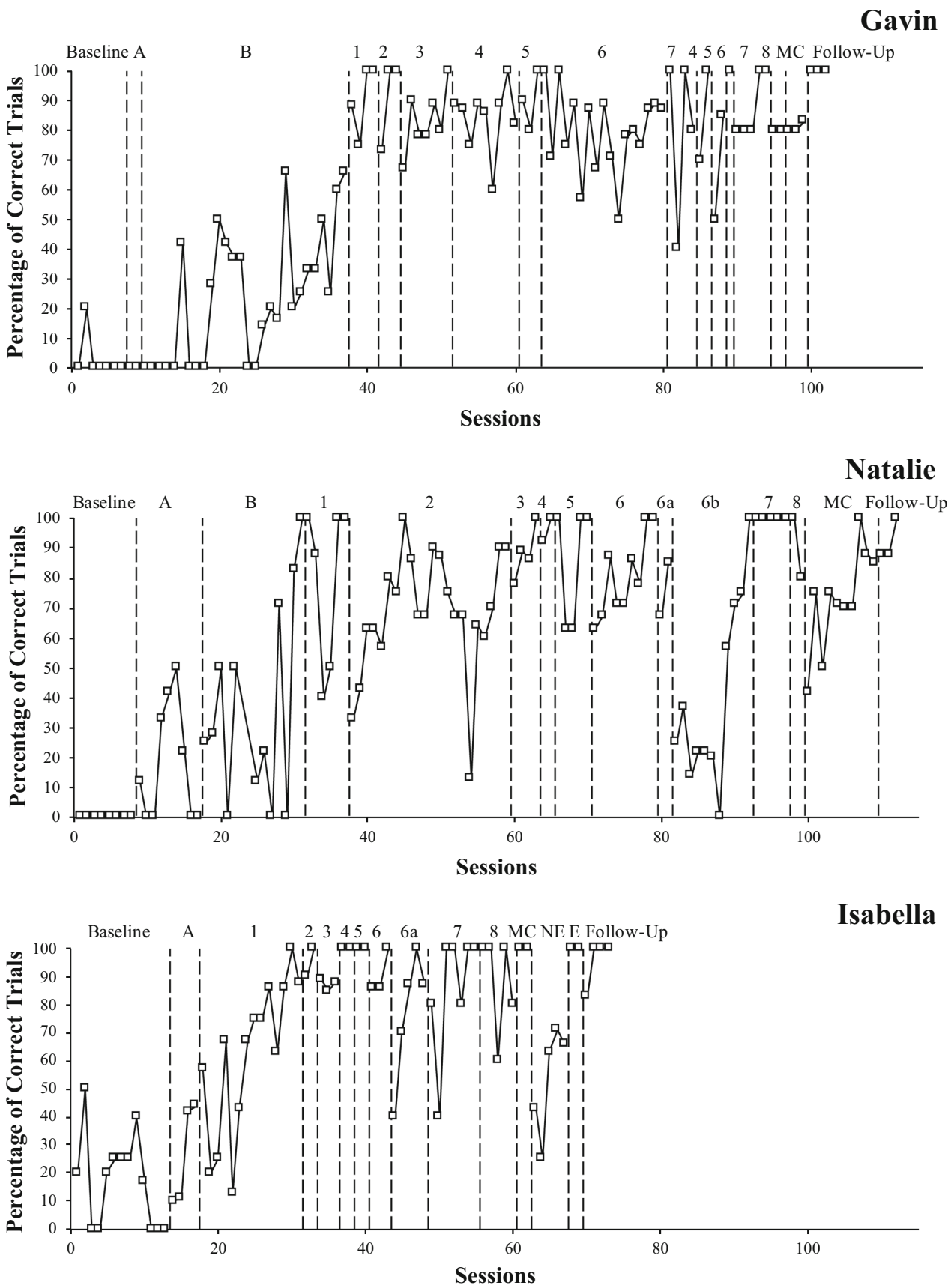

Fig. 1 Results of the shaping procedure for Gavin, Natalie, and Isabella

to allow us to block pointing if necessary). Although making eye contact without pointing was low initially, she began making eye contact without pointing by the tenth session. After assessing generalization across instructors and environments, the classroom had a 2-week break from school. When she returned, eye contact was lower than the mastery criterion and required seven sessions of training before meeting the criterion again. This time, responding remained at high, stable levels 1 month after the intervention, with a variety of instructors and in several environments (see Fig. 1).

Isabella's baseline began after Gavin's fourth baseline session. During the 13 sessions of baseline, Isabella made eye contact in an average of 17% of trials with a range of 0–50%. After four sessions of shaping body orientation, the instructor began only reinforcing instances of eye contact. The percentage of trials with eye contact was low and variable at first, but increased until meeting the mastery criterion within 14 sessions. Eye contact remained at the mastery criterion as the duration was shaped to 3 s and as high-probability responses were introduced. Isabella would often open her mouth when making eye contact, so the instructor began differentially reinforcing eye contact only when her mouth was closed. She met the mastery criterion within five sessions. When novel instructors were introduced to assess generalization, eye contact decreased; therefore, eye contact with the novel instructors was reinforced. After that training, eye contact remained at the mastery criterion across each subsequent phase. Next, the instructor attempted to eliminate edibles as consequences and use preferred toys as reinforcers for the differential reinforcement procedure, but responding decreased and never reached the mastery criterion. When edibles were reintroduced, responding increased to 100% and maintained for 1 month, across instructors and settings (see Fig. 1).

Discussion

The results of this study support the use of shaping to teach young children with ASD to engage in eye contact with their instructor. This procedure adds to the current research by providing an approach that, to be successful, does not require prompting or prompt fading, aversive control, or any initial instances of eye contact.

We taught eye contact in the absence of a vocal cue (e.g., "look at me," or the child's name) before teaching responding to name. The children who participated in this study rarely made eye contact, making it difficult to teach common early intervention targets (e.g., imitation) and did not demonstrate auditory discrimination at the beginning of treatment. Therefore, we implemented a procedure to teach eye contact as an attending response to increase the probability of observing necessary instructional components of a learning trial and as a prerequisite to responding to their names. Although generalization probes were not conducted during baseline, the lack of eye contact during baseline and data and concerns from the preliminary evaluations suggest that eye contacts made during follow-up with novel instructors were a result of this intervention.

Although effective, this shaping procedure required more than 60 5-min sessions for each participant and spanned 6 months. Further research might evaluate the effectiveness of this intervention when implemented intensively in isolation for the first days of early intervention services. More efficient implementation may result in quicker rates of acquisition of eye contact within this program and may influence learning when more complex programs are implemented later. Additionally, the only attempt to fade edible reinforcers was with Isabella and was unsuccessful. This apparent reliance on the intermittent delivery of preferred items and edibles may limit the generalization of this procedure to contexts other than those described in this study (outside of academic, discrete trial training contexts).

A final limitation of the experimental design was that the children's performance did not necessarily track phase changes. The primary goal of introducing this intervention with these children was to reach the final goal of 3-s eye contact during pauses in instruction and increased attending, as quickly as possible. However, if we had maintained performance and extended each phase to further demonstrate experimental control, it would have been easier to evaluate each component of this shaping treatment package. However, it is clear that all three children acquired eye contact and that this treatment package had its desired effect. Future research could attempt to tease apart the components to determine the necessary and sufficient phases of this intervention.

Compliance with Ethical Standards

Conflict of Interest The authors declare they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants 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.

Informed Consent Informed consent was obtained from all individual participants in the study.

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