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**BUILDING A REPERTOIRE OF JOINT ATTENTION BIDS IN CHILDREN WITH
AUTISM**

A Master's Thesis

Presented to

The Graduate College of

Missouri State University

In Partial Fulfillment

Of the Requirements for the Degree

Master of Science, Applied Behavior Analysis

By

Erica Rackers

December 2021

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BUILDING A REPERTOIRE OF JOINT ATTENTION BIDS IN CHILDREN WITH AUTISM

Applied Behavior Analysis

Missouri State University, December 2021

Master of Science

Erica Rackers

ABSTRACT

The current study extended previous research through evaluating if a multiple-probe procedure including auditory scripts and script-fading procedures could build a generalized repertoire of initiating bids for joint attention in three young children with autism. Stimuli were selected from four categories. Three categories were associated with teaching procedures and within-category generalization. The fourth category was associated with across-category generalization. The four categories were (a) visually alluring toys, (b) strangely placed objects, (c) large pictures, and (d) sounds. Category assignments in which teaching procedures or generalization were assessed were counterbalanced across the participants. Three different auditory scripts were selected and used during intervention for each of stimuli associated with teaching, which taught response generalization. All three participants learned to initiate bids for joint attention. After scripts were faded, bids for joint attention were maintained and generalized to novel stimuli and settings.

KEYWORDS: joint attention, scripts, script-fading, auditory scripts, behavioral reversals

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In the interest of academic freedom and the principle of free speech, approval of this thesis indicates the format is acceptable and meets the academic criteria for the discipline as determined by the faculty that constitute the thesis committee. The content and views expressed in this thesis are those of the student-scholar and are not endorsed by Missouri State University, its Graduate College, or its employees.

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INTRODUCTION

Joint attention, a major component of speech and language development, is the ability to share focus and engage simultaneously with another person regarding the same object, area, or experience (Jones et al., 2006; Murza et al., 2016). For example, if two people see a train passing by, then share attention with each other and the train by alternating their gaze between each other and the train, this would be a case of joint attention. Joint attention deficits have been observed in a majority of young children with autism (i.e., 2-years-old or younger) and have been shown to affect language development (Gillberg et al., 1990; Ohta et al., 1987; Stone, 1994).

Autism is a neurodevelopmental disorder characterized by impairment in brain development with differences in brain chemistry, structure, and function (Scheuermann et al., 2019). Autism is classified as a pervasive developmental disorder. Common deficits of pervasive developmental disorders include impaired communication, impaired reciprocal social interaction, and restricted, repetitive, and stereotyped patterns of behaviors or interests (Faras et al., 2010). While autism is typically diagnosed in children from 3 to 4 years of age (Chakrabarti & Fombonne, 2005; Charman & Baird, 2002), parents often voice concerns regarding joint attention deficits before their child reaches 2-years-old, and around 50% of parents notice some deficits within in their child's first year (Volkmar et al., 1985).

An individual must have deficits in three areas of social communication and interaction, and deficits in at least two of the types of restricted, repetitive behaviors to meet diagnostic criteria for ASD, according to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association, 2013). Symptoms of ASD must be present in the early stages of development, often 2-years-old or younger, and must cause clinically

significant impairment in crucial areas of current functioning (Gillberg et al., 1990; Ohta et al., 1987; Stone, 1994).

Joint attention involves a range of behaviors (e.g., gaze following, point following, showing, pointing) (Charman, 2003). Children diagnosed with autism spectrum disorder (ASD) display deficiencies in initiating bids for joint attention, as well as responding to a joint attention bid. *Initiating* a bid for joint attention includes an individual obtaining the attention of a person nearby, with the motive of sharing attention with the same object or event (Charman, 2003; Murza et al., 2016). For example, a child sees a bus and looks at the teacher, desiring to share attention to the bus with the teacher, thereby desiring to initiate a joint attention bid. A *response* to a joint attention bid can include a range of behaviors, including orienting, pointing, gaze-shifting, or verbal commentary. For example, a child says, “Look, a firetruck!” An adult or peer would then *respond* to the bid for attention by shifting their gaze and/or making a comment (e.g., “Cool!”). Joint attention mechanisms are relational and are sustained by positive or negative socially-mediated reinforcement (Gomes et al., 2020; Jones et al., 2006).

Successful procedures have been identified for teaching shared attention skills to individuals with autism. Two studies found that after discrete trial training (one-on-one teaching in which tasks are broken down and taught in small increments) and pivotal response training (play-based training to produce improvements in areas of social skills, communication, behavior and learning), participants initiated and responded to joint attention bids through gaze alternation, shifting their gaze between the experimenter and object (Jones et al., 2006; Whalen & Schreibman, 2003). Two additional studies have effectively trained their participants to initiate and react to joint attention bids (Isaksen & Holth, 2009; Taylor & Hoch, 2008).

Most of the behavior-analytic research regarding joint attention includes target behaviors such as gaze shifting and pointing (Gomes et al., 2020). Few studies have introduced a *vocal response* as a part of initiating a bid for joint attention. In a study conducted by Jones (2009), two participants were taught to use one to four-word vocal responses as a component of initiating bids for joint attention. A single auditory script (an auditory recording of a phrase expected to be repeated by participant) taught children with autism to initiate joint attention bids, as well as respond to them (MacDuff et al., 2007). These findings were repeated in a study performed by Pollard et al. (2012). Multiple scripts were used, as opposed to only a single script, but this did not increase unscripted (i.e., spontaneous) statements (Pollard et al., 2012). Given that joint attention is a crucial component of typical speech and language development, Bakeman & Adamson (1984) found that teaching a range of functionally equivalent vocal responses may be advantageous.

Additionally, research has been conducted on auditory placement when using auditory scripts to teach initiations for joint attention and responses to joint attention bids. In a study conducted by Garcia-Albea et al. (2014), difficulties appeared when fading auditory scripts, possibly due to the voice recorders being visible during teaching. A study conducted by Gallant et al. (2017) found that voice recorders do not need to be placed on target stimuli in order to successfully fade auditory scripts. If voice recorders are not noticeable to participants, contingencies of vocal elements can be more well-managed in facilitating joint attention bids, removing extraneous variables (Gomes et al., 2020).

Joint attention has been characterized not only topographically, but functionally (Gomes et al., 2020). Research has been conducted using preferred stimuli as expected discriminatory stimuli (i.e., stimuli used in order to produce a specific response) for joint attention responses

and providing access to target stimuli based on these responses (Gomes et al., 2020). This can make it challenging to differentiate between mands for the items or bids for joint attention. Joint attention was taught successfully by Taylor and Hoch (2008) by using social consequences with some participants, and Isaksen and Holth (2009) found conditioned reinforcers, such as smiling or nodding, were effective in teaching joint attention.

Research conducted by MacDuff et al. (2007) and Taylor & Hoch (2008) has prioritized and exhibited generalization of stimuli through objects or contexts with regard to joint attention. In all experiments performed in which participants with ASD were trained to initiate *and* react to joint attention bids, 2D stimuli (e.g., photographs) or 3D stimuli (e.g., toys) were used (Gomes et al., 2020). Gomes et al. (2020) notes that other forms of stimuli that can be used could be exposed through a large case study of stimuli that has attracted shared interest in previous studies (i.e., environmental sounds). Gomes et al. (2020) stated that using a novel stimulus should be investigated as a stimulating operation for joint attention. Increasing the novelty of stimuli may increase the benefit of joint attention initiation reinforcers and evoke habits that have previously been enhanced with social attention relevant to the target items (Gomes et al., 2020). In comparison, Gomes et al. (2020) additionally found that reducing the novelty of a stimulus could minimize initiations of joint attention that have previously been socially reinforced. Several examples of stimuli are required to improve stimulus generalization of initiations for mutual attention, and only a subset of these examples should be included in each teaching session.

Gomes et al. (2020) conducted the first research to use environmental sounds to assess bids for shared attention. An intervention package was introduced that included behavioral reversals, scripts, and script fading, using socially mediated consequences and tangible reinforcement. The treatment package resulted in increased bids for joint attention and a

generalized repertoire of joint attention bids was acquired by the children through a number of stimuli and environments. By the end of intervention, three of the four participants initiated bids for joint attention during the majority of trials, and this continued through maintenance and follow-up (Gomes et al., 2020).

Participants in the study conducted by Gomes et al. (2020) made vocal comments on some of the baseline stimuli they interacted with. Some of the statements made at baseline were matches for the predetermined scripts as script and script-fading interference was implemented. Recording scripts after baseline and ensuring the use of different scripts during the intervention could increase novel statements. Gomes et al. (2020) suggested auditory stimuli and the use of auditory scripts should continue to be evaluated in future research. Gomes et al. (2020) also suggested additional research should be conducted on using preferred or child-selected stimuli, to ensure that a bid for joint attention is not a mand for the item or activity, but a true bid for attention.

The goal of the current study was to replicate and extend previous research (e.g., Gomes et al., 2020) by training children with autism to initiate bids for joint attention with a verbal response that serves as a mechanism of socially mediated outcomes. This study will extend research conducted by Gomes et al. (2020) by using a sample of stimuli that generalize to naturalistic settings that exist spontaneously. Participants' bids for joint attention must include vocal responses taught by the use of auditory scripts, which were used out of the participants' view for contingency management. Three auditory scripts per target stimulus were used to promote response generalization, and the novelty of vocal responses produced were measured. In the current study, access to target stimuli will not be allowed, in order to ensure that bids for joint attention are not functioning only as mands for target stimuli as suggested by Gomes et al.,

(2020). Additionally, the experimenter and assistants documented scripts after baseline in the current study to ensure that novel remarks by participants do not form part of the documented scripts to be used during intervention.

METHOD

Participants

This study was approved by the Institutional Review Board (IRB) on 06/17/2021 and received Approval #IRB-FY2021-483 (See Appendix). Three children with autism spectrum disorder (ASD) participated in this study. AB was a 7-year-old female. She attended kindergarten in a special education school and actively participated in applied behavior analysis (ABA) therapy in the clinic setting 12 hours per week. Her language and social skills were deficient, based upon the *Verbal Behavior Milestones Assessment and Placement Program* (Sundberg, 2008) and *Social Skills Improvement System: Social-Emotional Learning Edition* (Elliot & Gresham, 2017) scores, when compared to age-matched peers. She had a limited variety of preferred toys and activities and often engaged in moderate levels of repetitive behaviors (i.e., scripts from favorite TV shows or movies). She displayed low levels of noncompliance, could speak using 5- to 10- word sentences, and seldom initiated conversations with peers or adults.

TH was a 7-year-old male. He attended first grade in a public-school system in a special education classroom and actively participated in ABA therapy in the clinic setting 12 hours per week. He regularly engaged in stereotypic behavior (i.e., scripts from favorite TV shows or movies, delayed echolalia). He seldom engaged in noncompliance and could speak using up to 5- word sentences, mostly to demand for a preferred item or activity.

PR was a 9-year-old male. He attended 3rd grade in a public-school system and had an individualized education program in place. He attended and actively participated in therapy in the clinic setting 12 hours per week. His language and social skills were deficient, based upon *VB-MAPP* and *SISS-SEL* scores, when compared to age-matched peers. He engaged in

noncompliance in the form of verbal aggression weekly. He could speak in 5- to 10-word sentences and often initiated conversations with adults and peers.

Each of the three participants did not reliably initiate bids for joint attention prior to the intervention. The participants were first be tested to see if they could tact all of the stimuli used in the study and if they could imitate phrases and/or questions. If they were unable to tact stimuli and imitate phrases/questions, different stimuli and phrases/questions were chosen. However, all participants had a history of imitating a variety of phrases/questions and had previously tacted over 100 common objects and toys. The participants used a token-based motivational system throughout 3-hour ABA therapy sessions. The participants were also familiar with learning scripts, as well as using many different types of script-fading techniques. Informed consent from the parents of each participant was obtained prior to beginning the study. Assent from the participants was obtained prior to beginning the study and was obtained daily or before each session within the study through verbal agreement (e.g., researcher said, "Do you want to come play with me?" and participant responded with, "Yes!" Researcher then said, "Come with me!" and began procedure and/or data collection).

Setting and Materials

Teaching sessions were conducted in the participants' individual learning rooms in a pediatric clinic for ABA therapy. Pre- and post-intervention generalization sessions were conducted in one of two small rooms in the clinic furnished with toys, shelves, one table, and chairs.

We used four different categories of stimuli: (a) visually alluring toys (e.g., ooze tube, bead maze, spiky ball), (b) strangely placed objects (e.g., upside-down chair or table, shelf in the

middle of the room, toys turned upside down), (c) large pictures of popular cartoon characters placed on one of the two tables in the room (e.g., Mickey Mouse, Peppa Pig), and (d) common sounds heard in naturalistic environments (e.g., a sound of a dog barking played for 5 seconds via an iPod). 13 different stimuli were included in each of the four categories (see Table 1).

Target stimuli were placed on a table, on the floor, or on a shelf.

Auditory Scripts

Scripts were identified based upon previous research (Gomes et al., 2020). Auditory scripts were devised for each stimulus. Table 2 shows an example of an auditory script for one stimulus from each category, as well as examples of experimenter responses.

Conditions

To test the teaching technique and its efficacy in teaching the participants to initiate bids for joint attention, a multiple baseline across participants design with a multiple-probe procedure was used. For each participant, the order in which the teaching procedure was applied was decided using counterbalancing, as long as each of the participants achieved steady-state responding in baseline.

Assignment of Stimulus Categories

Procedures used by Gomes et al. (2020) were replicated in which three stimulus categories were allocated to each participant as teaching categories, and the unassigned category was used to test generalization of initiations for joint attention across categories (Gomes et al., 2020). The first session included presentation of teaching categories in random order, using a

random order generator in Excel (Table 3). In the following sessions, the order in which categories associated with teaching procedures were presented was chosen using counterbalancing to ensure that the order is different for each session. The three categories in which teaching procedures were used remained the same for each participant; the order in which they were presented daily was counterbalanced. The unassigned stimulus category was solely used for across-category generalization probes.

13 stimuli were included in each category. For the three categories in which the teaching procedure for joint attention was used, ten of the 13 stimuli were used. The three stimuli leftover were not associated with teaching procedures and were instead utilized to evaluate generalization of joint attention bids within the teaching category. The three stimuli that were leftover were selected each session using counterbalancing. For the category in which no teaching procedures were associated, three of the ten stimuli were chosen using counterbalancing for three across-category generalization probe trials each session. (Gomes et al., 2020). Each session included 16 trials; ten teaching trials, three within-category generalization probe trials, and three across-category generalization probe trials (Gomes et al., 2020). To control for extraneous variables, the order in which teaching occurred was decided using counterbalancing, along with the within-category and across-category generalization probe trials.

Dependent Variables

An appropriate initiation for joint attention was defined as a child (a) orienting to the stimulus after coming within 7 ft. of the stimulus (within 10 seconds or less), (b) physically turning their head or body toward their conversation partner within 5 seconds of orienting to a stimulus, (c) emitting a contextually appropriate vocal statement at any point throughout steps (a)

or (b), and (d) orienting to the stimulus once again. If this sequence is completed correctly, an initiation for joint attention was scored, either as scripted, unscripted, or novel, for the three categories which included visual stimuli.

In the category including auditory stimuli (i.e., sounds), an initiation for joint attention was defined as the child (a) orienting to a conversation partner by physically turning their head or body toward the person within 5 seconds of sound being played and (b) emitting a contextually appropriate vocal statement at any point throughout (a) or (b). Eye contact was not required during component (a).

Contextually appropriate vocal statements were defined as scripted, unscripted, or novel. Data was summed as the number of initiations given for joint attention for each session. If a participant's vocal statement matched a script from the recorder, the statement was scored as a scripted initiation for joint attention. If a participant emitted a vocal statement (different through only a conjunction, preposition, pronoun, etc.) after hearing the recorded script, the vocal statement was scored as scripted (e.g., if the trained script was, "I hear a cow," and the vocal statement emitted by the participant was, "You hear a cow," the vocal statement was scripted) (Gomes et al., 2020). After fading all scripts, vocal statements that were the same as any of the original auditory scripts were scored as scripted (Gomes et al., 2020).

If a participant's vocal statement included the recombination of words from original scripts, the statement was scored as an unscripted initiation for joint attention (e.g., the trained script was, "That is silly," and the vocal statement emitted by the participant was, "That's crazy," the vocal statement was unscripted) (Gomes et al., 2020). An unscripted initiation must have included words from a script in the study, but also must have been different by more than just a conjunction, preposition, pronoun, etc.

If a participant emitted a vocal statement that did not contain any words from the original trained script (e.g., except for a preposition, pronoun, etc.) the vocal statement was scored as a novel initiation for joint attention (e.g., the vocal script “Wow, a giant vehicle!” was novel if the words, “Wow,” “giant,” and “vehicle,” weren’t used in other auditory scripts in the study) (Gomes et al., 2020). If a participant emitted a novel vocal statement in the first session, then repeated that same vocal statement in a following session, the statement was then scored as unscripted for that session and any following sessions.

Data Collection

Data were collected by four staff members employed at a pediatric ABA clinic. The first staff member was the experimenter, who was a Registered Behavior Technician (RBT) who had been employed at the clinic for 5 years and was a graduate student in the Applied Behavior Analysis (ABA) program at Missouri State University. The second observer served as an assistant to the experimenter. She was a board-certified behavior analyst (BCBA) with 15 years of experience working with children with autism. The third observer also served as an assistant to the experimenter and was an RBT who had been employed at the clinic for 1 year and was a graduate student in the ABA program. The fourth observer and final assistant to the experimenter was an RBT who had been employed at the clinic for 1 year. Interobserver agreement (IOA) data was collected on all dependent variables.

PROCEDURE

A session started when the experimenter requested that a participant to follow her into a room (e.g., “Come with me!”). The 10 stimuli were displayed in rooms within the participants’ clinic setting (e.g., playrooms) each session and were placed in random locations, using counterbalancing, to ensure generalization. Each stimulus was presented one at a time. A trial began when the participant was within close proximity to stimulus and was expected to initiate a bid for joint attention and ended once the initiation was made, unless error-correction was needed. Each trial lasted approximately 1 to 2 minutes, unless error-correction was needed.

Baseline

No scripts, physical, or verbal guidance were used. If a bid for attention was initiated from the participant, the experimenter remained neutral as to not provide reinforcement (these baseline sessions were performed as illustrated above). The data collector recorded scripts used by participants after baseline to ensure that novel remarks by participants did not form part of the documented scripts to be used during intervention.

Intervention

Throughout intervention, social consequences were given after a participant initiated a bid for joint attention. Physical or verbal guidance, as well as scripts, were added to aid participants to engage in other components of initiating bids for joint attention that did not regularly occur. Behavioral rehearsals were conducted for the trial, given a participant did not

initiate appropriately, until the participant successfully initiated a bid for joint attention at current script-fading level without any verbal or physical guidance.

Error-Correction Procedures

If a participant walked by an object from a visual stimulus category and did not request mutual attention in five seconds or less, the assistant utilized a verbal or physical prompt to have the participant (a) point to the object, (b) orient toward the experimenter, and (c) orient back to the object once again. The assistant simultaneously played the auditory script on the voice recorder as the participant's head was gently guided to orient towards the experimenter. The participant was then removed from the area near the stimulus and was verbally or physically guided to re-approach the target stimulus. No further prompts were provided unless an error to initiate a bid for joint attention occurred again. This sequence was repeated as needed until the participant independently initiated a bid for joint attention upon approaching the target stimulus. The next trial then began.

When the target stimuli were sounds, participants were either seated at a table or on the floor engaged with an activity or toy. If a sound was played and the participant did not initiate for joint attention within five seconds of hearing the sound, the assistant verbally or physically prompted the participant to move away from their activity, orient to the experimenter, and then continued the prompt sequence described above.

Access to target stimuli was not allowed after an initiation for joint attention was given, in order to ensure that bids for joint attention were not functioning only as mands for target stimuli. It was likely this could cause some problem behavior from participants. Common problem behaviors that occurred with the participants were vocal protest, in the form of fussing

or crying. If problem behavior occurred after the initiation was made, the implementer redirected the participant by saying, “Let’s play with something else!” If problem behavior intensified, the participant redirected participant into the hallway and required them to sit quietly and calmly for 10 seconds before re-entering playroom, where they were then prompted to play or engage with an alternative preferred stimulus.

Script-Fading

Script-fading began when participants successfully initiated bids for joint attention on at least 80% of teaching trials for two consecutive sessions. Scripts were faded in a most-to-least prompt-fading procedure. During this sequence, 80% of teaching trials for two sessions must have been achieved before moving to the next step of the fading procedure.

If the participant did not make a scripted, unscripted, or novel initiation for joint attention after hearing a partially or fully faded script, the assistant played the original auditory script. When the participant independently imitated the full auditory script, the experimenter then re-introduced the partial script. This sequence continued until the participant correctly and independently responded with the partial script, after which, the experimenter responded with a socially appropriate comment. This most-to-least prompt-fading procedure was chosen based upon previous success in research (Gomes et al., 2020).

Generalization

Generalization of stimuli was evaluated during each session with 6 generalization probe trials, using stimuli that were not involved with the teaching procedure. Three of the six trials were within-category generalization probe trials, and the remaining three trials were an across-

category generalization probe trial. No scripts, physical, or verbal guidance were used. If a bid for attention was initiated from the participant, the experimenter smiled, made a statement regarding the stimuli or sound, and oriented toward the stimuli.

Maintenance and Follow-Up

If a participant initiated bids for joint attention for at least 80% of the training stimuli for two consecutive sessions, with no scripts present, additional sessions were conducted. This provided the participant with continued exposure to stimuli. These sessions continued until two weeks passed after the final participant met criterion. Follow-up data was at 2 weeks, 4 weeks, and finally 6 weeks after the final participant met criterion. During that time, continued exposure to the stimuli was not provided. The conditions of maintenance and follow-up sessions were identical to generalization session conditions: no scripts, physical, or verbal guidance were used. If a bid for attention was initiated from the participant, the experimenter smiled, made a statement regarding the stimuli or sound, and oriented toward the stimuli.

TREATMENT FIDELITY

A treatment fidelity checklist for each phase (baseline, intervention, and maintenance) was utilized by experimenter to improve the reliability and validity of the behavioral intervention in place. The treatment fidelity checklists (Table 4) were completed before baseline began and were not collected throughout the remainder of the study. Assistants were scored on their ability to implement behavioral interventions adequately. Two practice sessions (in which each phase was practiced) were conducted by the experimenter. The following scale was used to rate the degree to which session goals were achieved: 0) Goal was not introduced or covered by the implementer, 1) goal was partially achieved, and 2) goal was fully achieved. A score of 8 (80%) or higher on 2 consecutive practice sessions must have been achieved by each assistant before the study began.

INTEROBSERVER AGREEMENT (IOA)

Interobserver agreement (IOA) was assessed for all components of initiating bids for joint attention. During intervention, sessions were recorded and IOA was assessed afterwards. During maintenance and follow-up, IOA was assessed live during sessions. An agreement was scored when both observers recorded a correct or incorrect response for the individual components in the bid. Interobserver agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. IOA data were collected for a minimum of 35% of sessions for each participant. Mean IOA was 98% or greater for all participants (Table 5).

RESULTS

Initiation of Bids for Joint Attention

Figure 1 shows the percentage of training trials with correctly initiated bids for joint attention across conditions and participants. The ordinate represents the percentage of training trials and the abscissa represents each individual session with the participant. Each of the graphs represents the individual data for each of the three participants.

During baseline, AB (Fig. 1, Top) seldom initiated bids for joint attention in the presence of stimuli. TH (Fig. 1, Middle) occasionally initiated bids for joint attention in the presence of stimuli. In the presence of stimuli, PR (Fig. 1, Bottom) occasionally initiated bids for joint attention as well. The failure to initiate bids for joint attention is attributed to deficiencies in many components of the initiation process, rather than just one. As intervention begun, initiation of bids for joint attention increased during teaching trials. The initiations remained high during maintenance and follow-up.

The mastery criterion for participants was two consecutive sessions with 80% of trials (8 of 10) including initiations for joint attention. These trials contained training stimuli, and initiations for joint attention must have been emitted in the absence of scripts. Script-fading included five steps. Two consecutive sessions at 80% (8 of 10) of total training trials must have been achieved in order for participant to continue onto the second fading step. The minimum number possible in which a participant could complete mastery criterion for intervention was 10 sessions. Minimum sessions to criterion were greater for AB than for TH and PR. Data indicate that AB required 19 sessions to meet mastery criterion. TH required 16 sessions to meet mastery criterion. PR required 17 sessions to meet mastery criterion.

Stimulus Generalization Within and Across Categories

Figure 2 shows the number of generalization trials with correctly initiated bids for joint attention within and across generalization trials. The ordinate represents the number of trials and the abscissa represents each individual session with the participant. Each of the graphs represents the individual data for each of the three participants.

There was a total of three opportunities possible per session to initiate a bid for joint attention across stimuli, within and across teaching categories. During baseline, AB (Fig. 2, Top) did not initiate bids for joint attention in either within- or across-category generalization trials. TH (Fig. 2, Middle) initiated bids for joint attention on average during 33% of within- and across-category generalization trials. PR (Fig. 2, Bottom) initiated bids for joint attention on average during 33-67% of within-category generalization trials and 33% of across-category generalization trials.

Correctly initiated bids for joint attention increased during intervention, maintenance, and remained steadily high through follow-up. The number of generalization trials with correctly initiated bids for joint attention in across-category generalization trials for PR was somewhat variable, however, this stabilized in maintenance. The number of generalization trials which included correctly initiated bids for joint attention during within-category generalization trials remained stable. The number of generalization trials with correctly initiated bids for both AB and TH remained stable during both within- and across-category generalization trials. In follow-up, all participants continued to initiate bids for joint attention at criterion level during within and across-category generalization trials.

Scripted, Unscripted, and Novel Comments During Initiations of Bids for Joint Attention

Figure 3 shows the number of training trials with novel, scripted, and unscripted interactions during initiation of bids for joint attention. The ordinate represents the number of trials and the abscissa represents each individual session with the participant. Each of the graphs represents the individual data for each of the three participants.

During baseline, AB (Fig. 3, Top) emitted an average of 0 to 1 comments. TH (Fig. 3, Middle) emitted an average of 1-2 comments. PR (Fig. 3, Bottom) emitted an average of 2-3 comments. No participant emitted more than five comments throughout any of the baseline sessions. The script-fading procedure, which included five steps, required a minimum of 10 sessions, with 2 sessions at 8 of 10 trials including comments. No participant met this minimum criterion. AB required 19 sessions to meet mastery criterion. TH required 16 sessions to meet mastery criterion. PR required 17 sessions to meet mastery criterion. The majority of AB's comments were scripted at the beginning of intervention, but then decreased as the number of unscripted and novel comments increased as intervention continued. This same pattern occurred for both TH and PR as well.

The majority of all participants' comments were novel, with low to zero levels of scripted comments and an average of 1-3 unscripted comments across participants, throughout maintenance and follow-up.

DISCUSSION

The results of the current study show that children with autism can build a generalized repertoire of joint attention bids across a variety of stimuli and settings. When treatment was introduced, the participants' initiations of bids for joint attention increased steadily and continued to maintain in follow-up. All participants gained a repertoire of joint attention bids in intervention and maintained this repertoire during follow-up with socially-mediated reinforcers (e.g., smiles or comments made by experimenter). Participants initiated bids for joint attention across training stimuli within teaching categories, to stimuli from a category not used in training. Parents and teachers of participants reported to experimenters that participants were initiating bids for joint attention outside of the training setting.

The current study replicated and extended that of Gomes et al., 2020, using environmental sounds to evaluate joint attention bids. Prior to this study, participants did not initiate bids for joint attention reliably. For example, all participants would keep playing with toys or keep working upon hearing auditory stimuli outside of the room, like the sound of an ambulance or fire truck driving by. On occasion, participants would make eye contact with experimenter, but would not make a comment about the sound they were hearing. This often occurred with 3D stimuli as well, such as toys, pictures, or an object placed in a spot out of the ordinary.

Previous research (Gomes et al., 2020; Naoi et al., 2008) allowed access to target stimuli from one category only, making it difficult to differentiate between a mand for attention versus a mand for the target stimuli. In the current study, access to target stimuli was not granted with any of the categories, even if the participant initiated a bid for joint attention, to ensure that bids for

joint attention were not functioning only as mands for target stimuli. All participants who took part in the study had extensive experience with applied behavior analysis (ABA) therapy. Given that a certain amount of instructional control was established prior to the study, participants did not engage in problem behavior when access to stimuli was denied. Future research should evaluate initiation of bids for joint attention without access to stimuli with participants with autism who are new to ABA therapy or do not have experience with ABA principles. Frequency of problem behavior can then be evaluated, and future research can ensure that bids for joint attention are functioning as mands for attention, rather than mands for target stimuli.

In the current research, auditory scripts were presented through the use of a voice recorder. All auditory scripts were played out of view from participants for contingency management. The current research contributes to existing research (Gallant et al., 2017; Garcia-Albea et al., 2014; Gomes et al., 2020) in that auditory scripts were effective when played out of view of participants. However, an assistant was needed in this process. At the beginning of intervention, participants in the current study would often make eye contact with both the assistant, who was playing auditory script out of view, as well as the experimenter, to initiate a bid for joint attention. This increases response effort for participants. They did initiate bids for joint attention successfully, while making eye contact and meeting response definition, yet they were often unsure of which adult in the room they should make eye contact with. As the intervention continued, eye contact with the experimenter who consistently responded with social reinforcement increased, and eye contact with the assistant decreased, as the assistant did not provide social reinforcement. Future research should continue to evaluate the most effective way to present auditory scripts.

One limitation of the current study is the possibility of experimenter bias. This can occur when the experimenter unintentionally responds or behaves in a particular, or more subjective, manner throughout the research process. This can lead to errors throughout data collection and incorrect interpretation of its results. In the current study, the experimenter had previous history working with all participants in an ABA clinic and knew the participants quite well, which can lead to reacting to clients in specific ways that have worked well in the past.

In Figures 1-3, the total number of trials with correctly initiated bids for joint attention increased with participants TH and PR just before intervention began. This could be due to repeated exposure to items in baseline without prompts or guidance on what to do with the items. The participants' previous history with ABA and previous history of positive reinforcement for interacting with stimuli throughout therapy could have been the reason for this increase. Participants could have had some idea of what they were "expected" to do when presented with stimuli.

In the current research, practice sessions with experimenter and assistants occurred and data was collected using treatment fidelity checklists. These practice sessions were recorded prior to baseline and were not continuously collected throughout the remainder of the study. This is a limitation as extensive data was collected over a long period of time. It is possible that both the experimenter and assistants could have benefited from more practice sessions throughout the study or before each phase change (e.g., before moving onto intervention, then before moving onto maintenance, etc.).

In previous research (Gomes et al., 2020), novel comments made during baseline were not recorded. In result, some of the recorded statements used during intervention matched the novel comments participants made during baseline. In the current study, novel comments were

recorded during baseline to ensure the participants' novel comments did not become part of the recorded scripts used during intervention. Future research should continue to take note of novel comments made in baseline to ensure that novel remarks made in intervention are truly novel and do not match those made in baseline.

The results of this study show that a procedure that includes reversals, scripts, and script-fading can teach a child with autism to successfully initiate bids for joint attention, using a wide variety of novel comments. These initiations of bids for joint attention generalized across a variety of stimuli and settings and were maintained up to six weeks from the end of intervention. This is significant as clinicians can use this type of intervention package to target joint attention deficits in their clients that seldomly or even never engage in any sort of joint attention behaviors, whether it be initiations for joint attention, gaze shifting and pointing, or responding to a bid for joint attention.

Joint attention is a crucial skill for children with autism and should be targeted early in development, as deficits are typically observed before an autism spectrum disorder diagnosis is made (Charman, 2003). The type of intervention used in the current research could prove successful in the future for other children with autism. Improving joint attention skills can increase autonomy in children with autism, which is important not only for clinicians and children themselves, but also for the teachers, parents, and therapists of those children. Joint attention skills help children communicate throughout everyday life, develop more advanced language, and increase social communication skills.

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Table 1. Categories of stimuli and stimuli included in each category

Category	A. Visually Alluring Toys	B. Strangely Placed Objects	C. Large Pictures	D. Sounds
Stimuli	<ol style="list-style-type: none"> 1. Ooze tube 2. Bead maze 3. Spiky ball 4. Giraffe tumble top 5. Dancing robot 6. See n' Say farmer toy 7. Spinning gears 8. Push n' Spin toy 9. Large foam blocks 10. Marble run 11. Mini trampoline 12. Liquid motion bubbler 13. Spinning top 	<ol style="list-style-type: none"> 1. Chair upside down 2. Puppets on teacher's hands 3. Table upside down 4. Shelf in middle of room 5. Trampoline upside down 6. Umbrella open on floor 7. Outdoor bike in playroom 8. Large hat on teacher 9. Toy in the bathroom 10. Trash on floor 11. Teacher pretending to sleep on floor 12. Animal mask on teacher 13. Teacher wearing wig 	<ol style="list-style-type: none"> 1. Nemo 2. Mickey 3. Minnie 4. SpongeBob 5. Donald Duck 6. Goofy 7. Peppa Pig 8. Olaf 9. Elsa 10. Woody 11. WALL-E 12. Lightning McQueen 13. Buzz Lightyear 	<ol style="list-style-type: none"> 1. Fire truck siren 2. Applause 3. Dog barking 4. Cat meowing 5. Elephant trumpeting 6. Cow mooing 7. Duck quacking 8. Police car siren 9. Car horn 10. Train 11. Door bell 12. Rain 13. Birds

Table 2. Auditory script and experimenter response examples

Category	A. Visually Alluring Toys	B. Strangely Placed Objects	C. Large Pictures	D. Sounds
Auditory Script Examples	Ex.) Marble Run	Ex.) Chair Upside down	Ex.) Nemo	Ex.) Cow mooing
	“Look at that!”	“Who did that?”	“Look, Nemo!”	“I hear a cow.”
	“So cool!”	“Look at that.”	“Look at this.”	“What is that?”
	“It’s a marble.”	“That’s silly.”	“Cool, Nemo!”	“I hear mooing.”
Response Examples	“Cool!”	“I don’t know!”	“I know!”	“Me too.”
	“It’s marble run!”	“That’s silly!”	“It’s Nemo!”	“Sounds like a cow.”
	“It is!”	“Yes, it is!”	“He’s a fish!”	“It’s a cow.”

Table 3. Category assignments for first session (following sessions will use counterbalancing)

Participant	Categories in which teaching procedures were used	Unassigned stimulus category used for across-category generalization
AB	Sounds Large-format pictures Toys	Unusually placed items
TH	Sounds Unusually placed items Toys	Large-format pictures
PR	Toys Large-format pictures Unusually placed items	Sounds

Table 4. Treatment fidelity checklist

Baseline Session Goals:		Practice Session 1: Rating				Practice Session 2: Rating			
1	Prepares materials needed prior session	0	1	2	N/A	0	1	2	N/A
2	Says “come with me!” to begin a trial	0	1	2	N/A	0	1	2	N/A
3	Participant initiates bid for joint attention, no reinforcement is delivered	0	1	2	N/A	0	1	2	N/A
A total score of 8 (80%) and higher reflects adequate treatment fidelity.		Total Score: ____				Total Score: ____			
Intervention Session Goals:		Practice Session 1: Rating				Practice Session 2: Rating			
1	Prepares materials needed prior session	0	1	2	N/A	0	1	2	N/A
2	Says “come with me!” to begin a trial	0	1	2	N/A	0	1	2	N/A
3	Plays auditory script	0	1	2	N/A	0	1	2	N/A
4	Participant initiates bid for joint attention, delivers social consequence	0	1	2	N/A	0	1	2	N/A
5	Participant DOES NOT initiate bid for joint attention, does behavioral reversal and error-correction until correct initiation is given	0	1	2	N/A	0	1	2	N/A
6	If problem behavior occurs due to no access to target stimulus, redirect to play with something else	0	1	2	N/A	0	1	2	N/A
7	If problem behavior occurs due to no access to target stimulus, redirect to hall for calm and quiet 10 seconds before returning to room	0	1	2	N/A	0	1	2	N/A
A total score of 8 (80%) and higher reflects adequate treatment fidelity.		Total Score: ____				Total Score: ____			

Table 4. Treatment fidelity checklist continued

Generalization & Maintenance Session Goals:	Practice Session 1: Rating				Practice Session 2: Rating			
1 Prepares materials needed prior session	0	1	2	N/A	0	1	2	N/A
2 Says “come with me!” to begin a trial	0	1	2	N/A	0	1	2	N/A
3 Bid for attention is initiated from the participant, delivers social consequence	0	1	2	N/A	0	1	2	N/A
A total score of 8 (80%) and higher reflects adequate treatment fidelity.	Total Score: ____				Total Score: ____			

Table 5. Interobserver agreement (IOA) by participant

Participant	Percentage of Sessions with IOA Assessed	Mean IOA (%)
AB	36	98
TH	38	98
PR	40	99

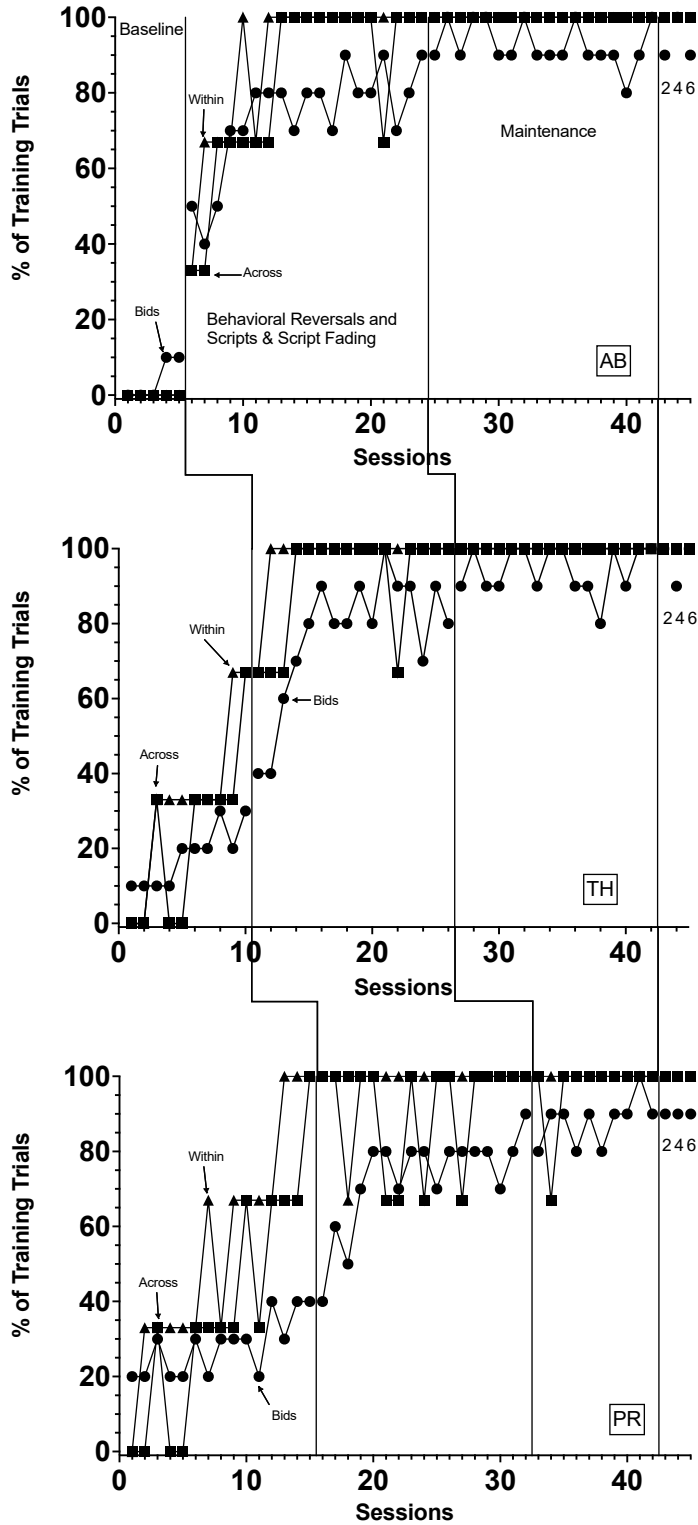


Figure 1. Percentage of training trials and percentage of within- and across-category generalization trials with correctly initiated bids for joint attention across conditions and participants

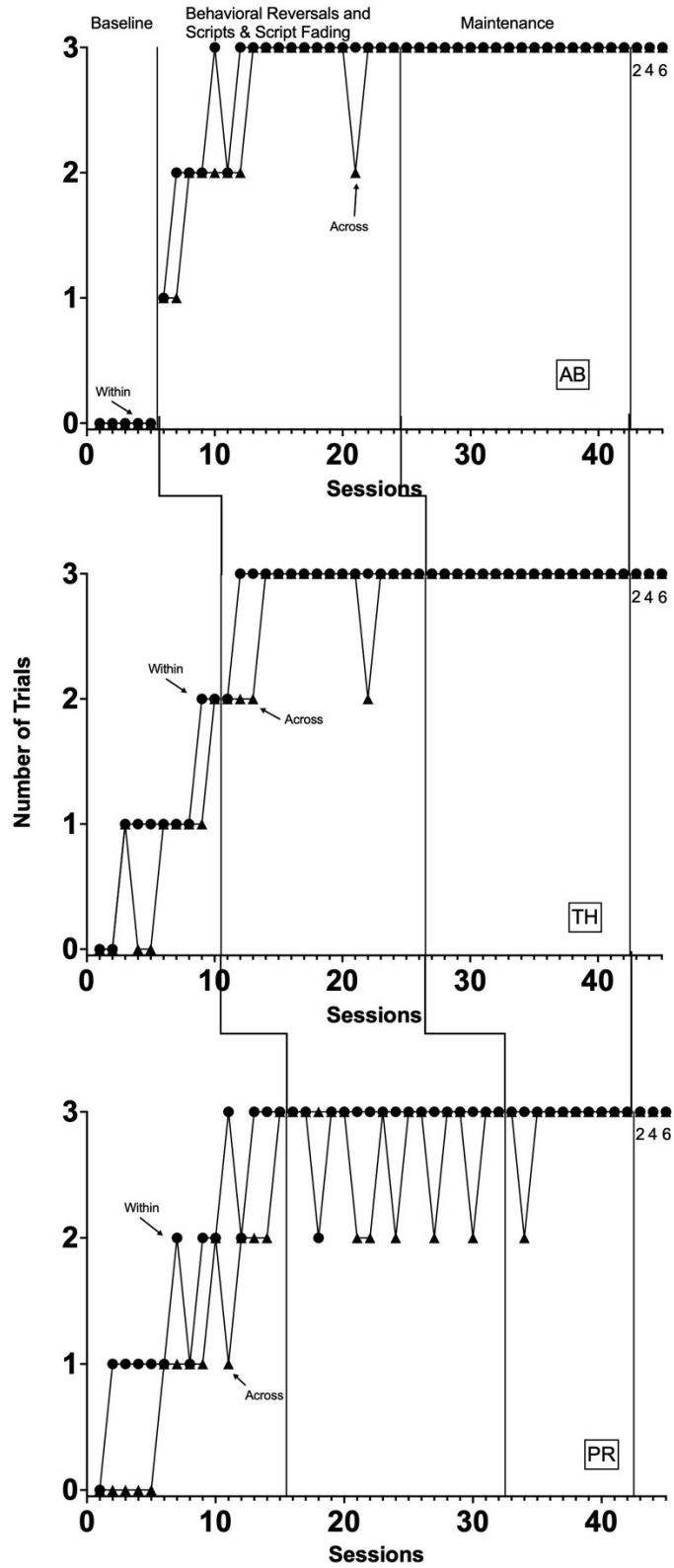


Figure 2. Number of generalization trials with correctly initiated bids for joint attention during within- and across-category generalization trials

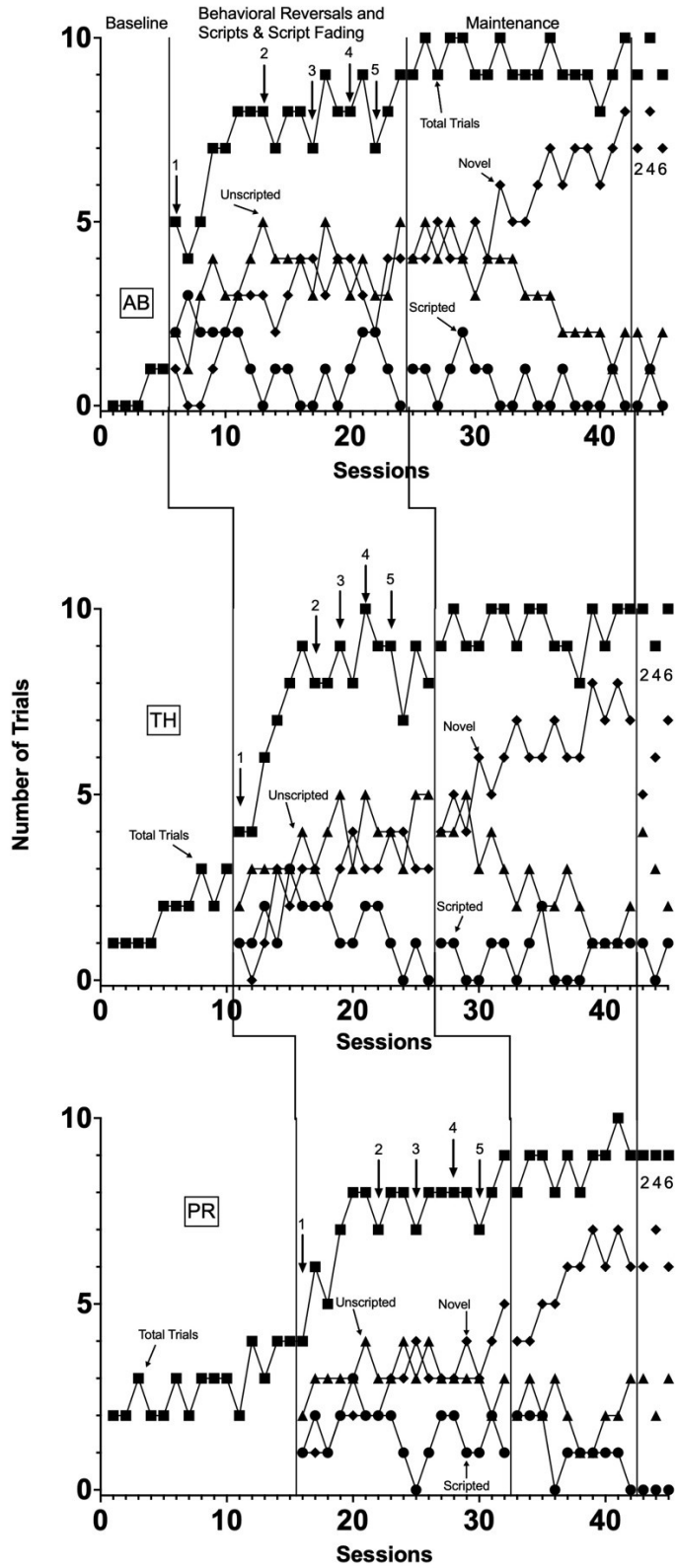


Figure 3. Number of training trials with novel, scripted, and unscripted interactions during initiation of bids for joint attention (numbered arrows indicate script-fading steps)

APPENDIX

Date: 6-17-2021

IRB #: IRB-FY2021-483

Title: Establishing a Generalized Repertoire of Initiating Bids for Joint Attention in Children with Autism

Creation Date: 2-18-2021

End Date:

Status: **Approved**

Principal Investigator: Michael Clayton

Review Board: MSU

Sponsor:

Study History

Submission Type Initial	Review Type Expedited	Decision Approved
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