

Effects of script-fading on social initiations during discrete-trial teaching with children with autism

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Abstract

The present study evaluated the use of auditory scripts and script-fading procedures to teach three children with autism to request additional instruction, select teaching materials, and solicit confirmation during discrete-trial teaching. Scripts were placed on instructional materials to evoke initiations, and script fading strategies were used to transfer stimulus control to the materials used for each discrete-trial activity. A multiple-probe across-activities design was used. Generalization of initiations was promoted by teaching to multiple exemplars, including common stimuli, and using naturally maintaining contingencies. The results showed that scripts and script-fading procedures were effective in increasing the number of initiations made during discrete-trial teaching, and generalization across activities, settings, and instructors. These procedures provide a way to increase the number of opportunities for initiations during discrete-trial teaching in place of passively waiting between instructor-initiated trials.

KEYWORDS

antecedent control, autism, discrete-trial teaching, generalization, script fading, social initiations

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1 | INTRODUCTION

Discrete trial teaching (DTT) is one of the most widely used instructional methods for teaching individuals with autism (Smith, 2001; Smith et al., 2000; Stahmer et al., 2003). The highly structured nature of DTT allows the teacher to set the pace for instruction (Delprato, 2001), while providing many teaching trials in a relatively short time (Sundberg & Partington, 1999). The literature suggests that although increases in vocal responses may occur because of DTT, this does not necessarily produce an increase in initiations (e.g., Odom et al., 1985). DTT often incorporates withholding instruction, and thus access to reinforcement, until learners engage in a readiness response of being still (Sarokoff & Sturmey, 2004). As a result, DTT may result in teachers inadvertently reinforcing the absence of initiations during inter-trial intervals.

This type of highly structured intervention may lead to a lack of spontaneity (Schreibman, et al., 2015) and student responses being dependent on adult instruction, and resulting in few elaborations (McClannahan & Krantz, 2005). For example, if an instructor asks the question, "What is this?", the student may respond (e.g., "a cup"), the instructor may respond by providing praise (e.g., "Good, you said 'a cup'"), further reducing opportunities for elaborations. Additional teaching strategies may be necessary to teach more elaborate communication interactions, thereby increasing the likelihood that individuals with autism learn to engage in social interactions found in the natural environment.

A core symptom of autism spectrum disorder is a deficit in social communication and interaction skills (American Psychiatric Association, 2013). Teaching students to initiate is a critical aspect of improving upon social deficits. Scripts and script-fading procedures can be used to teach children with autism to emit communication interactions, and to engage in reciprocal interactions and conversations (e.g., Krantz & McClannahan, 1993; Krantz & McClannahan, 1998). A script is an auditory script or written word, phrase, or sentence that enables people with autism to start or continue conversation (McClannahan & Krantz, 2005). Script-fading procedures allow for transfer of stimulus control to natural stimuli in the environment. For example, Sarokoff et al. (2001) used scripts with embedded textual stimuli on product labels on food and video packaging to teach students to initiate conversation about those items. Similarly, Groskreutz et al. (2015) embedded scripts on sets of toys to teach students make play-related comments about toys. In both studies, scripts were faded until only the materials necessary for the task remained.

Brown et al. (2008) used script-fading procedures with selected stimuli at a video-tape rental, convenience store, and sporting goods store to ultimately evoke conversational initiations in those settings. The use of those items served as a common stimulus to promote generalization from the "mock" store used for teaching to community settings. Wichnick-Gillis et al. (2016) replicated this procedure by super-imposing scripts on leisure activities (e.g., movies, coloring books, toys, puzzles). In 2019, Wichnick-Gillis et al. (2019) similarly placed textual scripts on a laptop, Lego pieces, and lunch materials to teach students to initiate during these activities. Each of these studies used textual scripts affixed to stimuli. Stevenson et al. (2000) taught social initiations to non-readers by embedding auditory scripts with learners' activity schedules. Learners were taught to initiate to an instructor before resuming the next activity within the schedule.

Auditory scripts were selected for use in the present study because the participants had limited reading repertoires. Recorders were attached to stimuli used during discrete-trial teaching to facilitate transfer of stimulus control from the scripts to the instructional materials. Auditory scripts were used to minimize the reliance on prompts from instructors, allowing the instructor to serve as a conversation partner during reciprocal interactions with the student.

Generalization was assessed across activities, and across a novel category of activities. A general case analysis was used to identify a variety of categories of DTT activities, scripts, and materials (Horner et al., 1986; O'Neill, 1990). An additional generalization measure was obtained with an alternate instructor in a different location. Akers et al. (2016) reviewed script-fading procedures and called for future researchers to address the lack of agreement in the definition of unscripted initiations and recommended that responses be defined in a manner that allows researchers to determine if participants engaged in not only scripted responses, but also novel

responses, following teaching. In the present study, unscripted responses were those that included any words not previously affixed to a script, serving as a measure of response generalization, and providing information regarding participants' use of initiations that were never specifically scripted during this study.

The incorporation of script-fading procedures into discrete-trial teaching may provide repeated opportunities for children with autism to practice initiating social exchanges. It may also provide an opportunity to engage in an alternative behavior instead of quietly waiting between trials. Because the use of script-fading procedures may allow the instructor to serve as a conversation partner during exchanges, this may, in turn, reduce the likelihood that students speak only when prompted to do so.

The present study expands upon the work of Brown et al. (2008) by examining the effects of the placement of scripts on materials to aid in the transfer of stimulus control and by incorporating the use of auditory scripts to minimize vocal prompts by adults and maintain the role of the communication partner. By combining script-fading procedures with discrete-trial teaching, participants were provided with numerous teaching opportunities during the highly structured format of DTT, and increased opportunities to initiate interactions during teacher-directed tasks.

2 | METHOD

2.1 | Participants

Three boys who attended a private school for individuals with autism participated. All were diagnosed with autism by an outside agency. Prior to the study, the participants were evaluated with the Preschool Language Scale, Fourth Edition (Zimmerman et al., 2002), Peabody Picture Vocabulary Test, Third Edition (Dunn & Dunn, 1997), and the Receptive and Expressive One-Word Picture Vocabulary Test, Fourth Edition (Brownell, 2000) (see Supporting Information S1 for results of these assessments).

Jake was 4 years, 5 months old, and had been enrolled in the school for 12 months prior to the study. Trevor was 5 years, 5 months old and had been enrolled at the school for 12 months. Tim was 5 years, 6 months old, and had been enrolled in the school for 26 months.

All three participants previously acquired skills using a variety of behavior analytic teaching procedures, including DTT, and token economies, as evidenced by clinical data collection. All of the participants had learned to imitate auditory scripts and had used scripts to answer questions and mand for items. None of the participants had been exposed to the use of auditory scripts presented within DTT. All participants were familiar with the DTT activities similar to those used during teaching. Program data indicated that each participant reliably imitated 3- to 4-word phrases presented on audio recordings. Prior to the study, each participant was asked to imitate each audio recorded model twice, for a total of 18 trials. Data indicated that all participants reliably imitated at least 17 of the 18 models.

2.2 | Setting and materials

The study was conducted at a private school that provided services to individuals with autism using behavior analytic teaching procedures. Experimental sessions were conducted in a room different from those used for the participants' daily instructional activities. The room contained a table, three chairs, and a shelving unit holding binders and bins with instructional materials used during the study. The experimenter and a data collection assistant were present during all sessions.

During their typical school day, all participants used a token board to learn most skills. Tokens were also contingently delivered for non-targeted skills in the study (e.g., question answering, reading site words etc.). Tokens were not delivered for initiations.

Auditory scripts were presented on Voice-Over™ button-activated recorders that could record 10-s audio clips. Auditory scripts were then placed on relevant stimuli used within the DTT session to increase the likelihood of these stimuli functioning as discriminative stimuli for initiations when the scripts were systematically faded. The sequence of scripts was rotated across sessions, with each of three scripts being presented twice per activity, for a total of 18 scripts. All sessions were recorded with a video camera on a tripod, for data analysis purposes.

Scripts were developed following observations of same age peers of typical development to create content of initiations during teaching activities. Vocalizations were transcribed, verbatim, and contributed to the creation of scripts used throughout the study. The latency and duration of interactions was also recorded. This information resulted in the use of a 10-s data interval. Normative data suggested that peers emitted an average of 1 (range, 0–3) vocal comments during the 10-s data-collection interval. This was used to determine the average rate of initiations expected during the data collection window.

2.3 | Response categories

Three categories of activities were taught to each participant with six trials conducted for each activity for a total of 18 trials per category. Activities were selected on the basis that the student had the necessary prerequisites to complete the task but had no previous instruction with the specific materials in use. All categories were presented in a DTT format and included choice, question, and art activities.

2.3.1 | Requests to choose materials (choice activities)

Choice materials consisted of assembling blocks, finding an object hidden in a bag, sequencing pictures, and identifying a missing portion of a photograph (e.g., a bicycle with a missing wheel). For each of these activities, materials were presented in a bin, and the participant was given an opportunity to select the items used for instruction (e.g., which block configuration to assemble). Corresponding choice pictures were presented in card holders attached to a 31 cm × 30.5 cm board using Velcro™. Scripts were attached to the bottom left corner of each picture and used to evoke a request for materials prior to each trial beginning.

2.3.2 | Requests to initiate instruction (question activities)

Question-answering activities had scripts used to evoke requests for instruction preceding the onset of the activity (e.g., activities included general information question-answering (e.g., “What animal is the king of the jungle?”), single words to be read (e.g., “Look”), pictures featuring a subject and action (e.g., “What is the girl doing?” with a picture of a girl running), and three-word phrases with corresponding pictures (e.g., “Which is a blue circle,” with pictures of a blue circle, a red circle, and a blue square). Each task was presented in baseball card holders placed in a folder inside a 22 cm × 28 cm 3-ring binder. Scripts were attached to the inside cover of the binder.

2.3.3 | Requests for confirmation (art activities)

Art activities were targeted via DTT and were used to evoke a request for confirmation at the conclusion of each art activity. Scripts were attached to a laminated piece of 30.5 cm by 45.5 cm paper that served as an art mat for each of these activities. Activities included coloring, cutting, drawing, and stickers.

2.4 | Dependent variables

An initiation was defined as any contextually and grammatically correct statement or question that included a noun, or pronoun, and a verb. To be scored, the participant was required to orient, by gazing at the recipient's face at some point during the initiation, or within 3 s following the initiation. Answers to questions and prompted vocal responses were not scored as initiations (Krantz & McClannahan, 1993, 1998; Stevenson et al., 2000). The number of initiations within 10-s intervals was scored using continuous event-recording. Initiations were scored as scripted or unscripted.

2.4.1 | Scripted initiations

Scripted initiations were defined as vocal productions that matched the most recently played script. An initiation would be scored as scripted if the language of the script included modifying or deleting pronouns, prepositions, articles, and conjunctions, or adding the listener's name. Statements or questions that matched the complete version of faded scripts were scored as scripted initiations (Krantz & McClannahan, 1993, 1998; Stevenson et al., 2000). For example, if the script was faded to "Is" and the participant said, "Is this right?" as stated in the original script, a scripted initiation was scored. Even after the full script was removed, all initiations that matched prior scripts were scored as scripted.

2.4.2 | Unscripted initiations

Unscripted initiations were defined as initiations that contained any words that were not present on current or previously taught scripts (Garcia-Albea et al., 2014), or included a different combination of words presented on the scripts. For example, the response "Look, a car" was scored as unscripted, because the word "car" was never presented on a script. The response "Can I pick one?" was also scored as an unscripted initiation because previous scripts included "Can I pick?" and "I'll get one."

2.5 | Experimental design

A concurrent multiple-probe across-categories design was used to provide sufficient baseline sessions, while permitting sufficient sessions for the ongoing assessment of generalization. Assignment of activities was partially counterbalanced across participants, such that each activity was taught to two of the three participants. Three of the four activities within each category were targeted for instruction for each participant, with the fourth being reserved to assess generalization across activities.

2.6 | Procedure

2.6.1 | General format

Each category of DTT activities (i.e., Questions, Building, and Art) was 15 min in duration as, as were daily experimental sessions. If probes were conducted across all categories of activities, we ran 3 consecutive sessions for a total duration of 45 min. Instructional materials for DTT activities were present on the shelving unit at the start of each session. Participants obtained the necessary materials and placed them on the desk. The experimenter

then presented the materials and began instruction. Six trials were conducted for each activity, resulting in 18 trials across the 3 activities targeted (i.e., six trials of art activities, six trials of questions, six trials of play activities).

2.6.2 | Session format

Instructors responded to initiations by providing an appropriate and relevant comment. For example, if the participant said, "Look at this," the experimenter responded with a statement such as "That looks great!" (see Supporting Information S1 for scripts and sample responses).

2.6.3 | Data collection

Across all categories of activities, data were collected during a 10-s interval. This data collection window occurred at either the beginning, middle or end of the trial for each category of activities. To target requests for confirmation, the 10-s data collection interval began immediately after the learner completed the art activity (i.e., placed the last sticker on the page, colored the picture, cut out the shape, or completed a drawing). For requests for instruction (Question Activities), the 10-s data collection interval began at the end of each trial, immediately following a praise statement or error correction depending on the participant's response. For requests for materials (Choice Activities), the 10-s data collection interval began at the onset of the trial, immediately after the experimenter presented the array of choices, with an instruction to begin (e.g., "Let's build something").

2.6.4 | Baseline

Scripts were not present. Manual prompts were delivered for responses related to the instructional activity (e.g., cutting), but were not delivered for initiations. Praise and tokens were only delivered for discrete-trial tasks as described above, but not for initiations to the instructor. Six trials were conducted for each activity.

2.6.5 | Intervention

The experimenter arranged materials and provided instruction for each category of responses. During all activities, tokens were delivered contingent upon correct responses for discrete-trial tasks, but not for initiations to the instructor. See Supporting Information S1 for a description of all scripts used during teaching.

For requests for confirmation (Art Activities), the experimenter presented the art materials and an instruction. If he did not respond, or made an error, manual prompts were delivered to guide the correct response. Scripts during this activity pertained to requests for confirmation (e.g., "Look, I'm done.>").

For requests for instruction (Question Activities), the experimenter opened the binder containing six cards attached to the inside of the binder and selected a card. She then presented the question or instruction (e.g., "What color is grass?"). If he did not respond, or responded incorrectly, a vocal model was provided (e.g., "Green"). During teaching, scripts pertained to requests for instruction (e.g., "Next one please").

For requests for materials (Choice Activities), the experimenter presented a choice board and all necessary materials and gave an instruction (e.g., "Let's build something.>"). During teaching, scripts for this activity pertained to requests for materials (e.g., "Can I pick?"). The learner selected a picture of relevant materials from the felt board and was asked to complete the task (i.e., build with the blocks, find the item hidden in the bag, sequence the

pictures, or find the missing portion of the picture). If he did not respond or made an error, the experimenter provided a manual prompt to guide task completion.

During teaching sessions, voice recorders containing auditory scripts were attached to instructional materials. Recorders were placed on the art mat for Art Activities, on the inside of the binder for Question Activities, and on photographs on the choice board for Choice Activities. The instructor manually guided the activation of the audio recorder for the first two sessions of each activity to prevent errors. After this, manual prompts were only used if the participant did not activate the recorder within 10 s of the previous response (as specified above) or otherwise made an error. If the participant did not imitate the auditory script, manual prompts were used to assist him in activating the recorder again. If the participant did not repeat the auditory script after being provided with a manual prompt, the instructor provided a vocal model simultaneously with the auditory script. This final step was only necessary for Jake.

When a participant repeated at least 15 of 18 scripts independently for one session, scripts were faded from end to beginning, one word at a time. For example, the fading sequence for the script, "Look, I'm done," was (1) "Look, I'm," (2) "Look," (3) recorder present with no recording, and (4) no recorder present (Krantz & McClannahan, 1993). During these fading steps, if the participant did not complete a partial script contextually, the experimenter activated the full script. The partial script was then presented again. This sequence continued until the participant responded to the partial script.

A revision to this sequence was made for Jake during *Requests for Instruction* because he did not maintain initiations in the absence of scripts. Specifically, scripts were activated by the experimenter using a 0-s delay for sessions 40–41. Full scripts were then reinstated for sessions 42–43. A blank recorder (fading step 3) was presented during sessions 44 through 49. When it was removed at session 50, Jake's initiations decreased again. The error correction procedure was revised at this point to address this decrease in initiations following the second fading of scripts. Following session 51, when Jake did not imitate the auditory script, a manual prompt was delivered for him to point to the location where scripts had been previously attached. During this error-correction procedure, Jake correctly responded to an initial manual prompt following each error. For subsequent response categories, this modification was not required for Jake.

2.6.6 | Generalization

Generalization was programmed using multiple exemplar training. Five measures of generalization were obtained with each participant. Three consisted of within-category activities like those used in teaching and one was across a novel activity and provided participants with an opportunity to emit each type of response targeted (i.e., request to choose materials, request to initiate instruction, request for confirmation). Generalization was also assessed within a Combined Probe, in which participants completed a Connect the Dot worksheet. During this activity, participants were given the opportunities to emit each of the targeted responses by selecting the worksheet, initiating to begin the worksheet, and requesting confirmation at the end of the task. An additional measure was used to assess generalization across instructors and locations with the students' instructor, in their primary classroom to assess transfer to the setting where DTT was most likely to occur. See Supporting Information S1 for a summary of all generalization measures obtained.

2.6.7 | Maintenance

The maintenance condition was identical to baseline. Scripts were not available, and audio scripts were not used. Tokens were delivered contingent upon correct responding for the discrete-trial activity, but not for initiations. Data were collected for each participant 2 weeks and 1 month after the scripts were faded.

2.6.8 | Data analysis

Data were collected in vivo. The frequency of scripted and unscripted initiations during each 10-s data collection interval was summarized per category. Generalization data were summarized as initiations for within-category activities, combined probes, and novel instructors/settings. Maintenance data were summarized as the number of scripted and unscripted initiations made.

2.6.9 | Interobserver agreement and procedural integrity

Interobserver agreement (IOA) data were collected in vivo on all dependent variables by instructors at the school who had received a minimum of 1 year of training in the use of behavior-analytic procedures and data collection. Training sessions were conducted on response definitions and measurement procedures, with opportunities to practice scoring data using video clips of sessions. Percentage of IOA was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. Interobserver agreement data were obtained on scripted and unscripted initiations. An agreement was scored if both observers recorded the same number of initiations, and the same type of initiation per trial. The observers scored 49%, 48%, and 38% of sessions for Tim, Jake, and Trevor, respectively. The mean agreement for initiations was 95% (range, 72%–100%) for Tim, 96% (range, 78%–100%) for Jake, and 95% (range, 77%–100%) for Trevor. Procedural integrity was also assessed in vivo by instructors at the school who had received a minimum of 1 year of training in the use of behavior-analytic procedures and data collection (see Supporting Information S1 for the Procedural Integrity checklist and results).

2.6.10 | Social validity

Teachers at the participants' school were asked to complete the *Treatment Acceptability Rating Form—Revised* (TARF; Reimers & Wacker, 2007) to determine the likelihood that they might use scripts embedded within DTT. Overall, the raters provided high scores for the acceptability of the procedures used (See Supporting Information S1 for the Social Validity Questionnaire and results). A social validity questionnaire was also provided to graduate students after observing pre- and post-intervention video clips of each participant. Half of the video clips were drawn from the baseline condition and the other half were drawn from the last 10 intervention sessions (following script fading). Video clips were presented in a quasi-randomized order, such that pre- and post-intervention clips were not shown sequentially for each participant. Respondents were asked to respond to the question "Did the child initiate to the teacher during instruction?". In measuring the social validity of outcomes, viewers rated 14% of all pre-intervention video clips as including an initiation and rated 92% of the post-intervention video clips as including an initiation.

3 | RESULTS

Figures 1–3 show the number of scripted and unscripted initiations for each category of activities across all participants. During baseline, few initiations to instructors were made. Systematic increases in initiations were observed across all participants and conditions when treatment was implemented (see Table 1 and Figures 1–3). All participants met criterion (at least 15 initiations per session) within the first five sessions in which the script was introduced. After participants reliably imitated the full auditory script, the script fading sequence was completed

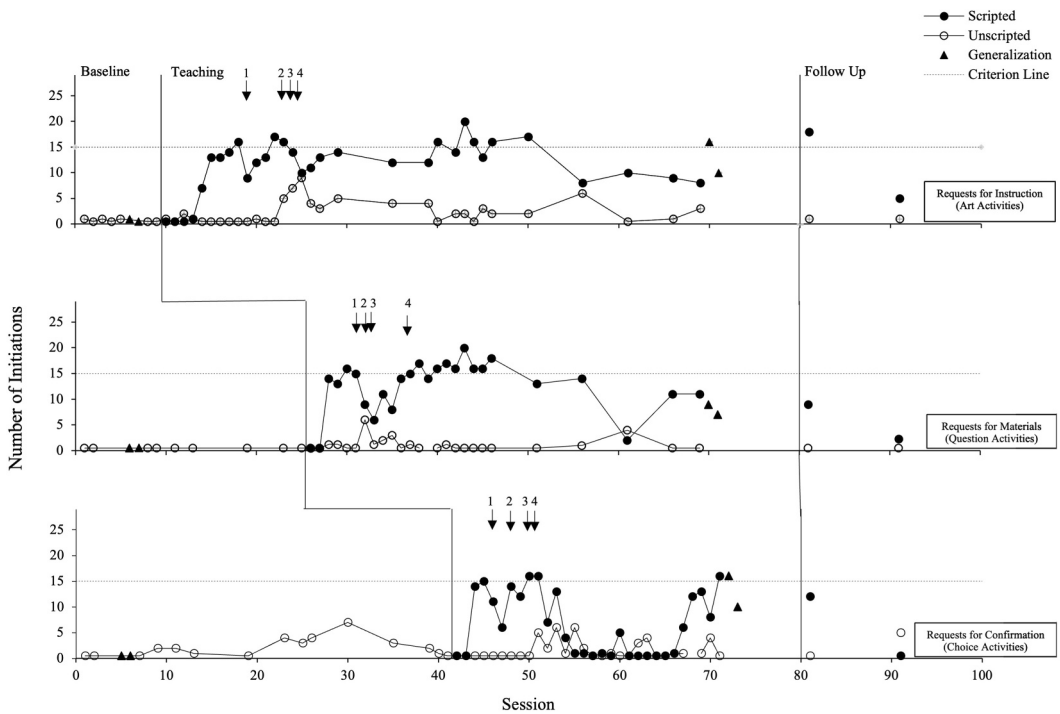


FIGURE 1 Tim initiations. Number of scripted and unscripted initiations for Tim. Horizontal dashed lines indicate the number of scripts available. Numerals denote script-fading sequence.

within 10 sessions for all participants, except for Requests for Confirmation for Jake, which required 26 sessions to complete.

Figures 4–6 depict data from within-category and combined generalization probes. Generalization of initiations was assessed pre-intervention, and post-intervention with an instructor who was not associated with teaching in a setting not used for teaching. Prior to teaching, Tim made 1 initiation during a generalization probe. Following teaching, he made between 7 and 16 initiations per category (See Figure 1). Similarly, Jake emitted only one initiation prior to teaching, and emitted between 16 and 25 initiations per category following teaching (See Figure 2). Trevor made between 1 and 11 initiations prior to teaching, and 7–26 initiations following teaching (See Figure 3). See Supporting Information S1 for a summary of the results of alternate generalization probes.

4 | DISCUSSION

Prior to teaching, the participants in the present study made minimal initiations to instructors during discrete-trial teaching. With the introduction of scripts and script-fading procedures, the children learned to initiate interactions with instructors. These results are consistent with previous literature, indicating that script-fading procedures are effective in teaching individuals with autism to initiate interactions (e.g., Argott et al., 2008; Dotto-Fojut et al., 2011; Krantz & McClannahan, 1993).

Incorporating script-fading procedures into DTT provides additional opportunities for students to respond, addressing limitations in this type of instruction (Schreibman, et al., 2015). This also permits the instructor to reinforce initiations during intertrial intervals, as an alternative to reinforcing readiness responses that requires students to remain still and quiet.

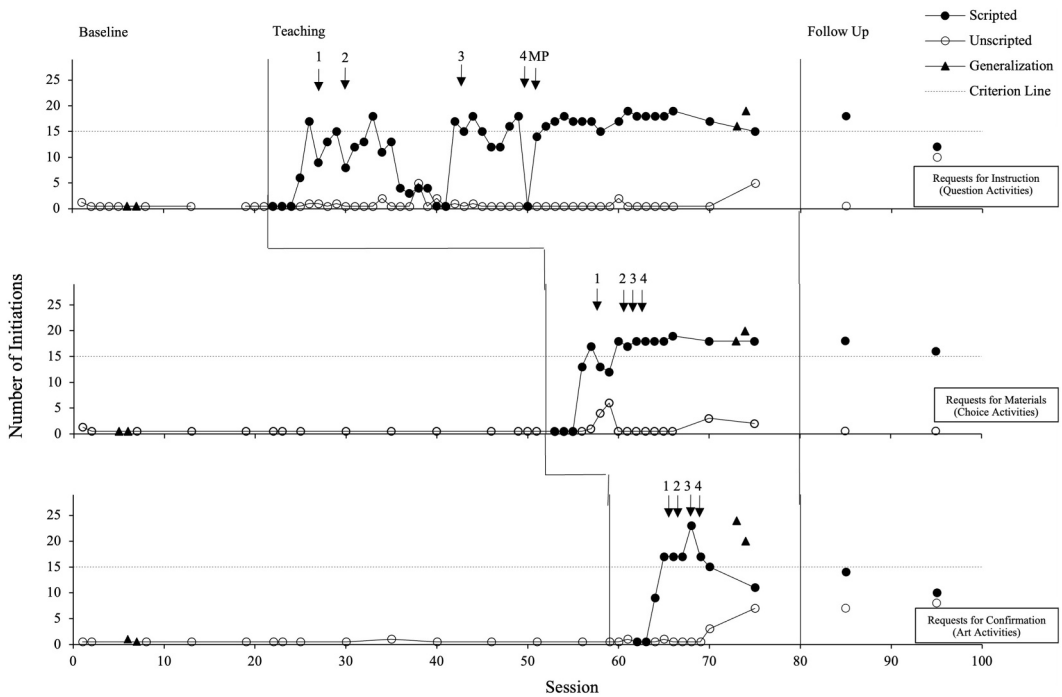


FIGURE 2 Jake initiations. Number of scripted and unscripted initiations for Jake. Horizontal dashed lines indicate the number of scripts available. Numerals denote script-fading sequence. MP denotes use of manual prompts and vocal models.

The careful placement of these scripts on relevant materials used during DTT resulted in the transfer of stimulus control to the relevant discriminative stimuli, as done by Brown et al. (2008), Sarokoff et al. (2001), Groskreutz et al. (2015), Wichnick-Gillis et al. (2016), and Wichnick-Gillis et al. (2019). This shift occurred for 2 of 3 participants. An alternate teaching procedure was required for Jake, in which the instructor provided a vocal model while providing a manual prompt to press the blank recorder, or pointed to the area in which the blank recorder was previously attached. This failure to transfer stimulus control is similar to results obtained by Betz et al. (2011) and Sellers (2011) in that traditional script fading procedures were not initially successful. Additional research is needed to explore participant variables that may contribute to the efficacy of script-fading procedures, including prerequisite skills, such as vocal imitation, orienting to a conversation partner, and cooperation with instructional activities. The participants prior exposure to scripts and script-fading procedures within this study may also have had an impact on the varied acquisition observed across participants.

This present study also did not include pre-programmed reinforcers for initiations. This differs from the study conducted by Brown et al. (2008) in which points were delivered via a point counter for initiations. It is possible that initiations were primarily motivated by the terminal consequences of the DTT session. Scripted responses may have served as an additional requirement within the task. This may account for the errors produced by Jake. Perhaps it might be necessary for some participants to add reinforcement contingencies for initiations as scripts are faded.

When participants were engaged in discrete-trial teaching tasks in their classrooms with a different teacher, initiations generalized. Generalization was also observed during within-category generalization trials using novel materials and a combined generalization probe, using an activity that provided opportunities for multiple initiations. These results are likely due to several strategies used to facilitate generalization (Stokes & Baer, 1977). First, multiple exemplar training was used. A variety of scripts promoted response generalization, and a variety of instructional activities within each category of activities promoted stimulus generalization. Common stimuli were

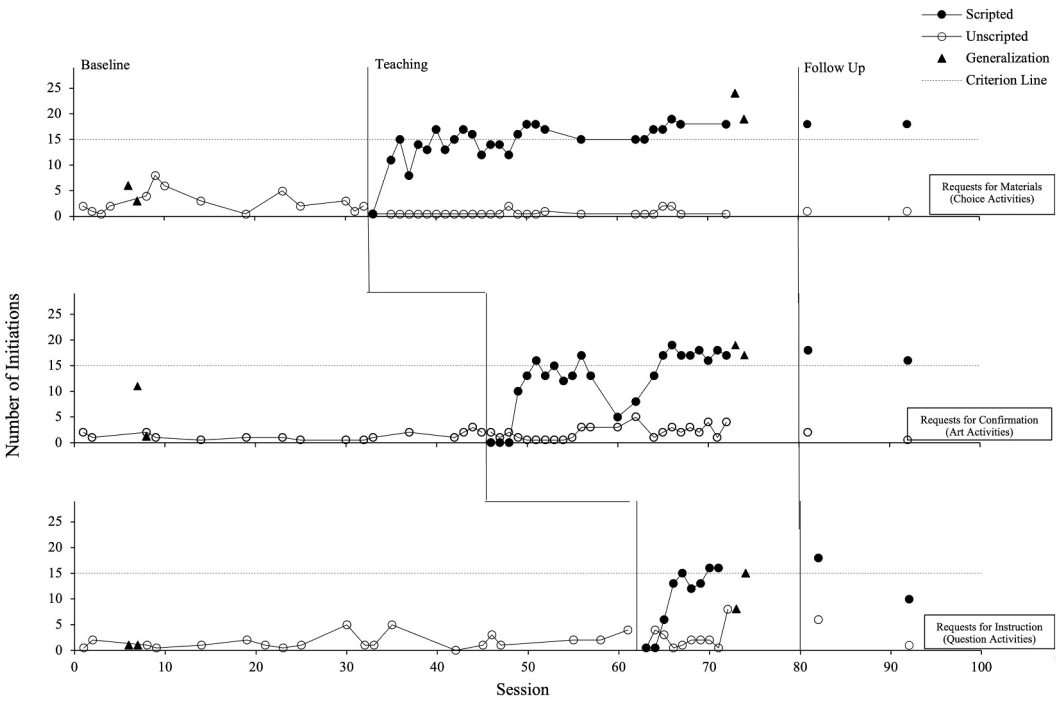


FIGURE 3 Trevor initiations. Number of scripted and unscripted initiations for Trevor. Horizontal dashed lines indicate the number of scripts available. Numerals denote script-fading sequence.

TABLE 1 Means and ranges of scripted and unscripted initiations.

Participant	Baseline		Post-intervention final 3 teaching sessions		2-week follow up		1-month follow up	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Scripted initiations								
Tim	0.9	0–1	13	11–16	13	9–18	2.3	1–5
Jake	0.1	0–1	18.7	17–21	16.7	14–18	12.7	10–16
Trevor	2.0	0–11	17.6	8–24	16.3	13–18	14.7	10–16
Unscripted initiations								
Tim	1.0	0–7	1.52	0–10	0.3	0–1	2.0	1–5
Jake	0.1	0–1	1.01	0–10	2.3	0–7	7.6	3–11
Trevor	1.8	0–8	1.3	0–8	3.0	1–6	0.7	0–1

also selected to promote generalization across settings and activities. During teaching, scripts were attached to materials relevant to the instructional tasks. These materials were also presented during the pre- and post-intervention, within-category, and combined generalization probes. Attaching stimuli to relevant materials likely resulted in stimulus control shifting from the auditory scripts to instructional materials to evoke initiations. Future studies may explore whether initiations generalize when these materials are removed or changed (e.g., in the absence of the Questions binder, or with a different binder).

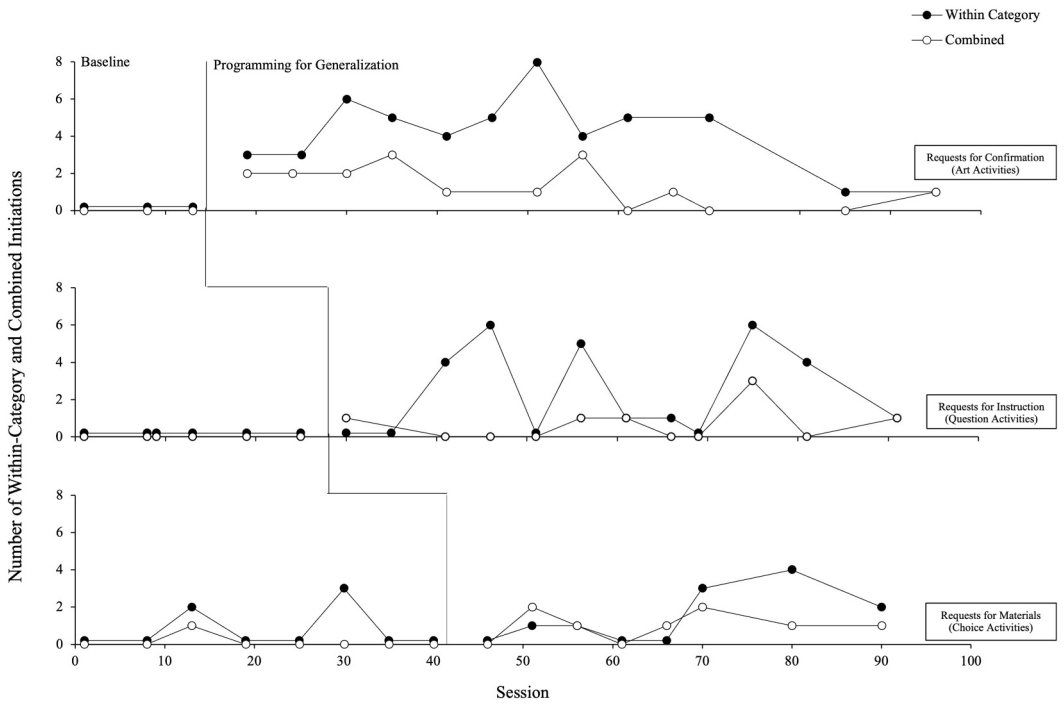


FIGURE 4 Generalization data for Tim. Number of generalization initiations for Tim.

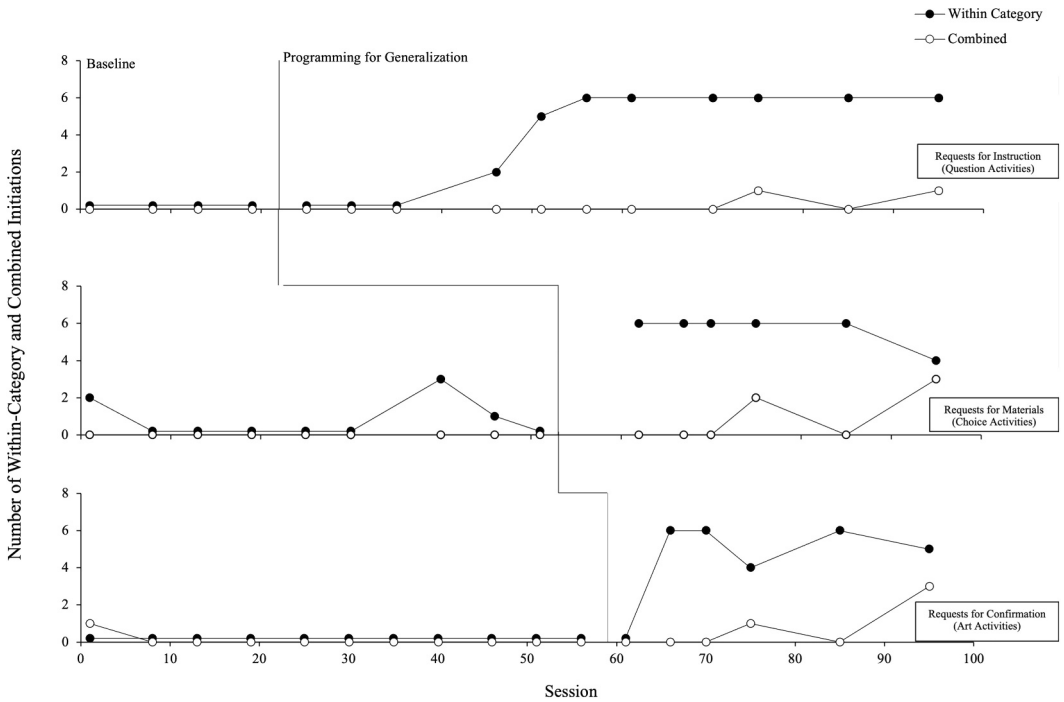


FIGURE 5 Generalization data for Jake. Number of generalization initiations for Jake.

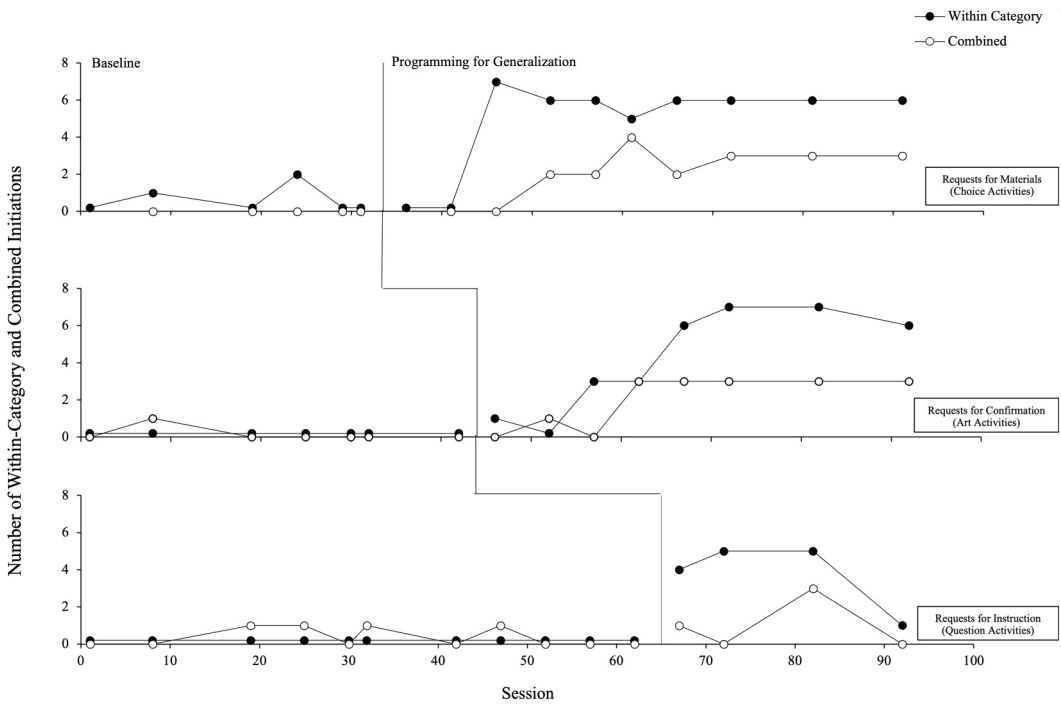


FIGURE 6 Generalization Data for Trevor. Number of generalization initiations for Trevor.

Follow up data suggest that results maintained for 2 of 3 participants. For Tim, the number of initiations emitted decreased at the 2-week follow-up, and further decreased at the 1-month follow-up. Anecdotal observations indicate that Tim often emitted an initiation after the 10-s data collection interval. The response latency appeared to increase as the skill was practiced less frequently. Experimental sessions were not run between the final teaching probe and follow-up probes. Thus, participants were not given an opportunity to practice this skill. It is unclear if initiations would have been maintained if students were exposed to these materials during this time.

Several limitations existed within this study that might be improved upon in future studies. First, the categories selected for the multiple-probe design varied. The extent to which this impacted participants' initiations is unclear. During the baseline condition Trevor and Tim emitted unscripted initiations for requests for materials. It is possible that this was in part due to their prior history of reinforcement for using vocal initiations to mand for items.

For all participants, a greater number of unscripted initiations were made during Art Activities, and fewer were made during Question Activities. These results may be due to the presence of a picture that provides content for a novel initiation. The lack of a visual cue, due to the removal of the question card before the onset of data collection for Requests for Instruction, may have resulted in less content for a novel initiation for this activity. For example, after coloring a picture, Tim often pointed to the picture, and made a statement such as "Look, I made a ball." Following a Question Activity, the experimenter immediately placed the card back in the binder, resulting in fewer visual stimuli to evoke initiations. A more careful analysis of the type of categories of instruction may be useful to determine how instructional materials impact initiations.

Another limitation of the study was the lack of analysis of the types of initiations emitted. A measure of novel initiations may have been more valuable than a measure of unscripted initiations, as it would indicate the extent to which the unscripted initiations varied. Wichnick, Vener, Keating, & Poulson, 2010 measured novel initiations, defined as the first instance since the beginning of data collection in which a statement was emitted that differed from all previously emitted scripts by more than verb tense, conjunctions, articles, prepositions, or pronouns. In the

current study, all initiations in baseline were scored as unscripted, however, many were repetitions and demonstrated little variability. The short data-collection window (10-s) likely also limited the extent to which novel utterances were emitted. Anecdotal evidence suggests that two of the participants varied initiations, by alternating the scripts taught, whereas Trevor tended to repeat the same initiation. For example, most initiations emitted by Trevor in baseline took the form ("It's a ____"). Alternate strategies, such as lag schedules (Susa & Schlinger, 2012) may be useful in increasing the variety of initiations emitted and may result in comments that remain interesting and novel to conversation partners.

The goal of the current study was to incorporate scripts and script-fading procedures into DTT. However, a direct measure on whether the acceptability of DTT with and without script-fading was not included. It would be valuable to assess instructor and learner preferences regarding the incorporation of script-fading procedures within DTT. Additionally, The introduction of scripts within DTT may result in fewer trials per session, potentially reducing the efficacy of the DTT procedures. Future studies may compare rates of acquisition within DTT when scripts and script-fading procedures are incorporated to increase student initiations to determine whether doing so is detrimental to skill acquisition for some learners.

The results of the present study are important for several reasons. The procedures provided additional opportunities for children with autism to initiate to instructors. Incorporating scripts and script-fading procedures also limited the number of instances in which children received reinforcement for passive waiting between trials during DTT. The use of multiple exemplar training, common stimuli, and naturally maintaining contingencies also increased the likelihood that skill generalization would occur. Using this procedure, children with autism spectrum disorder may learn to request confirmation, materials, and instruction during DTT, while continuing to learn to complete DTT tasks.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

Consent was obtained by guardians of all participations. This study received IRB approval.

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