Script fading for children with autism: Generalization of social initiation skills from school to home

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We used a script-fading package to teach children with autism to initiate social interactions across various activities in the school setting, and we programmed for generalization in the untrained home setting with a sibling. The three participants, ages 8 to 10 years, demonstrated deficits in social initiations with their peers. During baseline, the participants emitted initiations to one another, although this behavior was variable and did not endure over time. With the introduction of the script-fading package, however, social initiations systematically increased. Moreover, the effects of the script-fading package generalized to the untrained home setting with a sibling. This study expands upon previous research by demonstrating the generalization of social initiations from school with peers to the home setting with siblings.
    Key words: autism, generalization, interactions, script fading, social skills

A core symptom of autism spectrum disorder is a deficit in social communication and interaction skills (American Psychiatric Association, 2013). Social skills constitute a complex class of behavior that is expected to occur across a variety of different situations. A critical component of effectively teaching social communication and interaction skills is the generalization, or transfer, of behavior change from training conditions to untrained conditions including other people, objects, and events in various environments (Garcia, 1974; Stokes & Baer, 1977).

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The generalization of behavior change across appropriate conditions would suggest that some of the relevant stimuli may have acquired discriminative control over the behavior.

    Researchers in the field of behavior analysis have demonstrated that script fading can be used to increase social interactions among people with autism (Betz, Higbee, & Reagon, 2008; Krantz & McClannahan, 1993, 1998; Wichnick, Vener, Keating, & Poulson, 2010). A script is a written or audiotaped word, phrase, or sentence that is presented as a model to teach conversation. A main objective of the script-fading procedure is an increase in the number of unscripted social interactions emitted by participants as the scripts are faded out. Unscripted social interactions can be defined as statements that differ from the scripts that are provided in teaching by more than verb tense, conjunctions, articles, prepositions, or pronouns (Krantz & McClannahan, 1993). As people with autism reliably emit the scripts, the scripts are faded out and the number of unscripted social interactions

should increase systematically (McClannahan & Krantz, 2005).

Several researchers have used script-fading procedures to successfully increase unscripted social interactions emitted by people with autism to adults. Krantz and McClannahan (1998) embedded scripts into activity schedules to teach three children with autism to initiate to adults about on-going events. For example, the children were taught to say, "Look" or "Watch me" as they played with Legos© or a puzzle. The authors observed a systematic increase in the number of unscripted social initiations as the scripts were faded. Similarly, Groskreutz, Peters, Groskreutz, and Higbee (2015) taught three children with autism to emit comments to adults when playing with toys through a script-frame procedure. Scripts consisted of incomplete statements to be completed by the participants and were attached directly to the toys. The use of this procedure led to a systematic increase in the rate of unique comments emitted by each of the three participants. Similar procedures and outcomes have been observed by other researchers who used script-fading to teach interactions with adults (e.g., Garcia-Albea, Reeve, Reeve, & Brothers, 2014; MacDuff, Ledo, McClannahan, & Krantz, 2007; Reagon & Higbee, 2009; Stevenson, Krantz, & McClannahan, 2000).

Researchers have also used script-fading procedures to teach people with autism to interact with their peers. In their seminal study on script-fading procedures, Krantz and McClannahan (1993) used written scripts to teach four children with autism to emit initiations to their peers during art activities. The authors provided each participant with a sheet of paper that contained a cue to talk and a list of ten different scripts pertaining to the stimuli present in the environment. The number of unscripted initiations emitted by the participants increased systematically as scripts were faded out.

Brown, Krantz, McClannahan, and Poulson (2008) also used a script-fading procedure to increase the number of social interactions among three children with autism. The authors attached textual scripts directly onto stimuli in the participants' environment. Stimuli included items commonly found in a convenience store, such as candy bars, in a sporting-goods store, such as a football, and in a video store, such as videotapes. The authors created mock stores in which to present the stimuli. As scripts were removed, the environmental stimuli evoked the social interactions, and a systematic increase in unscripted interactions was observed. Similarly, Wichnick-Gillis, Vener, and Poulson (2016) superimposed scripts onto academic and play materials to teach three children with autism to interact with one another. The introduction of the scripts led to a systematic increase in interactions among the three children. As the scripts were systematically faded, the stimuli on which the scripts were superimposed evoked the social interactions. Other script-fading studies have demonstrated comparable results in teaching people with autism to interact with their peers (e.g., Ganz et al., 2012; Ganz, Kaylor, Bourgeois, & Hadden, 2008; Ledbetter-Cho et al., 2015; Sarokoff, Taylor, & Poulson, 2001).

Although these studies have demonstrated the effectiveness of the script-fading procedure in teaching people with autism to interact with adults and peers, it is also important to consider the siblings of people with autism as conversation partners. Siblings serve as social partners in the home setting, with whom many interactions may occur that affect development (Knott, Lewis, & Williams, 2007). Children with autism, however, may be less likely to interact with their siblings because of the social-skills deficit characteristic of the disorder. Moreover, children with autism may demonstrate a greater degree of social isolation in settings that are less structured, such as during meals or play times (Bauminger, Shulman, & Agam, 2003). Furthermore, Kaminsky and Dewey (2001) reported that siblings of children with autism have reported lower levels of

intimacy, prosocial behavior, and nurturance by their siblings with autism in comparison to the levels reported by siblings of typically developing children.

None of the researchers in the studies reviewed thus far used a script-fading procedure to teach children with autism to interact with their siblings. A recent study by Akers, Higbee, Pollard, and Reinert (2018), however, did investigate the effectiveness of the script-fading procedure on the number of statements emitted by children with autism as they played with their siblings at home. The authors taught the participants' siblings to implement an audio script-fading procedure and found that the number of statements increased for all participants. Moreover, these results were obtained without the use of any artificial reinforcement systems, indicating that perhaps the siblings' verbal response functioned as a reinforcer for the occurrence of the statement.

The results obtained by Akers et al. (2018) demonstrate that siblings can be effective conversation partners in script-fading interventions. Given the frequency with which siblings and children with autism interact, further research in this area seems warranted. Therefore, the aim of this study was to use a script-fading package to increase the number of unscripted initiations emitted by three children with autism in their school environment, and to measure the generalization of unscripted initiations in the presence of their typically developing siblings in the home setting.

METHOD

Participants and Setting

The participants included three boys attending a day school and intervention program for children with autism that provides services based on the principles of applied behavior analysis. Prior to enrollment, each of the participants had received diagnoses of autism from an outside agency. The participants had been

attending the school for between 8 months and 5 years, and demonstrated minimal social interaction skills. All participants were able to follow a written activity schedule, and they had been taught to interact with instructors about activities with script-fading procedures since their enrollment in the program. All three participants also demonstrated the ability to read.

At the beginning of the study, Ollie was an 8-year-old boy who demonstrated limitations in conversational and spontaneous language with both his teachers and his peers. Ollie scored 86 on the socialization domain of the Vineland Adaptive Behavior Scale, 2nd ed. (Sparrow, Balla, & Cicchetti, 1984), falling in the 18th percentile. Although this score falls into the scale's "adequate" range, Ollie's interpersonal relationships were found to be characterized by significant developmental delay. On the Gilliam Autism Rating Scale, 2nd ed. (GARS-2; Gilliam, 2006), Ollie scored a 9 on the social interaction domain and an 8 on the communication domain. Both of these scores fall within the "Very Likely" range of autism. Ollie's verbal IQ on the Wechsler Intelligence Scale for Children, 4th ed. (Wechsler, 2003), was 89, falling in the 23rd percentile. These assessments were completed 2 years prior to the onset of the study. Ollie was enrolled in the program only 8 months prior to the beginning of the study and, therefore, had the least experience with scripts and script-fading procedures among the participants.

Ian was a 10-year-old boy who emitted spontaneous language, and who occasionally interacted with his peers. He engaged in simple conversation with peers and adults that consisted of two or three exchanges. He also emitted full sentences to respond to questions or to request preferred items and activities. One year prior to the onset of the study, Ian received a core language score of 50 on the Clinical Evaluation of Language Fundamentals, 4th ed. (CELF-4; Semel, Wiig, & Secord, 2006),

with a range of age equivalents on the subtests from 5 years, 5 months to 7 years, 0 months.

Aiden was an 8-year-old boy who also demonstrated limited conversational and spontaneous language. Aiden scored 68 on the socialization domain of the Vineland Adaptive Behavior Scale, 2nd ed. (Sparrow et al., 1984), with an age equivalent of 2 years, 2 months. Aiden received a verbal IQ of 87 on the Stanford-Binet Intelligence Scale, 5th ed. (Roid, 2003), falling into the 19th percentile with an age equivalent of 4 years, 3 months. Aiden received a core language score of 58 on the Clinical Evaluation of Language Fundamentals, 4th ed. (Semel et al., 2006), with a percentile rank of 0.3. Aiden's assessments were completed almost 4.5 years prior to the onset of the study.

For all three participants, the siblings who were included in the generalization assessments in the home setting presented with no developmental delays. All of the siblings engaged in and were familiar with the activities that were used during the study. At the onset of the study, Ollie's sister was 5 years old, Ian's sister was 8 years old, and Aiden's brother was 6 years old. All siblings lived at home with each of the participants.

The research was conducted in two different classrooms at the program throughout the school day. The classrooms measured about 4.0 m x 7.5 m and 3.35 m x 3.35 m, respectively, and were each furnished with desks, chairs, bookcases, computers, and a television.

Generalization sessions in Ollie's home were conducted in the dining room for the model-building and lunch activities, and in an office room for the laptop activity. The dining room measured approximately 6.5 m x 5.5 m, and it was furnished with a dining table and six chairs. The office room measured approximately 3.5 m x 2.5 m, and it was furnished with a table, a computer, a bed, and a bookshelf.

In Ian's home, generalization sessions were conducted in the living room for the model-building, lunch, and laptop activities. The living room measured approximately 3.5 m x 4.0 m, and it was furnished with a couch, a table, two chairs, a bookshelf, and a television.

In Aiden's home, generalization sessions were conducted in the living room for the model-building and laptop activities, and in the dining room for the lunch activity. The living room measured approximately 8.0 m x 5.5 m, and it was furnished with a couch, a fish tank, a coffee table, a chair, and a television. The dining room measured approximately 3.0 m x 5.0 m, and it was furnished with a dining table, six chairs, a cabinet, and a fish tank.

Stimuli

Throughout the school day, the participants followed a textual activity schedule on either an Apple iTouch © (Ian and Aiden) or on a sheet of paper (Ollie). Activity schedules consisted of the activities that were typically presented to them on a daily basis, which included academic, self-care, and leisure activities. The order of these activities varied on a daily basis. This study focused on the social initiations that occurred when the participants were together when playing games on the laptop, engaging in a Lego© model-building task, and eating lunch together. Multiple exemplars of stimuli that are typically present during each of these activities were presented to the participants. For example, the participants had the opportunity to play several different laptop games and to build different Lego© models, and had various different utensils, containers, and dishes during lunch. Within the laptop activity, one program and five internet websites were used as training stimuli. The model-building activity consisted of six exemplars of different Lego© models. Within the lunch activity, the participants' food was always present, and three sets of utensils, containers, and dishes available at the school were used.

For each participant, all five textual scripts were superimposed upon the stimuli (see Supporting Information). The location of scripts on the stimuli changed daily. The scripts were

printed in 17-point condensed Helsinki font on clear self-adhesive labels. The scripts measured about 1 cm high, and the length was determined by the number of words in the script. Across the three participants, scripts ranged in length from three to five words. The scripts were attached to each stimulus in an area that did not contain text. For example, on the laptop, scripts were placed on the outside cover, the spaces around the keyboard, and on the border of the screen (see Supplemental Information). For the model-building activity, scripts were placed on Lego© pieces, the box, and the blank spaces of the instruction booklet. For the lunch activity, scripts were placed on the lunchbox, the juice box or water bottle, and the food packaging. Scripts consisted of statements that referred to the given activities. For example, when playing on the laptop, two of Ollie's scripts were, "I love this game," and "Check out what I'm playing." Scripts were faded one word at a time, from beginning to end, until all words were completely removed. For example, fading step one for the script "I love this game" was "I love this," fading step two was "I love," fading step three was "I," and the final fading step consisted of the removal of all words. (Scripts and script-fading steps for Ollie are displayed in Supporting Information). Scripts and script-fading steps were similar for Ian and Aiden, and are available upon request.

Dependent Variables

Initiation. An initiation was defined as any phrase, sentence, or question that was emitted independent of instructor prompts (Krantz & McClannahan, 1993), and was directed toward a peer. Initiations did not have to be grammatically correct. Verbal productions that were repeated consecutively by the participant were not scored as initiations. Initiations that were repeated by a participant within a given session were only scored as correct if the participant emitted a different initiation in between the repeated initiations (a lag 1 schedule). Repeating an initiation

that had just been emitted by a peer was not scored as an initiation. One-word utterances and greetings to a peer (e.g., "Hi Ian") were also not scored as initiations. For an initiation to count as being directed toward a peer, the participant needed to have facial orientation toward a peer for a duration of at least 1 s while emitting an initiation, or to have included one of the peer's names in the initiation. An initiation could be scored as scripted or unscripted.

Scripted initiation. A scripted initiation was defined as a vocal production that matched a textual script provided for the participant, with the exception that conjunctions, articles, prepositions, pronouns, and verb tense may have changed. For example, if the script was "I love this game," and the participant said, "You love this game," then this was scored as a scripted initiation. Adding the peer's name to the end or beginning of a script was also counted as a scripted initiation (Krantz & McClannahan, 1993). Once script fading began, an initiation that matched the original script provided for that participant was still scored as scripted, whether the textual script was present or absent.

Unscripted initiation. An unscripted initiation was defined as a vocal production that differed from any of the taught scripts by more than conjunctions, articles, prepositions, pronouns, or changes in verb tense (Krantz & McClannahan, 1993). For example, if the script was "I love this game," then the statement "I like this game" was scored as an unscripted initiation. Unscripted initiations needed to be contextually relevant to the given activity to be scored as correct. For example, a statement such as, "I like cookies" during the laptop activity would not be scored as a correct unscripted initiation, unless cookies were somehow present in the context of the laptop game.

Measurement

We collected data on both the number and the word-for-word record of initiations emitted

by each participant. Observers scored the initia-
tions that were emitted without instructor
prompts. For each participant, we collected
data during each of the three activities once per
school day, and graphed data as the number of
unscripted initiations emitted across activities.
Data collection spanned approximately
11 months.

General Procedure

For each session, we selected one exemplar
from each of the three activities for each partic-
ipant by using a random number table (Elmes,
Kantowitz, & Roediger, 2005). For example,
within the model-building activity, we assigned
each of the six different models the numbers
1 through 6 prior to the onset of the study.
Using the random number table, we deter-
mined which of the six models would be pre-
sented for each participant in a given session.
For the laptop and model-building activities,
each participant was assigned a different exem-
plar within that activity. For the lunch activity,
however, the exemplar selected was used for all
three.

During a session, each participant's schedule
included cues to engage in the target activities
with a peer, such as "Play computers with Ollie
and Ian," "Build a model with Aiden and
Ollie," or "Eat lunch." These cues appeared
once each day for each of the three activities
throughout each participant's activity schedule.
Prior to the onset of the study, cues for each of
these activities typically appeared in each of the
participants' schedules. The names of their
peers were added to each activity for the pur-
pose of the study. These cues prompted the
participants to obtain the relevant materials for
the given activity, and to sit with one another
at the table. The participants were always pre-
sent during one another's sessions, and they
functioned as peers for one another. A session
began when all three participants were seated
together with the relevant materials, and when

the instructor provided a verbal cue to begin
the activity, such as "You can build your
models together," or "Play computers with Ian
and Aiden." If necessary, instructors used hand-
over-hand manual guidance, delivered from
behind, to assist the participants in engaging in
appropriate play skills and/or eating responses.
For example, instructors may have prompted
the participants to use a napkin when eating, to
find a piece of the model, or to navigate a web-
site. The activities were selected because they
were activities during which interaction was
appropriate, but during which the participants
were observed not to emit reliable interactions
with one another. Moreover, these activities
already appeared in the participants' schedules
prior to the study, and the participants gener-
ally completed these activities without many
instructor prompts. If the participant stopped
engaging in the activity for a duration of about
10 s or required assistance in completing the
activity, then instructors provided manual guid-
ance. Instructors used manual guidance, as
opposed to verbal or gestural prompts, to
decrease the likelihood of errors being emitted,
and for the purpose of fading instructor
involvement as quickly as possible (MacDuff,
Krantz, & McClannahan, 2001). Instructors
faded the use of manual guidance from hand-
over-hand to wrist, to arm, to elbow, and to
shoulder. Instructors then shadowed and gradu-
ally decreased their proximity to the partici-
pants (McClannahan & Krantz, 1999). No
problem behavior occurred during the sessions.

Instructors delivered reinforcers contingent
upon the occurrence of contextually relevant
peer initiations according to the participants'
individualized motivational systems throughout
all experimental conditions, except during gen-
eralization assessments. Reinforcers were not
provided for initiations that were not contextu-
ally relevant. The participants' individualized
token motivational systems consisted of a desig-
nated number of checkmarks that could be
earned throughout the day. To make an

exchange for a reinforcer, Ollie needed to earn 10 checkmarks, whereas Ian and Aiden needed to earn 20 checkmarks. Checkmarks were delivered by instructors, and instructors ensured that this delivery was visible to the participant. When delivering checkmarks, instructors sometimes also provided statements such as, "You get two checks!" When the designated number of checkmarks was earned, the participants were able to exchange for a preferred snack, toy, or activity. The participants had the opportunity to make at least two exchanges for a back-up reinforcer during each session. Behavior-specific praise statements, such as "Nice talking to your friend!" and physical touch, in the forms of high fives or pats on the back, were also delivered by instructors contingent upon the occurrence of peer initiations. Behavior-specific praise statements and physical touch had previously been identified as potential reinforcers for the three participants and were used to increase the magnitude of reinforcement for emitting an initiation. Instructors delivered these reinforcers in a manner that did not interfere with an interaction between participants.

Throughout all conditions, initiations were always followed by responses from one of the participants. If responses to initiations were not emitted independently, then instructors vocally prompted the response. Responses consisted of general phrases such as, "That's cool" or "Sounds awesome," unless a more specific answer was appropriate. For example, if the participant initiated the question, "What game are you playing?" then a peer would be prompted to emit the correct answer. Responses to initiations were reinforced and prompted across baseline and training conditions, as well as during generalization assessments in the untrained home setting. Reinforcers were provided only for responses to initiations that were not prompted by an instructor. Data were not collected on responses to peer initiations.

The session ended 15 min following the delivery of the initial verbal cue from the instructor. Sessions were equal in duration both within and across participants.

Baseline. Scripts were not superimposed upon any of the stimuli during the baseline condition. Reinforcement was available for initiations.

Training. During a given training session, all five textual scripts were superimposed upon the stimuli for a given activity. From the beginning to the end of the 15-min session, the five scripts remained on the stimuli. Using hand-over-hand manual guidance from behind the learner, instructors taught the participant to point to and to read the script. Manual guidance was faded in the same manner as when teaching appropriate play skills and eating responses. If the script was not emitted correctly, then the instructor manually prompted the participant to point to the script again until the script was emitted correctly. Vocal models were not required to teach the participants to emit the scripts. Script fading for each activity began after at least four of the five scripts were emitted correctly once within one session. Subsequent script-fading steps were introduced after the participant emitted a total of at least five initiations, scripted and/or unscripted, for one session (e.g., five scripted initiations, or three scripted initiations and two unscripted initiations, etc.). Scripts were faded by deleting one word at a time from the end of the script, until all words were removed.

Initially, instructors delivered reinforcers for both prompted and unprompted scripted initiations on a continuous schedule of reinforcement. Instructors delivered reinforcers only for unprompted scripted initiations when the participant emitted at least two unprompted scripted initiations within a single session. The magnitude of reinforcer delivery was greater for the occurrence of unscripted initiations than for scripted initiations to promote variable language. For example, one checkmark was

delivered for a scripted initiation, and two checkmarks were delivered for an unscripted initiation. Instructors shifted from a continuous to a variable-ratio 3 (VR-3) schedule of reinforcement after the participants had emitted five unscripted initiations within a given session.

Generalization. We assessed generalization in the untrained home setting with a sibling throughout the study. At least three generalization data points were obtained during the baseline and training conditions. To ensure the consistency of procedures across conditions, generalization was not assessed during the first or last session of either the baseline or the training conditions. During the training condition in the school setting, reinforcers were delivered contingent upon the occurrence of initiations in the first and last sessions to increase the likelihood of responding in subsequent sessions.

We assessed generalization from school with peers to the untrained home setting with a sibling by having the participants engage in the activities selected for training with a sibling in each of their homes. Therefore, this generalization assessment consisted of both an untrained setting and an untrained conversation partner. The same sibling participated as the untrained conversation partner throughout the duration of the study. During a generalization assessment, the same general procedure was conducted as during the baseline sessions in the school setting, with the exception that reinforcers were not delivered contingent upon the occurrence of an initiation. The participants used the stimuli within each activity with which scripts were presented in the school setting, but no scripts were presented with these stimuli in the untrained home setting. The training stimuli were used in the home setting in an effort to increase the likelihood of generalization from the school setting. The sibling received coaching from the investigator, if needed, on engaging in the activity or on responding to the participant's initiations. For

example, if the sibling demonstrated difficulty with completing the model building activity, the instructor provided guidance in completing the task. Similarly, if the participant emitted an initiation to the sibling, but the sibling did not respond, then the instructor suggested a contextually relevant response for the sibling to provide.

Experimental Design

This study used a multiple-baseline across-activities (laptop, model building, lunch) design to assess the effects of a script-fading package on the number of unscripted initiations emitted across three activities by each of the three children with autism. We also assessed the effect of the script-fading package on the generalization of initiations in the untrained home setting with a sibling.

Interobserver Agreement

Two observers simultaneously transcribed each participant's initiations on separate data sheets. Observers stood across the table from one another and compared their data after the session ended. An agreement was scored when both observers matched in their records of the occurrence or nonoccurrence of an initiation, as well as in their verbatim account of an initiation. Discrepancies in plural endings, articles, prepositions, and conjunctions were counted as an agreement. Disagreements consisted of a mismatch in their records on the occurrence or nonoccurrence of an initiation, or when their word-for-word accounts of an initiation differed by more than plural endings, articles, prepositions, or conjunctions. Interobserver agreement (IOA) was calculated for each participant by dividing the number of agreements by the number of agreements plus disagreements and multiplying this number by 100%.

For Ollie, IOA on the word-for-word records of peer initiations in the trained school setting with peers was obtained for 41% of the

sessions for the laptop activity, 36% of the sessions for the model-building activity, and 35% of the sessions for the lunch activity. The mean agreement for the laptop was 88%, with a range of 50-100%, for model building was 93%, with a range of 67-100%, and for lunch was 99%, with a range of 54-100%. In the untrained home setting with a sibling, IOA was obtained for 39% of the sessions for the laptop activity, 53% of the sessions for the model-building activity, and 61% of the sessions for the lunch activity. The mean agreement for the laptop activity was 91%, with a range of 77-100%, for the model-building activity was 93%, with a range of 71-100%, and for the lunch activity was 94%, with a range of 50-100%.

For Ian, IOA on the word-for-word records of peer initiations in the trained school setting with peers was obtained for 37% of the sessions for the laptop activity, 34% of the sessions for the lunch activity, and 34% of the sessions for the model-building activity. The mean agreement for the laptop was 93%, with a range of 78-100%, for lunch was 96%, with a range of 79-100%, and for model building was 97%, with a range of 77-100%. In the untrained home setting with a sibling, IOA was obtained for 41% of the sessions for the laptop activity, 38% of the sessions for the lunch activity, and 40% of the sessions for the model-building activity. The mean agreement for the laptop activity was 90%, with a range of 73-100%, for the lunch activity was 94%, with a range of 78-100%, and for the model-building activity was 96%, with a range of 81-100%.

For Aiden, IOA on the word-for-word records of peer initiations in the trained school setting with peers was obtained for 37% of the sessions for the laptop activity, 34% of the sessions for the model-building activity, and 34% of the sessions for the lunch activity. The mean agreement for the laptop was 93%, with a range of 50-100%, for model building was 96%, with a range of 76-100%, and for lunch

was 98%, with a range of 50-100%. In the untrained home setting with a sibling, IOA was obtained for 53% of the sessions for the laptop activity, 58% of the sessions for the model-building activity, and 47% of the sessions for the lunch activity. The mean agreement for the laptop activity was 96%, with a range of 86-100%, for the model-building activity was 96%, with a range of 80-100%, and for the lunch activity was 95%, with a range of 71-100%.

Across the three participants, there were some low levels and wide ranges of interobserver agreement data obtained. This is likely due to the fact that if a participant emitted few initiations during a given session, one disagreement on the occurrence of an initiation would greatly decrease the percentage of agreement between observers.

RESULTS

All participants readily learned to emit the scripts following their introduction. Ollie emitted all five scripts within three to five sessions for the three activities. Ian and Aiden emitted all five scripts within four or five sessions for the laptop, and within only one session for the model-building and lunch activities. With the introduction of script fading, there was also a systematic increase in the number of unscripted initiations emitted by all three participants across the three activities. The participants emitted few unscripted initiations during the baseline condition. Ollie emitted a range of between zero and three unscripted initiations and Aiden emitted a range of between zero and six unscripted initiations during the baseline condition. Ian demonstrated similar behavior during the baseline condition for the laptop and lunch activities, but he emitted a range of between zero and 16 unscripted initiations during the baseline condition for the model-building activity. All of Ollie's scripts for the laptop and model building were fully faded

after eight sessions, and after seven sessions for the lunch activity. Ian's scripts for the laptop were fully faded after eight sessions, and after five sessions for the lunch and model-building activities. Aiden's scripts for the laptop were fully faded after twelve sessions, and after five sessions for the model-building and lunch activities. As shown by the closed circles, unscripted initiations increased systematically with the introduction of script fading across all three activities for each of the participants. After the scripts were fully faded, the participants continued to reliably emit unscripted peer initiations across the three activities. Throughout the course of teaching, Ollie emitted a mean of 16 unscripted initiations (range: 0-38) per session during the laptop activity, 17 unscripted initiations (range: 0-34) during the model-building activity, and 9 unscripted initiations (range: 1-25) during the lunch activity. Ian emitted a mean of 13 unscripted initiations (range: 0-33) during the laptop activity, a mean of 13 unscripted initiations (range: 0-28) during the lunch activity, and 15 unscripted initiations (range: 5-32) during the model-building activity. Aiden emitted a mean of 5 unscripted initiations (range: 0-21) for the laptop activity, 13 unscripted initiations (range: 5-21) for the model-building activity, and 16 unscripted initiations (range: 1-30) for the lunch activity.

In the untrained home setting with a sibling, the number of unscripted initiations increased systematically with the introduction of script fading in the trained school setting with peers. Figures 1–3 demonstrate that Ollie and Aiden emitted few, if any, unscripted initiations during the baseline condition for all three activities. Ian, however, emitted up to four unscripted initiations during the baseline condition for each of the activities, although this behavior decreased over successive sessions. The number of unscripted initiations in the untrained home setting with a sibling increased systematically as the script-fading package was introduced in the trained school setting with peers. The participants continued to emit an increased number of unscripted initiations throughout the rest of the study. After scripts had been fully faded in the school setting, Ollie emitted a mean of 19 unscripted initiations (range: 0-40) per session in the home during the laptop, 11 unscripted initiations (range: 0-23) during model building, and seven unscripted initiations (range: 3-10) during the lunch. Ian emitted a mean of 11 unscripted initiations (range: 5-22) per session during the laptop activity in the home, 12 unscripted initiations (range: 7-15) during the lunch activity, and 13 unscripted initiations (range: 11-15) during the model-building activity in the home setting. Aiden emitted a mean of 9 unscripted initiations (range: 0-27) per session in the home setting during the laptop activity, 15 unscripted initiations (range: 9-23) during the model-building activity, and 6 unscripted initiations (range: 2-11) during the lunch activity.

DISCUSSION

This study demonstrates a functional relation between a script-fading package and the number of unscripted initiations emitted by children with autism. The training package consisted of script-fading and the differential reinforcement of untrained language. Results also show that this script-fading package was an effective method for promoting the generalization of social initiations from school with peers to the untrained home setting with siblings, which may affect not only the child's development but also the dynamic of relationships with others in the family.

The generalization of initiations in the untrained home setting could have been the result of a combination of several procedures. First, the use of common stimuli might have increased the probability that initiations would generalize from the trained school
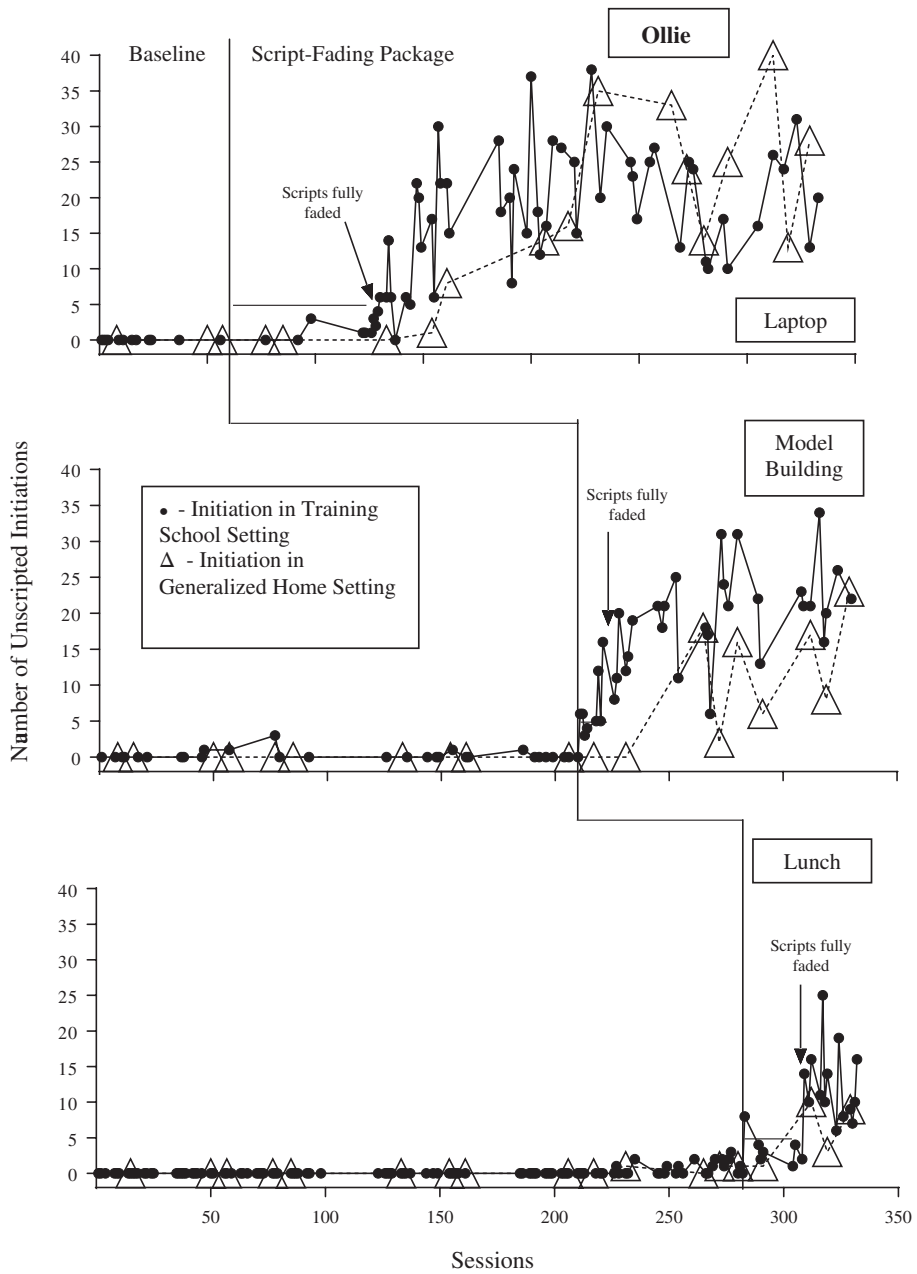
Figure 1. The number of unscripted initiations emitted by Ollie across the laptop, model-building, and lunch activities. The solid horizontal line represents the number of scripts provided within a given teaching session at school.

setting to the untrained home setting. One can infer that social initiations likely generalized to the home setting in part because the laptop, model-building materials, and lunch stimuli had acquired some degree of stimulus control over the behavior during training with the script-fading package. Second, script-fading is a stimulus-fading procedure
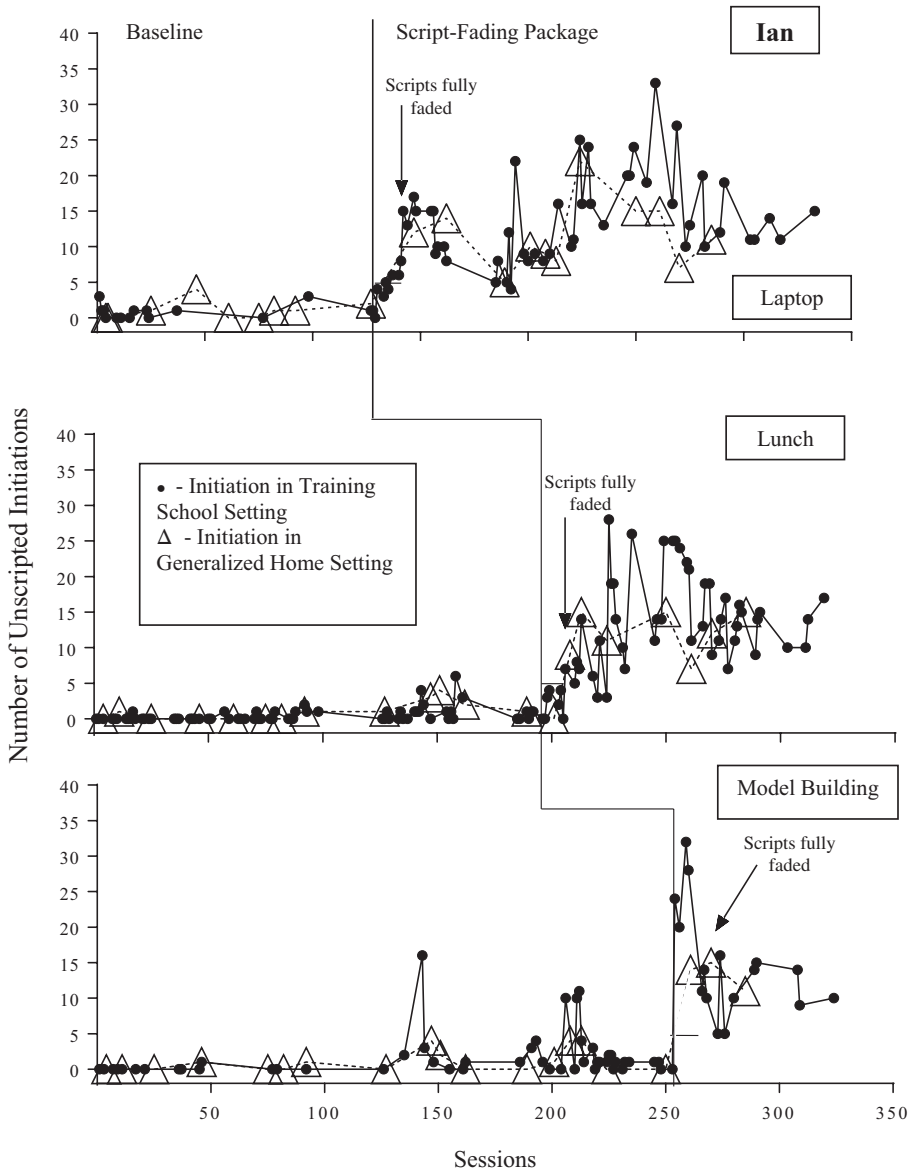
Figure 2.   The number of unscripted initiations emitted by Ian across the laptop, lunch, and model-building activities. The solid horizontal line represents the number of scripts provided within a given teaching session at school.

that is designed to decrease the discriminability between training and nontraining reinforcement contingencies. As the scripts were faded from the stimuli onto which they were attached, it is possible that discriminative control transferred from the scripts to those stimuli.

This study has extended the research on script fading by demonstrating the generalization of initiations emitted by children with autism to their siblings in the home setting. Aside from the Akers et al. (2018) study, previous researchers have taught people with autism to interact with adults and peers, but have not
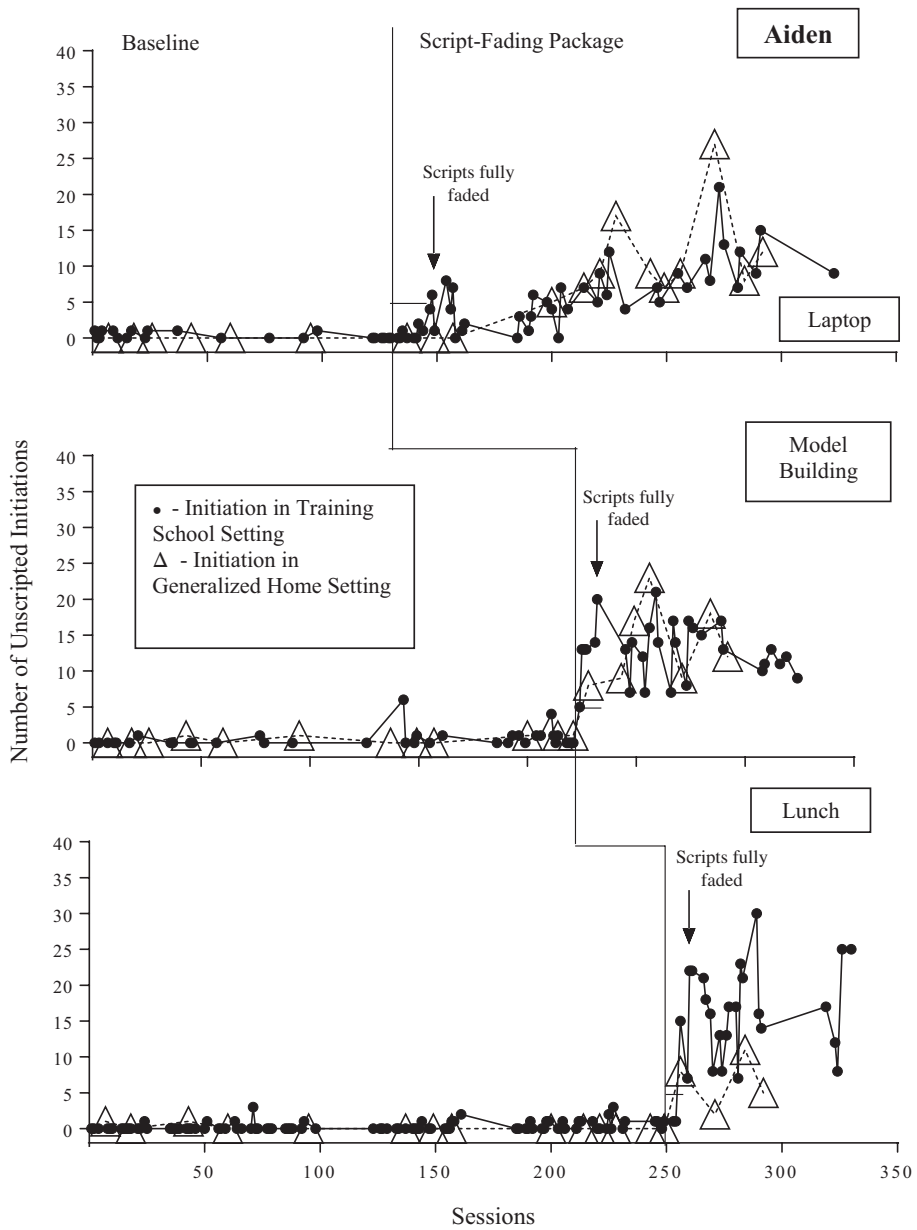
Figure 3. The number of unscripted initiations emitted by Aiden across the laptop, model-building, and lunch activities. The solid horizontal line represents the number of scripts provided within a given teaching session at school.

included siblings as conversation partners. There are, however, several limitations that future researchers might address. For example, the current study evaluated a treatment package that consisted of scripts, script fading, a token economy, manual prompts, and verbal prompts. Future researchers might conduct a component analysis to determine the extent to which each variable was necessary to produce behavior change. Similarly, reinforcement

contingencies in the school and home settings were not fully faded out. The delivery of check-marks was never faded out, and participants continued to make at least two exchanges for a backup reinforcer by the conclusion of the study. The delivery of behavior-specific praise and physical touch was faded out over the course of the study as the participants reliably emitted initiations to one another in the school setting. This, however, was not conducted in a systematic manner. Of the script-fading research cited, only the studies by Garcia-Albea et al. (2014) and Akers et al. (2018) included a thinning of reinforcement schedules or the lack of artificial reinforcement systems. Future studies might attempt to fade reinforcer delivery in a similar manner to help maintain behavior in the absence of an instructor. Perhaps reinforcers could be delivered and faded by the conversation recipient to increase the likelihood that the behavior is maintained in the absence of an instructor. Given that the peer response is the natural reinforcer that should maintain initiations over time, a future study could also include the tracking of peer responses to initiations. Although these data were not collected in this study, we can report anecdotally that the conversation recipient initially did require prompts to respond to an initiation, but these prompts were not required by the end of the study. Moreover, it is possible that the primary investigator acquired some degree of discriminative control over the occurrence of initiations. The primary investigator was present during all baseline, training, and generalization sessions. Therefore, it is possible that the primary investigator served as a discriminative stimulus for initiating. Of the script-fading studies cited, it does not appear that the presence of instructors or experimenters was systematically faded in any case. Future researchers could vary or fade instructor proximity to decrease the likelihood that initiations are under the discriminative control of an instructor's presence.

In addition, this study did not include normative data for comparative purposes. Therefore, although there was an increase in the number of initiations, it cannot be determined if the rate of initiations was similar to that of their typically developing peers. This study was successful, however, in teaching unscripted language that was appropriate for the given activities. Scripted responses may be appropriate for certain moments within these activities, such as "Let's build together" at the start of the activity, or "I'm all finished" at the conclusion of the activity, but throughout the course of these activities, it is appropriate for statements to be varied. By promoting unscripted language, this intervention may help participants acquire language that more closely resembles that of their typically developing peers.

Furthermore, due to the length of this study, maintenance data were not collected. Such data may be helpful in assessing the durability of the script-fading intervention. A factor that contributed to the length of the study was the extended baseline. Intervention was not introduced in subsequent activities until a change in behavior during the first activity was observed in the home setting. Finally, anecdotal reports indicated that parents were pleased with the outcome of the study, and that they enjoyed seeing their children playing and interacting with one another. Future researchers could conduct a social validity assessment to gather information on family members' perceptions of the value of the behavior change.

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