THE EFFECTS OF SCRIPT-FADING AND A LAG-1 SCHEDULE ON VARIED SOCIAL RESPONDING IN CHILDREN WITH AUTISM

By

RONALD LEE

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ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

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Peter Sturmey

Date — Chair of Examining Committee

Joseph Glick

Date — Executive Officer

Lanny Fields

Nancy Hemmes
Supervisory Committee

THE CITY UNIVERSITY OF NEW YORK

Abstract

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Adviser: Professor Peter Sturmey

Individuals with autism have significant deficits in speech and social skills. Script-fading procedures have been shown to be an effective means for increasing conversational skills and unscripted statements in individuals with autism. Nevertheless, the effects of these procedures on varied language in the context of conversations remain unclear. The present study investigated the effects of a script-fading procedure and a treatment package consisting of a Lag-1 reinforcement schedule with repeated trials contingent on the occurrence of repeated responses on varied responding during brief conversations by one girl and two boys with autism. Varied responding was defined as any vocal response that differed from the response emitted on the previous trial. The effects of the interventions were evaluated in the context of a multiple-baseline-across-participants design. The study took place in a school program for students with autism. During baseline (Lag-0), the experimenter engaged the participant in a three-turn conversation and reinforced appropriate responding. During scripting and the subsequent fading of the script, the participants were given audio taped models to imitate during the same three-turn conversation. During Lag-1 with repeated trials contingent on repeated responses, reinforcement was delivered contingent on variations in any part of the social

conversation. Contingent on repetitive responding, the same experimenter-delivered antecedent was repeated for up to 5 trials or until an appropriate and varied response was emitted. The results showed that during the baseline Lag-0, low levels of appropriate and varied responding were observed. Scripting resulted in an increase in appropriate and varied responding. With the return to Lag-0, appropriate responding remained high, but appropriate and varied responding decreased to baseline levels. During Lag-1 with repeated trials, varied and appropriate responding increased to levels analogous to that obtained during scripting. Generalization of varied responding to different settings, people, and conversations was not observed. The results of a social validity scale showed that the participants were rated as having better social and language skills following exposure to the Lag-1 with repeated trials correction procedure. These results are discussed in terms of extinction-induced variability and stimulus control.

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The Effects of Script-Fading and a Lag-1 Schedule on Varied Social Responding in Children with Autism

Individuals with autism exhibit a wide variety of language and social deficits including deficits in communication and social skills (American Psychiatric Association, 2000). For example, it is common to find that individuals with autism may not respond appropriately to social initiations. Others may respond appropriately to initiations and questions but fail to reciprocate or engage in turn-taking behavior during conversational exchanges. Another common characteristic is the tendency for people with autism to engage in repetitive speech. For example, people with autism who demonstrate echolalic speech may repeat words and phrases that are emitted in their presence with the repetition occurring immediately (i.e., immediate echolalia) or after some interval of time has elapsed (i.e., delayed echolalia). Additionally, individuals with autism may acquire appropriate responding to different social initiations and questions but fail to exhibit a socially-appropriate level of response variability. That is, an individual with autism might always emit the same response to social initiations or questions despite having a repertoire sufficient for response variation to occur (e.g., Lee, McComas, & Jawor, 2002). For example, when presented with the question, "How are you?" the response, "Fine" might always be emitted. These characteristics have debilitating effects on socialization in individuals with autism. For example, individuals with autism receive quantitatively and qualitatively less social attention compared to individuals without similar deficits (Koegel, R. L, Koegel, L. K., & Surratt, A., 1992). As a result, numerous interventions have been developed to increase social competency in individuals with autism (Rogers, 2000).

One procedure that has been effective for increasing conversational skills in people with autism is scripting fading. Script-fading procedures involve the presentation of textual or auditory models that are imitated by the individual. The script is gradually removed leading to the independent performance of the previously scripted responses. Findings that are typically reported in studies on script-fading procedures are the emergence and increase in the frequency of unscripted statements. An unscripted response has been defined as any response that does not match a previously scripted response, with the exception of changes in prepositions, articles, pronouns, and verb tense. For example, Krantz and McClannahan (1993) investigated the effects of training 10 scripted statements followed by the gradual removal of the script on the initiations emitted by 4 participants with autism during a social activity. Training the participants to emit scripted statements increased the frequency of initiations. Additionally, the removal of the script was correlated with an increase in the frequency of unscripted initiations. Unscripted initiations consisted of recombined elements of scripted responses and novel statements. Thus, the participants were reported to engage in spontaneous and generative language.

Krantz and McClannahan (1998) extended the scripting procedure to 3 participants with autism with minimal reading skills. Prior to scripting, the participants were taught to read words that were embedded into their respective activity schedules. The fading of these cues resulted in an increase in novel, unscripted interactions, and other social responses that had not occurred during baseline. Stevenson, Krantz, and McClannahan (2000) used audiotaped scripts to apply a scripting and script-fading

procedure to four students with autism who were nonreaders and also found an increase in social language following the introduction of the scripting procedure.

In these studies, different unscripted responses were not distinguished from each other. Nor have data been reported on the variety of unscripted responses. As a result, it is possible that a small set of responses were emitted with high frequency. That is, although unscripted responses increased throughout the course of the scripting and script-fading procedure, variability in the participant's language has not been reported. It is feasible that some individuals with autism might repeatedly emit a small set of unscripted statements after the script is removed. It would be important for these individuals to receive additional interventions to address their repetitive use of language and increase the variety of unscripted statements emitted following script-fading procedures. One such procedure would involve making reinforcement contingent on varied responding following a script-fading procedure.

Response variability has been demonstrated to be a reinforceable dimension of behavior (Page & Neuringer, 1985). A variety of contingencies have been used to increase response variability in basic and applied settings (Neuringer, 2002). One such contingency is the Lag *X* reinforcement schedule (Page & Neuringer, 1985). During a Lag *X* schedule, reinforcement is delivered contingent on a response that differs from responding emitted on a specified number of previous opportunities. For example, on a Lag-5 schedule, a response is reinforced if it differs from the 5 responses previously emitted. Lag schedules have been used to increase response variability in a variety of contexts and for a variety of responses (Lee, Sturmey, & Fields, in press). Page and Neuringer (1985) demonstrated the efficacy of lag schedules for increasing the variability

in the response sequences of pigeons' key pecking. Neuringer and Huntley (1991) observed the effects lag schedules on the variability of sequences of rats' bar pressing.

In the context of discrete-trial teaching, Lee et al. (2002) demonstrated that a Lag-1 schedule increased varied responding to the question, "What do you like to do?" for 2 out of 3 participants with autism. Lee and Sturmey (2006) replicated these results for another 2 out of 3 students with autism. Although the Lag-1 schedule was effective at increasing varied vocal responding, this finding has been limited to responding to the social question, "What do you like to do?" In Lee et al. (2002), the levels of varied responding remained unchanged from baseline levels following the introduction of a Lag-1 schedule for a participant who was presented with the question, "How are you?" throughout the experiment as opposed to the question, "What do you like to do?"

Lee et al. (2002) suggested that during exposure to the Lag-1 schedule, a strategy that assisted the participants in fulfilling the reinforcement requirement might have emerged for those participants for whom the Lag-1 schedule effectively increased varied responding. That is, when presented with the question, "What do you like to do?" participants emitted the names of stimuli in their proximal environment. For example, in the presence of crayons and toys, the responses "I like to color" and "I like to play" were emitted across trials. This strategy, however, was not available to a participant who was presented with the question, "How are you?" as opposed to the question, "What do you like to do?" Additionally, use of such a strategy was not evident in the responding by one participant who was presented with the question, "What do you like to do?" in Lee and Sturmey (2006). As a result, the effects of lag schedules on the variability of responding with more complex language and social behavior remain unclear. Additionally, it may be

argued that lag schedules may not produce effects robust enough to have clinical utility across individuals with autism, other populations, and responses.

Despite these weaknesses, Lee et al. (2002) and Lee and Sturmey (2006) have shown an increase in varied responding without the need for adult prompting using a Lag-1 schedule in a total of 4 out of 6 participants. This suggests that for some individuals with autism, repetitive responding to social questions might be a function of environments that do not require varied language or do not set the occasion for varied language to be reinforced. With individuals with restricted language repertoires, it would also be necessary to precede exposure to a lag schedule with language training procedures. Scripting, because of its effectiveness in teaching individuals with autism to engage in conversational speech without the need for adult prompting, may be such a procedure. Additionally, scripting provides for an experimenter-controlled set of responses to become part of an individual's repertoire. Variations within this repertoire can be reinforced using lag schedules to increase appropriate levels of varied language.

The aim of the present study was to assess the amount of varied language that occurred during a brief conversation as a function of a scripting and a script-fading procedure. If varied and appropriate responding during the conversation decreased following the removal of scripting materials, t a treatment package consisting of a Lag-1 schedule and repeated trials contingent on repeated responses procedure was introduced and evaluated. Generalization to different people, in different settings, with similar conversations was also assessed. Additionally, a social validity rating scale was used to assess the behavior change prior to scripting, following scripting, and following the Lag-1 with repeated trials package.

Method

Participants and Setting

The study took place in a school for elementary school-aged children with autism. One girl, Chely, and two boys, Alan and Bernard, participated in the study. Chely was 6-years-old and Alan and Bernard were 6- and 11-years-old, respectively. Each had been diagnosed with autism by an independent practitioner prior to their enrollment in the school. None was taking psychotropic medications during the study. Chely had been enrolled in the school for approximately 2 years. She could follow multi-step directions, answer simple social questions, and speak in full sentences. She also demonstrated generalized vocal imitation. Often, she required prompting to speak in grammatically correct sentences. She engaged in social interactions that consisted of up to 2 reciprocations but typically repeated statements when interacting with adults or peers. Alan had been enrolled in the school for 3 years. His language skills included generalized vocal imitation, object labeling, and vocal manding (single words to full sentences). He exhibited spontaneous commenting (i.e., not initiated by an adult), but was repetitive in his initiations. For example, he often repeated the question, "What are you doing?" when encountering a familiar adult. Bernard had been enrolled in the school for 1 year. His expressive language skills included generalized vocal imitation, object labeling, manding in few word utterances, and answering simple social questions. He also engaged in spontaneous initiations that were limited to greetings, asking "What's that noise?", or commenting, "That's cute."

Experimental sessions took place in a separate office in the school building. The room was approximately 5 m X 5 m and contained a desk, computer, and containers for

various teaching materials and rewards that were typically found in each classroom. During a session, the participant was seated across from the experimenter on the same side of the desk. The reinforcement system for each participant included vocal praise for target responding paired with the delivery of a token (i.e., a penny). Each penny could be attached to a clipboard, and the clipboard contained three available slots. After filling all three slots on the token board, the participant could trade in the pennies for access to small portions of preferred edibles, such as chips and various candies, or brief access to a preferred toy. Paired stimulus preference assessments (Fisher, et al., 1992) and multiple-stimulus preference assessments (DeLeon & Iwata, 1996) were conducted by classroom staff personnel throughout the study as a typical part of each participant's educational programming. Typically, Chely selected candy, potato chips, bracelets, necklaces, and keys. Alan selected pudding, cereal, potato chips, and baby food. Bernard selected musical toys, high fives, skittles, Gummi bears, and potato chips.

Measurement, Target Behavior, and Design

The experimenter initiated a conversation that consisted of an alternation of statements with the participant until each speaker emitted three statements, ending with a statement by the participant. Thus, each speaker had 3 turns to speak. Each statement delivered by the experimenter initiated a trial after which the participant's response was scored. Each conversation between the experimenter and the participant consisted of three trials. Five conversations were conducted per session, for a total of 15 trials. An interval of approximately 10 min (range of 6 to 21 min) elapsed between conversations. One session was conducted per day; and one to five sessions were conducted per week. Each conversation was audiotaped using a handheld micro cassette recorder.

Data were collected on the percentage of trials with 1) appropriate responding, 2) varied responding, and 3) appropriate and varied responding. An appropriate response was defined as any word, sentence, or sentence fragment that was contextually appropriate and relevant to the initiation/reciprocation presented by the experimenter during the social interaction. For example, when presented with the question, "Hi. How are you doing?" an appropriate response was any vocal response that indicated a feeling, such as "Not bad" or "Alright." During scripting and script-fading, an appropriate response also had to match the scripted response (Krantz & McClannahan, 1993). That is, during scripting and the script-fading procedure, an appropriate response was any response that matched the audiotaped script, with the exception that conjunctions, articles, prepositions, or pronouns could be altered or deleted.

A varied response was defined as a vocal response that differed from the response emitted during the same turn in the previous conversation. That is, the response emitted during the first turn of a conversation was compared to the response emitted during the first turn of the previous conversation whereas the response emitted during the second turn of a conversation was compared to the response emitted during the second turn of previous conversation. Additionally, statements, from which there were omissions compared to previous responses, that had the same meaning of the prior statement were considered repetitions of that response. For example, when presented with the question, "What are you going to do now?" the responses, "I'm going to work" and "Work" were considered repetitions. The responses, "I have work to do" and "I'm going to do work", however, were considered variations. The definition of a varied response incorporated Krantz and McClannahan's (1993) definition for an unscripted statement. That is, a

varied response had to differ from the last response emitted by more than changes in conjunctions, articles, prepositions, or pronouns. Appropriate and varied responding was defined as any response that met the criteria for both an appropriate response and a varied response.

The frequency of novel responses during each turn of the conversation was also collected. A response was considered novel if it had not been emitted in the same turn of any previous conversation. Thus, it was possible for a response to be considered novel on several occasions if it was emitted in different turns of the conversations. For example, the first occurrence of a response during the first turn of the conversation and the first occurrence of the same response on the second turn of the conversation was scored as two separate instances of a novel response. Additionally, novel responses could include either appropriate or inappropriate responding. Changes in tone, volume, or pitch were not considered in any of the response definitions.

Each vocal response emitted by the participants in each trial was given a variability score. The variability score for a response was determined by comparing a response with responses emitted during the same turn on previous conversations until a match was found. The number of intervening conversations between the last occurrence and the present recurrence was the variability score of that response (Machado, 1989). For example, if R_1 was emitted during the first turn of both the first conversation and third conversation of a session, the variability score for the first occurrence of R_1 in the session would be the number of conversations since the last occurrence of R_1 whereas the second occurrence of R_1 in the session would be given a variability score of 2. For each experimental condition, the variability scores for all of the responses emitted during each

experimental condition were totaled and then divided by the total number of responses that were emitted. The closer the mean variability score was to 1.0, the greater the likelihood for the participant to emit a repetitive pattern of responding. Similarly, the closer the mean variability score was to 2.0, the greater the likelihood for an overall tendency for the participant to emit an alternating pattern between two responses on consecutive opportunities. As the mean variability score increased, the greater the degree of variations within that phase.

An ABA reversal experimental-design was used to evaluate the effects of a script-fading procedure on the percentage of trials with appropriate and varied responding during three-turn conversations. Following the return to baseline, a Lag-1 reinforcement schedule with a repeated trials procedure was introduced for each of the participants. The effects of this treatment package on the percentage of trials with appropriate and varied vocal responding were evaluated using a multiple-baseline-across-participants experimental design. As a result, each participant was exposed to an ABAC design with the initiation of each experimental condition being staggered across participants. Generalization of the effects of a script-fading procedure and the Lag-1 with repeated trials treatment package was also assessed.

Experimenter-delivered Antecedents

During the conversation, the experimenter presented a greeting in the first turn, a question about the participant's day in the second turn, and a general comment about his own day in the third turn. For each turn, three exemplars were prepared, for a total of nine different phrases. Table 1 shows the specific statements/questions that could have been presented by the experimenter.

Each antecedent within each turn was assigned a number from 1 to 3. A total of 27 different combinations of experimenter-delivered antecedents were possible given the 3 different antecedents that could be presented for each turn of the conversation. As shown in Table 2, all of the possible variants of sequences of phrases were listed and assigned a number from 1 to 27. These numeric assignments referred to a combination of the three antecedent stimuli corresponding to the first, second, and third turn of the conversation. For example, the combination assigned to number 5 in Table 2 referred to antecedent phrases 1, 2, and 2 for the first, second, and third turns of the conversation. The exact phrases that would be presented were indicated in Table 1. Thus, for the combination, 1 – 2 – 2, the experimenter presented the phrase, "Hey (name). How're you doing?" during for the first turn, the phrase, "What've you been doing?" during the second turn, and the phrase, "Man, what a day!" during the third turn.

A random number generator was used to select nine different numbers between and including 1 and 27 without replacement. Thus, any number could only be selected once. The combination of phrases that corresponded to each of the nine different numbers, as shown in Table 2, was selected to be presented throughout the study. The only constraint on the selection of combinations was that each phrase in each turn of the conversation be presented an equal number of times. For example, the first phrase in the first turn of the conversation was found in three of the selected combinations, the second phrase in the first turn of the conversation was found in three of the selected combinations, etc. If at any time the random number generator resulted in the selection of a combination of phrases that would result in a greater frequency of any single phrase than any other phrase, that combination was not used, and another number was generated.

At the completion of the selection of the combination of experimenter-delivered antecedents, each specific phrase in each turn of the conversation was found in three different combinations.

Scripts

Table 1 also shows the set of responses that were scripted for each of the participant's turns in the conversation. Similar to the experimenter-delivered antecedents, the first turn of the conversation consisted of three exemplars of responding to a greeting, the second turn consisted of three exemplars of describing a recent activity, and the third turn consisted of a question seeking additional information from the conversation partner. As with the experimenter-delivered antecedents, each response in each turn of the conversation was assigned a number from 1 to 3, resulting in a total of 27 different combinations of scripted responses. The numeric representations for the scripted responses in these combinations are identical to those shown in Table 2. The combinations of experimenter-delivered antecedents for each participant that were selected using the random number generator were also used to select the combination of scripted responses for the participants. For example, if the random number generator selected combination 3 (i.e., 1 – 3 – 1), this combination was used to identify the corresponding experimenter-delivered antecedents for each turn as well as the corresponding scripted responses for the participant in each turn of the conversation. Table 3 shows the nine combinations of numbers corresponding to the combinations of antecedents and responses that were selected for each participant using the random number generator.

The order in which these combinations of antecedent phrases and combinations of scripted responses were presented throughout the study was also determined randomly. The combinations under each participant's name, listed in Table 3, were assigned a number from 1 to 9. Prior to each session, five numbers, from 1 to 9, were generated using the random number generator. The numbers were generated with replacement. That is, the same number could be generated multiple times. These numbers served to identify the combination of stimuli that were to be presented during the course of the conversation. For example, if the number 3 was generated when identifying the sequence of experimenter-delivered antecedents with Chely, the experimenter presented the antecedent phrases corresponding to the first antecedent for the first turn, the third antecedent for the second turn, and the first antecedent for the third turn. From Table 1, this would refer to the stimuli, "Hey (name). How're you doing?" during the first turn, "So, what's new?" during the second turn, and, "I've been busy" during the third turn.

Similarly, when the script was introduced, this procedure was used to identify the sequence of scripted responses during a conversation. If the number 8 was generated with Alan, corresponding to the combination 3 – 1 – 3, the scripted responses corresponding to the third response for the first turn (i.e., "Alright. How about you?"), the first response for the second turn (i.e., "I'm working hard."), and the first response for the third turn (i.e., "Really? Why?"), was presented. Constraints were not imposed on the selection of the order of combinations. As a result, it was possible for the identical sequence of antecedent phrases or sequence of scripted responses to be presented on consecutive conversations. The numeric representations for the combination of experimenter-delivered antecedents and combination of scripted responses were identical

within each participant (i.e., Table 3). As a result, to ensure that specific antecedents were not always correlated with specific responses, the generation of numbers used to identify the combinations of experiment-delivered antecedents and scripted responses were independent of each other.

Procedure

Pretraining. Prior to the Lag-0 condition, each participant was taught to imitate responses recorded on Language Master© cards. Training sessions consisted of 10 trials during which different words or phrases were presented in random order. Initially, recordings of single words were presented. A delayed prompting procedure was used where the instructor played the Language Master© card and immediately modeled the recording. Correct imitation of the adult model by the participant was reinforced. If the participant did not respond within 5 s of the model or emitted other non-vocal or vocal behavior, the instructor stated "No," and, if necessary, physically corrected non-vocal behavior. The next trial was initiated after attending was re-established. After four consecutive trials with correct imitation of the instructor's model or independent imitation of the recording prior to the instructor's model, the instructor's prompt was delayed for an additional 2 s up to a maximum delay of 6 s. After two consecutive trials with incorrect responding, the instructor reduced the delay by 2 s. The mastery criteria to increase the length of the recordings were independent imitation of the recorded phrases on at least 90% of trials for two consecutive sessions. Upon meeting the mastery criteria, the recordings on the Language Master cards were increased by 1 word (i.e., from 1- to 2-word phrases, to 3-word phrases, etc.). This training procedure was repeated until the mastery criteria were met for imitating 4-word phrases.

Lag-0. After the participants demonstrated independent imitation of recordings of four-word phrases, the Lag-0 condition began. During Lag-0, the experimenter asked the participant to follow him to the experimental room. After both were seated the participant was given his/her token board and the experimenter began the conversation. The experimenter presented an antecedent for the first turn of the conversation and waited up to 5 s for the participant to emit a response. If the participant emitted an appropriate response, the experimenter delivered a token and acknowledged the response with a praise statement (e.g., "That's good," or "Great"). The experimenter paused for an additional 2 to 3 s following the delivery of the praise statement to permit an opportunity for the participant to emit additional responses. If the participant did not emit any further appropriate vocalizations after 3 s, the experimenter continued the conversation by presenting the antecedent for the second turn of the conversation. If the participant did not respond to an antecedent within 5 s, the experimenter provided no feedback and continued with the next turn of the interaction. If the participant emitted a response to any antecedent that was considered inappropriate, the experimenter said, "No", paused until attending behavior by the student was re-established, and continued with the next turn of the conversation. Correction procedures were delivered only for errors in sentence structure or word pronunciation. The correction procedure consisted of a vocal model for the participant to imitate. For example, if a participant responded, "I go work" to the question, "What are you going to do now?" the experimenter modeled, "I'm going to work" for the participant to imitate. After the model was imitated correctly, the instructor gave specific feedback for imitating correctly and continued with the

interaction. At the end of the three-turn interaction, the experimenter thanked the participant for interacting with him and provided access to any earned reinforcers.

Scripting and script-fading. During scripting and script-fading, three Language Master© cards and a card player were placed on the desk between the experimenter and the participant. The experimenter began the conversation and immediately provided manual guidance for the participant to select the first card and move it through the card player, which played the script. This consisted of providing hand-over-hand guidance for the participant to pick up the card and place it through the card player. After the recording completed playing, the experimenter waited up to 5 s for the participant to imitate the script. If the participant imitated the recording appropriately, the experimenter delivered a token and a praise statement with moderate enthusiasm. The experimenter paused for up to 2 s to present an opportunity for the participant to emit additional appropriate social statements. The experimenter continued to the next turn of the conversation if none was emitted. If the participant gave no response within 5 s of the end of the recorded script or emitted other non-vocal or vocal behavior, the experimenter delivered manual guidance for the participant to replay the card. This procedure was repeated until the participant imitated the script without error. At no time did the experimenter deliver vocal prompts or instructions. When the participant imitated the scripted recording accurately, the experimenter acknowledged the response and presented the next turn of the interaction. This procedure was repeated until the end of the interaction. After every four consecutive correct responses a step towards fading the physical prompts for the card playing response was taken. The sequence of fading steps for the card playing response is shown in Table 4.

The fading steps consisted of moving from manual guidance to graduated guidance, which consisted of lessening the amount of physical assistance delivered by the experimenter's hand-over-hand prompt the participant. A brief spatial-fading procedure was used with graduated guidance, where the location of the prompt was moved from hand-over-hand to guidance at the wrist, and then the forearm. When the prompt reached the forearm, a delay was introduced. The delay increased in 2 s intervals, similar to the procedure used during pre-training, to a maximum of 6 s. If the participant failed to complete the card-playing response, the experimenter moved to full manual guidance. If the participant emitted a vocal response prior to playing the card, it was scored as an incorrect response and the identical antecedent was presented again with a physical correction to play the card immediately.

A script-fading procedure began, and progressed through each fading step, following every two consecutive sessions in which the participant imitated the scripted responses with no more than 2 errors within any single session. Fading of the recordings consisted of 4 stages, with each stage consisting of a gradual cumulative reduction in the recorded response. For example, the recording for the scripted response, "I'm fine. How are you?" would be changed to "I'm fine. How are y" during stage 1. By stage 4 of script-fading, this response would be changed to, "I'm." The script-fading steps for all scripted responses are shown in Table 5.

Lag-0. Following the fourth stage of script-fading, a return to Lag-0 was introduced if the percentage of trials with appropriate responding was stable. During the return to Lag-0, all of the materials associated with the scripting procedure were removed

and were no longer in view of the participants. Procedures identical to those used in the initial Lag-0 condition were followed.

Lag-1 with Repeated Trials. After responding had stabilized during the return to Lag-0, a treatment package consisting of a Lag-1 reinforcement contingency and repeated trials contingent on repeated responses was introduced. In this condition, the procedures were identical to those used in the Lag-0 condition with the exception that reinforcement was contingent on an appropriate response that was considered varied from the response emitted during the same turn in the previous conversation. If the participant repeated the same response that was emitted on the same turn of the previous conversation, the experimenter provided no feedback, paused for up to 5 s, and re-presented the same antecedent (i.e., a repeated trial). This repeated-trials procedure was continued until an appropriate and varied response was emitted or 5 repetitions of the same antecedent were completed without an appropriate and varied response. Responding that occurred during the intertrial interval was ignored. The experimenter continued to the next turn of the conversation following the repeated-trials procedure.

Generalization. Throughout all experimental conditions, generalization probes were conducted with programmed consequences that were identical to those specified during Lag-0. All appropriate responding was reinforced and differential consequences were not provided for varied responding. On probe trials, a different classroom instructor presented antecedents similar to those used on experimental trials. Additionally, these probe trials took place in a setting other than the training setting, such as in the hallway, in the gymnasium, or in the participant's classroom. The antecedents presented during

the probes consisted of the following sequence, 1) “Hey (name). How are you?” 2) “What’s going on?” and 3) “Today’s been busy.”

Interobserver agreement. Interobserver agreement (IOA) was measured for the percentage of trials with appropriate responding, the percentage of trials with varied responding, and the percentage of trials with appropriate and varied responding on a total of 36%, 36%, and 42% of all the sessions for Chely, Alan, and Bernard, respectively. Agreement was calculated by taking the total number of agreements and dividing by the total number of agreements and disagreements and multiplying the result by 100%. The mean percentages of agreement across the dependent variables for each experimental condition and for each participant are shown in Table 6. Overall, IOA ranged from a mean of 93% to a mean of 100% across the three participants and all dependent variables.

Social Validity. At the end of the study, a group of professionals, consisting of administrators and clinicians, who were not familiar with the purposes of the study, the participants, or the procedures, was asked to rate transcripts of participant’s conversations during each of the experimental phases. For each participant, all five conversations from the last session of the initial Lag-0 condition, the return to Lag-0, and the Lag-1 with repeated trials conditions were transcribed. Each rater was given three forms (i.e., sessions), that were randomly selected, to rate. Because the forms were selected randomly, any rater may have received conversations from any of the experimental conditions for any of the three participants. At the bottom of the form, the rater was asked to rate the extent to which they thought five statements regarding the speaker was true. The statements were related to the child’s language skills, social skills, the extent to

which they changed their responses, and skill as a conversationalist (e.g., “This child has good language skills”). A 5-point Likert scale was used, where “1” represented a statement that was not true at all and “5” represented a statement that was very true. The statements that were rated are shown in Table 7.

Results

Figure 1 shows the percentage of trials with appropriate responding during experimental sessions and generalization probes for each of the participants for each experimental condition. Data on the percentage of trials with appropriate responding during generalization probes conducted throughout the study are also shown for each participant. For each of the participants, a low to moderate level the percentage of trials with appropriate responding was observed during Lag-0, ranging from 20% to 70% across the three participants. The percentage of trials with appropriate responding increased systematically across all three participants with the introduction of scripting. High levels of appropriate responding were maintained throughout the four stages of script-fading. The data for two participants showed no variability but Bernard showed slight variability. For Chely and Alan, high levels of appropriate responding were maintained throughout the return to Lag-0. Similarly, appropriate responding stabilized at 100% with the return to the Lag-0 experimental condition. High levels of appropriate responding remained stable at high levels throughout the introduction of the Lag-1 schedule with repeated trials experimental condition. The results of the generalization probes show that the percentage of trials with appropriate responding remained stable throughout all experimental conditions for all three participants. A slight increase in the overall level of the percentage of trials with appropriate responding during the generalization probes was observed with Chely following the introduction of scripting and remained stable at this higher level throughout the remainder of the study.

Figure 2 shows the percentage of trials with varied responding for each of the participants across each of the experimental conditions and during generalization probes.

During Lag-0, all three participants showed low and slightly variable levels varied responding. The introduction of scripting resulted in a systematic increase in varied responding that was maintained throughout the stages of script-fading. A slight decreasing trend was observed for Alan and Bernard during the script-fading steps, but stabilized towards the final sessions of the scripting condition. A systematic decrease in the percentage of trials with varied responding was observed with all three participants with the return to Lag-0. The introduction of the Lag-1 schedule with repeated trials condition resulted in a systematic increase in the percentage of trials with varied responding across all three participants. The results of the generalization probes show little varied responding for each of the participants throughout each of the experimental conditions. Low levels of varied responding were obtained with Chely and Alan, whereas Bernard showed higher, but also stable levels of varied responding during the generalization probes.

Figure 3 shows the percentage of trials with appropriate and varied responding for each of the participants across each of the experimental conditions and during the generalization probes. These data were similar to those obtained for the percentage of trials with varied responding but show somewhat less variability. During Lag-0, all three participants showed little or no appropriate and varied responding. The introduction of scripting resulted in a systematic increase for all three participants within the first session of scripting. Levels of appropriate and varied responding higher than those seen during Lag-0 were maintained throughout the progression of the script-fading steps for all three participants. A slight decreasing trend in appropriate and varied responding was seen during the third and fourth stage of script-fading with Bernard, but stabilized for the final

6 sessions of the scripting condition. This was followed by a systematic decrease in the percentage of trials with appropriate and varied responding with the return to Lag-0 for each of the participants. The levels of appropriate and varied responding increased to levels similar to that seen during scripting, with the introduction of Lag-1 schedule with repeated trials treatment package for all three participants. The results of the generalization probes showed that the percentage of trials with appropriate and varied responding remained stable at a low level throughout each of the experimental conditions for each of the participants.

Figure 4 shows the mean variability score for all of the responses emitted by each participant during each of the experimental conditions. Across the three participants, the initial Lag-0 condition resulted in a mean variability score above 1.0 for each of the participants. The random presentation of scripted responses during the scripting condition and throughout the script-fading stages resulted in an increase in the mean variability scores above the initial Lag-0 condition for all three participants. The removal of scripting materials and return to Lag-0 resulted in a decrease in the mean variability score of all the responses emitted to levels below that obtained in the initial Lag-0 condition, with the exception of Chely, who showed a slight increase in the mean variability score from the preceding scripting condition. The introduction of the Lag-1 with repeated trials treatment package resulted in an increase in the mean variability score as compared to the return to Lag-0 condition. Generally, the mean variability scores obtained during either the initial Lag-0 condition or the return to Lag-0 condition were lower than the mean variability scores obtained during the scripting or the Lag-1 schedule with repeated trials conditions with the exception of Chely. For Chely, the

return to Lag-0 condition resulted in a mean variability score greater than that obtained during the scripting condition. The mean variability score for responding during Lag-1 with repeated trials was typically higher than in any other experimental condition, with the exception of Bernard, for whom the highest mean variability score for responding was obtained during the scripting condition. The condition typically associated with the lowest mean variability score was the return to Lag-0 condition, with the exception of Chely, for whom the initial Lag-0 condition resulted in the lowest mean variability score.

The overall mean variability score for responses in each condition would obscure the occurrence of highly varied responding during any turn of the conversation with highly repetitive responding to another turn in the conversation. As a result, the mean variability scores were evaluated for responses to each turn in the conversation. Figure 5 shows the mean variability score for all of the responses emitted during each turn of the conversation for each participant across the experimental conditions. In general, the mean variability score for responses emitted during each turn of the conversation throughout the experimental conditions followed the same pattern as that found in the overall mean variability scores for each participant. The initial Lag-0 condition resulted in low mean variability scores for each turn of the conversation for each of the participants, with an increase during the introduction of scripting. The return to Lag-0 resulted in a decrease in the mean variability scores across responses to each turn for each participant, with the exception of Chely. For Chely, a slight increase in the mean variability scores for responding to each turn of the conversation was observed from the scripting condition to the return to Lag-0 condition. Similar to the mean variability scores for all responding, the mean variability scores for responding during each turn of

the conversation increased from the return to Lag-0 condition to the Lag-1 with repeated trials condition. These patterns on the effects of the experimental manipulations on the mean variability scores for responding during each turn of the conversation were consistent across each turn. The only exception was that a decrease in the mean variability score was seen for Chely from the return to Lag-0 to the Lag-1 with repeated trials condition for the first turn in the conversation.

It was possible that elevations in the percentage of appropriate and varied responding seen in Figure 3 might have been due to the random presentation of different experimenter-delivered antecedents that each occasioned a specific but different response. As a result, the mean variability score of responses to each of the three experimenter-delivered antecedents was reviewed within each turn of the conversation. The variability scores for responses occasioned by a specific experimenter-delivered antecedent were determined by omitting trials in which any other antecedent was delivered. This was repeated for responding to each of the experimenter-delivered antecedents within each turn. Table 8 shows the mean variability score for responses emitted to each specific experimenter-delivered antecedent during each turn for each experimental condition for Chely, Alan, and Bernard. In contrast to the data reported in Figure 5, these data show the degree of variability in responding to any single antecedent rather than throughout the entire condition. The actual variability scores for responding to each antecedent during each turn of the conversation may be found in Tables A1, A2, and A3 in the appendix.

Across all three participants, the lowest mean variability scores were obtained during the Lag-0 condition, regardless of the turn. Additionally, the most elevated mean

variability score for each turn of the conversation was typically associated with the Lag-1 with repeated trials condition. The only exceptions were the scripting conditions for Chely during turn 1 and with Bernard during turn 3 of the conversation.

Table 9 shows the mean rating for all of the scores obtained for the participant during each condition with the social validity scale. A total of 32 of the sessions were rated, and at least 3 conversations within each condition were rated for each participant. Differences between the mean ratings were modest, but consistently highest for conversations that occurred during the Lag-1 with repeated trials condition.

Discussion

The purpose of the present study was to investigate the effects of a scripting procedure on the variety of appropriate social responses emitted during a brief conversation that consisted of a total of six turns between an adult and a child with autism. Additionally, the effects of a treatment package consisting of a Lag-1 reinforcement schedule with repeated trials contingent on repetitive responding on the variety of responding emitted during the same 3-turn conversation was evaluated. Scripting increased appropriate and varied responding to each part of the 3-turn conversation. Appropriate and varied responding maintained at levels above those obtained during Lag-0 as the script was gradually removed. Appropriate and varied responding was not maintained, however, when the script was completely removed and the Lag-0 schedule was reinstated. In fact, dominant responses during each turn of the conversation emerged within a few sessions for all three participants despite a prior demonstration of a varied repertoire. Appropriate and varied responding systematically increased during the 3-turn conversation for each participant with the introduction of a Lag-1 reinforcement schedule with repeated trials contingent on repetitive responding.

Lag reinforcement schedules have had limited but promising applications in previous studies increasing variability in the verbal behavior with people with autism (e.g., Lee et al., 2002; Lee & Sturmey, 2006). The present study differs from, and extends, previous research on lag reinforcement schedules with people with autism. In the present study, the participants did not exhibit a high degree of appropriate social responding to the experimenter-delivered antecedents during the initial Lag-0 condition. This outcome was in contrast to Lee et al. (2002) and Lee and Sturmey (2006). As a

result, training was required to increase appropriate responding to the antecedent stimuli presented throughout the study for all three participants. This was accomplished through a scripting and script-fading procedure. In previous studies with people with autism, a Lag-1 schedule has been applied to responding to a single social question, typically, "What do you like to do?" In the present study, a treatment package incorporating a Lag-1 schedule was applied to responding to experimenter-delivered antecedents in each turn of a 3-turn conversation. Additionally, three variations of experimenter-delivered antecedents for each turn of the conversation were presented throughout the study, whereas the experimenter-delivered antecedent did not vary across trials and sessions in previous studies. Finally, previous demonstrations of the effects of a Lag-1 schedule were within the context of discrete-trial teaching. In these contexts, exposure to the lag contingency occurred at short intertrial intervals, such as a few seconds. Another component of the procedures found in previous studies was a relatively higher rate of trials. In the present study, exposure to the Lag-1 contingency occurred at intervals that were relatively longer than that typically found in applications of discrete-trial teaching and with fewer trials. When the repeated trials procedure was not needed, several minutes elapsed before the experimenter and participant engaged in the conversation again. When the repeated trials procedure was implemented, the intertrial interval was reduced to a few seconds. Despite these variations, the treatment package including a Lag-1 schedule was effective at increase varied responding to each experimenter-delivered antecedent during each turn of the conversation.

Although the order in which experimenter-delivered antecedents and scripted responses were randomly selected, an increase in varied responding would be obtained if

different antecedent stimuli were discriminative for specific responses. For example, if S^D_1 always occasioned R_1 and S^D_2 always occasioned R_s, then the random presentation of S^D_1 and S^D_2 would result in an overall varied pattern of responding despite repetitive responding to each antecedent. This would indicate an overall varied pattern of responding across conversations, but a highly repetitive pattern of responding to each antecedent. This would be shown by variability scores for responding to each antecedent stimulus in a particular turn of the conversation that were close to 1 and a high level of percentage of trials of appropriate and varied responding during the corresponding experimental condition. The results showed, however, that varied responding occurred across each of the experimenter-delivered antecedents. The mean variability score for responses to each antecedent in each part of the conversation were higher during scripting and the Lag-1 with repeated trials condition than during either Lag-0 or the return to Lag-0 condition. Similarly, the percentage of trials with varied and appropriate responding was higher during scripting and the Lag-1 with repeated trials condition than either Lag-0 or the return to Lag-0 condition. These data, reported in Figure 3 and Table 8 show that the increase in varied responding was not a function of the random presentation of stimuli that exerted discriminative control over specific responses.

During a Lag-1 reinforcement schedule, the alternation between 2 appropriate responses would be sufficient to meet the reinforcement criteria on each trial. Both Lee, et al (2002) and Lee & Sturmey (2006) observed this in some of their participants during exposure to the Lag-1 schedule when presenting the social question, “What do you like to do?” on 11 consecutive trials. If consistent alternation of 2 responses occurred during any turn in the present study, the variability score for each response would be 2. Figure 4

shows the mean variability score for all of the responses emitted across each of the experimental conditions for each participant. Generally, the mean variability during the initial Lag-0 conditions was around 2.0. However, as seen in Figure 1, appropriate responding was low or variable. Participants typically emitted different responses, and often incorrect responses that included echoing all or parts of the antecedent stimulus presented by the experimenter. Thus, the random presentation of experimenter-delivered antecedents within in turn across conversations contributed to a higher variability score. With the introduction of the script, the variability scores for during each of the turns increased as a result of the randomization procedure for the presentation of scripted responses exemplars. During the return to Lag-0, Alan and Bernard both show a decrease in their variability scores for responding during the conversation to less than 2 for each step in the conversation. Chely, however, showed an increase in the mean variability score. This overall increase, however, can be attributed to single responses in each of the parts of the conversation with extraordinarily high variability scores. For example, in the first session of the return to Lag-0, Chely emitted the response, "Good" in the first step of the conversation. This response had a variability score of 155. No other response emitted in the first step of the conversation had a variability score that exceeded 11. Similar instances occurred in the second and third step of the conversation. During the introduction of Lag-1 with repeated trials, the variability scores increased across each step of the conversation and for each participant. Bernard showed the greatest tendency to alternate between a few responses, with variability scores at or around 2.0.

Several factors may account for the general absence of a consistent alternation of 2 responses during exposure to the Lag-1 reinforcement schedule. First, the experimenter

presented a variety of antecedent statements in each turn of the conversation in a random sequence from one conversation to the next. Although this procedure was followed throughout all of the experimental conditions, the extent to which this procedural aspect influenced varied responding is unclear. Second, the participants were prompted to emit a varied pattern of responding from one conversation to the next during scripting and script-fading. Extinction-trials that occurred during the Lag-1 condition may have resulted in recovery of this pattern of responding because it had previously been reinforced. Third, the mean interval of time between conversations was 10 minutes. This is in contrast to the intertrial interval of a few seconds found in traditional massed discrete-trial teaching procedures. Similarly, Neuringer (1991) showed that sequence variability in lever presses emitted by rats increased as the minimum interresponse time increased. Although this interval of time did not have an effect of varied responding during previous conditions, the extent to which the spacing of trials interact with the effects of the Lag-0 schedule remains to be investigated. Future research may also investigate higher and variable parameters of a Lag reinforcement schedule in terms of their effects of the consistent alternation of responding that may occur during exposure to a Lag-1 reinforcement schedule.

These results were consistent with previous studies. That is, despite having a sufficiently varied language repertoire, the participants in the present study failed to vary responding in the absence of scripting materials during the return to Lag-0. Thus, when the participant's environment did not occasion or require response variability, repetitive responding emerged. The introduction of a treatment package that incorporated a Lag-1 reinforcement schedule effectively increased varied responding for all three participants

to experimenter-delivered antecedents to each turn of the conversation. The variations from previous experiments found in the present study provide support for the application of lag reinforcement schedules in areas with more complex social interactions and in teaching situations that are less structured than typical discrete-trial teaching settings.

The current study also extends applications of scripting procedures by targeting appropriate responding to experimenter-delivered antecedents rather than the frequency of initiations by participants with autism. In the present study, scripting was found to be an effective means of increasing appropriate responding by children with autism to experimenter-delivered antecedents in the context of a brief conversation. In addition, the effects on appropriate language were durable. High levels of appropriate responding maintained throughout the stages of the script-fading procedure, the removal of scripting materials during the return to Lag-0, and throughout the Lag-1 with repeated trials condition. In the present study, the random presentation of scripted responses within each turn of the conversation resulted in an increase in varied responding. Additionally, varied responding was maintained at levels above those obtained during baseline levels as the script was faded and until just a portion of the script was present. When the scripting materials, such as the card player and cards, were removed, appropriate responding maintained at a high level but varied responding decreased for all three participants. Thus, despite having a sufficient repertoire within which to vary and responding in a variable manner during the final stage of the script-fading procedure, the removal and absence of stimuli correlated with the scripted responses during the return to Lag-0 resulted in the emergence of a dominant response within a few sessions for all three participants.

One interpretation of this result is consistent with studies on the effects of continuous reinforcement on response variability. For example, although reinforcement was available for different responses, a high rate of reinforcement, unless contingent on variability within some dimension of the response, typically results in an increase in repetitive responding and the emergence of a dominant response (Vogel & Annau, 1973; Schwartz, 1980; Schwartz, 1982).

Although this may be responsible for the decrease in appropriate and varied responding, a high rate of reinforcement was present throughout all experimental conditions with the exception of the initial Lag-0 condition. Thus, at least two other explanations for the decrease in appropriate and varied responding during the return to Lag-0 are possible.

The scripting procedure in the current study involved the random selection of responses that were scripted within each turn of the conversation. This led to the imitation of scripts that were relatively varied across conversations. Thus, rather than an induced schedule-effect, the decrease in varied responding during the return to Lag-0 may reflect the removal of varied language models that were imitated by the participants. Alternatively, although reinforcement was not contingent on varied responding during the scripting condition, a high proportion of varied responding contacted reinforcement in the presence of the scripting materials. Thus, the materials that were associated with the script were also associated with, and may have come to signal reinforcement for, varied responding. The removal of these materials may have represented the removal of discriminative stimuli for varied responding. A manipulation in regards to the manner in which multiple scripted responses are presented would dissociate the effects of stimulus control of varied responding as opposed to the imitation of a varied pattern of scripted

responses. Additionally, because the effects of scripting on varied responding was immediate, future studies may investigate establishing and transferring stimulus control of varied responding exerted by scripting materials to stimuli more commonly found in social environments.

Because unscripted statements and repetitive responding were not incompatible, it was hypothesized that repetitive responding would emerge following the completion of script-fading despite previously reported increases in unscripted statements following script-fading. In addition to a decrease in varied responding following script-fading, the results of the scripting procedures used in the present study showed negligible increases in unscripted statements during scripting and the script-fading stages to the extent that those data were not reported. This may be explained by differences in the scripting procedure used in the current study as opposed to those used in previously studies. Krantz and McClannahan (1993) taught four participants to emit 10 different scripted responses during art activities. The current procedure consisted of 3 response exemplars to each step of the conversation, which may have been an insufficient number of exemplars to obtain response generalization. Additionally, Krantz and McClannahan (1993) also taught their participants to write a mark next to the scripted response after emitting that response. They found that even when the script was faded to just quotation marks, the participants continued to write check marks next to the script. This self-recording behavior may have provided additional cues that might have evoked particular responses and may have also served as conditioned reinforcement for social initiations.

Analysis of Chely's and Alan's responding during the first session of the return to Lag-0 condition also provides a possible explanation for the lack of the emergence of

unscripted responses in the present study. Occasionally, Chely and Alan emitted a response that was scripted for a particular turn of the conversation during another turn of the conversation. For example, when presented with an antecedent from the second turn of the conversation, such as, "What's new?" a participant might emit a response that had been scripted for the third turn in the conversation, such as, "Really? Why?" Occasionally, a recombination of previously scripted responses, such as, "Really, I'm fine" was also emitted during the wrong turn of the conversation. Such cases of unscripted responses and recombined portions of scripted responses were considered inappropriate responses to the experimenter-delivered antecedents and were likely extinguished. With the continuation of differential reinforcement of appropriate responding during the return to Lag-0, a dominant response emerged to each step in the conversation to the eventual exclusion of all other previously scripted responses.

It is also feasible that the specific experimenter-delivered antecedents restricted the range of possible appropriate responses to a relatively small set within all possible responses. As a result, a larger proportion of all the possible combinations of elements of previously scripted responses would result in extinction in the current study than would contact reinforcement. In previous studies that employed scripting procedures, responding to experimenter-delivered antecedents did not provide a constraint on the range of possible appropriate responses. Thus, a larger proportion of all of the possible combinations of elements of previously scripted responses were likely to contact reinforcement than be extinguished. The effects of lag reinforcement schedules on initiations emitted by participants with autism during social contexts remain to be investigated.

There are several areas that are lacking in the present study. In contrast to demonstrations of the schedule control over varied responding, at least two factors may be responsible for the systematic decrease in varied responding during the return to Lag-0. First, the removal of scripting materials may have resulted in the removal of discriminative stimuli for varied responding. This may have been addressed by systematically removing and presenting script-related materials during exposure to Lag-0 and Lag-1 reinforcement schedules. Additionally, the elimination of the model presented by the auditory script resulted in the removal of imitative prompts for responding that occurred in a varied pattern. An alternative acquisition procedure may eliminate this possibility. For example, the training of target responses in isolation (i.e., repetitive presentation) until mastery before the subsequent introduction of new responses would avoid the varied presentation of target responses. A reversal to Lag-0, following the Lag-1 condition, with a corresponding decrease in appropriate and varied responding would have provided a stronger demonstration of control over appropriate and varied responding by the reinforcement schedule.

Similarly, the subsequent increase in appropriate and varied responding with the introduction of the Lag-1 with repeated trials contingent on repetitive responding may be due to several factors. These include the schedule requirements of the Lag-1 contingency and potential negative reinforcement associated with the cessation or avoidance of the repeated trials procedure. Although appropriate and varied responding was increased in these participants, the extent to which speech should be varied also remains to be determined. For example, although social and language skills were perceived to be superior at the introduction of the treatment package, comparative ratings and data on the

variability of speech emitted by age-matched typically developing peers should be collected. The results of the social validity scale suggest that varied social language during brief conversations may be correlated with more positive attitudes towards the speaker. While this needs further investigation, the extent to which this is true indicates the need to conduct language training for individuals with autism that addresses response variability during social interactions. Generalization of the effects of scripting, script-fading, and the Lag-1 with repeated trials procedure were not obtained and maintenance of desired levels of appropriate speech was not demonstrated. These also remain areas for future investigations.

The present study also introduces several new variables for investigation. In contrast to previous studies where language training did not occur prior to the introduction of a lag schedule, in present study, a total of nine different responses were taught. The number of response exemplars presented during scripting may be a critical factor for increasing variability using a lag schedule. The number of trained exemplars may have important effect on the amount of variability obtained during exposure to the lag schedule. For example, Day and Horner (1989) found that characteristics of response exemplars during training could influence later performance when a variety of responses are required. Similarly, a sufficient range of language exemplars may be required for later variability in different parts of speech. Alternatively, training a wide variety of response exemplars might result in an increase in the degree of response variability as a result of response generalization. Future studies can investigate the relation between the number of response exemplars present during training, response generalization, and response variability. In addition to the number of response exemplars taught, the type

and structure of scripted responses may play a role in later response variability and response generalization. For example, response variation in the absence of the script may be affected by the extent to which different scripted responses contained similar structures (e.g., beginning with the phrase, “I really like…”, or “I can’t stand…”). Alternatively, later response variations might be inhibited by scripted statements that are similar in structure, and highly discriminable statements may be more advantageous to independent response variations in the absence of a script. The extent to which the script-fading procedure used in this and previous applications of script-fading either inhibit or facilitate response variability may also be investigated. Finally, these results support the application of lag schedules to enhance response variability following the use of a scripting procedure to establish language responses. Lag schedules may also enhance the effects of other skills-training procedures, such as chaining, general case teaching, to produce appropriate levels of response variability in populations and individuals with deficits in appropriate levels of varied behavior.

Table 1

Scripted Antecedents and Responses

Turn	Phrase #	Experimenter Antecedent	Scripted Responses
First	1	Hey (name). How're you doing?	I'm fine. How are you?
	2	How's it going?	Not bad. And you?
	3	Hi. How are you?	Alright. How about you?
Second	1	How's your day going?	I'm working hard.
	2	What've you been doing?	I'm working with my teachers.
	3	So, what's new?	I'm working on my book.
Third	1	I've been busy.	Really? Why?
	2	Man, what a day!	What happened?
	3	Today's been tough!	Is it the new class?

Table 2

Combinations of Antecedent Stimuli or Scripted Responses

	Turn		
Combination #	First	Second	Third
1	1	1	1
2	1	2	1
3	1	3	1
4	1	1	2
5	1	2	2
6	1	3	2
7	1	1	3
8	1	2	3
9	1	3	3
10	2	1	1
11	2	2	1
12	2	3	1
13	2	1	2
14	2	2	2
15	2	3	2
16	2	1	3

(Table continued)

Combination #	Turn		
	First	Second	Third
17	2	2	3
18	2	3	3
19	3	1	1
20	3	2	1
21	3	3	1
22	3	1	2
23	3	2	2
24	3	3	2
25	3	1	3
26	3	2	3
27	3	3	3

Table 3

Antecedent/Response Combinations for Each Participant

#	Chely	Alan	Bernard
1	1 – 1 – 1	1 – 2 – 3	1 – 1 – 2
2	1 – 2 – 3	1 – 3 – 2	1 – 2 – 1
3	1 – 3 – 1	1 – 3 – 3	1 – 3 – 2
4	2 – 1 – 2	2 – 1 – 2	2 – 1 – 3
5	2 – 2 – 3	2 – 2 – 2	2 – 2 – 3
6	2 – 3 – 1	2 – 3 – 1	2 – 3 – 1
7	3 – 1 – 3	3 – 1 – 1	3 – 1 – 1
8	3 – 2 – 2	3 – 1 – 3	3 – 2 – 3
9	3 – 3 – 2	3 – 2 – 1	3 – 3 – 2

Table 4

Physical Prompt Fading Steps for the Card Playing Response

1. Full manual guidance (hand-over-hand)
2. Graduated guidance at hand
3. Graduated guidance at wrist
4. Graduated guidance at the forearm
5. Graduated guidance at the forearm at 1 – 2 s delay
6. Graduated guidance at the forearm at 3 – 4 s delay
7. Graduated guidance at the forearm at 5 – 6 s delay

Table 5

Script-fading Steps

Turn	Stage		Scripted Response	
First	0	I'm fine. How are you?	I'm working hard.	Really? Why?
	1	I'm fine. How are y	I'm working ha	Really? Wh
	2	I'm fine. How	I'm working	Really?
	3	I'm fine.	I'm w	Reall
	4	I'm		Re
Second	0	Not bad. And you?	I'm working with my teachers.	What happened?
	1	Not bad. And y	I'm working with my teach	What happen
	2	Not bad. An	I'm working with my te	What hap
	3	Not ba	I'm working wi	What
	4	No	I'm wo	Wh
Third	0	Alright. How about you?	I'm working on my book.	Is it the new class?
	1	Alright. How about y	I'm working on my b	Is it the new cla
	2	Alright. How abo	I'm working on	Is it the ne
	3	Alright. H	I'm work	Is it th
	4	Alr	I'm w	Is i

Table 6

Percentage of Interobserver Agreement for three dependent variables across the Lag-0, Scripting, Return to Lag-0, and Lag-1 with Repeated Trials conditions, respectively.

Participant	Experimental Condition	*n* sessions	Dependent Variable		
			% Appropriate Responding	% Varied Responding	% Appropriate and Varied Responding
Chely	Lag-0	3	98%	100%	100%
	Scripting	9	98%	98%	97%
	Lag-0	4	100%	100%	100%
	Lag-1	5	100%	99%	99%
Bernard	Lag-0	7	95%	93%	95%
	Scripting	6	99%	98%	100%
	Lag-0	6	100%	100%	100%
	Lag-1	4	100%	100%	97%
Alan	Lag-0	11	97%	97%	95%
	Scripting	12	99%	98%	100%
	Lag-0	5	100%	100%	100%
	Lag-1	5	96%	96%	100%

Table 7

Social Validity Statements

1. This child is not very repetitive, unlike a child with autism.
2. This child is likely more social than a child with autism.
3. This child has better language skills than a child with autism.
4. This child changes his/her answers like any other child.
5. This child is a good conversationalist.

Table 8

Mean Variability Scores for Responses Emitted to Each Experimenter-Delivered Antecedent During Each Turn for Each Experimental Condition

		Lag 0	Script	Lag 0	Lag 1
Turn 1	Chely	1.21	3.24	1.31	2.82
	Alan	1.94	3.05	1.18	5.46
	Bernard	1	2.92	1.71	3.27
Turn 2	Chely	1.39	2.71	1.18	5.57
	Alan	1.98	2.57	1.08	2.92
	Bernard	0.79	2.48	1.23	3.19
Turn 3	Chely	1.64	3.2	1.8	3.36
	Alan	2.36	3.03	1.53	4.36
	Bernard	0.94	3.4	1.17	3.06

Table 9

Results of Social Validation Scale

Participant	Lag-0	Return to Lag-0	Lag-1 with Repeated Trials
Chely	2.8	2.67	2.93
Alan	2.2	2.53	3.8
Bernard	1.9	1.8	3.1

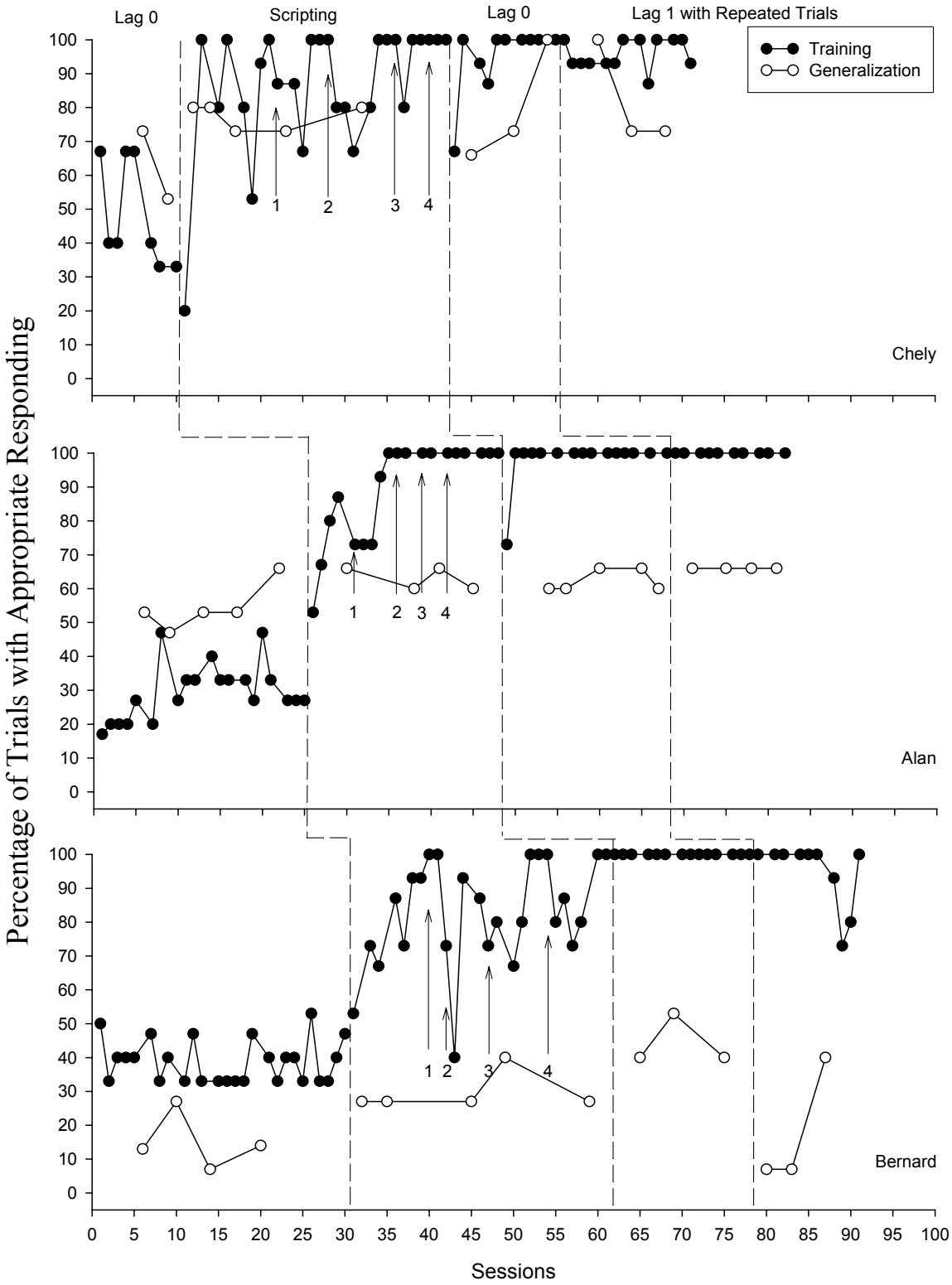

Figure 1. The percentage of trials with appropriate vocal responding to experimenter-delivered statements during conversations for each participant. Generalization probes were conducted with a different person, in a different setting, and with different conversations.

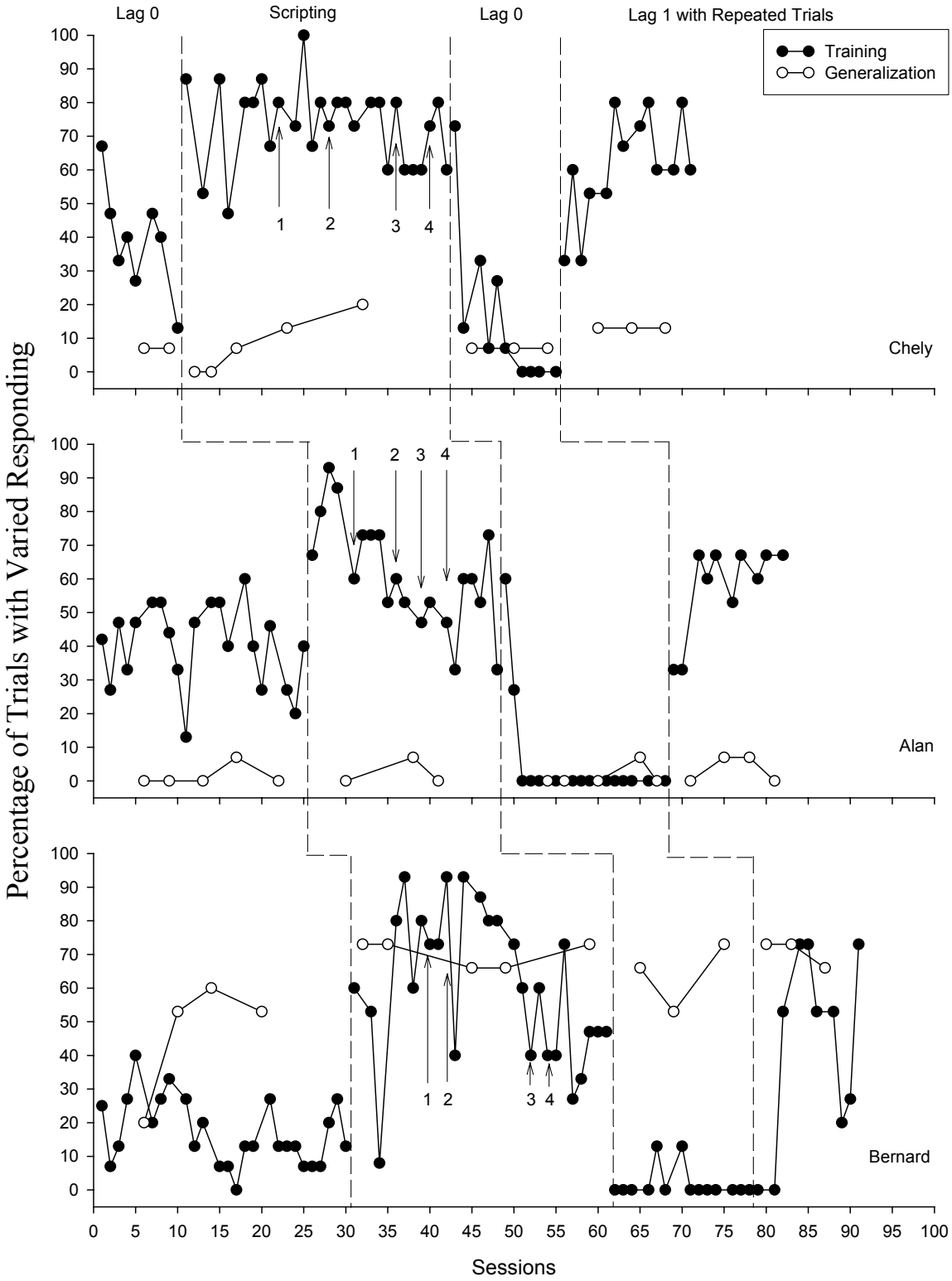

Figure 2. The percentage of trials with varied vocal responding to experimenter-delivered statements during conversations for each participant. Generalization probes were conducted with a different person, in a different setting, and with different conversations.

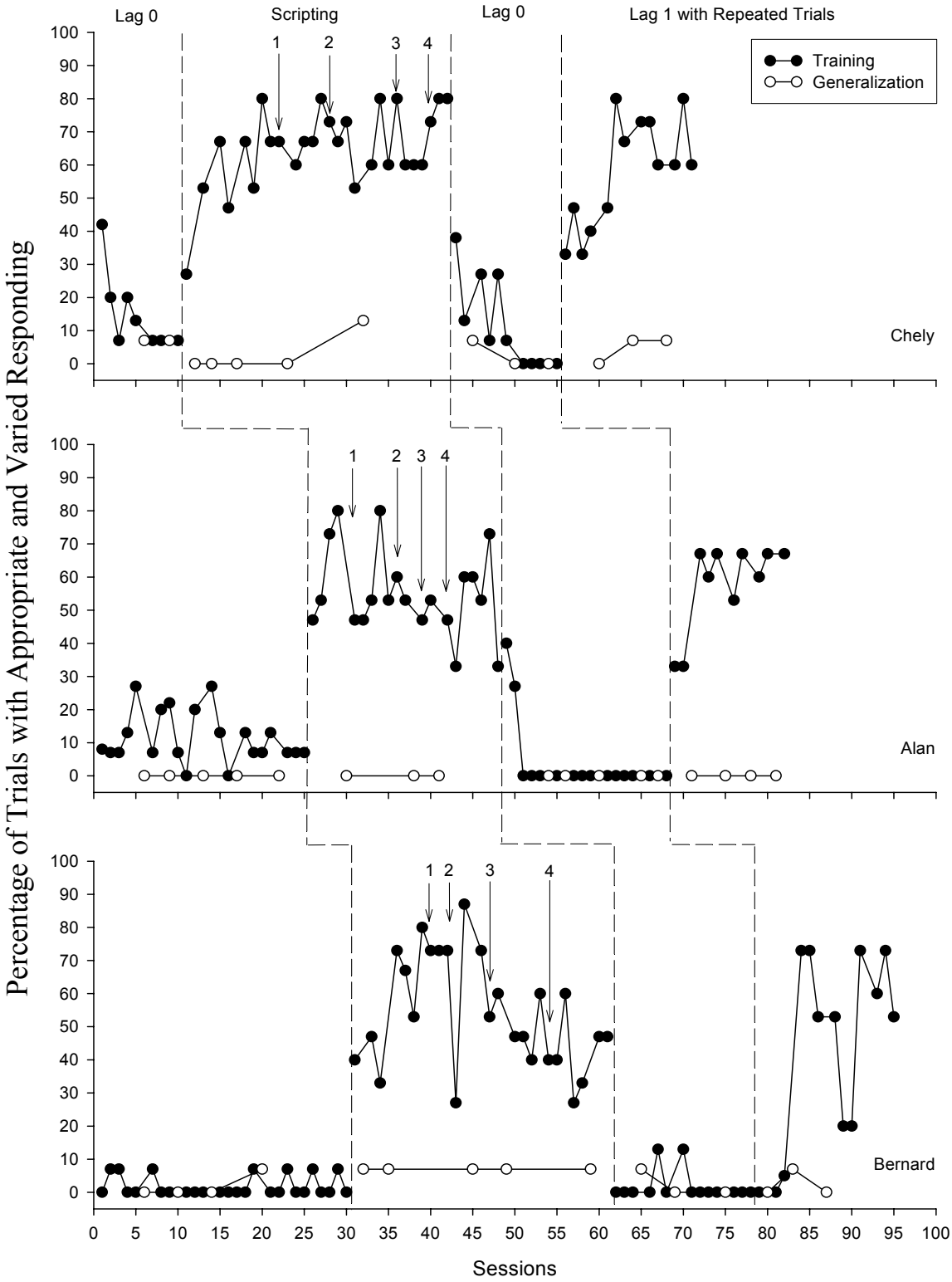

Figure 3. The percentage of trials with appropriate and varied vocal responding to experimenter-delivered statements during conversations for each participant. Generalization probes were conducted with a different person, in a different setting, and with different conversations.

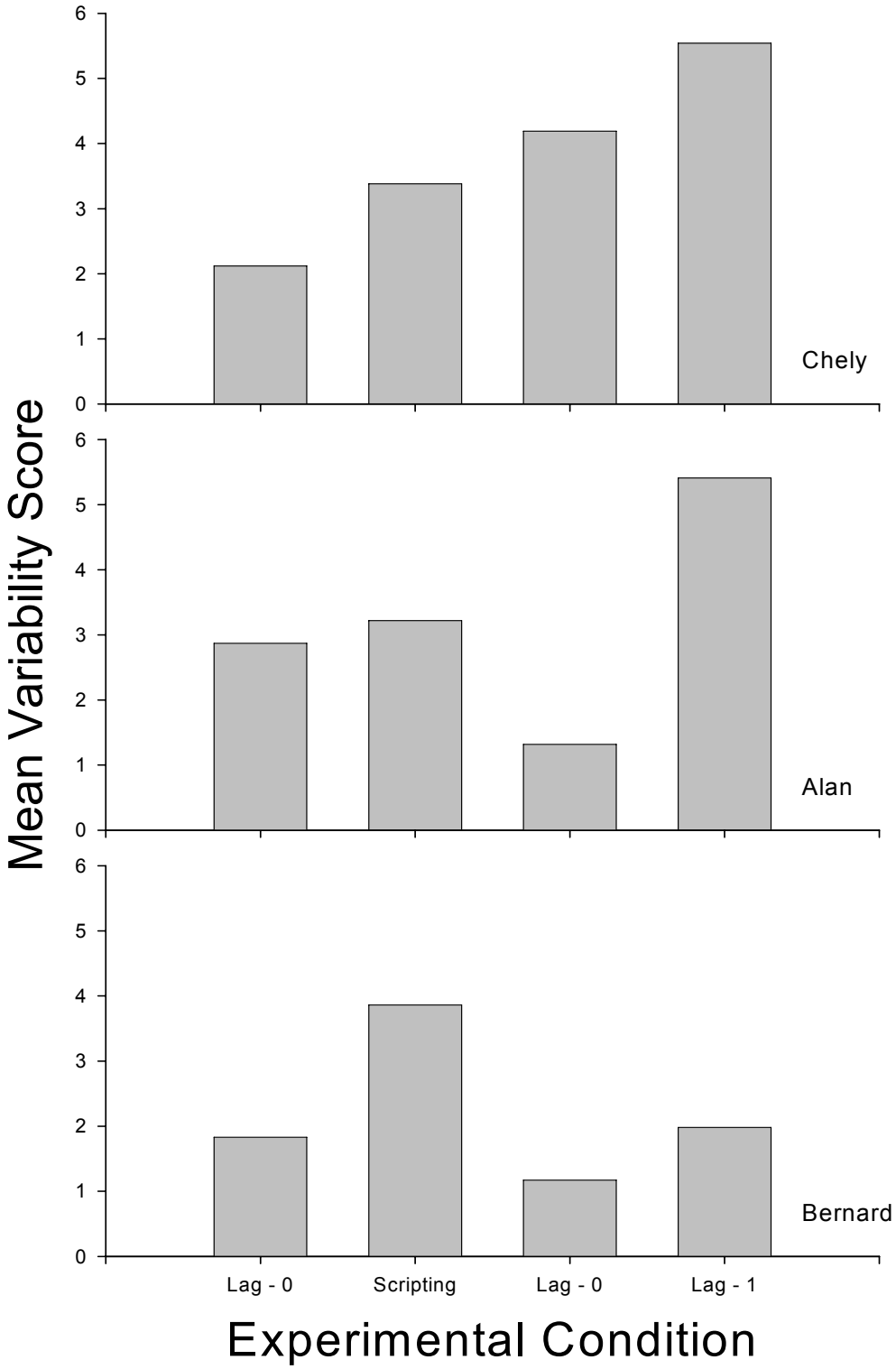

Figure 4. The mean variability scores for all of the responses emitted during each experimental condition for each participant.

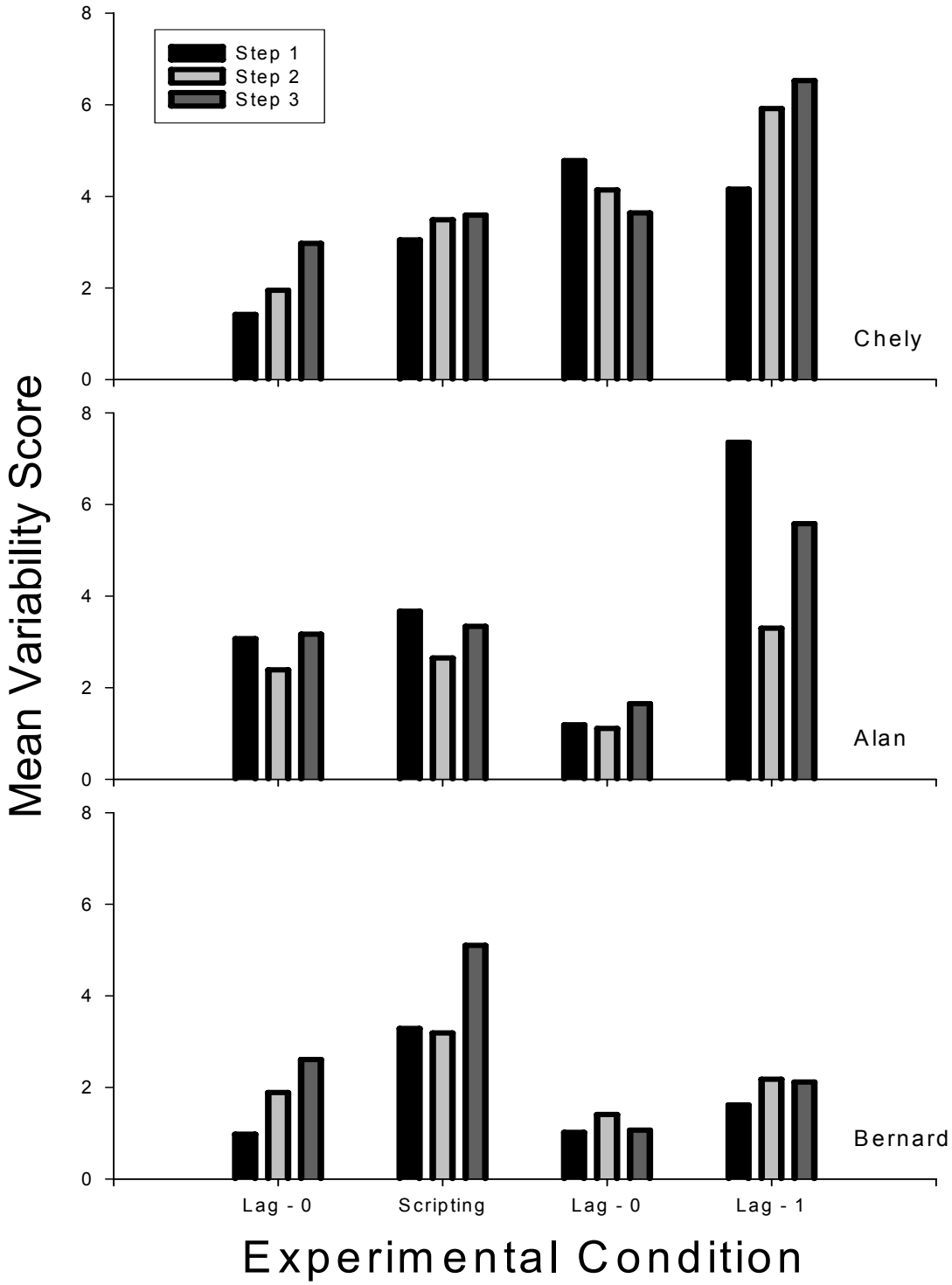

Figure 5. The mean variability scores of all of the responses emitted during steps 1, 2, and 3 of the conversations across each experimental condition for each participant.

Appendix

Overall, no consistent pattern was present in regards to whether any single antecedent was consistently associated with the highest or lowest variability scores across the experimental conditions for each participant. The sole exception was that the second antecedent presented to Alan during Turn 2 of the conversation consistently resulted in responding that resulted in the highest mean variability score across the experimental conditions. In general, the mean variability score for responding to any single experimenter-delivered antecedent within any experimental condition was similar to the mean variability scores for the other experimenter-delivered antecedents within that condition. This was consistent across all three participants. The mean variability scores for each of the antecedents also showed the same direction of change within each experimental condition with one exception. The mean variability scores to each antecedent were low during Lag-0, increased with the introduction of scripting, decreased with the return to Lag-0, and returned to levels similar to or greater than that seen during scripting with the introduction of the Lag-1 with repeated trials condition. Thus, the most elevated variability scores were associated with either the scripting condition or the Lag-1 with repeated trials condition, whereas the lowest variability scores were associated with Lag-0. The single exception was that the highest variability score for Chely was seen for the second antecedent during the return to Lag-0 condition. This, however, may have been due to a few responses with extraordinarily high variability scores.

Table A1

Mean Variability Scores for Responses Emitted to Each Antecedent During Each Turn and Each Experimental Condition for Chely

Experimental Condition	Antecedent #	Turn 1		Turn 2		Turn 3	
		n	Mean v score	*n*	Mean v score	*n*	Mean v score
Lag 0 (1)	1	11	1.11	14	0.67	12	1.00
	2	12	1.30	13	2.30	15	1.91
	3	17	1.20	13	2.00	13	1.89
SCRIPT	1	43	3.40	42	2.67	49	3.38
	2	51	2.93	43	2.80	39	3.18
	3	38	3.44	47	2.68	44	3.00
Lag 0 (2)	1	8	1.60	14	1.50	12	1.08
	2	19	1.44	17	1.06	16	3.44
	3	23	1.14	19	1.11	22	1.00
Lag 1	1	18	3.00	15	3.69	15	2.93
	2	24	3.43	27	6.08	22	2.71
	3	23	2.05	23	6.15	28	4.12

Table A2

Mean Variability Scores for Responses Emitted to Each Antecedent During Each Turn and Each Experimental Condition for Alan

Experimental Condition	Antecedent #	Turn 1		Turn 2		Turn 3	
		n	Mean v score	*n*	Mean v score	*n*	Mean v score
Lag 0 (1)	1	30	1.60	42	2.13	41	1.75
	2	32	3.19	29	2.25	27	1.54
	3	41	1.26	32	1.54	35	3.78
SCRIPT	1	41	2.81	17	2.57	39	2.33
	2	27	3.68	38	2.65	31	2.67
	3	27	2.75	40	2.49	31	4.04
Lag 0 (2)	1	29	1.41	24	1.00	19	1.67
	2	22	1.05	29	1.21	23	1.56
	3	24	1.00	22	1.00	33	1.44
Lag 1	1	13	6.83	20	2.21	14	3.21
	2	19	4.61	15	3.67	18	3.28
	3	18	5.39	15	3.53	18	6.33

Table A3

Mean Variability Scores for Responses Emitted to Each Antecedent During Each Turn and Each Experimental Condition for Bernard

Experimental Condition	Antecedent #	Turn 1		Turn 2		Turn 3	
		n	Mean v score	*n*	Mean v score	*n*	Mean v score
Lag 0 (1)	1	39	1.00	41	1.07	41	0.88
	2	39	0.97	35	0.00	50	1.04
	3	52	1.00	54	1.24	39	0.89
SCRIPT	1	46	3.17	51	2.17	49	3.37
	2	43	3.02	41	2.59	38	3.45
	3	41	2.51	38	2.78	43	3.38
Lag 0 (2)	1	28	1.04	21	1.09	26	1.23
	2	17	1.00	21	1.00	27	1.15
	3	25	1.44	28	1.52	17	1.12
Lag 1	1	22	3.14	21	2.95	16	3.19
	2	21	2.95	19	3.72	18	3.33
	3	12	4.08	15	2.86	21	2.17

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