

Use of a Modified Chaining Procedure with Textual Prompts to Establish Intraverbal Storytelling

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Abstract Echoic, tact, and textual transfer procedures have been proven successful in establishing simple intraverbals (Braam and Poling *Applied Research in Mental Retardation*, 4, 279–302, 1983; Luciano *Applied Research in Mental Retardation*, 102, 346–357, 1986; Watkins et al. *The Analysis of Verbal Behavior*, 7, 69–81, 1989). However, these strategies may be ineffective for some children due to the complexity of the targeted intraverbals. The current study investigated the use of a novel procedure which included a modified chaining procedure and textual prompts to establish intraverbal behavior in the form of telling short stories. Visual prompts and rule statements were used with some of the participants in order to produce the desired behavior change. Results indicated that the procedure was effective for teaching retelling of short stories in three children with autism.

Keywords Autism · Chaining · Intraverbals · Storytelling · Textual prompts

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The intraverbal is under the influence of a verbal stimulus, with which it lacks point-to-point correspondence, and is maintained by generalized reinforcement (Skinner 1957). Examples of intraverbals may include simple exchanges (e.g., “I’m fine” in response to

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“How are you?,” “ten” in response to “What is five plus five?”) or more complex exchanges (e.g., lengthy responses to “What did you do last night?” or “Tell me about your family”). In educational settings, children are often required to produce intraverbals in the form of responding to academic tasks (e.g., math facts, reciting the capitals of the states, or recalling stories previously read). It is particularly important to identify effective strategies for teaching intraverbals to learners with autism because of the ubiquity of intraverbals in academics, work and professional environments, intelligence tests, and daily social interactions (Braam and Poling 1983; Partington and Bailey 1993; Sundberg and Partington 1998).

Echoic prompts can be used to evoke vocal-verbal responses, and then, transfer-of-stimulus control procedures can be used to transfer stimulus control from an instructor’s vocal prompt to the verbal antecedent for the specified intraverbal response (Watkins et al. 1989). For example, an instructor may provide a vocal prompt, “five,” following the question “How old are you?” to which the speaker may echo the word “five.” In order to establish an intraverbal response, the instructor fades the vocal prompt, five, such that the verbal antecedent, How old are you?, ultimately controls the speaker’s response, five. Visual (tact or textual) prompts have also been successfully used to teach intraverbals. Pictures, objects, or text are used as prompts in these procedures, and the visual prompt is subsequently faded so that stimulus control is transferred from the picture, object, or text to the verbal antecedent for the specific intraverbal response. For example, an instructor may present the written number “5” following the question, How old are you? which the speaker may tact, five. In order to establish an intraverbal response, the instructor would fade the picture of the number 5 such that the verbal antecedent, How old are you?, ultimately controls the speaker’s response, five. Researchers have demonstrated the effectiveness of tact and textual prompting procedures in establishing intraverbals (Braam and Poling 1983; Luciano 1986). Furthermore, previous studies have directly compared echoic prompts to visual prompts for their effectiveness in establishing intraverbal responding and have generally found that the use of visual prompts resulted in more rapid acquisition (Ingvarsson and Hollobaugh 2011; Vedora et al. 2009) or higher levels of correct responding (Finkel and Williams 2001).

As the intraverbal repertoire becomes more complex, multiple words and multiple phrases may be required for a correct response. Complex intraverbals are targeted in academic programming for children with autism when working on reading comprehension programs. For example, when presented with the verbal stimulus “Tell me about the book you are reading,” the speaker must engage in a complex response that includes multiple words and phrases. The aforementioned prompting strategies may need to be modified to accommodate lengthier intraverbal responses, such as retelling of short stories. There are research studies that have demonstrated the successful use of chaining in combination with echoic training to increase the complexity of vocal responses (Seiverling et al. 2010; Tarbox et al. 2009). Thus, it is possible that echoic and visual prompting methods may be combined with chaining to teach complex intraverbal responses like storytelling to children with autism.

To date, there is a paucity of behavior analytic research investigating procedures designed specifically to teach the retelling of stories to children with autism. It has been suggested that as children age, a developmental shift occurs from retelling stories verbatim to providing the “gist” of stories (Brainerd and Reyna 1998). Therefore, it

Table 1 Descriptions of existing verbal behavior repertoires for James, Justin, and Roger, as demonstrated on ABLLS-R assessments conducted outside of and prior to the study

Age	Echoic	Motor imitation	Listener	Tact	Intraverbal	
James	7 years	Up to 6 words	Novel movements	Objects, pictures, emotions, items by feature, function, and class	Objects, pictures, emotions, items by feature, function, and class, letters and sight words	Fill in phrases and functions, answer “what” and “where” questions, answer questions about personal information
Justin	4 years	Up to 6 words	Novel movements	Objects, pictures, items by feature, function, and class	Tact parts of items and up to 3-word carrier phrases, letters and sight words	Songs and phrases, fill-ins regarding the features, functions, and classes
Roger	8 years	Up to 6 words	Novel movements	Objects, pictures, emotions, items by feature, function, and class	Objects, pictures, emotions, items by feature, function, and class, letters and sight words	Answers to who, what, where, and why questions regarding personal information, objects and common activities

may be useful for practitioners to begin by teaching verbatim retelling of simple stories to children with autism. The purpose of the current study was to examine the effectiveness of a novel procedure designed to teach three children with autism to retell short stories that were previously read to them using echoic, textual, and picture prompts, combined with repeated practice, differential reinforcement, and a modified backward chaining procedure.

Method

Participants, Setting, and Materials

Three boys, all diagnosed with autism, participated in the current study. James was 7, Justin was 4, and Roger was 8 years old. All three children attended a clinic-based Applied Behavior Analysis (ABA) program. For a description of some of the important verbal behavior repertoires for each participant at the start of the study, see Table 1. James had two goals on his individualized education plan (IEP) that included dictating stories read by his teacher and retelling stories presented orally in class. Roger also had goals on his IEP pertaining to sequencing events from and answering questions about stories read in class. Justin was not yet enrolled in public school at the start of the study, but he had recently begun to display a strong interest in books and in having stories read to him, according to anecdotal therapist and parent reports.

All sessions were conducted in a classroom with other children and instructors. The participants' individual teaching areas contained a table, chairs, and other classroom materials. Fourteen books (one per story; four for James, five for Justin, and five for Roger) were created using 1-in three-ring binders. The stories were constructed by printing each segment of the story with a related picture on an 8.5"×11" piece of white paper and placing them in the binder, along with blank pages. The front cover of each binder included the story title, and the back cover of each binder was blank. The stories were created by the experimenters in an effort to control for exposure to stories typically used at the clinic. For James, we used four stories that were ten segments in length, with six words in each segment. For Justin, we used five stories that were five segments in length, with five words in each segment. For Roger, we used five stories that were eight segments in length, with five words in each segment. The number of words and pages differed across participants. See Appendices A, B, and C for sample stories for each of the three participants. Generalization probes were conducted with Justin in the lobby of the clinic where the participant received services. The lobby consisted of tables, chairs, computers, books, and two to three adults.

Response Measurement

Response Definition The target response, retelling the targeted story, was defined as vocally retelling all segments of a story. For example, if a story was five pages long, each page represented one segment. In order to systematically observe and record approximations to the target behavior, *correctly retelling story segments* served as the primary dependent variable, which was defined as the participant vocally stating a targeted story segment or engaging in a pre-established acceptable approximation. To

allow for flexible responding and avoid training rote responses, the following approximations were added to the response definition: word reversals (switching order of consecutive words), omission of articles (a, an, or the), use of any synonyms as replacement for words or correct pronouns (he/she) in place of names, or the addition of adjectives. The response definition also included paraphrasing more than one segment with a single sentence (although Roger was the only participant to engage in this behavior). For example, in the story “Annie and Albert” (Appendix C), segments 1 and 2 might be summarized by one sentence like “Albert is a bus who takes kids to school.” In the event of such a paraphrase, both segments were recorded as correct. The terminal target behavior consisted of the participant retelling all segments of the story or summarizing them with acceptable approximations as defined above. Responses were only considered correct if they occurred sequentially but not necessarily consecutively. For example, a participant could respond with segment 1 followed by segment 4, and both responses would be scored as correct. However, if the participant responded with segment 3 following segment 4, segment 3 would be scored as incorrect due to incorrect sequencing. This aspect of the response definition was slightly different for Roger. A few segments in some of Roger’s targeted stories could be switched while retaining appropriate sequencing of the stories. These particular segments were counted as correct in either order. Incorrect responses were recorded for segments that were retold out of order or that included errors or omissions. No response was recorded for a given segment if the participant did not emit any words included in the segment. Data were collected using event recording and graphed as the total number of correct story segments. The mastery criterion for an entire story was two consecutive trials with 100 % of all story segments retold correctly. During the *Baseline*, *Reading*, and *Treatment Probe Trials* phases, the experimenter ended the trial if the participant did not respond for 10 s, or if any phrase was repeated three times.

Interobserver Agreement (IOA) IOA was calculated on a session-by-session basis by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100 to obtain a percentage. An agreement occurred if both the primary and secondary data collector recorded a correct or incorrect response for a particular segment. The mean IOA for James was 97.9 % (range 70–100 %) and was collected during 46.7 % of sessions. The mean IOA for Justin was 98.7 % (range 80–100 %) and was collected during 43.9 % of sessions. The mean IOA for Roger was 98 % (range 75–100 %) and was collected during 45 % of sessions.

Procedure

Experimental Design A nonconcurrent multiple baseline design across stories was used to demonstrate the effects of the intervention in producing acquisition of the targeted behaviors. The introduction of the reading phases was staggered across all three participants to establish experimental control, and the baseline phase was staggered for one participant (Roger) to increase experimental control.

Preference Assessment Prior to each session, the experimenter either asked the participant for what he wanted to work or waited for the participant to mand for a

preferred item present in the classroom. These items were used to reinforce responding during the session. Items typically included small portions of edibles (e.g., small pieces of snack items, sips of juice) or access to leisure activities (e.g., short movie clips, pictures of sports cars).

Baseline During the baseline phase, the story was not read to the participant. The experimenter presented the S^D “Tell me the story about...” followed by the name of the story (e.g., “Tell me the story about ‘Bowling Bear’”). This condition was included to verify that the participants were not familiar with the stories. There were no programmed consequences for incorrect responses or no responses. Verbal praise and a prompt to continue (e.g., “Good job, what else?”) would have been provided following correct retelling of individual story segments, although this never occurred. At the end of the session, reinforcement in the form of praise and a preferred item would have been provided if the participant correctly retold any story segment; however, this never occurred.

Reading During this phase, the experimenter initiated each session by reading the story one time while showing the book to the participant, pointing to each word and turning each page as he read. The experimenter then allowed 30 s to pass and presented the S^D to retell the story (e.g., “Tell me the story about ‘Lisa Ladybug’”). Programmed consequences were procedurally identical to those in baseline.

Treatment Sessions Treatment consisted of modified chaining, textual prompting, and vocal prompting. Treatment sessions included a probe trial, a prompted trial, and a transfer trial, in that order. However, the very first treatment session for each story included only a prompted and a transfer trial. Treatment sessions for each story were conducted a minimum of 24 h apart, and only one session per day was conducted for each story in treatment. See Fig. 1 for a flowchart demonstrating the trial order and session format, which are explained in greater detail below. The mastery criterion for moving on to the next segment within the same story consisted of independently retelling the targeted segments (and all previously mastered segments) of the story for two consecutive probe trials (probe trials are described below).

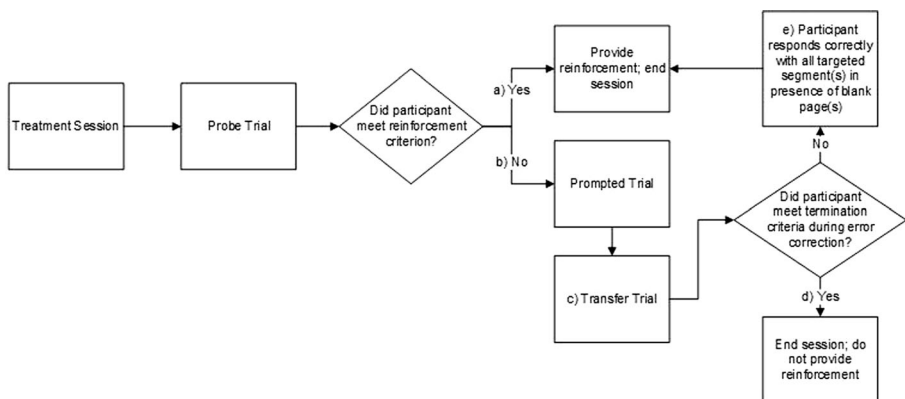


Fig. 1 The sequence of trials comprising each treatment session and the contingencies for initiating or terminating each trial is depicted

Modified Chaining The treatment condition included the backward chaining procedure, specifically, backward chaining with leaps ahead. Backward chaining was selected in order to provide exposure to all story segments prior to requiring a response from participants. One story segment was targeted during each treatment session. As the participant's responding met the mastery criterion for one story segment, two segments were targeted, and then three segments until all story segments were mastered. Targeted segments always started at the end of the story and moved backward to the beginning of the story.

During treatment sessions, the initial criterion for reinforcement required that the participant retell at least the last segment of the targeted story during the probe trial, unless prior to the initiation of treatment, the participant had retold the last segment correctly for two consecutive sessions during the reading phase. In that case, at the initiation of treatment, the initial criterion required that the participant retell the last two segments, and so on if additional segments had been mastered during the reading phase. If the participant's responding had met the reinforcement criterion during two consecutive treatment probe trials, the criterion for the next treatment session required the retelling of the next segment (the next segment closer to the beginning of the story) in addition to the mastered segments to produce the delivery of the reinforcer. The reinforcement criterion was modified in the aforementioned manner until the entire story was mastered. It is important to note that since the participant was allowed to retell any or all story segments following presentation of the S^D on probe trials (described below), it was possible for the participant to master segments that had not yet been targeted (e.g., by responding with segments 1, 9, and 10 correctly for two consecutive sessions when only segment 10 was required to produce reinforcement). In this event, segments that were retold correctly for two consecutive treatment probe trials prior to being targeted were skipped over when increasing the reinforcement criterion, defined as a leap ahead (Spooner et al. 1986). For example, once the participant mastered segment 10, the reinforcement criterion would leap ahead to include segments 7 through 10 if segments 8 and 9 were previously mastered. The reinforcement criterion was never moved back a step. For example, if segments 7 through 10 were currently targeted, but the participant began to respond incorrectly with segment 10 on treatment probe trials, the reinforcement criterion was not moved back to target segment 10 again. Rather, the reinforcement criterion would continue to include segments 7 through 10 until all four segments were retold correctly on two consecutive treatment probe trials.

Probe Trials The experimenter began the probe trial by presenting the S^D ("Tell me the story about..."). Contingencies for responding were identical to those in *Baseline*, except that if the participant correctly stated all segments targeted by the reinforcement criterion, praise and a preferred item were provided, and the session was terminated without proceeding to the prompted trial or the transfer trial (described below; Fig. 1a). This was done in order to differentially reinforce correct independent responding during the probe trial. If the participant met the termination criterion without stating all targeted segments (Fig. 1b), the prompted trial was initiated.

Prompted Trials During the prompted trial, the experimenter presented the S^D , and then immediately opened the book to the first page of the story (i.e., the text and picture

for the first segment of the story). If at any time the participant did not respond or stopped responding (i.e., stopped reading) for 3 s, the experimenter pointed to the next word and provided a vocal prompt. The vocal prompt involved the experimenter vocally stating the next word in the text while pointing to it (e.g., if “bear” was the next word, the experimenter pointed to that word, said bear, and allowed the participant 2 to 3 s to echo this word). Incorrect responses resulted in the experimenter prompting the current segment again from the beginning by pointing to the first word printed on the page and providing a vocal prompt. Once the participant had read all words in the first segment, the experimenter provided praise and a prompt to continue (e.g., “Good, and then what?”), then turned to the next page. This continued until the participant had correctly stated all story segments (including all targeted and nontargeted segments), at which point praise was provided and the transfer trial was initiated (Fig. 1c).

Transfer Trials The purpose of the transfer trial was to transfer stimulus control from the text to the verbal antecedent (“Tell me the story about...”). Before beginning the transfer trial, each segment that was currently targeted was covered with a blank page. At the start of the trial, the experimenter re-presented the S^D and opened the book to the first page. Textual and vocal prompts were utilized on all nontargeted segments exactly as during the prompted trial. Once the participant had correctly responded with all nontargeted segments, the experimenter turned to the first blank page (no pictures or text). If the participant responded with the correct story segment (i.e., the first targeted segment) at this time, praise was provided and the experimenter turned to the next blank page. If the participant responded incorrectly in the presence of a blank page, an error-correction procedure was implemented. This procedure consisted of the experimenter turning the blank page over, revealing the text and picture for that segment, providing vocal prompts if needed (as during the prompted trial), and then returning to the blank page. The error-correction procedure continued until the participant responded correctly in the presence of a blank page and was repeated a maximum of five times for each segment. If the error-correction procedure was not successful after five repetitions for a particular segment (Fig. 1d), the experimenter read the word using the text one final time, and then terminated the session.

The transfer trial continued until the participant’s responding had met the termination criterion or the participant had responded correctly in the presence of the blank page for all targeted segments (Fig. 1e). In the latter case, praise and a preferred item were provided, and the session was terminated. Praise and a preferred item were provided at this point regardless of whether the error-correction procedure was implemented at any point in the transfer trial.

Modifications for Justin Some modifications of the treatment package were made to address patterns of responding that emerged with Justin. These modifications were made due to low levels of correct responding and repetitive vocal responses, such as imitating praise statements or prompts to continue (e.g., Justin often replied “great job, and then what?” during opportunities to respond, statements that had been previously made by the experimenter).

Add Vocal Prompt (VP) to Transfer Trial If Justin responded incorrectly upon reaching a blank page during the transfer trial, the error-correction procedure was

initiated. However, upon returning to the blank page, an immediate vocal prompt was provided that consisted of the starting sound of the first word of the current segment (e.g., “sh” for the word “she”). Praise and a preferred item were provided for correct responding following this prompt. This modification was included to extinguish his repetitive vocal responses (e.g., imitating praise statements).

Move VP to Start of Transfer Trial The experimenter provided the additional vocal prompt immediately upon reaching a blank page during transfer trials, rather than following the error-correction procedure, as described above. For example, upon reaching the blank page, the experimenter immediately said sh if the first word in that segment was she. This modification was included to address his low levels of correct responding.

Move VP to Probe Trial The experimenter provided the additional vocal prompt (e.g., sh for she) once Justin’s responding had met the termination criterion on the probe trial. If Justin responded correctly with the targeted segment following this prompt, praise was provided, and the prompted trial was initiated as described above. Correct responses following this vocal prompt were not recorded as correct probe trial responses. This modification was included to address both the repetitive vocal responses and low levels of correct responding.

Treatment (Tx) + Book Prompt Following the presentation of the S^D during probe trials, the experimenter opened to the first page of a book that looked identical to the book used previously (i.e., a light blue binder with the story title on the front cover) but contained only blank pages. If the participant retold a story segment correctly in the presence of a blank book page, the experimenter would turn to the next blank page in the book. Correct responses using this book prompt were scored as correct probe trial responses and reinforced accordingly. All procedures were otherwise identical to the original treatment sessions described above. This modification was included to address Justin’s low levels of correct responding.

Modifications for Roger Modifications to the treatment package were made to address patterns of responding that emerged with Roger. For Roger, no correct responses were observed across any conditions until the book prompt was introduced. Both Justin and Roger engaged in repetitive responding across all conditions at some point during intervention. For Justin, this occurred prior to the implementation of the book prompt, and for Roger, this occurred after. We added the book prompt after several sessions during which Roger did not engage in correct responding. Roger’s repetitive behavior consisted of repeating the S^D three times, “Tell me the story about ‘Betty Bird’... ‘Betty Bird’... tell me the story about ‘Betty Bird’.” The mastery criterion was not met using the book prompt, and Roger began to engage in another form of repetitive responding that involved stating some story segments, then saying “...and what else...and what else...and what else” until his responding met the termination criterion. Thus, the rule condition (described below) was introduced.

Treatment (Tx) + Book Prompt This modification was procedurally identical to the treatment and book prompt used with Justin.

Rules During treatment + book prompt, probe trials, reading sessions, and baseline sessions under the rule condition, the termination criterion was modified. During this condition, a 2-min timer was set at the start of each session following the delivery of the S^D. Roger was allowed to continue responding until either he correctly stated all story segments or until the timer rang and indicated the end of the 2 min. Using an FT 30-s schedule, if Roger was not retelling story segments correctly (was quiet or was making a comment not related to the story, such as, “and what else?”), the experimenter made one of the following rule statements, “Roger, you need to keep telling me about the story,” or “Remember Roger, we are talking about the story. What else happened?” During treatment probes using the book prompt, the experimenter pointed to the blank page while providing the rule statements. If Roger had said, “and what else?” within 10 s of the 2-min timer, the experimenter waited until 10 s had elapsed without his saying, “and what else?” before terminating the session.

One-Week Maintenance Probe (James Only) Maintenance probes were conducted 1 week following mastery of all stories. Maintenance probes were procedurally identical to the baseline probes.

Generalization Probe: Lobby (Justin Only) These sessions were identical to baseline sessions except that they were conducted in the lobby of the clinic. These probes were conducted without visual stimuli (e.g., book or text).

Generalization Probe: Mom (Justin Only) These sessions were identical to baseline sessions except that they were conducted by the participant’s mother in the lobby of the clinic. The participant’s mother delivered all S^Ds and consequences. These probes were conducted without visual stimuli (e.g., book or text).

Results

Figures 2, 3, and 4 depict the number of correct story segments during baseline, reading, and treatment probe trials for James, Justin, and Roger, respectively. Data for prompted and transfer trials are available upon request. The closed data path represents correct story segments out of the total number of story segments, and the open data path represents the number of correct story segments only out of those that were targeted using the reinforcement criterion. For example, when the story was introduced and only one segment was targeted, the open data path represents the correct responses out of that one segment that was targeted. The horizontal dashed lines represent the criterion for reinforcement. For example, since the criterion for reinforcement was based on a certain number of segments from the end of the story moving backward, a criterion line at 2 denoted that the reinforcement criterion required the participant to respond with the last two segments correctly.

During baseline (Fig. 2), James did not correctly retell story segments for any of the targeted stories (panels 1, 2, 3, and 4). During the reading phase for the stories “Muffin Bear” and “Apple Alligator,” James did not respond or engaged in limited responding (panels 1 and 2). Once treatment was implemented with the target “Muffin Bear,”

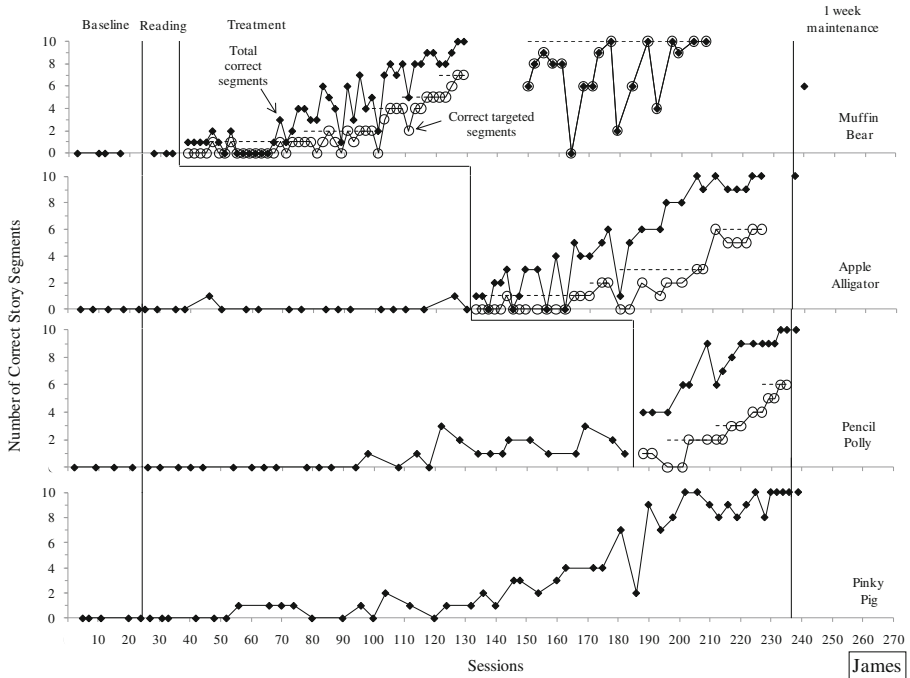


Fig. 2 James’ number of correct story segments during baseline, reading, and treatment probe trials for the targeted story responses is depicted. Also depicted are changes in reinforcement criterion, as indicated by horizontal dashed lines in treatment phases

James began to emit correct responses, although he initially retold story segments other than those targeted by the reinforcement criterion. As James began to respond with targeted story segments and the criterion was modified, he steadily retold additional story segments until his responding met mastery criterion by stating the entire story on two consecutive probe trials. When treatment was implemented with Apple Alligator, a pattern of acquisition similar to that observed with Muffin Bear was demonstrated until James’ responding met mastery criterion. During the reading phase for the story “Pencil Polly,” James emitted one to four correct responses (panel 3), but these responses were only observed after treatment was initiated with Muffin Bear. Since correct responding was not at the desired level and did not show an increasing trend, treatment was introduced with the Pencil Polly story. Correct responses were quickly acquired, and the mastery criterion was met. Probes (and teaching, if needed) of the story Muffin Bear continued (panel 1) during treatment of the stories Apple Alligator and Pencil Polly. Initial responding for the story Muffin Bear following mastery was variable; however, responding eventually returned to mastery levels following ten sessions. Finally, the story “Pinky Pig” remained in the reading phase, and James emitted the correct responses for all segments of the story without direct teaching (panel 4). Mastery of Pinky Pig was not observed until after treatment was initiated with the other three stories, though it had been read multiple times during the reading phase. James correctly told all four stories during 1-week maintenance probes, with the exception of Muffin Bear, for which he responded with six out of ten correct segments.

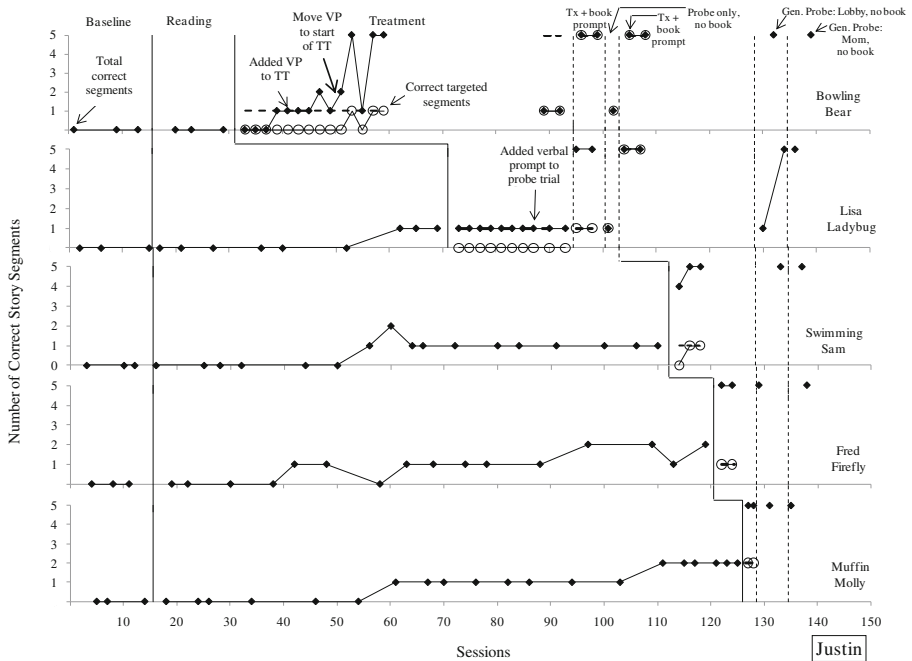


Fig. 3 Justin’s number of correct story segments during baseline, reading, and treatment probe trials for the targeted story responses is depicted. Also depicted are changes in reinforcement criterion, as indicated by horizontal dashed lines in treatment phases

During baseline (Fig. 3), Justin did not emit correct responses for any of the targeted stories (panels 1–5). During the reading phase for the story *Bowling Bear*, Justin did not emit any correct responses (panel 1). He also did not emit correct responses for the other four stories (panels 2, 3, 4, and 5) during the reading sessions that occurred before treatment was initiated with *Bowling Bear*. Once treatment was implemented with *Bowling Bear*, Justin did not retell any story segments correctly but began to respond correctly with the first segment of the story after four sessions of treatment. However, all treatment sessions through session 39 were terminated following five presentations of the error-correction procedure on the transfer trial, and therefore, a modification was deemed necessary. A vocal prompt was added to the transfer trial procedures starting with session 41. Due to continued low levels of correct responding, this vocal prompt was presented at the start of the transfer trial beginning with session 47. Shortly thereafter, Justin acquired all segments of the story, and his responding met the mastery criterion.

Following treatment with *Bowling Bear*, Justin began to emit some correct responses with the four remaining stories during reading (panels 2, 3, 4, and 5). Once treatment was implemented with “*Lisa Ladybug*,” Justin continued to respond with only the first segment of the story on probe trials. At this time, Justin was engaging in an incorrect response chain across all stories in treatment and reading conditions. The incorrect response chain involved stating only the first segment of the story, and then engaging in repetitive vocal responses, typically imitating praise statements or prompts previously made by the experimenter (e.g., “good try,” “then what happened?”). A

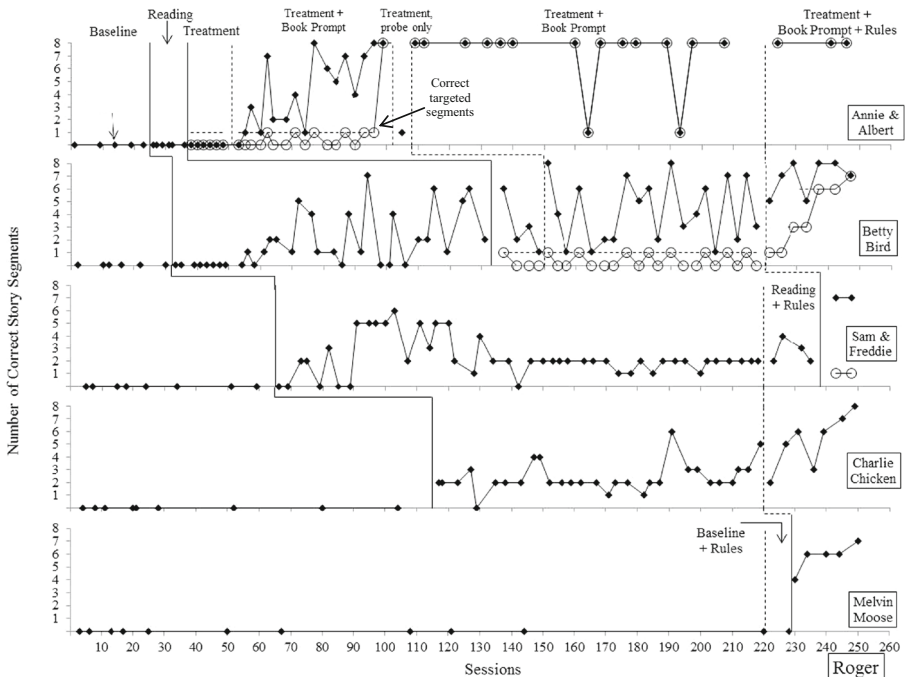


Fig. 4 Roger’s number of correct story segments during baseline, reading, and treatment probe trials for the targeted story responses is depicted. Also depicted are changes in reinforcement criterion, as indicated by horizontal dashed lines in treatment phases

vocal prompt was added to the probe trial. Treatment was reintroduced with Bowling Bear at this time and with the same modifications.

Following three sessions, there was not an observed change in independent responding on the probe trial for Lisa Ladybug, and a similar pattern of responding (reciting the first segment, then engaging in repetitive responding) emerged with Bowling Bear, which had been previously mastered. At this time, Justin’s repetitive responding started to include gestures and mands for the book used on the prompted trial (e.g., “book,” “I want the blue book”). Thus, the treatment + book prompt phase was introduced. Once the blank book was used during probe trials, Justin responded correctly with all story segments, and his responding met the mastery criterion for the story Lisa Ladybug. Responding with Bowling Bear also returned to mastery levels. A single-session reversal was conducted for both Bowling Bear and Lisa Ladybug, wherein the blank book was removed from probe trials. Again, Justin responded with only the first segment of each story and then engaged in repetitive vocal responding. Once the book was reintroduced, levels of responding for both stories returned to mastery levels for two consecutive sessions. Justin continued to retell a limited number of segments during the reading phase for the stories “Swimming Sam,” “Fred Firefly,” and “Muffin Molly” (panels 3, 4, and 5). Once treatment with the book prompt was implemented with each of the remaining stories, Justin’s responding met mastery criterion within two to three sessions.

Once Justin’s responding met the mastery criterion for all stories utilizing the book prompt, two series of generalization probes were conducted. One series was conducted

in the lobby with the experimenter who had conducted all of the previous sessions, and the other was conducted in the same lobby with his mother (Fig. 3, panels 1, 2, 3, 4, and 5). The book was not present during either set of probes. Justin retold all the story segments correctly for each story during both series of generalization probes.

Roger did not respond with correct story segments during baseline for any of the stories (Fig. 4). During reading, responding was at zero for the first story, “Annie & Albert” (panel 1), and the second story, “Betty Bird” (panel 2). When treatment was introduced with Annie & Albert, responding remained at zero until the book prompt was introduced, and mastery criterion was met after 17 sessions. A brief reversal to the treatment only phase indicated low levels of correct responding. When the book prompt condition was reintroduced for the story Annie & Albert, correct responding returned to 100 %. For Betty Bird, correct responding during reading began to emerge at the same time that the book prompt was implemented with Annie & Albert. The treatment condition was then initiated with Betty Bird, and responding decreased across four sessions. The book prompt was subsequently added and while responding remained variable, the number of correct segments was higher overall than what was previously observed in the treatment phase.

The reading condition was initiated with “Sam & Freddie” (panel 3) and “Charlie Chicken” (panel 4), in that order. Correct responding for these stories in the reading condition was variable at first, but eventually stabilized around two correct segments for both stories. At this time, Roger was engaging in a response pattern similar to that observed previously with Justin. Specifically, Roger would retell an average of two correct story segments, and then said “and what else?” three times. With this, his responding met the termination criterion, and the experimenter subsequently terminated the session. This pattern was also observed in ongoing treatment + book prompt sessions for Annie & Albert and Betty Bird, although less frequently. Thus, a rule contingency was added to all stories across all conditions. Once the rule condition was added to treatment + book prompt sessions for Betty Bird (panel 2), Roger’s responding met mastery criterion for that story within seven sessions. Responding for Annie & Albert (panel 1) remained stable at mastery levels after the rule condition was introduced.

For Sam & Freddie and Charlie Chicken, the reading phase continued as before, with the addition of the rule contingencies. For Sam & Freddie (panel 3), correct responding remained low; so, the treatment + book prompt + rule condition was introduced, and Roger’s responding immediately met the mastery criterion. For Charlie Chicken (panel 4), Roger responded correctly with all segments of the story within seven sessions of the reading + rule condition. Thus, the treatment condition was never initiated for this story. Finally, for the story “Melvin Moose” (panel 5), the rules were first added to the baseline condition, which did not produce correct responding. When the reading + rule condition was implemented for Melvin Moose, Roger responded correctly with all story segments within five sessions.

Discussion

The results of the current study extend the research literature on teaching intraverbals by demonstrating that a modified chaining procedure in conjunction with echoic and

textual prompts was effective in teaching storytelling to three boys diagnosed with autism. Procedural modifications were necessary for two of the participants, Justin and Roger. Generalization of storytelling across settings and instructional agents was observed in two participants.

The Naming Theory, which defines naming as responding both as a speaker and a listener to a given stimulus (Horne and Lowe 1996), may represent one way to conceptualize these outcomes. Participants initially observed the experimenter point to and tact the textual stimuli and the participant acted as a listener by orienting to the stimuli while listening to the experimenter. Later, during the treatment condition, the participants were reinforced for looking at the word and imitating (echoing) the experimenter. Essentially, they were reinforced for acting as both a speaker and a listener with respect to those textual stimuli. Correct responding with stories introduced after treatment may be due to the establishment of a naming repertoire. The participants observed the experimenter tact and point to the textual stimuli, and they may have participated as a speaker by covertly or overtly echoing the stimuli (a response directly reinforced during the treatment phase), resulting in being able to emit the correct responses when asked to retell the story at a later time.

The participants were able to engage in delayed motor and vocal imitation. Recalling a story that is read by another person is an example of delayed imitation. Accordingly, these treatment procedures produced differential reinforcement of echoic responding. When the experimenter read the story during reading sessions that followed the initiation of treatment with the first story, it is possible that participants engaged in a generalized form of imitation. The participants may have overtly or covertly echoed either parts of the story or the entire story. Such a conceptualization is supported by behavior that was observed with James. Beginning with session 124 (reading phase for Pinky Pig), James began to read stories out loud with the experimenter. This behavior continued during reading sessions for all stories until session 219, during which James stopped reading out loud halfway through the story. For the remaining reading sessions, James no longer engaged in reading out loud with the therapist. It may be the case that James' initial overt echoic behavior later became covert. This is consistent with the findings of Sautter et al. (2011) wherein children emitted audible self-prompts initially when responding to intraverbal categorization tasks but that audible self-prompts decreased over time. James' initial overt behavior may have served as an echoic self-prompt or rehearsal strategy, which may have eventually become covert. Because the initial S^D ("Tell me the story about...") remained consistent across conditions, it may have started to evoke the response of recalling the story segments across those conditions.

An additional visual prompt (the blank book prompt) was necessary for Justin and Roger. For Roger, correct responses were not observed until the book prompt was implemented. Both Justin and Roger engaged in repetitive responding across all conditions at some point during intervention; for Justin, this occurred prior to the implementation of the book prompt, and for Roger, this occurred afterward. Roger's repetitive behavior consisted of repeating the S^D three times. Thus, the role of the book prompt and the presence of repetitive responding might be considered separately. The book prompt may be considered an extension of the transfer-of-stimulus control procedures that were already utilized in treatment session transfer trials. That is, participants had already received reinforcement for responding correctly in the presence

of a blank page for targeted segments, immediately following a prompted trial. The book prompt represented an opportunity to respond correctly in the presence of familiar stimuli (blank book pages) on a probe trial at least 24 h later. The book prompt served to evoke correct probe trial responding for Justin and Roger.

Both Justin and Roger engaged in repeated vocalizations that resulted in the termination of the probe trial. For both participants, these vocalizations were identical to prompts used by the experimenter (e.g., “What else?” “Then what happened?”). For Justin, repetitive responding ceased with the implementation of the book prompt; however, for Roger, repetitive responding emerged well after the book prompt had been introduced. It is possible that this repetitive responding was maintained by negative reinforcement in the form of trial termination. Thus, the use of a time-based termination criterion (like those used with Roger) from the initiation of treatment might have prevented the occurrence of repetitive responding.

There are some limitations to the study that are worth noting. Due to the multiple components involved in the procedure, it remains unclear precisely which components were critical in producing behavior change. The procedure included backward chaining, textual prompts, and vocal prompts with the transfer of stimulus control to the vocal verbal antecedent (“Tell me the story about...”) for all three participants. It is possible that similar results would have been achieved through the use of forward chaining. Roger’s results, in particular, suggest that changing the reinforcement criterion was not a significant contributor to behavior change, and all three participants tended to respond with the first segments of stories prior to meeting mastery criterion for the last segment. Researchers may wish to compare other types of modified chaining procedures in terms of the number of trials to mastery and conduct a component analysis of this procedure.

Another limitation is that data on participants’ echoic responses were not collected. Other researchers may collect data on self-prompting behaviors throughout intervention and baseline phases to further investigate the mechanisms by which generalized storytelling repertoires may emerge. Additionally, researchers may investigate the use of procedures that directly target echoic self-prompts, or other problem-solving strategies, to teach a storytelling repertoire. Furthermore, although participants engaged in flexible responding within the range of approximations included in the response definition, specific data on response variation were not collected. Thus, future researchers in this area may collect data on response variation to determine to what extent the current procedures might teach either a flexible or rote storytelling repertoire. Additional data may also help determine the source of stimulus control for this type of storytelling. It is likely that recall is under the control of multiple variables (e.g., echoic, visual, and verbal stimuli) and further examination of the source of control could lead to refined intervention strategies to teach this type of multiply-controlled responding (Michael et al. 2011).

The current study should be viewed as an initial step in establishing a more complex intraverbal repertoire. The procedures examined in this study may be used as an initial intervention strategy to teach prerequisites to other complex behaviors, such as recalling important features of a story, story comprehension, or creating and telling original stories. Researchers and clinicians can contribute to this body of literature by replicating the outcomes of this study and by examining the efficacy of these procedures to teach other forms of complex intraverbals.

Appendix A—Pages from One of the Stories (“Muffin Bear”) Used with James

Segment
1

One day, Susie was making muffins.



Segment
2

A bear knocked down her door.



Segment
3

The bear came into her kitchen.



Segment
4

Then, he ate two blueberry muffins.



Segment
5

Suddenly, Susie had a bright idea



Segment
6

She got honey from the cupboard.



Segment
7

And made some yummy honey muffins.



Segment
8

She put them in her van.



Segment
9

The bear jumped in the van.



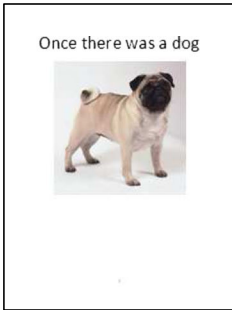
Segment
10

She drove him to the forest.

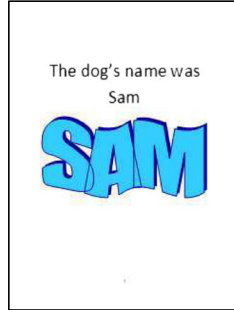


Appendix B—Pages from One of the Stories (“Swimming Sam”) Used with Justin

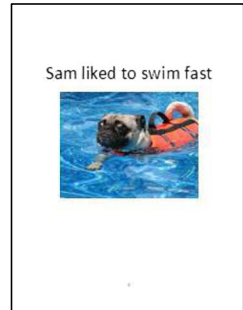
Segment
1



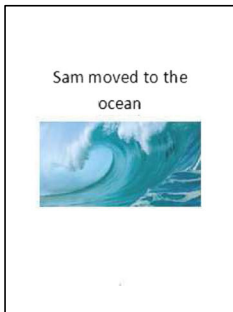
Segment
2



Segment
3



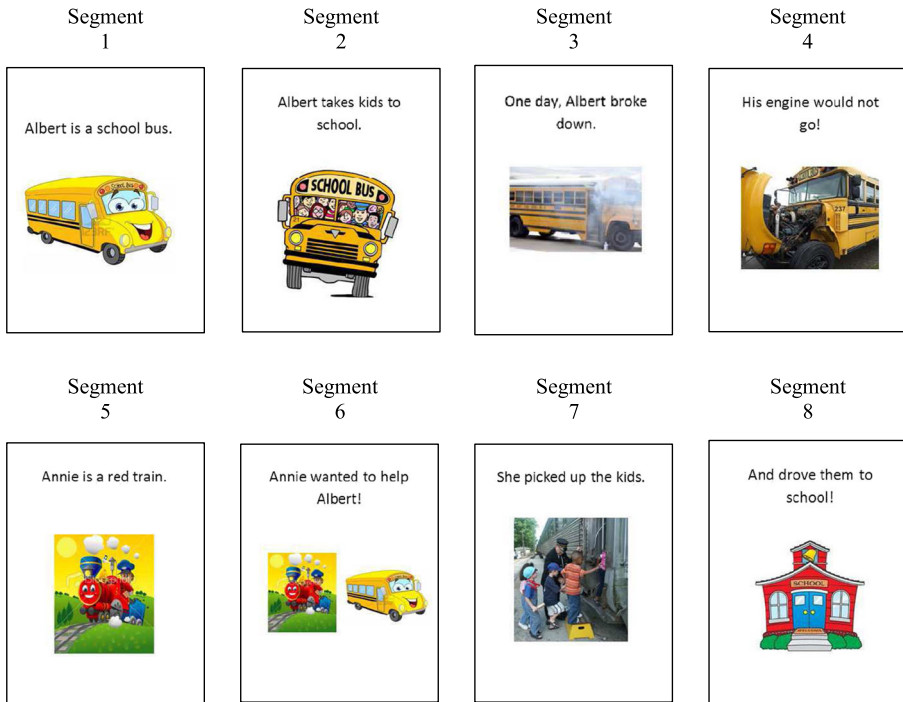
Segment
4



Segment
5



Appendix C—Pages from One of the Stories (“Annie and Albert”) Used with Roger



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