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Teaching Children with ASD Intraverbal Responses About the Past

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Teaching Children with ASD Intraverbal Responses About the Past

A Thesis

By

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at Rollins College in Partial Fulfillment
of the Requirements for the Degree of

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Abstract

Research has demonstrated that responding to questions regarding past events is a developmental milestone typically reached by age three or four. Individuals with Autism Spectrum Disorder (ASD) might struggle with this skill in comparison to their neurotypical peers. This study describes a methodology for teaching subjects with ASD intraverbal responses about past events by systematically increasing delays between the presentation of target stimuli and the delivery of a question about the target stimuli. Probes of the terminal delay were conducted after each successive increase in delay. Results showed both subjects successfully responded to questions after a 30-min delay following some level of treatment. This study demonstrated an effective method for teaching intraverbal responses describing past events. More research is needed to replicate these results, study different methods for teaching this skill, and test theoretical mechanisms for remembering.

Keywords: advanced intraverbals behavior, autism spectrum disorder, stimulus control.
Introduction

In the United States, the Centers for Disease Control and Prevention has identified one in 68 children as being diagnosed with Autism Spectrum Disorder (Christensen et al., 2016). This disorder is diagnosed by trained physicians and psychologists using diagnostic criteria from the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013). The DSM-5 diagnostic criteria for ASD include social deficits, communication deficits, and repetitive behavior. Neurotypical children might meet some of the criteria, but an ASD diagnosis is based on behavior severe enough to hinder learning in the natural environment (“DSM-5 diagnostic criteria: What is autism?”, 2017).

Scientifically supported behavioral treatments for ASD such as applied behavior analysis and the Early Start Denver Model include communication, or verbal behavior, as a starting point for treating ASD (“How is Autism Treated,” 2017). Skinner (1957) conceptualized verbal language as learned behavior with various functions. “Intrverbs” are one time of verbal behavior described by Skinner. The source of antecedent control for intraverbal behavior is a verbal stimulus by a listener; it is followed by a verbal response from the speaker. In a question and answer exchange, the antecedent verbal stimulus is the question, and the intraverbal behavior, or verbal response, is the answer to the question. For example, a listener would say “What is something that is blue?” and a speaker would respond with the intraverbal, “the sky.” The consequence is a generalized conditioned reinforcer such as continued conversation. Intraverbal behavior is said to have no point-to-point correspondence, which means the question and the response are topographically dissimilar.

Intraverbal responding can be simple or complex (Sundberg & Sundberg, 2011). Simple intraverbal behavior might include filling in a blank within a song, such as “Mary had a little
“___” with the response being “lamb.” In simple intraverbal behavior, responding is under the control of simple stimulus control. Stimulus control occurs when a discriminative stimulus reliably evokes a behavior (Mayer, Sulzer-Azaroff, & Wallace, 2014). Complex intraverbal behavior is under the control of conditional discriminations. Conditional discriminations occur when one discriminative stimulus alters the evocative effect of a second stimulus in the same antecedent event (or vice versa) and both alter the response (Sundberg & Sundberg, 2011). For example, the question “What is an animal that is brown?” requires a response that identifies an animal, but it is also controlled by the stimulus brown. The question “What did you eat Saturday?” requires a response pertaining to one’s diet (as opposed to an activity he or she engaged in) but is also controlled by the day of the week, Saturday (as opposed to another day of the week).

Conditional discriminations are described by Skinner (1957) as having one of two types of multiple control in verbal behavior: “(1) the strength of a single response may be, and usually is, a function of more than one variable and (2) a single variable usually affects more than one response” (p. 221). Michael, Palmer, and Sundberg (2011) labeled these types of control as “convergent multiple control (the control of a single response by more than one variable) and divergent multiple control (the strengthening of more than one response by a single variable)” (p. 4). Considering the previous example regarding a brown animal, convergent multiple control is demonstrated by the response “bear” being under the control of “animal” and “brown.” Divergent multiple control would be demonstrated by the responses “bear,” “dog,” and “squirrel” all being under control of “animal” and “brown.”

Intraverbal behavior about the past is complex (i.e., involves conditional discriminations under control of multiple variables) because “memory” must exert stimulus control over the
response. When considering an intraverbal response about the past, one must look at the multiple contextual variables required to correctly respond. Responses for a question, such as “What did you have for breakfast?” might vary daily. Further, stimulus control is based on a specific event requiring a child to make a conditional discrimination based on the temporal frame (e.g., playing on the computer this weekend instead of going to a theme park the weekend before) and the category of the response (e.g., answering a where, when, or what question).

**Review of Literature**

Palmer (1991) conceptualized memory in behavioral terms. Because memory cannot be observed, the behavior observed is “remembering” (p. 264). Palmer described remembering as a learned, problem-solving procedure in which an absent stimulus has stimulus control over the response. He noted “there is no behavioral process by which stimulus control declines in an orderly way solely as a result of the lapse of time” (p., 266). Instead, an individual might not remember because of a number of environmental variables such as motivating operations, competing stimuli, and different schedules of reinforcement. For example, consider a child who responds “dolls,” despite playing with blocks 30 min prior, when asked “What did you play with?” The response might be under the control of a motivating operation for dolls, dolls might be in sight, or the response “dolls” might have been reinforced under different stimulus conditions in the past.

There is a body of behavioral literature related, in part, to responding under the control of past stimuli. These studies have been published under different domain areas, including correspondence training and delayed match to sample (MTS). In relation to intraverbal behavior, there are some studies regarding complex intraverbal behavior, but there is no peer-reviewed research on responding regarding past events.
Correspondence Training

Correspondence is when nonverbal behavior has stimulus control over a verbal response (Lloyd, 2002). Two types of correspondence have been studied empirically: say-do correspondence and do-say correspondence. Say-do correspondence involves subjects stating a verbal promise to engage in a behavior, then engaging in that behavior. Do-say correspondence, which is relevant to the current study, involves subjects engaging in a behavior, followed by accurately reporting the behavior in which they engaged. The research in correspondence training does not conceptualize correspondence as “memory,” but as “truth” or “lies.” Correspondence indicates subjects tell the truth; no correspondence indicates subjects tell a lie.

A standard correspondence training procedure is composed of three phases (Panigua, 1990). First, target behavior rates (typically a free-operant activity or toy with which subjects engage at low rates) are assessed in baseline. Second, researchers reinforce verbal behavior regarding the activity, but not engagement in the activity. Last, researchers reinforce verbal behavior only if subjects engage in the target activity and verbal behavior corresponds. For example, Karoly and Dirks (1977) began with baseline data on the rate of preschoolers’ engagement in a self-control task before any interventions were incorporated. Following baseline, the authors provided an edible when a subject stated he or she had engaged in the self-control activity, regardless of whether or not he or she did engage with the activity. Last, Karoly and Dirks provided an edible when a subject’s verbal response about engaging in the self-control task corresponded with motor behavior; no edible was provided if a subject did not engage in the task regardless of verbal behavior stating he or she did. While the purpose of this research was to increase the frequency of engagement in a self-control task, results demonstrated that self-control
task engagement only increased when an edible was provided after the verbal report corresponded with the child’s motor behavior.

Correspondence research with subjects who have disabilities typically involve say-do rather than do-say correspondence training (Sainato, Goldstein, & Strain, 1992; Whitman, Scibak, Butler, Richter, & Johnson, 1982; Wilson, Rusch, & Lee, 1992); however, do-say correspondence more closely resembles the paradigm of the current study. Wilson et al. (1992) conducted a do-say experiment with four teenagers diagnosed with moderate mental retardation. During pre-assessment, subjects accurately reported their behavior in 83% of opportunities, on average. However, subjects reported their behavior with pictures selected from an array, rather than with an intraverbal response.

The majority of do-say correspondence research involves neurotypical subjects (e.g., Ribeiro, 1989; Fixsen, Phillips, & Wolf, 1972; Israel & O’Leary, 1973; Karoly & Dirks, 1977; Paniagua & Baer, 1982; Risley & Hart, 1968; Rogers-Warren & Baer, 1976). Ribeiro (1989) most notably conducted an experiment with neurotypical children aged 3-5 years. In the first part of the experiment, Ribeiro assessed subjects’ abilities to discuss past activities. The author noted subjects had no issues reporting events that occurred in the past. Panigua and Baer (1982) increased eight, neurotypical, 3- to 5-year-old subjects’ engagement with less-common activities. Initially, subjects were taught to tact all target activities. During treatment, the authors compared engagement with the target activity under two conditions: presenting a preferred toy contingent on say-do correspondence or presenting a preferred toy contingent on do-say correspondence. Subjects were provided pictures from which they could select their response. The authors found reinforcing say-do correspondence resulted in greater increases of target behavior compared to reinforcing do-say correspondence.
Although correspondence training resembles the experimental design of the current research project, it does not provide an appropriate model for answering questions about past events. First, the goal of correspondence training is to increase some motor behavior such as engagement with an activity (e.g., engagement with a novel toy) rather than teaching functional verbal behavior as would be the purpose of intraverbal training. Second, the delay implemented in correspondence training is not systematic; some studies use brief delays while others implement longer or no defined delay (e.g., Risley & Hart, 1968; Paniagua & Baer, 1982; Ribeiro, 1989). Finally, there is a confound in that subjects can often tact their response to questions about past events using pictures provided rather than engage in intraverbal behavior (e.g., Paniagua & Baer, 1982; Wilson et al., 1992). Presenting pictures from which subjects can choose closely resembles a delayed MTS procedure. Some applied research has specifically used a delayed MTS task similar to how one might teach intraverbals responses about past events.

**Match to Sample**

Delayed MTS involves presenting a sample stimulus, removing the stimulus, then presenting comparison stimuli from which subjects select (Gutowski & Stromer, 2003). Subjects are instructed to select the comparison stimulus corresponding to the original sample stimulus. This paradigm is similar to responding to questions about the past in that responding is under the control of a stimulus no longer visible.

Some MTS studies have taught subjects to respond accurately by systematically increasing delays between the presentation of the sample and comparison stimuli (Constantine & Sidman, 1975; Gutowski & Stromer, 2003; Stromer, Mackay, McVay, & Fowler, 1998). Constantine and Sidman (1975) conducted research with four teenagers diagnosed with ASD. First, the authors demonstrated subjects accurately selected the comparison stimulus
Teaching IntraVerbal Responses about the Past

Corresponding to the sample picture while the sample picture was present (i.e., simultaneous presentation). Subsequently, the authors tested MTS with a brief delay of a few seconds between presentation of the sample stimulus and the comparison stimuli. All subjects performed poorly when a delay was incorporated; therefore, Constantine and Sidman tested picture-to-dictated name MTS after a delay (instead of picture-to-picture). In the picture-to-dictated name condition, subjects were provided a sample stimulus, then comparison stimuli were spoken by the experimenter. Subjects would then respond by echoing the verbal stimulus that matched the sample stimulus. Three out of four subjects successfully completed the MTS trials with dictated names after a delay. In the second experiment, subjects named the initial sample stimulus when it was presented which improved accuracy in picture-to-picture MTS. Constantine and Sidman went from a simultaneous delay to a few-second delay, but did not increase the delay further.

Gutowski and Stromer (2003) and Stromer et al. (1993) observed responding to one sample picture under two conditions. Initially, one sample stimulus was presented; then comparison stimuli were presented while the sample stimulus was still visible (simultaneous presentation). Subsequently, one sample stimulus was presented, removed, and comparison stimuli were presented with a 0-s delay (i.e., immediately). For example, a sample stimulus, cat, was presented, removed, then a comparison array was presented which included the correct picture, cat, and another picture, for example a bee. Then, two sample stimuli were presented instead of one. For example, if a cat and dog were presented, the comparison array would then have a cat and bee. The correct response would be cat. Both simultaneous presentation and 0-s delay were assessed with two sample stimuli as was done with a single sample stimulus.

Both one-sample and two-sample conditions were repeated in the final phase. New delays of 5 s and 10 s were added to both one-sample and two-sample conditions. Furthermore, in some
trials subjects were prompted to name the stimuli before attempting the MTS response, like Constantine and Sidman (1975). Subjects’ response accuracies were high during one-sample MTS with and without delays; two-sample MTS had high accuracy without a delay and low accuracy with a delay. Accuracy increased on two-sample delay MTS trials when subjects were required to name the two-sample stimuli prior to responding. Gutowski and Stromer (2003) went on to conduct a second experiment, replicating these results with preschoolers and a 13-year-old boy with ASD. The authors also tested dictated-name-picture MTS where the sample stimulus was stated by the experimenters, and subjects selected a corresponding picture from the comparison array. Results were similar in picture-name sample stimuli and dictated-name sample stimuli.

Research in MTS closely resembles the current experiment but there are notable differences. First, delays in previously discussed studies are not longer than 30 s. Second, as mentioned earlier, an MTS procedure includes either presenting pictures or providing a vocal verbal list as a prompt for subjects to respond correctly, instead of pure intraverbal behavior. Conclusions regarding how to teach delayed responding with prompts does not necessarily generalize to research in intraverbal behavior. Although delayed MTS research is similar to responding to questions about the past, more research is needed on intraverbal responses after a delay when target stimuli are no longer visible.

Intraverbals

Sundberg and Sundberg (2011) created an intraverbal subtest to determine patterns of intraverbal responding in children. The authors administered the subtest to 39 neurotypical subjects and 71 subjects with ASD. The authors noted neurotypical subjects, 3 years or older, had higher scores on the subtest compared to matched subjects with ASD; scores for
neurotypical subjects were particularly high when tested on questions with complex verbal conditional discriminations. The most advanced subtest (i.e., the one with the most conditional discriminations) included one question about the past; subjects with total scores at the level of 5-year-olds (with or without ASD) were most likely to respond correctly. Sundberg and Sundberg also noted correlations among neurotypical subjects’ ages and the type of incorrect responses, complexity of questions answered, and level of problem behavior. Children with ASD did not demonstrate a reliable correlation between scores on the subtests and age. This further supports the conclusion of Ribeiro (1989), who stated neurotypical children are able to respond to questions about the past by the age of 5; however, children with ASD have considerable variability in responding in this domain regardless of age.

Furthermore, teaching intraverbal responses has been studied within ABA in several contexts (c.f., Axe, 2008; Cihon, 2007; Stauch, LaLonde, Plavnick, Savana, & Gatewood, 2017). In his review of intraverbal research, Axe (2008) discussed trends in teaching intraverbal behavior from 1983 to 2007. Some research in teaching intraverbal behavior examines methods to transfer stimulus control (Braam & Poling, 1983; Ingvarsson & Hollobaugh, 2011). One example comes from Ingvarsson and Hollobaugh (2011) who transferred stimulus control from echoic, tact, and textual prompts to an intraverbal response. Ingvarsson and Hollobaugh recruited four subjects with ASD who were asked questions, then prompted to respond with either a tact, echoic, or textural prompt. Once echoic, tact, or textual prompts were provided, a delay of 5 s was implemented to fade the prompt. The authors found echoic prompts were the most efficient method for teaching intraverbal responses across the four subjects. Because the response in the current study was not the same across trials, a tact prompt (as opposed to an echoic prompt) was
necessary to facilitate discrimination of intraverbal responses based on an item as opposed to a question (i.e., the question in the current study was always the same but the response was not).

Stauch et al. (2017) more recently published a review of literature regarding teaching intraverbals to subjects with ASD. Stauch et al. specifically looked at the outcomes of research on complex intraverbal responses involving multiple sources of stimulus control. Out of 36 studies, 31 included questions that could have multiple intraverbal responses. For example, “What’s your name?” might only have one possible response for a child, but “tell me an animal” has more than one possible response. Similarly, a question about the past might have one response (e.g., “Where did you go to preschool?”) or multiple responses (e.g., “Who did you see yesterday?”). However, a question about the past might have multiple responses based on the time frame of the question (e.g., naming what someone had for breakfast might be different every day). Further, while Stauch et al. found 86% of studies on intraverbal behavior taught complex intraverbal responses, no studies examined intraverbal responses about past events. The only reference to questions about the past is in a book by Sundberg and Partington (1998) who described a procedure for teaching advanced intraverbal responses about the past when no physical stimuli are available to tact. The authors suggested gradually increasing the time between the event and the question about the event; no empirical support for this method was provided.

Heacock (2013) evaluated a procedure similar to Sundberg and Partington’s (1998) recommendation in a thesis project. Subjects were three adolescents diagnosed with ASD who had tact repertoires and answered simple questions but did not respond correctly to questions about the past. An initial baseline, in which all subjects had no correct responses to a question about a past activity, was followed by an intervention using gradual increases in delay. Subjects
played with one activity for 5 min during which the researcher would play and talk to the student about the activity. After 5 min, the activity materials were removed, a delay was implemented, and the experimenter asked subjects a question regarding the activity they played with earlier. For two subjects, Heacock gradually increased the delay without imbedded probes of the terminal criteria of 30 min. One subject was exposed to a single probe of the 30-min delay criterion after mastering the intraverbal following a 0-s delay. Once all subjects correctly responded after a 30-min delay, generalization probes were conducted with longer delays, new activities, and different people asking questions. All subjects responded correctly following 30-min delays and correctly responded to some of the generalization probes.

Heacock (2013) had limitations that were addressed in this experiment. First, after baseline with zero correct responding following a 30-min delay, we taught an intraverbal response with the item present (tact prompt), then retested the 30-min delay. This was to determine if incorrect responding after a delay was actually a function of the question lacking stimulus control over the intraverbal response or because further training was needed with the delay. Second, probes of the terminal 30-min delay were conducted throughout our evaluation rather than only once to determine the necessity of each delay increase.

**Statement of the Problem**

According to Skinner (1957), verbal behavior is an integral component of human relations and culture. That said, individuals with ASD often struggle with the development of verbal behavior compared to neurotypical peers of the same age (Sundberg & Sundberg, 2011). Ample research has shown a behavior-analytic approach is effective at teaching individuals with ASD how to develop verbal behavior, including intraverbal behavior (Axe, 2008; Cihon, 2007; Stauch, LaLonde, Plavnick, Savana, & Gatewood, 2017). Questions about the past are
particularly relevant because of how common they are in conversation. Furthermore, the ability to accurately report information about an individual’s previous environment might be a significant skill as a safety precaution. For example, children need to be able to tell their parents if they were in an unsafe situation contingent on a question such as, “What happened at school today?”

Despite the existing research in correspondence training, delayed MTS, and complex intraverbal behavior, weaknesses prevent them from being applied to teaching questions about the past with no further empirical support. First, no systematic delays in teaching intraverbal responses were demonstrated in correspondence training and no delays longer than 30 s have been assessed in delayed MTS literature. Second, some MTS and correspondence research only uses tact responses after a delay instead of intraverbal responses. Finally, no peer-reviewed studies have been published on training intraverbal responses regarding the past. Therefore, the purpose of this study was to evaluate the effects of a titrating time delay procedure on the delayed intraverbal responses of two subjects while addressing limitations in previous research.

Method

Subjects, Setting, and Materials

Two subjects, Alton and Harvey, aged 5 and 4, respectively, participated in this study. Alton was diagnosed with ASD and Harvey was diagnosed with a speech delay. Subjects were recruited from a Central Florida, in-home behavior-analytic service provider. Both scored in level 2 of the intraverbal portion of the VB-MAPP and had generalized tact repertoires. Subjects could answer “what” questions consistently without any tact or other verbal prompts but could not respond to questions about the past or other “wh” questions. Alton’s sessions were conducted at the library or at home, at a designated table. Harvey’s sessions were conducted at home, at one
of two small tables where discrete trial training was conducted during regular therapy. Materials included a Macbook, an iPhone 7 plus, an iPhone tripod, a handheld timer, and edibles (during treatment). Four videos (and four toys for Alton) were used in the experiment selected individually based on a multiple stimulus without replacement (MSWO) preference assessment (Deleon & Iwata, 1996) of eight videos and 10 toys.

**Response Measurement, Interobserver Agreement, and Experimental Design**

The dependent variable was the percentage of correct independent responses each session. A *correct independent response* was scored if subjects accurately reported the specific item he engaged with at the start of the trial (toys and videos will be referred to as “items” throughout the document unless otherwise noted). For example, if he watched Chicken Little, a correct independent response to a question about what movie he watched would have been “chicken” or “Chicken Little.” An *incorrect response* was scored if subjects inaccurately reported the item he engaged with at the start of a trial. For example, if he watched Chicken Little, an incorrect response to a question about what movie he watched would have been “movie” or “letters.” Correct independent responses for each item were determined idiosyncratically based on how each subject tacted items during pre-assessment. Responses were scored on a computerized datasheet as either correct or incorrect for each trial. Sessions were video recorded.

A second observer collected data from videos on the dependent variable and on treatment integrity. Interobserver agreement (IOA) was calculated using a trial-by-trial method each session for 22% of sessions for Alton and 27% of sessions for Harvey. Each trial was scored as an agreement (i.e., both observers scored a correct independent response or both observers scored an incorrect response) or disagreement (i.e., one observer scored a correct independent
response while the other scored an incorrect response). The total number of agreements was divided by the sum of agreements and disagreements in each session and multiplied by 100 to obtain a percentage IOA per session. IOA was 100% across Alton’s and Harvey’s sessions.

An integrity check was conducted for one video of each condition (baseline, 30-min reinforcement probes, and all treatment conditions) for each subject. The integrity check consisted of a task analysis (see Appendix A) scored by an independent observer. Correct TA items were summed and divided by total items to obtain a percentage of treatment integrity for each type of condition. Treatment integrity checks averaged 96% (88% - 100%) for Alton and 92% (77% - 100%) for Harvey. To demonstrate experimental control, we used a concurrent, multiple-probe design across subjects and behaviors.

Procedure

Initially, to determine items to include, MSWO preference assessments were conducted, one for toys and one for videos (Deleon & Iwata, 1996). First, subjects were exposed to each item to be assessed for 1 min. After forced exposure, subjects selected from an array of items (toys were presented on a table and videos were presented on a document with a screenshot of all videos, see Appendix B). Subjects pointed to or named an item to gain access for 30 s. The selected item was removed from the array, and remaining items were then rearranged. The items were represented until no item was selected for 30 s, subjects made a verbal statement to end the session, or all the items had been selected. During trials, if the subject verbally stated an item that was no longer available, he was directed to choose from the remaining items in the array. After the preference assessments were completed, the items selected for the experiment were the four items with the least difference in the percentage rank order. Rank order was determined as the percentage of trials each item was selected out of the number of times it was present in the array.
Edibles were provided contingent on correct independent responding during treatment conditions and 30-min reinforcement probe conditions. During an interview, parents described four preferred edibles that might act as a reinforcer. Subjects could select which edible to earn during treatment at the start of each session. The first edible selected was then provided during same-day sessions following any correct independent responses during treatment and probes. Alton’s parents indicated chocolate sandwich cookies, gummies, chewy chocolate chip cookies, and chocolate candies as highly preferred edibles and Harvey’s parents indicated gluten-free chocolate cookies, chips, gummy rabbits, and animal crackers as highly preferred edibles. During all sessions Alton selected mini Oreos and Harvey selected gummy rabbits or cookies.

Across all conditions including baseline, 30-min reinforcement probes, and treatment, sessions were four trials, with each item presented once in random order. First, sessions were prepped by the experimenter removing all materials and stimuli not related to the item. Next, the subject was provided 30 s to engage with an item (either playing with a toy or watching a video on a Macbook). If he did not attend to the item, the experimenter prompted play and verbally stated commentary in regard to the item (e.g., “look at the silly monkey playing”). After 30 s, all trials began.

**Baseline.** In baseline, after presenting a video for 30 s and removing it, a 30-min timer was set by the experimenter. After 30 min, the subject was brought back to the table and all materials and stimuli not related to the item were removed. The experimenter asked, “What [item] did you [engage with] earlier?” No differential consequences were provided for responding during baseline. After responding with any statement, correct independent or incorrect, the experimenter responded with a general statement such as, “thanks for talking to
me.” A correct independent or incorrect response was scored, and the trial was complete. Again, each session consisted of four trials, one with each item.

**Simultaneous presentation.** Conditional discriminations across the intraverbal targets were taught with the item present. For simultaneous presentation trials, after 30 s to engage with the item, the item was removed but kept in sight, and the experimenter asked, “What [item] did you [engage with] earlier?” If subjects responded correctly during any treatment session, they were given three pieces of their preferred edible and verbal praise such as “that’s right” or “you got it.”

Contingent on incorrect responses, error correction such as “no” or “that wasn’t right” was provided, edibles were withheld, and the question was repeated with a gestural and verbal prompt. For instance, if a subject watched the Curious George video, then responded, “Biscuit” when asked “What video did you watch earlier?” the experimenter would say “No, that’s not right; let’s try again. What video did you watch earlier?” followed by pointing to the screen and providing an immediate verbal prompt, “say, ‘Curious George’.” If the subject then responded correctly, one piece of his preferred edible was provided. This prompt always produced a correct response. For all subsequent treatment sessions, excluding 30-min reinforcement probes, this error-correction procedure was in place. Simultaneous presentation sessions continued until three consecutive sessions with at least 75% correct independent responding was reached.

**30-min reinforcement probes.** After simultaneous presentation responding was mastered (i.e., after the subject responded at 75% for three sessions), a reinforcement probe of the 30-min delay (referred to as a “probe” from this point forward) was conducted. Incorrect responses resulted in the therapist giving a general statement like baseline; no error correction was conducted. Correct responses resulted in the therapist providing verbal praise and three
pieces of a preferred edible. If correct independent responding was at 75% or higher, probes were continued until three consecutive sessions with a minimum of 75% correct independent responding was obtained. At this point the evaluation was considered complete for that group of items. If accuracy fell below 75% correct independent responding, we moved to the next delay increase value. These probes were conducted between every increase in the delay.

**Delay increase.** The procedure of increasing the delay between when the subject engaged with an item and the intraverbal prompt resembled probes but with varying delays instead of the delay always being 30 min. After the subject accessed an item for 30 s and the item was removed, a delay was implemented. The first delay was 0 s. Subjects were presented with an item for 30 s, the item was removed from sight, and the question was immediately asked. Correct independent responding resulted in three pieces of the subject’s preferred edible and a verbal praise statement. Incorrect responding resulted in the error-correction procedure described above.

Contingent on reaching 75% correct independent responding or higher for three sessions during 0-s delay, another probe was conducted. If subjects did not respond with a minimum of 75% correct independent responding during probes, the subsequent delay was introduced. The planned delay increased following the 0-s delay was: 30 s, 1 min, 3 min, 6 min, 10 min, and 15 min, until correct independent responding following a 30-min delay (i.e., responded at 75% accuracy during three consecutive probes).

After simultaneous presentation and 0-s delays were mastered (i.e., after the subject responded with 75% correct responding or higher for three consecutive sessions for both of these conditions), the mastery criterion for subsequent delays was only 1 session at 75% of higher correct independent responding. For example, if a subject had 75% or higher correct independent responding during the first 30-s delay session, he moved to another probe. If he did not meet the
criterion for advancement in the first session of a new condition, he was required to have at least
three consecutive sessions with 75% or higher correct independent responding to demonstrate
mastery.

Any incorrect responding during delay-increase sessions was followed by the error-
correction procedure described above. If three consecutive sessions at or below 50% correct
independent responding occurred, the delay was decreased by one-half the total time between the
current delay and the previously mastered delay. For example, if a subject previously mastered
the 30-s delay, and he had 50% or less correct independent responses for three consecutive
sessions during the 1-min delay, the delay was decreased to 45 s (halfway between the 1-min and
the 30-s delay) to regain correct independent responding. After correct independent responding
was 75% or higher to the new delay, subjects attempted the previously unsuccessful delay again
(in this example, 1 min). Because responding was not initially correct, 3 consecutive sessions at
75% or higher correct independent responding was required before another probe was conducted.

**Preferred stimulus modification for Harvey.** After mastering the 1 min delay,
Harvey’s responding was inconsistent in the 3-min delay. Therefore, we decreased the delay to 2
min; Harvey was still unsuccessful. We went back to the 1-min delay he had already mastered.
When Harvey did not respond accurately in this condition, the reinforcer was changed from three
pieces of his preferred edible to a 1-min break with a highly preferred item contingent on correct
independent responding (this is noted in his graph by an arrow). Items were selected at the start
of sessions through a free operant preference assessment (Roane, Vollmer, Ringdahl, & Marcus,
1998) or by asking Harvey, “What would you like to do today?” Once Harvey selected an item,
he was told he could play with it after he worked nicely. After Harvey accessed an item,
preference was reassessed for the following trial.
Results

Figure 1 displays a bar graph with the results for the preference assessments. Items are ranked from most- to least-often selected, left to right, respectively. Each item was given a percentage designation for each trial based on when it was selected. For instance, the first video selected was 100% or 1 out of 1. The second item selected was 50% because it was selected once out of 2 trials it was presented, and so on. All percentage designations for each item across all trials were then averaged to determine an overall preference hierarchy. Items selected for use in the study are shaded dark gray.

The top panel of Figure 1 displays the results of Alton’s video preference assessment. Alton demonstrated a preference for the copier and Cars videos. Pete the Cat was never selected; Alton would sometimes say “all done” after watching a few videos. Videos selected for use in the study should have been Chicken Little, Chika Chika Boom Boom, Curious George, and Biscuit because they had less than a 10% difference in rank order difference. Due to a video malfunction on the first day of baseline, Curious George was replaced with Gerald and Piggie, the third highest preferred item. The second panel of Figure 1 displays the results for Harvey’s video preference assessment. Harvey demonstrated a consistent preference for the Cars video compared to all other videos. He selected the Cars video first during every initial presentation of the document with the screenshots. Harvey never chose the copier video. During all sessions, Harvey said, “all done” after watching some of the videos. Videos selected (Chika Chika Boom Boom, Chicken Little, Curious George, and Biscuit the Dog) for use in the study had less than a 10% difference in rank order difference. Finally, the third panel of Figure 1 displays the results for Alton’s toy preference assessment. Alton preferred the Mickey drawing pad and Spooky book across all sessions. Alton selected all toys during sessions, but the least-preferred were the
caterpillar and Peppa Pig toy. Toys selected (monster putty, BrainFlakes, cars, and dinosaurs) for use in the study had less than a 10% difference in rank order.

Figure 2 displays the results of treatment. The graph includes data for Alton across two items, videos and toys and for Harvey across videos. Sessions are graphed in the order they were conducted in accordance with a concurrent multiple probe design (Horner and Baer, 1978). Across all subjects, zero correct independent responding occurred in baseline.

The top and middle panels of Figure 2 show the results for responding to questions about a video watched in the past for Alton and Harvey, respectively. Alton’s correct independent responding increased to 100% after 4 sessions of the simultaneous presentation condition while Harvey took 11 sessions. During the first probe, Alton and Harvey had no correct independent responses. Correct independent responding was 100% across three consecutive sessions of the 0-s delay condition. Both subjects had low correct independent responding during the subsequent probe (25%). Responding continued in this way until the delay was increased to 1-min. Both subjects’ correct independent responding decreased, and the delay was reduced to 45 s. After Alton and Harvey’s correct independent responding increased to 100%, the delay was increased back to 1 min. Following mastery of the 1-min delay, Alton’s correct independent responding was 100%, 75%, and 100% during probes. At this point, he met mastery and movies were no longer assessed. During a maintenance probe one month after meeting mastery Alton had 100% correct responding.

Harvey did not meet mastery in the initial 3-min delay condition. The delay was decreased to 2 mins and again to 1 min based on low accuracy of responding. When Harvey did not successfully reacquire the previously mastered delay (1 min), the reinforcer was changed. At this point Harvey reacquired correct independent responding in the 1-min delay condition,
successfully mastered the 3-min delay, and reached mastery during the following probes (75%, 75%, and 100%) concluding the assessment. The last panel of Figure 2 displays the results for Alton’s responding to a question about a toy he played with in the past. Alton quickly progressed through the first 3 delay conditions with low rates (25%) of correct independent responding during probes. After one session at 75% responding during the 30-s delay, Alton met mastery criteria during the following probes, and treatment was complete.

Discussion

The current study presents a simple and effective procedure to teach complex intraverbal responses by systematically increasing delays between interacting with items and questions about those items for 2 subjects. Alton responded correctly after 30 min following mastery of a 1-min delay with videos and a 30-s delay with toys. Harvey responded correctly after 30 min after mastering a 3-min delay with videos. To date, no peer-reviewed empirical research has evaluated methods for teaching children intraverbal responses regarding events in the past. The current procedure could be adapted to a variety of situations such as asking individuals what they had for breakfast, what they learned in school, or with whom they played.

Employing probes is a practical procedure that might save time during acquisition-based programming that resembles shaping. It is possible responding for Alton generalized after acquisition of the 1-min delay because the 1-min delay condition more closely resembled the probes compared to previous conditions. During the simultaneous-presentation, 0-s, and 30-s delay conditions, subjects did not have time to engage in other behavior during the delay. During longer delays (e.g., 1 min and longer), regular therapy activities occurred throughout the interval. Therefore, the 1-min delay was the first condition that included regular therapy activities similar to the probes conducted previously. This could have produced generalized responding in the
probe following the 1-min delay condition. It is also possible that correct responding was a function of repeated exposure to training sessions (24 videos trials for Alton and 49 video trials for Harvey). Any procedure with time-based shaping (e.g., increasing the time a child tolerates waiting for a preferred item) might benefit from probes of terminal criteria after mastering shorter delays. However, it is also possible acquisition can be hindered by these probes. Responding during probes always resulted in escape (i.e., no error correction) which might have delayed stimulus control of the question across all conditions. Future research should evaluate the point at which terminal criteria are mastered without the need for further shaping and under what conditions these probes facilitate or slow learning.

There were several limitations of this experiment that warrant discussion. First, the experiment was conducted with subjects who received in-home services. Alton began sessions at a library, then switched libraries, and had some sessions in his home. On two occasions Harvey’s trials were discarded because his younger sibling ate meals while watching a video. Although the setting weakened internal validity, it likely strengthened external validity. A procedure involving verbal behavior related to social conversation is more likely to generalize if it is taught in multiple settings (as was the case for Alton) and is more socially appropriate if taught in the natural setting compared to a contrived environment such as a clinic (as was the case for both subjects). Future research might examine how acquisition of intraverbals about the past is affected by a different setting. Another limitation of the in-home setting was the possible access to reinforcers used in the study. Alton’s edible reinforcer was only available during experimental sessions. Due to Harvey’s limited diet, he was accessing the edibles selected for appropriate behaviors at home outside of experiment sessions. This might have reduced the strength of the edibles as reinforcers. As evident in the results, Harvey’s responding increased when the
reinforcer was changed to a preferred activity he chose. However, an activity is possibly a more natural reinforcer for intraverbal responses than an edible. It is common practice for adults to allow children to escape and access activities contingent on conversation.

Another procedural limitation was the inclusion of edible and verbal praise after correct responding in the probes. The edible is not a naturally occurring reinforcer; future research should examine fading the edible to transfer stimulus control to more natural settings. Furthermore, the use of an edible and verbal praise during probes instead of a true return to baseline with no reinforcement might confound the increase in responding when comparing baseline and probes. Had we responded with a general verbal statement (e.g., “thanks for talking to me”) rather than praise, our procedure might have more so resembled natural conversation. However, subjects never had an opportunity to contact reinforcement during baseline sessions, so there was no change in contingencies across these two conditions from the perspective of the subjects.

As this is one of the first experiments demonstrating methods for reaching intraverbal responses regarding past events, more research is needed to increase ecological validity. For example, future research might expand the subject pool to include neurotypical children and children of different ages. Also, we used a contrived question and intraverbal response in this study. We did this to increase our control over the past event, but the overall goal of responding to questions about the past is to teach individuals to respond to more important questions (e.g., “What did the man trying to abduct you look like?”) Further, the delay is unlikely to always be 30 min (e.g., someone might be asked about activities 1 year ago or 1 day ago). This study should be replicated with more functional intraverbals following varying delays. Last, future research might reconsider the arbitrary method for increasing delay intervals. Because of the
limited research in this area, delay increases were loosely based on the delays in Heacock (2013). However, Alton and Harvey both struggled with the 1-min delay possibly because the increase from 30 s to 1 min was too great. Future research should find the best sequence of delay increases to promote efficient learning.

This research also has implications for behavioral views of memory. Even though we did not test the mechanism(s) for learning to respond after a delay, these data allow us to speculate on some potential variables. The generalization of responding to a longer delay might support Palmer’s (1998) theory of memory that time is not a variable in the weakening of responding. This experiment was a procedure that systematically increased time between an item and a question about it to increase correct independent responding. However, both Alton and Harvey mastered responding after a 30-min delay after mastering responding to shorter delays (1 min and 3 min, respectively). Furthermore, Harvey had errors in responding that are more likely related to stimulus control (e.g., responding with a previously reinforced intraverbal response outside the scope of this study) than time (e.g., saying he can’t remember or not responding) further supporting Palmer’s theory. The passage of time was not isolated in this experiment; future research should compare rate of acquisition of these intraverbals when other responses are required and reinforced during the delay (e.g., other intraverbals, tacts, echoics, etc.) compared to when the delay does not include the requirement of any other responses (i.e., no demands placed) to further support Palmer’s theory. If fewer trials to criterion are necessary when there are no other responses required compared to when there are other responses required during the delay, this would support Palmer’s theory that time itself is not a variable in deterioration of responding over time.
During one 30-s delay treatment trial, Alton repeated the name of the video twice during the delay. For example, while drawing, he said, “Gerald and Piggy.” When asked what video he had watched on this trial, he anecdotally responded more quickly. This might be similar to rehearsal within joint control theories (Lowenkron, 1998). Lowenkron (1998) describes joint control as a response under the control of two stimuli. In this example, Alton first watched the video and then engaged in auto-echoic behavior (repeating the tact over the course of the delay; Lowenkron, 1998). Finally, when the intraverbal was asked, the response was under the control of both the auto-echoic and the intraverbal. Alton only engaged in spoken rehearsal behavior once. Harvey never engaged in spoken rehearsal. There were instances during which Harvey incorrectly responded with a previously reinforced intraverbal from his normal therapy to the question about the video. Both of these errors appear to be a result of faulty stimulus control. Further research is needed to test the role of joint control in responding to questions about the past.

We implemented one method for teaching responding to questions about the past; however, other methods such as stimulus fading should be examined. The experimenter might keep the item present and point to the activity when asking the question following a delay. Over time, the presence of the activity could be faded. Future research could also increase the delay more slowly (e.g., by a few seconds each time rather than always doubling the delay) or use picture prompts like an MTS procedure. Another prompt method might be to ask the question multiple times during the delay and systematically decrease the number of times the question is asked during the delay. Once multiple methods for teaching intraverbal responses following a delay are found to be effective, follow-up studies might compare methods to determine which is
most efficient or if idiosyncratic factors contribute to the success of one method compared to
another similar to Ingvarsson and Hollobaugh (2011).

Overall, this study was one of the first empirical studies (see also Heacock, 2013) to test a
method for teaching intraverbals about the past. From a clinical perspective, this procedure might
be effectively employed to target this type of responding about the past for any client who is
struggling with accurately describing activities, settings, items, or people. Future research is
needed on applications of this procedure to other populations, other methods to teach this skill,
and the mechanism responsible for correct responding following a delay.
References


https://www.autismspeaks.org/what-autism/diagnosis/dsm-5-diagnostic-criteria


http://rave.ohiolink.edu/etdc/view?acc_num=osu1374194687


doi: 10.1901/jaba.1978.11-189


https://www.autismspeaks.org/what-autism/treatment


doi:10.1901/jaba.2011.44-659


correspondence by boys with moderate mental retardation: Collateral changes in

classroom behavior in mentally retarded children through correspondence training.
Figure 1. Preference assessment data for both subjects. Items are ranked from highest preferred to least preferred. The dark gray bars represent items selected for use during the experiment.
Figure 2. Results for Alton and Harvey’s treatment evaluation. Alton’s results are displayed on the top and bottom panels for his movie and toy evaluations, respectively. Harvey’s data are displayed in the middle panel.
Appendix A. Treatment integrity task analysis. Observers scored a check if the step was done correctly, an "x" if the step was incorrect or incomplete, and a dash if the step was not necessary (e.g., if the subject responded correctly, a dash was placed in box 11).

<table>
<thead>
<tr>
<th>Treatment Integrity TA</th>
<th>Date:</th>
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<tbody>
<tr>
<td>1. Therapist removes stimuli subject is engaged with.</td>
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<td>2. Therapist presents one item to subject for 25-35 s.</td>
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<td>3. Therapist encourages subject to play.</td>
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<td>4. Therapist removes activity.</td>
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<td>5. After current delay, therapist removes stimuli in environment.</td>
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<td>7. After response, therapist says verbal statement: Baseline: “thanks for talking to me” or other neutral statement/Treatment: “no” if incorrect praise if correct/Baseline Probe: “thanks for talking to me” if incorrect praise if correct</td>
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<td>8. If response is correct, therapist provides 3 pieces of preferred edible. <em>(Except in baseline).</em></td>
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<td>9. If response is incorrect, therapist runs error correction procedure. <em>(Unless delay was 30 min)</em></td>
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Appendix B. Chart used during the preference assessment to present a visual stimulus from which subjects chose a video to watch. After a video was selected, the picture was deleted from the array, and the last picture, in this example the copier, was moved to the first spot, in this example ahead of Chika Chika Boom Boom®. Once subjects finished watching the selected video, the array was represented with the changes.