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INCREASING INSTRUCTIONAL EFFICIENCY BY PRESENTING ADDITIONAL STIMULI IN LEARNING TRIALS FOR CHILDREN WITH AUTISM SPECTRUM DISORDERS

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The current study examined the effectiveness and efficiency of presenting secondary targets within learning trials for 4 children with an autism spectrum disorder. Specifically, we compared 4 instructional conditions using a progressive prompt delay. In 3 conditions, we presented secondary targets in the antecedent or consequence portion of learning trials, or in the absence of prompts and reinforcement. In the fourth condition (control), we did not include secondary targets in learning trials. Results replicate and extend previous research by demonstrating that the majority of participants acquired secondary targets presented in the antecedent and consequent events of learning trials.

Key words: autism spectrum disorders, discrete-trial instruction, instructional efficiency, instructive feedback

Although discrete-trial instruction (DTI) is an effective teaching practice for many learners with an autism spectrum disorder (ASD), it may not close the gap between their skill level and that of their typically developing peers. Therefore, it is important to identify procedures that further increase the efficiency of this instruction format. Determinations regarding instructional efficiency have centered on how rapidly acquisition occurs during one instructional method compared to another. Comparisons may be made based on time or trials to criterion (e.g., Ingvarsson & Hollobaugh, 2011). It has also been suggested that conclusions regarding efficiency be based on the number of skills acquired and the effects on future learning (e.g., Reichow & Wolery, 2011; M. Wolery, Werts, & Holcombe, 1993; T. D. Wolery, Schuster, & Collins, 2000). The latter conceptualizations have been explored through the presentation of additional stimuli within learning trials (typically prior to or immediately following a response opportunity in the presence of a target stimulus). These additional stimuli are presented without requiring a response from the learner or programming consequences if the learner does engage in a correct response (Anthony, Wolery, Werts, Caldwell, & Snyder, 1996; Werts, Wolery, Holcombe, & Frederick, 1993).[1]

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[1] Previous research has used a variety of terms to refer to additional stimuli presented in the learning trial (i.e., *future target stimuli, instructive feedback stimuli, nontarget stimuli, nontarget information*). To increase clarity, we will refer to the targets being taught in the learning trial as *primary targets*. Primary targets are those that require a response from a learner, and feedback is provided based on the learner's response. We will refer to the additional stimuli presented in the learning trial as *secondary targets*. The learner is not required to respond to the secondary targets, and no differential consequences are programmed if individuals do respond to them.

Some studies presented secondary targets in the antecedent portion of learning trials (i.e., prior to the presentation of the target discriminative stimulus; e.g., M. Wolery, Ault, Gast, Doyle, & Mills, 1990), whereas others presented secondary targets during the consequence portion of learning trials (i.e., following the consequence provided contingent on the learner's behavior; e.g., Cromer, Schuster, Collins, & Grisham-Brown, 1998; M. Wolery et al., 1991). For example, while teaching sight words to three teenagers diagnosed with intellectual disabilities, T. D. Wolery et al. (2000) compared an instructional condition in which teachers presented secondary targets prior to the presentation of a primary target (e.g., "This word is 'pencil', followed by holding up a different card and presenting the instruction "what word?") to an instructional condition in which teachers presented secondary targets after delivering praise contingent on a correct response to a target stimulus (e.g., "Great work reading the word 'book'! This word is 'pencil'"). Although the participants did not demonstrate mastery-level responding to the secondary targets in either condition without direct teaching, they acquired the secondary targets more quickly than targets not presented in earlier learning trials. These results are consistent with other studies (e.g., Winterling, 1990) and indicate that presenting secondary targets in the antecedent or consequence portion of the learning trial may increase instructional efficiency.

Reichow and Wolery (2011) extended previous research on the effects of presenting secondary targets on the acquisition of sight words to children with an ASD. The experimenters examined the efficacy and efficiency of this strategy by comparing the number of sessions and time required to achieve mastery-level performance during progressive prompt-delay conditions with or without secondary targets. Their results indicated that presenting secondary targets in a progressive prompt-delay procedure was approximately twice as efficient compared to instruction without secondary targets.

However, Reichow and Wolery (2011) did not evaluate the point at which the participants acquired the secondary targets. That is, they presented secondary targets in the learning trials and evaluated whether participants acquired these targets following mastery-level responding to primary targets exposed to direct training. It may be beneficial to determine the point at which secondary targets are acquired during training and observe the rate of acquisition of these stimuli. This information may provide an estimate of the acquisition of secondary targets prior to the completion of training with primary targets, which may indicate whether additional training with secondary targets will be necessary. In addition, Reichow and Wolery, as well as other previous studies (e.g., T. D. Wolery et al., 2000), did not include a condition in which instructors presented secondary targets in the absence of instruction. Such a condition could be used to examine the minimal conditions under which learners may acquire secondary targets. Finally, to our knowledge, no studies involving secondary targets have evaluated participant behavior (e.g., imitating the teacher's presentation of the secondary target) that may aid in the acquisition of secondary targets.

The current investigation sought to replicate and extend the extant literature on presenting secondary targets in learning trials in several ways. First, we assessed the efficiency of presenting secondary targets in the antecedent portion of learning trials with individuals with an autism spectrum disorder. Second, we compared the efficiency of presenting secondary targets in the antecedent and consequence portion of learning trials. To our knowledge, this study represents the first comparison between these conditions for participants with an autism spectrum disorder. Third, we included probes of the secondary targets during the training of primary targets to determine if and when the participants acquired the secondary targets. Fourth, we measured whether participants echoed the experimenter's presentation of secondary targets. Fifth, we

included a comparison condition in which we exposed participants to secondary targets in the absence of teaching (i.e., the secondary targets were not presented in learning trials).

METHOD

Participants and Setting

Four children with an autism spectrum disorder participated. Each child received his or her diagnosis from a multidisciplinary clinic specializing in the assessment of ASD. All children received early intervention services at a hospital-based clinic and had a history of training with prompt-delay procedures. However, none of the participants had previous exposure to the presentation of secondary targets within learning trials. Winnie was a Caucasian 7-year-old girl who had been diagnosed with autism and who used four- to six-word phrases to mand for or tact items spontaneously. Winnie answered simple social questions (e.g., "How are you?") and completed fill-in-the-blank statements (e.g., "Twinkle, twinkle little" [child says "star"]). We conducted a Peabody Picture Vocabulary Test-4 (PPVT-4) with Winnie, and her age equivalent score was 3.6.

Kevin was a Caucasian 5-year-old boy who had been diagnosed with autism and who used two- to four-word phrases mainly to mand for items. He responded correctly to a small number of fill-in-the-blank questions, identified common objects, and had a well-developed echoic repertoire. Kevin's PPVT-4 results indicated an age equivalent score of 2.3. Dwight was a Caucasian 3-year-old boy who had been diagnosed with pervasive developmental disorder not otherwise specified and who spontaneously engaged in mands for items and activities using three or more words. Dwight also emitted at least 300 tacts of items, activities, and people, and he answered social questions (e.g., "How are you today?"). Rick was an African-American 6-year-old boy who had been diagnosed with autism and who spontaneously engaged in mands for and tacts of at least 300 items using four- to seven-word phrases. He answered and initiated social questions and completed fill-in-the-blank statements.

We conducted all sessions in the participant's typical therapy room. Each room contained a table, chairs, and plastic tubs in which we placed materials for the session. The therapist and participant sat adjacent to or across from each other at a table during all sessions. A secondary observer sat in a chair at or close to the table during a proportion of sessions.

Response Measurement and Interobserver Agreement

Observers recorded data using data sheets specifically prepared for each session. For each trial, the data sheet specified the target, the correct answer, and letter codes corresponding to participants' (a) correct response, defined as the participant emitting the target response prior to the delivery of the controlling prompt; (b) incorrect response or no response, defined as the participant emitting an error of commission (i.e., responding incorrectly) or omission (i.e., nonresponding) prior to the delivery of the controlling prompt, respectively; (c) prompted correct response, defined as the participant providing the target response after the delivery of the controlling prompt; (d) prompted incorrect response or prompted no response, defined as the participant making an error of commission or omission following the delivery of the controlling prompt, respectively; and (e) correct echo (for conditions including secondary targets), defined as the participant correctly imitating the experimenter's vocal model of the secondary target within 5 s. Data were collected on participants' incorrect responses to make decisions to increase the prompt delay (described below). We recorded session duration using a digital handheld timer for Dwight and Rick, but not for Kevin and Winnie.

A second independent observer simultaneously collected data during at least 44% of the sessions

in each condition, and we calculated agreement by comparing observers' records on a trial-by-trial basis. We scored an agreement for trials that both observers coded identically. We divided the number of trials in agreement by the number of trials with agreements plus disagreements and converted the ratio to a percentage. Mean interobserver agreement for trials across all conditions was 98% (range, 50% to 100%) for Winnie, 98% (range, 67% to 100%) for Kevin, 99% (range, 83% to 100%) for Dwight, and 97% (range, 67% to 100%) for Rick.

Preference Assessment

The experimenter conducted a paired-choice preference assessment (Fisher et al., 1992) with each participant prior to the beginning of the evaluation to identify highly preferred food items. In addition, we conducted a daily multiple-stimulus without replacement (MSWO; DeLeon & Iwata, 1996) assessment with the top five ranked items from the paired-choice assessment. The experimenter delivered the three most highly preferred food items following correct responding during training.

Pretest

Prior to baseline, the experimenter conducted pretests to identify target stimuli for each condition and participant. We created a pool of potential targets based on individualized intervention goals for each participant. These included tacts of pictures (for Kevin and Winnie) and intraverbal fill-in-the-blank statements (for Dwight and Rick). Pretest trials consisted of the experimenter holding up a picture card and asking, "What is it?" or presenting an antecedent verbal stimulus associated with the fill-in-the-blank statement (e.g., "The opposite of hot is —"). Participants had 5 s to respond. The experimenter presented each potential target four times per session in a random order. The experimenter did not provide feedback for correct or incorrect responses during the pretest; mastered tasks were interspersed on about every other trial. Reinforcement was provided for correct responses to mastered tasks to maintain motivation.

We discarded all potential targets to which the participant responded correctly at least once; we pseudorandomly assigned the remaining targets to one of six or eight sets. For Winnie and Kevin, each set included three targets. Dwight's and Rick's sets included six intraverbal fill-in-the-blank statements. We equated stimulus sets by assigning stimuli to each condition based on the number of syllables contained in target responses and ensuring targets that sounded similar were not in the same set. We assigned sets to one of four conditions: (a) primary targets with secondary targets placed in the antecedent portion of the learning trial (hereafter referred to as the antecedent condition), (b) primary targets with secondary targets placed in the consequent portion of the learning trial (hereafter referred to as the consequence condition), (c) secondary targets in the absence of teaching primary targets (hereafter referred to as the secondary-targets-only condition), and (d) primary targets in the absence of secondary targets (hereafter referred to as the primary-targets-only condition). We assigned two sets of targets to the antecedent and consequence conditions. For these conditions, one set served as the primary targets and the other as the secondary targets. The secondary-targets-only or primary-targets-only conditions each contained one set. Baseline control sets also were included for Rick and during a replication comparison for Dwight. A list of the targets in each set and condition is available in the supporting information or from the first author.

Design and General Procedure

We evaluated the effects of training with and without secondary targets on the acquisition of tacts and intraverbal fill-in-the-blank statements using an adapted alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985). The treatment comparison was conducted twice with Dwight for replication purposes. We conducted one to 11 sessions per day, 1 to 5 days per week;

all sessions consisted of 12 trials (excluding the presentation of the secondary targets with the exception of the secondary targets-only condition).

The first two instructional sessions in the antecedent, consequence, and primary-targets-only conditions included trials with a 0-s prompt delay. During these trials, the experimenter immediately provided an echoic prompt following the presentation of the nonverbal or verbal stimulus, depending on the target stimuli. Following sessions at a 0-s delay, the experimenter increased the prompt delay to 1 s. The experimenter subsequently increased the prompt delay by 1 s per session based on each participant's pattern of responding. That is, we increased the prompt delay by 1 s if the participant engaged in no response (i.e., error of omission) for the majority ($\geq$50%) of the unprompted incorrect responses. If the majority of the participant's unprompted incorrect responses were incorrect responses (i.e., errors of commission), the prompt-delay value remained the same for the following session.

The experimenter implemented an error-correction procedure contingent on errors in the antecedent, consequence, and primary-targets-only conditions. During error correction, the experimenter provided a vocal model of the correct response and an opportunity for the participant to respond. The experimenter provided affirmative statements (e.g., "yep") contingent on the participant correctly echoing the vocal model prompt, and the experimenter repeated the trial until the participant provided an correct response (although correct responses during error correction were not included in the session data). The experimenter delivered praise and an edible item contingent on a correct response during error correction.

Teaching of the primary targets continued until the participant's correct responses reached the mastery criteria. Kevin's, Dwight's, and Rick's mastery criteria were three consecutive sessions with correct responses at or above 90% or two consecutive sessions at 100%. Winnie's mastery criterion was two consecutive sessions with correct responses at or above 90%. Similar to Reichow and Wolery (2011), we conducted review sessions after every other instructional session for any condition in which a participant demonstrated mastery-level responding while teaching continued in the other conditions. Review sessions had the same format as instructional sessions.

We conducted a probe session 10 min to 120 min after each session of the antecedent, consequence, and secondary-targets-only conditions to measure participants' acquisition of secondary targets. If the participant did not demonstrate mastery-level responding to secondary targets prior to mastery of all primary targets, we directly trained these secondary targets following mastery of all primary targets. Direct training was only necessary for Kevin.

Baseline. We conducted a minimum of three baseline sessions for each condition and extended baseline until participants demonstrated three consecutive sessions with a stable or decreasing trend in correct responding with a mean below 35%. For tact targets, the experimenter held up the target picture card and asked, "What is it?" For fill-in-the-blank statements, the experimenter presented the antecedent verbal stimulus that did not include the final word in the sentence (e.g., "The opposite of hot is —"). For both tasks, the participants had 5 s to respond. The experimenter did not provide any feedback for correct or incorrect responses. The experimenter presented targets an equal number of times in a random order during each session. For Winnie and Kevin, we conducted sessions under baseline conditions following mastery of the primary targets because they did not demonstrate mastery of the secondary targets during probes. This served as a baseline for teaching of the secondary targets.

Antecedent condition. Each trial consisted of the experimenter establishing ready behavior (e.g., ensuring that the participant's body was still or prompting the participant to put his or her

hands in the lap) and presenting a secondary target (e.g., holding up a picture and saying, "This is a seal"). The experimenter did not provide differential consequences for participant responses following the presentation of the secondary target. After approximately 3 s, the experimenter then presented the stimulus relevant to the primary target (e.g., held up a picture of a lion and asked, "What is it?"). The experimenter delivered a preferred edible and praise contingent on a correct response to the primary target. If the participant engaged in an error, the error-correction procedure was implemented (as previously described). We randomly assigned primary and secondary targets to trials (i.e., we did not systematically pair primary and secondary targets).

Consequence condition. Immediately following the delivery of reinforcement for responding to the primary target, the experimenter presented the secondary target. That is, while the child consumed the edible item, the experimenter presented the secondary target (i.e., held up a picture and said "This is a seal"). All other procedures were identical to the antecedent condition.

Secondary-targets-only condition. The experimenter presented secondary targets in the absence of primary targets. That is, the experimenter established ready behavior, presented the secondary target, recorded the participant's response to the secondary target, and moved to the next trial. The experimenter did not provide any differential consequences for responses to secondary targets, as in the other conditions and avoided incidental responses (e.g., a smile) during sessions. Contingent on appropriate behavior (e.g., sitting quietly, making eye contact), the experimenter provided a preferred edible and praise about every other trial during the intertrial interval to maintain participation in the session. This condition was designed to examine the effects of presenting secondary targets in the absence of instruction for primary targets and programmed consequences.

Primary-targets-only condition. The training procedures were identical to those described above (see antecedent and consequence conditions), with the exception that no secondary targets were included in trials. This condition was designed to measure acquisition under teaching practices typically encountered in early intervention programs. Thus, this condition allowed a comparison of the number of sessions required to reach the mastery criteria when we did not present secondary targets in learning trials.

Secondary-target probes. We measured the emergence and acquisition of secondary targets presented in the antecedent, consequence, and secondary-targets-only conditions during ongoing training with primary targets. Depending on the participant's schedule, the experimenter conducted a probe of secondary targets following every one to three sessions of training in other conditions. We conducted these probes using the procedures described in baseline.

Control condition. The experimenter conducted these sessions using procedures identical to those in the baseline condition. We included this condition in Rick's treatment comparison and in Dwight's second treatment comparison as a control condition. We believed this addition was necessary as the demonstration of experimental control for Winnie's treatment comparison and for Dwight's first treatment comparison was relatively weak. During these evaluations, Winnie and Dwight unexpectedly acquired the targets from the secondary-targets-only condition without direct teaching; we expected direct training to be necessary. Thus, we cannot rule out the effects of maturation or repeated exposure as an explanation for these gains.

RESULTS

Figures 1, 2, and 3 show the results of training in each condition for the participants. In each figure, the top panel shows the participants' percentage of correct responses to the primary targets across conditions. The participants'

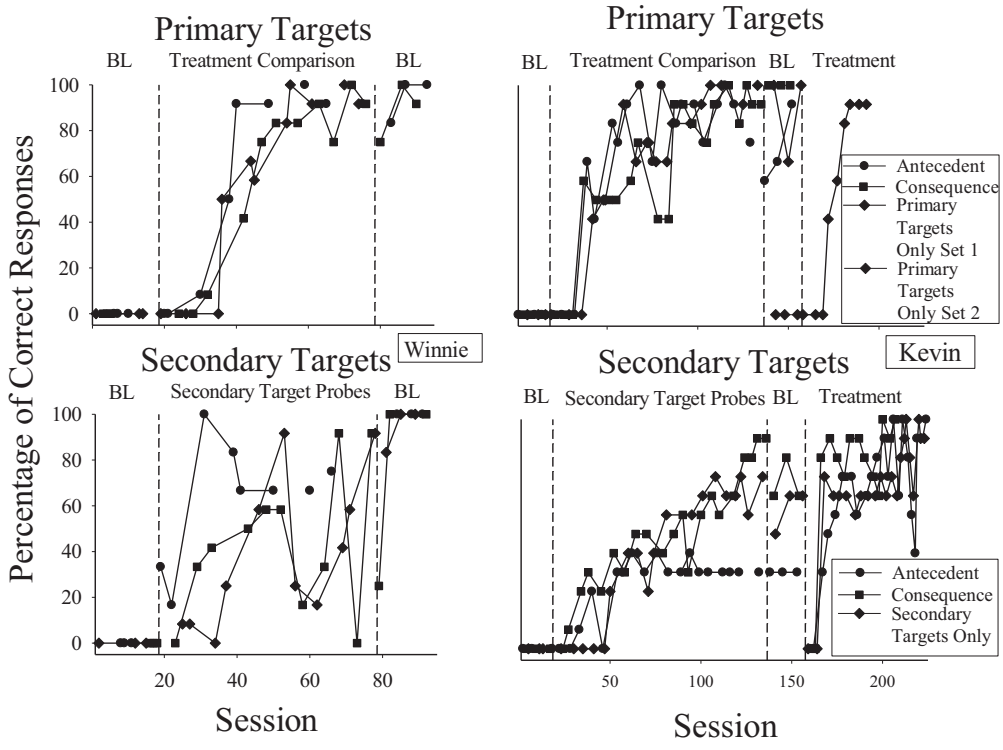

Figure 1. The percentage of correct responses to primary and secondary targets in each condition for Winnie and Kevin. Lines connecting data points were removed for review sessions that were conducted with mastered stimuli while we continued to conduct training in other conditions. BL = baseline.

percentage of correct responses during probes of the secondary targets is displayed in the bottom panel of each figure.

During baseline, the participants' correct responses were at or near zero across primary and secondary targets in all conditions. During training, Winnie acquired the primary targets in the antecedent, consequence, and primary-targets-only conditions in 6, 11, and 9 sessions, respectively (Figure 1, left column, top panel). During conditions that included the presentation of secondary targets, Winnie almost always echoed the experimenter's vocal model of secondary targets. She correctly echoed secondary targets on 96%, 98%, and 93% of opportunities during the antecedent, consequence, and secondary-targets-only conditions, respectively (data not depicted in Figure 1). She did not master the secondary target sets prior to acquisition of the primary targets, although there was improvement in each set. However, Winnie met the mastery criteria for all secondary targets during the subsequent baseline condition (Figure 1, left column, bottom panel). As such, direct training of secondary targets was unnecessary.

Figure 1 displays Kevin's responding to primary and secondary targets across conditions. Kevin showed mastery-level responding to the primary targets in 18, 21, and 17 sessions in the antecedent condition, consequence condition, and the primary-targets-only condition (Set 1), respectively (Figure 1, right column, top panel). Kevin correctly echoed secondary targets during the antecedent, consequence, and secondary-targets-only conditions during 90%, 85%, and 90% of opportunities, respectively. Unlike

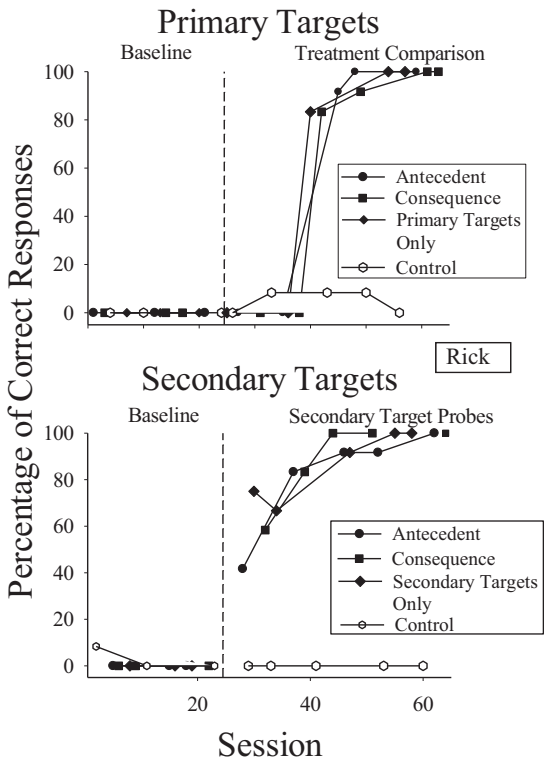

Figure 2. The percentage of correct responses to primary and secondary targets in each condition for Rick. Lines connecting data points were removed for review sessions that were conducted with mastered stimuli while we continued to conduct training in other conditions.

Winnie, Kevin did not reach criteria-level performance for the secondary targets prior to or immediately following mastery of the primary targets. Therefore, we directly taught all secondary targets as well as a new set of primary targets in the primary-targets-only condition (Set 2). Kevin acquired the second set of primary targets in the primary-targets-only condition in nine sessions, but he required substantially more sessions (22, 14, and 22 sessions, respectively) to master the secondary targets from the antecedent, consequence, and secondary-targets-only conditions.

During training, Rick acquired the primary targets in the antecedent, consequence, and primary-targets-only conditions (Figure 2, top panel) in five, six, and five sessions, respectively (Figure 2, top panel). He correctly echoed the secondary targets on 100% of opportunities during the antecedent, consequence, and secondary-targets-only conditions. Rick demonstrated mastery of the secondary targets during the training of primary targets; in fact these secondary targets were mastered in a similar number of sessions as the primary targets (Figure 2, bottom panel).

Dwight's responding to primary and secondary targets during his first treatment comparison is displayed in Figure 3 (left column). Dwight mastered the primary targets in the antecedent, consequence, and primary-targets-only conditions in 7, 10, and 8 sessions, respectively (Figure 3, left column, top panel). Similar to the other participants, he correctly echoed the secondary targets during 100%, 99%, and 100% of opportunities in the antecedent, consequence, and secondary-targets-only conditions, respectively. Dwight acquired the secondary targets presented within the antecedent and consequence conditions in five and nine probe sessions, respectively. Dwight reached criteria-level performance for the secondary-targets-only condition in just four probe sessions (Figure 3, left column, bottom panel).

Figure 3 (right column) contains the replication data for Dwight. He acquired the primary targets in seven sessions in the antecedent, consequence, and primary-targets-only conditions (Figure 3, right column, top panel). Dwight echoed secondary targets during 100% of opportunities in the antecedent, consequence, and secondary-targets-only conditions. Dwight also showed mastery-level responding to all secondary targets during the training of primary targets and in a number of sessions similar to that of the primary targets (Figure 3, right column, bottom panel). He acquired the secondary targets presented within the antecedent and consequence conditions in eight and four probe sessions, respectively. Dwight reached criteria-level performance for the secondary-targets-only condition in six probe sessions.

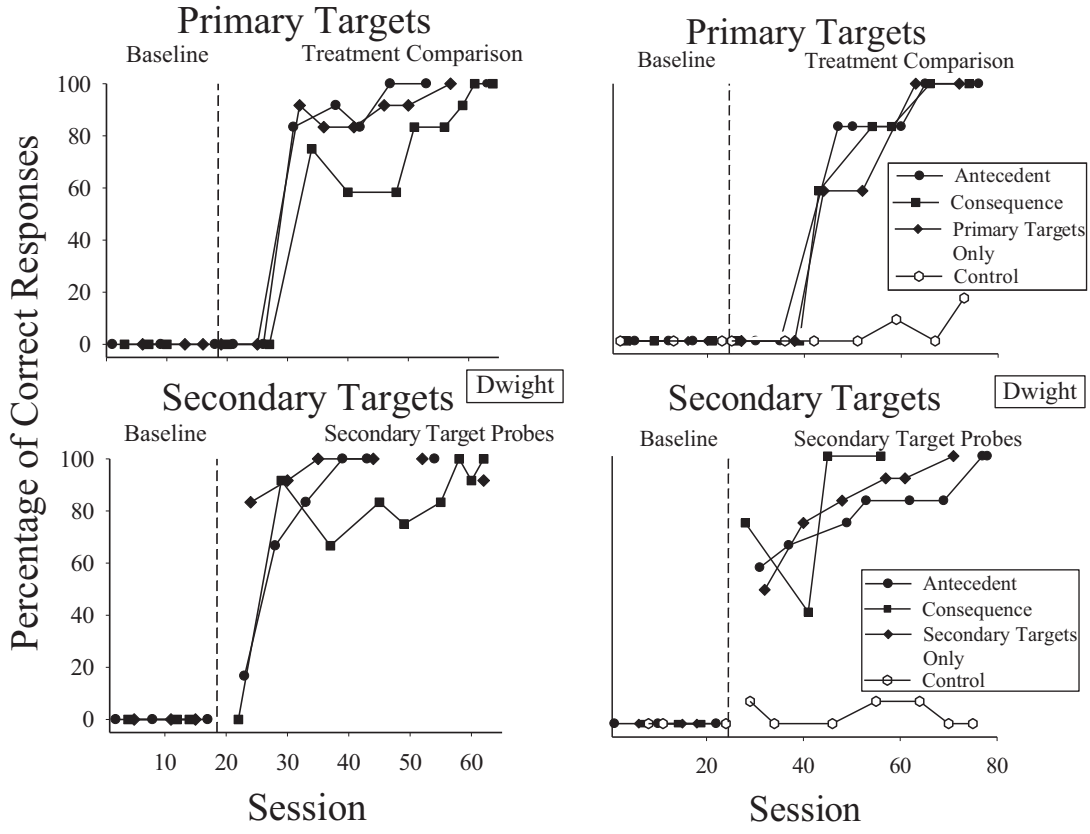

Figure 3. The percentage of correct responses to primary and secondary targets in each condition for Dwight. Lines connecting data points were removed for review sessions that were conducted with mastered stimuli while we continued to conduct training in other conditions.

To make additional comparisons regarding instructional efficiency, we calculated the training time per acquired target for each condition by dividing the total training time for each condition by the number of acquired targets for Rick and Dwight (session duration data were unavailable for Kevin and Winnie). For both participants, conditions involving secondary targets required the least amount of training time per target ($M = 1$ min 42 s, $M = 1$ min 50 s, $M = 2$ min in the antecedent, consequence, and secondary-targets-only conditions, respectively, for Rick; $M = 2$ min 31 s, $M = 3$ min, $M = 1$ min 53 s in the antecedent, consequence, and secondary-targets-only conditions, respectively, for Dwight's first treatment comparison; and $M = 3$ min 1 s, $M = 2$ min 41 s, $M = 3$ min 6 s in the antecedent, consequence, and secondary-targets-only conditions, respectively, for Dwight's second treatment comparison) relative to the primary-targets-only condition, which is the procedure that is used often during instruction in early intervention programs ($M = 3$ min 17 s for Rick; $M = 5$ min 2 s for Dwight's first comparison; and $M = 4$ min 51 s for Dwight's second comparison).

DISCUSSION

We evaluated the effects of presenting secondary targets in learning trials to teach four children with ASD to tact common objects and respond to

intraverbal fill-in-the-blank statements. Three of the four participants acquired the secondary targets without explicit instruction. Presenting secondary targets in learning trials also was a more efficient approach to intervention for three of the four participants because they mastered double the number of stimuli in conditions that included primary and secondary targets compared to conditions that included primary targets only in a similar amount of training time. Furthermore, participants frequently echoed the experimenter's vocal model of secondary targets in the absence of prompting or reinforcement of that response. These results provide additional evidence to support the use of these teaching procedures during early intervention programming with children with an ASD.

Results are similar to those of Reichow and Wolery (2011) who demonstrated that presenting secondary targets as a consequent event during learning trials was more efficient for teaching sight words than similar teaching protocols without secondary targets. The present study also extended previous research by demonstrating that, for at least some learners with an ASD, (a) presenting secondary targets in the antecedent portion of learning trials may produce outcomes similar to presenting secondary targets in the consequence portion, (b) some children may acquire targets in a condition in which most of the components of DTI are omitted (i.e., the secondary-targets-only condition in which participants were not required to emit a response, and the experimenter did not deliver controlling prompts or provide reinforcement for correct responses; as demonstrated by Winnie, Dwight, and Rick), and (c) collecting ongoing probe data are useful for evaluating the emergence and acquisition of secondary targets during primary-target instruction.

Similar to T. D. Wolery et al. (2000), our results suggest that differences in the results of antecedent and consequence conditions were often minimal. The selection of one of these arrangements may be left to the instructional programmer's discretion. However, it seems preferable to evaluate the learner's preference for these different experimental arrangements. Future studies could evaluate children's preference for teaching arrangements that do or do not include the presentation of secondary targets. It is also possible that differences in the efficiency of procedures may be related to the learner's response characteristics (Kodak et al., 2011) or instructional history (Coon & Miguel, 2012). Identifying the predictors of efficient teaching procedures are important areas for research.

By evaluating the emergence and acquisition of secondary targets during ongoing instruction for primary targets, we were able to determine the point at which participants acquired the secondary targets. Surprisingly, several participants acquired the secondary targets before mastering the primary targets that were exposed to direct training. To our knowledge, only Anthony et al. (1996) evaluated the acquisition of secondary targets during primary-target instruction. Anthony et al. found that participants did not demonstrate mastery-level responding of secondary targets during probes prior to completing training of the primary targets. Thus, the authors recommended against conducting probes. However, our results suggested that some individuals may acquire secondary targets prior to primary targets; probes are necessary to identify this acquisition. If probes indicate the participant has mastered the secondary targets before the primary targets, it may be possible to introduce novel secondary targets; however determining the frequency of these probes to maximize teaching efficiency remains an important area for future research.

We, as well as previous researchers (Reichow & Wolery, 2011), hypothesize that a generalized-imitation repertoire may be important in the acquisition of secondary targets. All participants echoed the secondary targets consistently, but the acquisition of secondary targets was variable. Winnie, Dwight, and Rick learned the secondary targets without direct training, whereas Kevin

required direct training. It is important to note that Kevin's attendance during the evaluation was inconsistent due to illness and family vacations; therefore, his results may not accurately reflect the role of echoic behavior in the success of this instructional procedure.

Acquisition of secondary targets may be related to a demand characteristic (M. Wolery et al., 1993). We presented all of the secondary targets within a similar instructional context as primary targets such that participants had prior histories of reinforcement for attending to stimuli and responding to instructions. Another, but similar, way to conceptualize responding to secondary targets is that participant's demonstrated generalized imitation (Baer, Peterson, & Sherman, 1967). We reinforced imitative behavior following prompts during the training of primary targets. The reinforcement contingencies for imitating the experimenter's vocal model may have been indiscriminable across conditions and targets.

Several limitations of the current evaluation should be mentioned. We did not collect treatment integrity data and recommend future studies collect these data, particularly in relation to the experimenter's responses to the secondary targets, to ensure the experimenter does not reinforce participant responses during probes. Also, the demonstration of experimental control for Winnie's and Dwight's first treatment comparison was relatively weak, as they unexpectedly acquired the targets from the secondary-targets-only condition without direct teaching. Thus, we cannot rule out the effects of maturation or repeated exposure as an explanation for these gains. We enhanced the demonstration of experimental control for Rick's treatment evaluation and for Dwight's second treatment comparison by including a control condition, controlling for the effects of repeated exposure to the materials and for maturation effects.

There was also overlap in responses taught within Dwight's first treatment comparison. More specifically, we included some symmetrical opposites across conditions (e.g., "The opposite of back is —" was a primary target in the antecedent condition, and "The opposite of front is —" was a primary target in the consequence condition). Although we cannot exclude the possibility that teaching of one response may have resulted in behavior change in another condition, it should be noted that Dwight consistently failed to demonstrate symmetrical intraverbal responses during his typical educational programming. Nonetheless, such relations are better avoided in future research.

Finally, there was minimal within-subject replication in this study (Dwight only). During Dwight's first treatment comparison, the secondary-targets-only condition was most efficient, whereas the consequence condition was most efficient in the second treatment comparison. This difference highlights the importance of within-subject replications; it is unclear if the results yielded from each participant represent a clear bias to one teaching procedure for that participant. We recommend additional within-subject replications in future research.

Additional research also could evaluate the outcome of exposing individuals to a condition analogous to our secondary-targets-only condition in less structured teaching settings (e.g., home, community outings). Outcomes of these studies will help demonstrate the generality of effects of the presentation of secondary targets only and may aid in the identification of behavioral processes responsible for the acquisition of secondary targets and help guide clinicians in determining the types of learners for whom these instructional practices are likely to be most effective.

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