Teaching Receptive Discriminations to Children With Autism: A Comparison of Traditional and Embedded Discrete Trial Teaching

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ABSTRACT

Discrete trial teaching (DTT) procedures have proven effective in teaching language to children with autism. Discrete trial teaching uses a highly structured, fast-paced format of instruction that is typically conducted in a one-to-one situation at a desk or table with minimal distractions. We compared this traditional model of DTT to a version of DTT in which instruction was embedded within the context of a more naturalistic, activity-based environment. However, all of the other characteristics of DTT (e.g., pacing, tight stimulus control, targets selected by the teacher) were retained. Receptive discriminations were taught to 2 4-year-old boys, diagnosed with autism in traditional or embedded DTT. Results showed that for both boys, traditional and embedded DTT were equally effective and efficient. Additionally, measures were collected on participant affect and a concurrent-chains preference evaluation was used to determine which teaching procedure was preferred by the participants. The two procedures produced similar levels of positive and negative affect and were equally preferred by 1 participant while embedded DTT produced more positive affect and was more preferred by the other.
Keywords: autism, conditional discriminations, discrete-trial teaching, embedded instruction, listener behavior, receptive discriminations

Discrete trial teaching (DTT) is a common technique within early and intensive behavioral interventions for children with autism (Leaf & McEachin, 1999; Smith, 2001). The discrete trial is a brief learning unit that lasts approximately 5 to 20 s that is presented rapidly to maximize the learning opportunities in each teaching session (Smith, 2001). Discrete trial teaching typically includes salient discriminative stimuli, structured prompting schedules, and tight stimulus control that are thought to enhance instruction for learners with autism (Newsom, 1998; Smith, 2001). In DTT, occurrences of the target behavior result in immediate reinforcement, such as praise, small snacks, or toys, whereas occurrences of incorrect responses result in extinction or error correction. Programmed reinforcers are selected for use based on consumer preference and may not be functionally related to the target behavior. In addition, DTT often occurs in a quiet, structured setting, where distractions are minimized (Delprato, 2001).

Discrete-trial teaching can be used to teach a number of language and academic skills including vocal and motor imitation, simple and conditional discriminations, labeling, and question answering (Smith, 2001; Sundberg & Partington, 1999). Despite its established efficacy, DTT has been criticized on a number of bases. One criticism is that, because DTT is highly structured with tight stimulus control, responses may not generalize to more naturalistic settings that have more distractions, looser stimulus control, and less salient discriminative stimuli (Charlop-Christy, LeBlanc, & Carpenter, 1999; Smith, 2001). Another criticism of DTT is that some children with autism may not be able to sit and attend to the instruction or stay motivated to continue working during highly structured DTT sessions (Koegel, Openden, Fredeen, & Koegel, 2006). This criticism could theoretically be countered with teaching sessions that appeared more play-like or that occurred in naturalistic conditions. A third criticism of DTT is that the rate of instruction may be too demanding for young children with autism and may evoke escape-maintained problem behavior (Koegel, Koegel, & Surratt, 1992).

In response to the above criticisms of DTT, a growing literature has investigated alternative teaching procedures that enhance generalization, are fun and appealing to children and caregivers, and keep motivation high (Delprato, 2001). Many of these studies have compared language acquisition under DTT and naturalistic interventions (Charlop-Christy et al., 1999) with children with autism. Delprato (2001) reviewed 10 such studies in which what he termed "normalized" interventions (hereafter referred to as *naturalistic*) were defined as having less structured teaching sessions, opportunities for teaching in the natural environment, child-led in regards to the target responses (i.e., the child's interests determine the timing and content of the instructional event), and the use of reinforcers that were naturally related to the target response. The studies included a variety of naturalistic intervention approaches such as incidental teaching, the natural language paradigm (NLP), pivotal response training, and embedded instruction. In general, the results of the studies have found DTT to be less optimal than the naturalistic interventions in the acquisition and generalization of language targets. However, Delprato's conclusions need to be weighed against two limitations commonly found within this literature.

First, many comparisons of DTT and naturalistic approaches are confounded by the fact that different verbal operants are taught in the two conditions. For example, Koegel, O'Dell, and Koegel (1987) compared NLP to DTT for teaching immediate and delayed vocal imitation with two children with autism and found NLP to be a superior intervention. In both conditions the experimenter held up an item (e.g., a ball) associated with the target response (e.g., "ball"), essentially teaching a tact relation. However, the reinforcer for correct responses in DTT was praise and an edible, whereas the reinforcer for NLP was praise and access to the item. Thus, the experimenters taught a pure tact in DTT and an impure tact with mand features in NLP, which could have accounted for the differences in acquisition. Similarly, Sigafoos et al. (2006) demonstrated that embedded instruction resulted in less problem behavior, slightly more positive affect, and slightly better compliance than DTT with a child with autism and severe intellectual disability. However, embedded instruction was used to teach mands and DTT was used to teach imitation and receptive labeling. Other similar comparative studies in this literature have suffered from similar confounds (e.g., Koegel & Williams, 1980; Neef, Walters, & Egel, 1984; Williams, Koegel, & Egel, 1981).

Second, many comparisons of DTT and naturalistic approaches have included iterations of DTT that may have been less than optimal. For example, McGee, Krantz, and McClannahan (1985) taught 3 participants to tact the location of stimuli using prepositions in DTT type training sessions compared to incidental teaching sessions. While the authors mention that the reinforcers (i.e., the same stimuli used during training) used for correct responses were "child-selected," they do not specifically state the use of a formal preference assessment for each participant, which is crucial to ensure an optimal DTT session. In another example, experimenters employed massed trial teaching (i.e., repeating the same trial) in the DTT condition and did not in the naturalistic conditions (Koegel, Bimbela, & Schreibman, 1996; Koegel, Camarata, Koegel, Ben-Tall, & Smith, 1998). The current best practice recommendations for an optimal DTT session would be to incorporate multiple targets by interspersing these targets during each teaching session as opposed to a massed trial format of repeatedly presenting individual targets (Green, 2001).

Although DTT and naturalistic interventions have both been shown to be effective at teaching language to children with autism, there are limitations of each. Discrete-trial teaching might be so overly structured that it has poor social validity for caregivers (Delprato, 2001; Koegel & Koegel, 2006), whereas some naturalistic interventions may not include sufficient learning trials. An instructor may find that a learner needs structure during instruction for quick acquisition, but wants to incorporate the fun, relaxed style of instruction associated with naturalistic interventions.

One form of naturalistic intervention—embedded instruction—might constitute a reasonable solution. Embedded instruction involves incorporating structured learning opportunities into naturally occurring activities (Daugherty, Grisham-Brown, & Hemmeter, 2001). One way to arrange embedded instruction is to identify play-based activities based on a learner's established preferences (e.g., Thomas the Tank Engine) and the type of skill that needs to be taught (e.g., receptive discriminations). The reinforcers could be directly embedded in the play-based activity such that if the learner responds correctly to the instructional trial, the reinforcer is advancement in a game (e.g., moving forward on a game board) or access to additional pieces of a desired play structure within the game or activity, respectively.

In the current study, we arranged two teaching conditions, one in which we implemented procedures consistent with traditional DTT and one in which we implemented procedures consistent with embedded instruction. In contrast to previous comparative studies in which the skills differed across the intervention conditions, we taught receptive skills in both teaching conditions. Thus, the purpose of the present study was to compare traditional and embedded DTT in terms of efficacy, efficiency, and participant affect. In addition, a concurrent-chains evaluation of preference (Hanley, 2010) was used to determine whether participants preferred either DTT procedure.

Method

Participants and Setting

Two, 4-year-old boys with a prior diagnosis of autism participated in the study. Ben had an overall score of 79 (out of 170) on the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP[1]; Sundberg, 2008), indicating that his language was on par with typically developing 18- to 30-month-olds. He spoke in short phrases, was able to follow simple instructions, and exhibited minimal problem behavior. Sawyer had an overall VB-MAPP score of 119, indicating that his language was on par with typically developing 30- to 48-month-olds. He spoke in full sentences and was able to follow some multistep instructions, but occasionally engaged in tantrums (e.g., crying, yelling, throwing materials).

All sessions were conducted in a small therapy room in the participants' preschool. The therapy room was approximately 4 m x 1 m and contained a child-sized table and two chairs. Traditional DTT sessions were conducted at the table and chairs. Embedded DTT sessions were conducted on the floor for Ben and at the table for Sawyer.

Materials

Materials for the traditional DTT sessions included picture cards and preferred edibles. Ben's embedded DTT sessions involved the Jump to It game, which included a tarp with 9 rows of 3 (total 27) 15 cm diameter foam circles with one picture attached to each (See Figure 1, top panel). Sawyer's embedded DTT sessions involved the Train activity, which included a small Thomas the Tank Engine Train and wooden interlocking train tracks with one picture card attached to each (See Figure 1, bottom panel).

Measurement and Interobserver Agreement

The main dependent measure for the treatment comparison was the percentage of correct trials per 9-trial session. A *correct response* was defined as a participant touching the correct picture within 3 s of the instruction. An *incorrect response* was defined as a participant touching the incorrect picture or not touching a picture within 3 s of the instruction. Data were also collected on session duration, affective behavior during instruction, and preference for instruction type. For *session duration*, the time from the beginning of the first instruction until the participant consumed the edible or the experimenter removed the train after the last trial was recorded for each session. Two classes of affective behavior were coded, positive and negative. Data collectors watched video recordings of sessions and used continuous 15-s partial-interval recording to code the presence of positive or negative affective behavior of the participant. Positive and negative affect were not mutually exclusive in that they could be coded during the same interval. *Positive affect* included smiling, laughing, clapping, and making positive statements about the activity (e.g., "This is fun."). *Negative affect* included frowning, crying, yelling, and making statements about disliking or wanting to terminate the activity (e.g., "I don't want to do this."). Finally, the *treatment preference* dependent variable was defined as a participant touching 1 of 3 pictures after the experimenter asked, "How do you want to learn?" during a choice trial.

A second trained observer independently collected data during a subset of sessions to calculate interobserver agreement (IOA). Point-by-point IOA on correct and incorrect responses was assessed for 98% and 72% of sessions for Ben and Sawyer, respectively. An agreement was scored when both observers recorded that the response was correct or incorrect for a given trial. Mean IOA was 99% (range, 78%–100%) for Ben and 99.7% (range, 78%–100%) for Sawyer. IOA on affective behavior was assessed for 100% and 39% of sessions for Ben and Sawyer, respectively. An agreement was scored if both observers recorded the presence or absence of positive and negative affect during a given interval. Mean IOA for affective behavior was 90% (range, 70%–100%) for Ben and 93% (range, 81%–100%) for Sawyer. IOA on picture selections during the preference test was assessed for 100% for both participants. An agreement was scored when both observers recorded the same card selection for the session. IOA was 100% for both participants.

Experimental Design

An adapted alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985) was used to compare the acquisition of target sets that were taught either with traditional or embedded DTT. Each target set included 3 stimuli. (See Table 1 for the list of targets in each set.) Target sets were

Table 1. Receptive Discrimination Targets Taught in Traditional and Embedded DTT and the Concurrent-Chain Preference Evaluation for Ben and Sawyer.

	Traditional DTT	Embedded DTT	Concurrent-Chain Preference Evaluation
Ben: Set 1	Llama Rhino Whale	Koala Platypus Cheetah	Salty Sweet Sour
Ben: Set 2	Stingray Hippo Polar bear	Meerkat Anteater Gecko	Bitter Spicy Cheesy
Sawyer: Set 1	Vegetable Dairy Fruit	Fats Grains Protein	Arctic animal Forest animal Desert animal
Sawyer: Set 2	Sweet Sour Bitter	Cheesy Salty Spicy	Mammal Insect Reptile

equated for difficulty across experimental conditions by the degree of dissimilarity of the pictures and of the first syllable in each auditory discriminative stimulus. Each session consisted of nine trials of one of the target sets (three trials per target). The order of sessions was randomly determined; however, once a randomly determined session occurred, the next session automatically consisted of the other condition. Additional target sets, including three stimuli each, were taught during the concurrent-chains evaluation of preference. (See Table 2 for the list of targets in the concurrent-chains preferences assessment.)

Procedure

Pre-experiment assessments. The VB-MAPP was conducted to assess each participant's language abilities and identify potential targets. The VB-MAPP was conducted according to the standard assessment procedures (Sundberg, 2008). A brief multiple stimulus (without replacement) preference assessment (MSWO; Carr, Nicolson, & Higbee, 2000) also was conducted to identify preferred edibles to use during DTT sessions. The brief MSWO consisted of three complete presentations of a 5-item array of edibles.

Baseline. During baseline sessions for traditional DTT, the experimenter placed three picture cards in front of the participant, provided the instruction (e.g., "Point to the cheetah"), and allowed 3 s for a response. Regardless of the participant's response, the experimenter said nothing, removed the stimuli, and presented the next trial. During Ben's embedded DTT sessions, the experimenter stood Ben in front of the Jump to It game, provided the instruction (e.g., "Jump to the anteater"), and allowed 3 s for a response. Regardless of Ben's response, the experimenter said nothing and presented the next trial. If Ben did not advance to the next row, the experimenter did not prompt him to advance. Sawyer's embedded DTT sessions were conducted identically to the traditional DTT condition.

Traditional DTT. During traditional DTT sessions, the experimenter presented the stimuli in front of the participant, provided the instruction, and allowed 3 s for a response. If the participant selected the correct item, the experimenter provided praise and a preferred edible. If the participant selected the incorrect item or did not select a picture within 3 s, the experimenter restated the instruction, pointed to the correct picture, and allowed 3 s for a response. For both participants, pointing to the correct picture resulted in a correct selection, so no additional prompts were used. Once the participant was correct, the experimenter provided praise and presented the next trial. Sessions continued until the participant reached the acquisition criterion of three consecutive sessions with 100% accuracy.

Embedded DTT. During Ben's embedded DTT sessions, the experimenter stood him in front of the Jump to It game, provided the instruction (e.g., "Jump to the cheetah."), and allowed 3 s for a response. If Ben jumped to the correct picture, the experimenter provided praise and a preferred edible. If Ben jumped to the wrong picture or did not jump within 3 s, the experimenter prompted him to back up, restated the instruction, pointed to the correct picture, and waited 3 s for a response. Pointing to the correct picture always resulted in a correct jump to the picture, so no additional prompts were used. Once Ben jumped to the correct picture, the experimenter provided praise and presented the next trial. Ben was not prompted to move from the picture after the trial was complete. Instead, the next trial was presented to Ben while he was standing on the picture from the previous trial.

During Sawyer's embedded DTT sessions, the experimenter allowed Sawyer to play with one piece of train track and the Thomas train for approximately 10 s. The experimenter then removed the track and train and presented the 3 picture cards, each attached to a piece of track. Then the experimenter provided the instruction (e.g., "Point to the vegetable") and allowed 3 s for a response. If Sawyer selected the correct picture card, the experimenter provided praise, gave the piece of track to Sawyer and allowed him to play with it, the other accumulated pieces of track, and the train for 30 s. Then the experimenter removed the train and tracks to present the next trial. The acquired pieces of track accumulated across trials so that if he got all of the trials correct in the session, he would have a complete 10-piece track that connected in an oval shape. If Sawyer selected the incorrect picture or did not select a picture within 3 s, the experimenter restated the instruction and pointed to the correct picture. Pointing to the correct picture always resulted in a correct selection, so no additional prompts were used. Once Sawyer was correct, the experimenter provided praise and allowed him to play with the train and his accumulated pieces of track for 30 s, but he did not acquire a new piece of track. Embedded DTT sessions continued until the participant reached the acquisition criterion of three consecutive sessions with 100% accuracy.

Concurrent-chains preference evaluation. During the concurrent-chains preference evaluation, the participant was taught a new target set during which he was allowed to periodically select the type of instruction, traditional or embedded DTT. Prior to the first selection opportunity, the experimenter exposed the participant to the selection contingency. A picture representing traditional DTT (a table, an array of stimuli, and an edible reinforcer) and another picture representing embedded DTT (the game) were attached to a laminated sheet of paper and presented to the participant. The experimenter then prompted the participant to select one picture by saying, "Point to this one," and pointing to the picture. Then she immediately presented one teaching trial of the corresponding type of instruction. The experimenter then prompted the participant to select the other picture and immediately completed one teaching trial of that condition. This exposure trial was completed once for each condition. Once the exposure was complete, the experimenter held up the pictures and asked, "How do you want to learn?" After the participant made a selection, the experimenter immediately completed three trials of the corresponding type of instruction. The participant was given a 30-s break before being asked to make another selection. Selections continued until the participant acquired the target set.

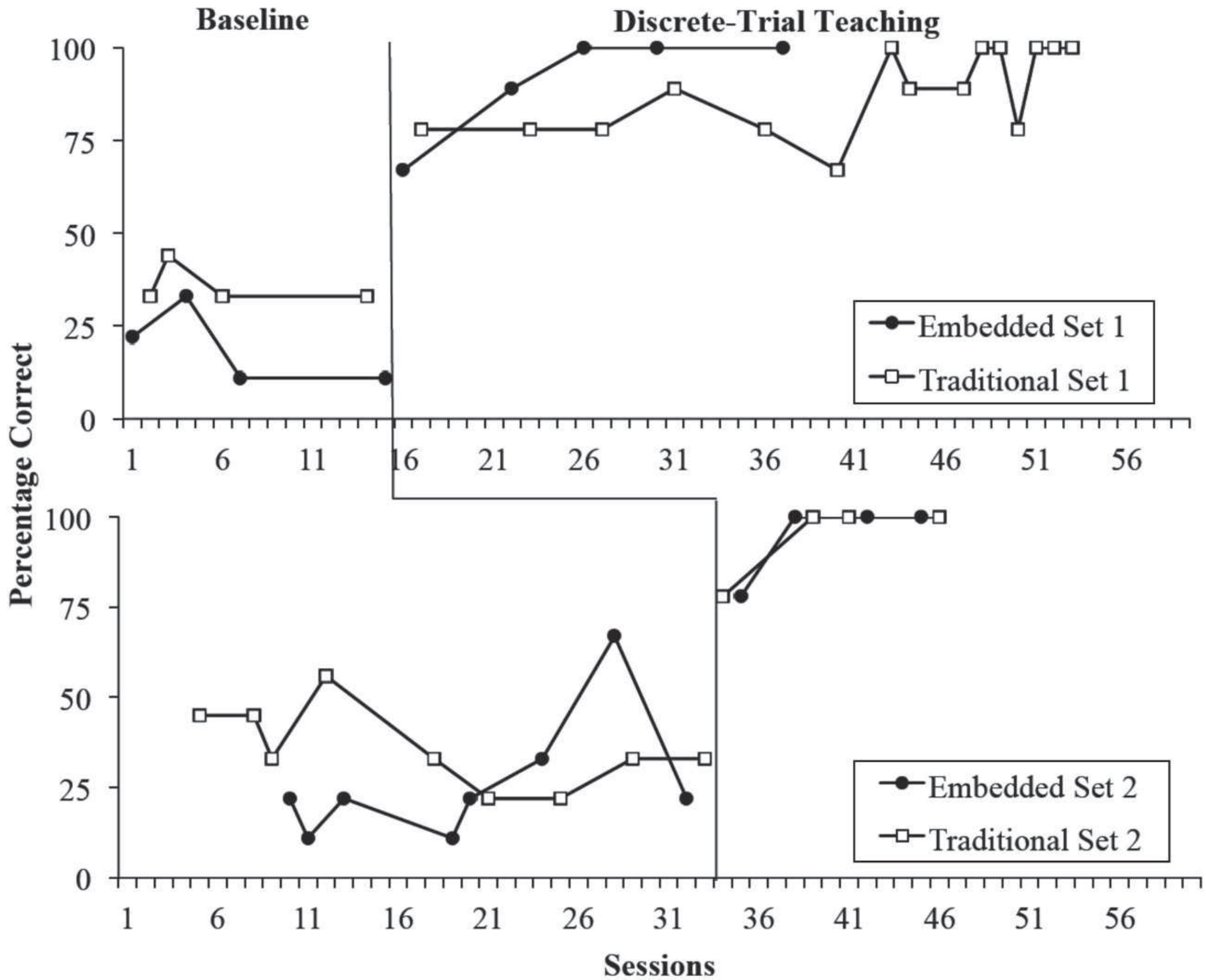

Figure 1. Percentage of correct responses during embedded and traditional DTT conditions across two comparisons for Ben.

If a participant did not differentially select one instruction type over another, a third picture of an empty chair was introduced. The empty-chair picture represented a control condition (no interaction) to distinguish between indiscriminant selections and equal preference. After the control picture was introduced, a 33% selection percentage for each of the three cards would indicate indiscriminant responding. Alternatively, if the selection percentage for the control picture deviated from 33%, either above or below, it would indicate that the participant was selecting meaningfully and had no significant preference for instruction type. When the control picture was introduced, the experimenter exposed the participant to the selection contingency for all three conditions (traditional DTT, embedded DTT, control). The exposure procedure for traditional and embedded DTT was identical to the first exposure trial. For the control condition, the experimenter prompted the participant to select the picture of the empty chair and immediately sat the participant in a chair and did not look at or interact with him for 30 s. After exposure trials were complete, selection trials began as described above except that selecting the control card resulted in 1 min of no interaction.

Procedural Integrity

Procedural integrity was assessed for 68% of traditional DTT sessions and 33% of embedded DTT sessions for Ben and 59% of traditional DTT sessions and 73% of embedded DTT sessions for Sawyer. Procedural steps assessed included presenting the correct instruction for the trial, waiting 3 s for the learner to respond, re-presenting the instruction and immediately providing a gestural prompt during error correction, and providing correct type of reinforcement for the trial. Procedural integrity was calculated as the percentage of steps correctly completed by the experimenter during an entire intervention session (i.e., nine trials). Mean procedural integrity was 100% for both of Ben's experimental conditions and 100% for traditional DTT and 99.6% (range, 96%–100%) for embedded DTT for Sawyer.

Results

Figure 1 depicts the percentage of correct responses for Ben during the comparison of traditional and embedded DTT. During both baseline conditions, Ben's responding failed to

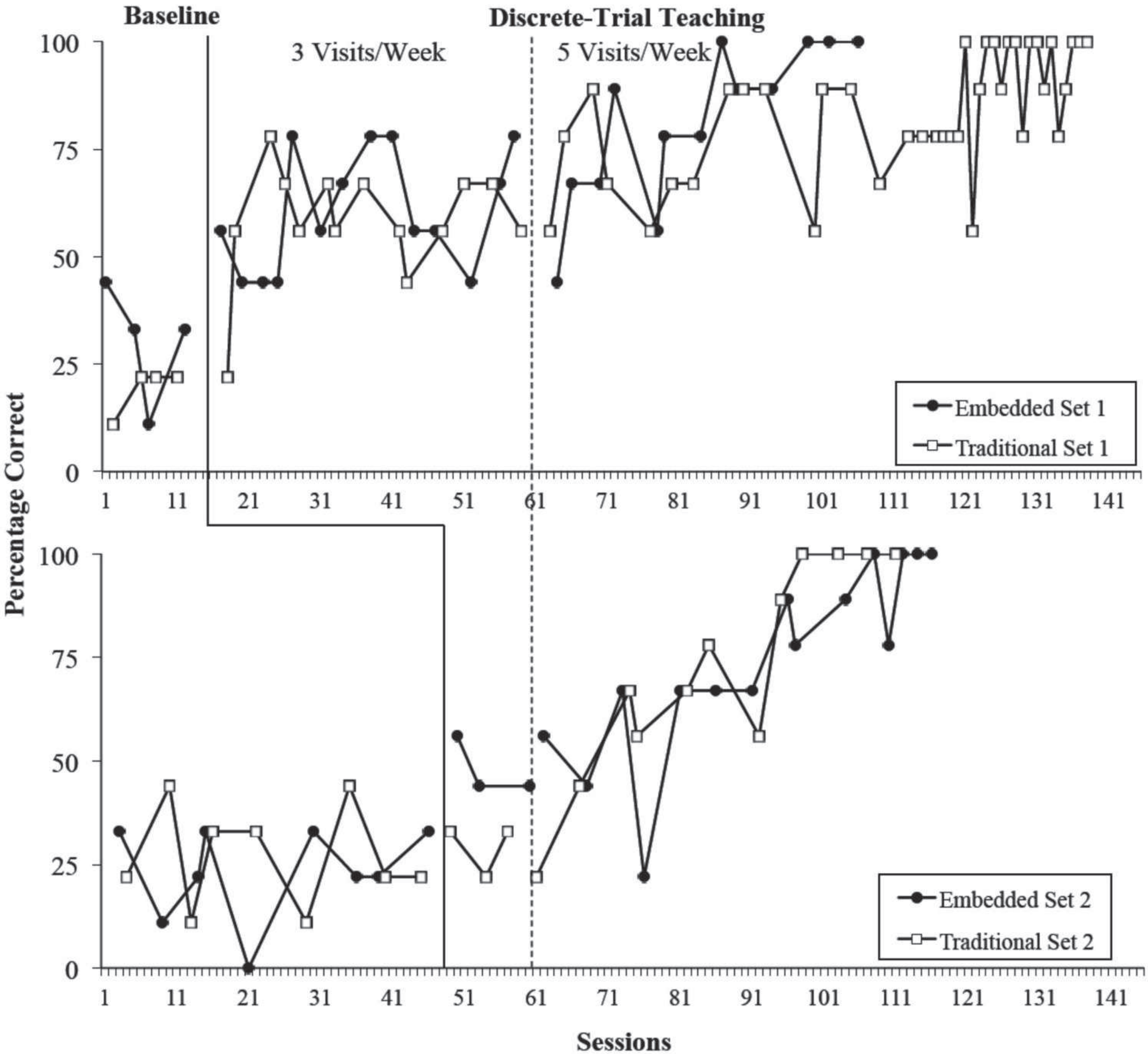

Figure 2. Percentage of correct responses during embedded and traditional DTT conditions across two comparisons for Sawyer.

reliably exceed chance level (33% correct). As seen in the first evaluation (top panel), embedded DTT produced rapid acquisition, with Ben acquiring the target set in 5 sessions, whereas traditional DTT produced a more modest acquisition pattern, with Ben acquiring the target set in 15 sessions. These results were not replicated in the second evaluation (bottom panel) as both embedded DTT and traditional DTT produced rapid acquisition; both target sets were acquired in 4 sessions each.

Figure 2 depicts the percentage of correct responses for Sawyer during the comparison of traditional and embedded DTT. During both baseline conditions, Sawyer's responding failed to reliably exceed chance level. As seen in the first evaluation (top panel), both embedded DTT and traditional DTT produced moderate improvements in accuracy of responding. When a change in participant availability allowed for more frequent visits during the week, embedded DTT produced more rapid acquisition than traditional DTT. The target set for embedded DTT was acquired in 27 sessions whereas the target set for traditional DTT was acquired in 52 sessions. As with Ben, these results were not replicated in the second evaluation (bottom panel). Sawyer exhibited similar acquisition patterns for both traditional and embedded DTT, acquiring the target sets for embedded DTT in 18 sessions and traditional DTT in 14 sessions.

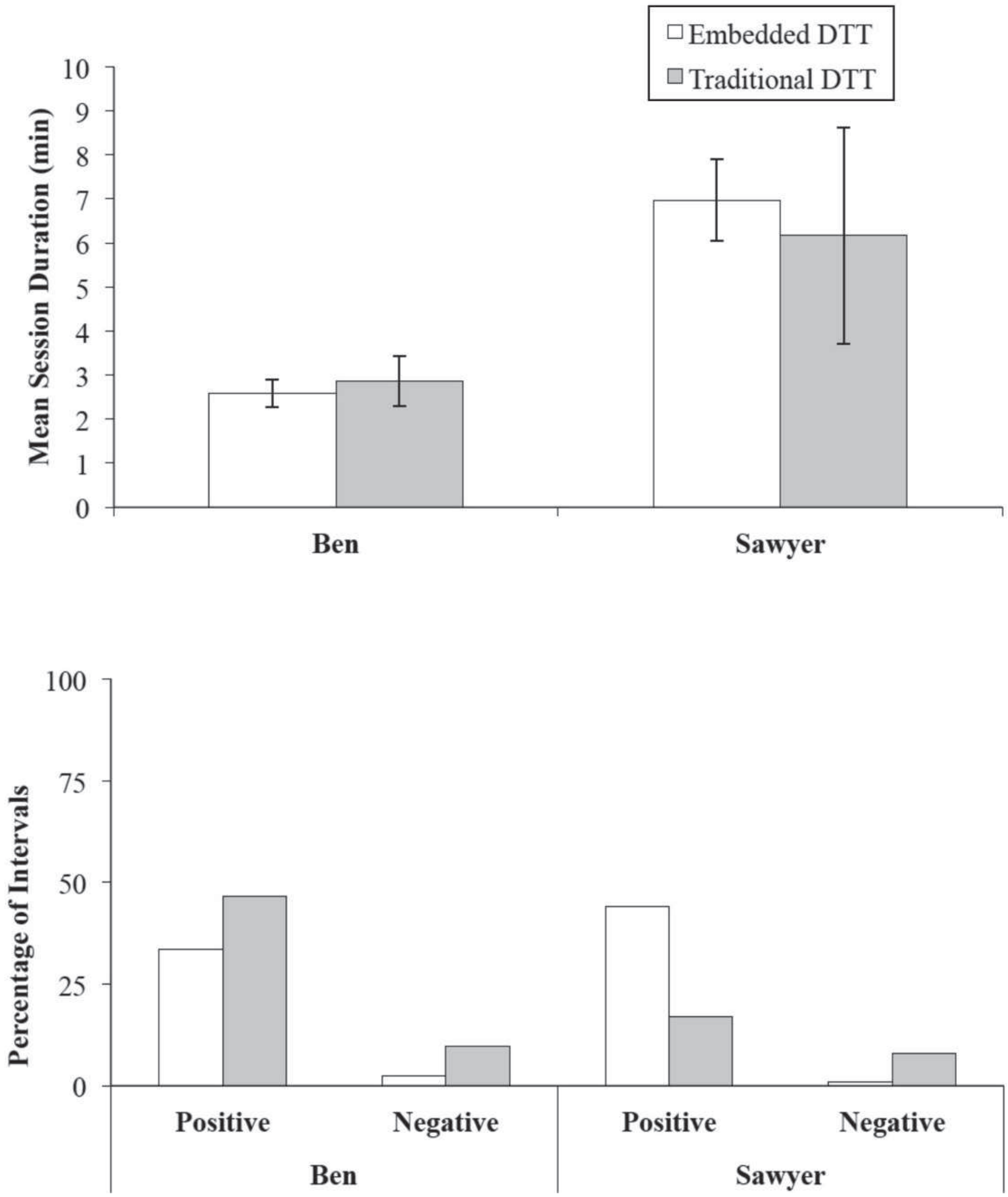

Figure 3. Mean session duration of embedded and traditional DTT for Ben and Sawyer (top panel). Note: error bars represent 1 standard deviation. Percentage of intervals of positive and negative affective behavior during each condition for Ben and Sawyer (bottom panel).

The top panel of Figure 3 depicts the mean session duration for traditional and embedded DTT for each participant. Across participants, embedded and traditional DTT had comparable mean session durations. Ben's mean session duration for embedded DTT was 2.6 min (range, 2.1–3.0 min) and for traditional DTT was 2.9 min (range, 2.0–4.2 min). Sawyer's mean session duration for embedded DTT was 7.0 min (range, 5.0–8.7 min) and for traditional DTT was 6.2 min (range, 2.5–12.8 min).

The bottom panel of Figure 3 depicts the participants' affective behavior during instruction. Ben's mean percentage of intervals with positive affective behavior for embedded DTT was 34% (range, 18%–66%) and for Traditional DTT was 48% (range, 17%–100%). Sawyer's mean percentage of intervals with positive affective behavior for embedded DTT was 44% (range, 5%–81%) and for traditional DTT was 17% (range, 0%–50%). Ben's mean percentage of intervals with negative affective behavior for embedded DTT was 3% (range, 0%–11%) and for traditional DTT was 11% (range, 0%–40%). Sawyer's mean percentage of intervals with negative affective behavior for embedded DTT was 1% (range, 0%–14%) and for traditional DTT was 9% (range, 0%–77%).

Figure 4 depicts the participants' cumulative selections during the concurrent-chains preference evaluation. Ben (top

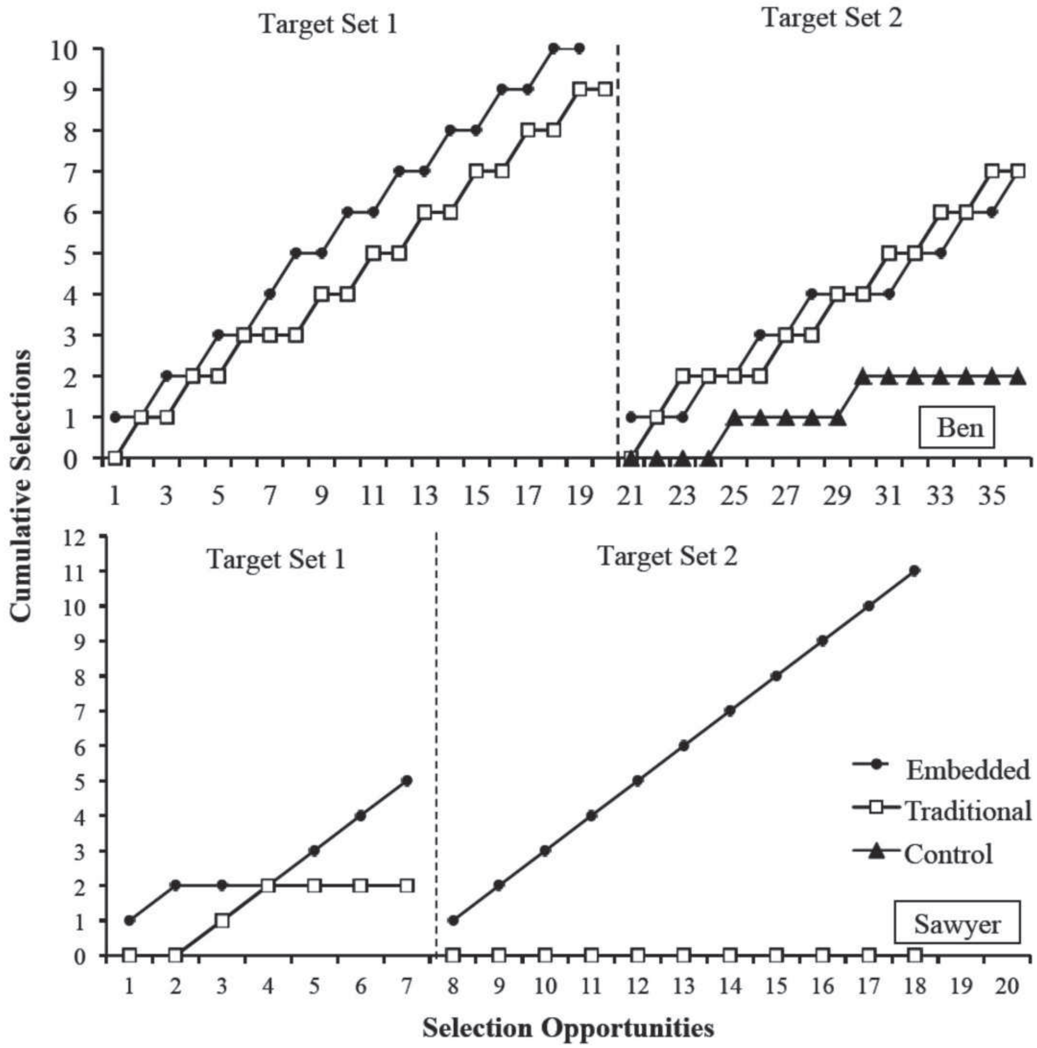

Figure 4. Cumulative selections during the concurrent-chains preference evaluation for Ben (top panel) and Sawyer (bottom panel).

panel) showed no differentiation in his selections between embedded DTT and traditional DTT during the first preference evaluation. After the control card was introduced, Ben continued to alternate his selections primarily between the embedded DTT and traditional DTT cards, selecting each seven times, while selecting the control card only twice. This selection pattern provides evidence against indiscriminate responding in the first preference test and suggests that Ben had no differential preference for embedded DTT or traditional DTT, but preferred both instructional procedures to the control condition. Sawyer (bottom panel) showed a slight preference for embedded DTT in the first preference evaluation. Sawyer's preference for embedded DTT was more pronounced in the second preference evaluation, where he selected the embedded DTT card 11 times and never selected the traditional DTT card. In addition to direct tests of preference, anecdotally, both participants described the embedded DTT as "fun" or "play" and the traditional DTT as "work," despite the fact that both embedded DTT and traditional DTT instructional trials were structured similarly except for the game and activity-based aspect of the embedded DTT condition.

Discussion

The present study was designed to compare two versions of the ubiquitous DTT procedure: traditional and embedded. The study was thematically related to previous comparisons of DTT with more naturalistic approaches such as embedded instruction, but controlled for two confounds with this literature. First, the same skill was taught in each condition. Second, both versions of DTT incorporated known best practices (e.g., highly preferred stimuli as reinforcers, no mass trials). The results of the study indicate that embedded DTT and traditional DTT were similarly effective in teaching receptive discriminations. Additionally, embedded DTT required a comparable amount of time to implement as traditional DTT. Traditional DTT session times were more variable than embedded DTT, possibly because of the variable amounts of time that the participant took to consume the edible reinforcer before the next trial could be presented.

Previous literature has characterized DTT as having poor social validity (Delprato, 2001); therefore, a concurrent-chains procedure was used as an indicator of participant preference and social validity. This preparation allowed Sawyer to indicate his preference for embedded DTT and Ben to indicate his indifference for which teaching method was used, and his preference for both traditional DTT and embedded DTT over a break. The incorporation of concurrent-chains preference assessments are important for selecting between equally effective treatments (Hanley, 2010). Several aspects of the embedded DTT procedure may have made it more appealing to Sawyer. For instance, Sawyer received highly preferred edibles in the traditional DTT condition and highly preferred train track pieces and play time in the embedded DTT condition. Perhaps the train track pieces were more preferred than the edibles. Interestingly, the presumably more fun response of jumping to a target stimulus (embedded DTT) compared to pointing to one while sitting (embedded DTT) did not appear to affect Ben's preference for the teaching procedures.

The results from the present study extend the literature in demonstrating that embedded DTT, a hybrid of traditional DTT and naturalistic approaches, can be an effective alternative to traditional DTT instruction, potentially mitigating some concerns regarding the social invalidity of the latter. Future research might compare embedded DTT to other naturalistic approaches if the targeted skills can be equated. Nevertheless, at least two limitations of the present study are worth noting. First, the reinforcers delivered during Ben's embedded DTT game were not functionally related to the activity itself. Instead, Ben's target behavior (i.e., jumping) was related to the game rather than the reinforcers (i.e., preferred edibles). Although this differentiates the design of his embedded activity from Sawyer's, the positive outcomes do suggest that a game-specific target behavior might have some utility. Second, the preparation time and cost of materials were not measured or compared for this study. When considering implementing any alternative treatment, it is important to not only consider whether session time is increased, but also if there is an increased cost associated with purchasing additional materials or investing additional time to prepare the materials. The embedded DTT materials did cost a little more money and took more time to create than did the traditional DTT materials. However, it is important to know how much more time and money are invested so that a practitioner can weigh those investments against any benefits of using embedded DTT over traditional DTT. These limitations aside, including embedded DTT into typical early and intensive behavioral intervention could be a practical, potential option to incorporate a learner's interests and preferences into skill acquisition, while retaining the efficacy of traditional DTT instruction.

Practical Considerations and Suggestions

Embedded DTT could be appropriate for many learners and in a number of different contexts, but there are some situations in which it might be particularly beneficial. Using embedded DTT could be an effective method of curricular and instructional revision for an individual who has escape-maintained problem behavior (Carr, Newsome, & Binkoff, 1980). Geiger, Carr, and LeBlanc (2010) recommended that the first step toward treating escape-maintained problem behavior should be to assess the curriculum and instructional activities and make revisions where appropriate. Making DTT instruction more game-like or play-based, as in embedded DTT, could decrease the aversiveness of the task and reduce the value of escape as a negative reinforcer. Additionally, embedded DTT may be beneficial if play skills or social skills are also appropriate curricular targets. Embedded DTT could allow an instructor to target turn-taking, rule following, rolling a die and counting spaces, tolerating losing, or gracious winning.

Embedded DTT may also be appropriate to use in settings where traditional DTT and other naturalistic approaches either have poor social validity or are difficult to implement. For example, if a practitioner was attempting to target a skill in a general education classroom, embedded DTT may allow the instructor to target that skill in the context of a game where other students could participate as well, whereas targeting the skill in traditional DTT or naturalistically would necessitate separating the learner from the rest of the class. Additionally, embedded DTT may be appropriate when instructors prefer to use more naturalistic approaches but need to target a skill that does not easily lend itself to providing a "functional" reinforcer (i.e., access to the item). With embedded DTT, the reinforcer is preferred and contextually appropriate for a game or activity that allows the therapist to target any skill (e.g., receptive discriminations for animals) rather than just those that are directly related to the reinforcers (e.g., requests for the item, receptive discrimination of parts of a train). Finally, embedded DTT may be appropriate when it would be difficult to train the person providing instruction to employ naturalistic approaches, such as identifying a motivating operation and quickly creating a learning opportunity. Some peers, siblings, or even parents and caregivers may struggle to implement naturalistic approaches effectively and may find it easier to implement embedded DTT because of its increased structure and arbitrary reinforcement.

The process of creating an embedded DTT game or activity should begin with a series of questions that prompt consideration of several variables (see Appendix A). First, consider the specific purpose of the instructional program with respect to the desired repertoire and stimulus control and the potential benefit of the game/activity. Careful consideration of the long-term value of the skill should always precede program implementation. It is also critical to ensure that the context of the game/activity will not create stimulus control that is unusual such that responding does not occur as we would ultimately hope in ongoing everyday activities.

If a program is already being used to target the skills and the purpose of the game/activity is curricular revision to make programming more fun, analyze why the existing program is not as enjoyable as it could be. Perhaps the materials are too frequently used or uninteresting or the learner is required to sit at a table without variation for too extended an amount of time. Additionally, the reinforcement schedule could be too lean or the prompts might be aversive. In each instance, the game/activity should be designed to alter each problem (e.g., include fun materials, allow movement as part of the game).

The third question guides consideration of whether a game/activity could be appropriate to target the skill without undue taxing of staff resources. Determine how a game/activity could target the skill while incorporating a fun and engaging activity that is allowable in the current instructional context (e.g., certain games/activities might work on the playground, others in circle time). In this step, determine whether the time and monetary resources are available to create and to prepare the stimulus materials. Games/activities that can be adapted for use with many different learners and targets are likely to be worth the initial investment given the long-term utility. If the resources are available, the next determinations are the specific presentation of stimuli in the context of the game/activity, and how the delivery of the reinforcer will play a part in the game/activity. Conduct preference assessments to identify highly preferred items or activities that could be used as the context for the instruction and consider using circumscribed interests as the context of the game/activity. For example, Sawyer had a strong interest in Thomas the Train so his activity incorporated Thomas and he acquired pieces of the train track as reinforcers. The instructor should also identify any ancillary play skills or social skills that could be targeted within the context of the game/activity and any prerequisite skills that need to be taught prior to the implementation of the game/activity. For example, the learner may need explicit instruction on the rules of a game or practice with turn-taking before he is ready to play the game with peers.

The final step is to develop and implement the embedded DTT program. In this step, the practitioner should assess if embedded DTT is at least as effective as other instructional procedures used to teach similar skills. Additionally, when implementing embedded DTT, it is important to assess session duration to determine if the amount of time being invested is appropriate for the number and type of target skills being acquired. Additionally, the practitioner should determine if the learner seems to enjoy embedded DTT by measuring affective behavior. When possible, it is also important to assess learner preference for embedded DTT to determine if there actually is a benefit to using embedded DTT over other efficacious instructional methods. A concurrent-chains preference assessment could easily and quickly provide some evidence for whether embedded DTT is preferred over traditional DTT or is preferred over other instructional activities. Alternatively, if the learner has a more extensive language repertoire, he could be asked which instructional activity he prefers.

In conclusion, this preliminary study demonstrated that embedded DTT was as efficacious and efficient as traditional DTT. Additionally, for one participant, embedded DTT produced more positive affect and was more preferred. Embedded DTT illustrates that practitioners do not have to sacrifice speed of acquisition to make instruction fun and appealing for learners with ASD and that DTT does not need to be defined by setting (e.g., teaching at a table). We hope that practitioners will consider incorporating embedded DTT into programs for learners with developmental disabilities and that the guidelines presented in Appendix A are useful toward this goal.

Note

The VB-MAPP is a criterion-referenced assessment used to design verbal behavior and preacademic curricula for children with autism. Multiple verbal repertoires are evaluated by scoring the frequency and independence of responses based on either direct observation or indirect assessment of the child's performance under the relevant environmental conditions.

References

Carr, E. G., Newsom, C. D., & Binkoff, J. A. (1980). Escape as a factor in the aggressive behavior of two retarded children. *Journal of Applied Behavior Analysis, 13,* 101–117.

Carr, J. E., Nicolson, A. C., & Higbee, T. S. (2000). Evaluation of a brief multiple-stimulus preference assessment in a naturalistic context. *Journal of Applied Behavior Analysis, 33,* 353–357.

Charlop-Christy, M. H., LeBlanc, L. A., & Carpenter, M. H. (1999). Naturalistic teaching strategies (NaTS) to teach speech to children with autism: Historical perspective, development, and current practice. *California School Psychologist, 4,* 30–46.

Daugherty, S., Grisham-Brown, J., & Hemmeter, M. L. (2001). The effects of embedded skill instruction on the acquisition of target and nontarget skills in preschoolers with developmental delays. *Topics in Early Childhood Special Education, 21,* 213–221.

Delprato, D. J. (2001). Comparisons of discrete-trial and normalized behavioral language intervention for young children with autism. *Journal of Autism & Developmental Disorders, 31,* 315–325.

Geiger, K. B., Carr, J. E., & LeBlanc, L. A. (2010). Function-based treatments for escape-maintained problem behavior: A treatment-selection model for practicing behavior analysts. *Behavior Analysis in Practice, 3,* 22–32.

Green, G. (2001). Behavior analytic instruction for learners with autism: Advances in stimulus control technology. *Focus on Autism and Other Developmental Disabilities, 16,* 72–85.

Hanley, G. P. (2010). Identifying effective and preferred behavior-change programs: A case for the objective measurement of social validity. *Behavior Analysis in Practice, 3,* 13–21.

Koegel, R. L., Bimbela, A., & Schreibman, L. (1996). Collateral effects of parent training on family interactions. *Journal of Autism and Developmental Disorders, 26,* 347–359.

Koegel, R. L., Camarata, S., Koegel, L. K., Ben-Tall, A., & Smith, A. E. (1998). Increasing speech intelligibility in children with autism. *Journal of Autism and Developmental Disorders, 28,* 241–251.

Koegel, R. L., & Koegel, R. L. (2006). *Pivotal response treatments for autism: Communication, social and academic development.* Baltimore, MD: Paul Brookes.

Koegel, R. L., Koegel, L. K., & Surratt, A. (1992). Language intervention and disruptive behavior in preschool children with autism. *Journal of Autism and Developmental Disorders, 22,* 141–153.

Koegel, R. L., O'Dell, M. C., & Koegel, L. K. (1987). A natural language paradigm for teaching non-verbal autistic children. *Journal of Autism and Developmental Disorders, 17,* 187–199.

Koegel, R. L., Openden, D., Fredeen, R. M., & Koegel, L. K. (2006). The basics of pivotal response treatment. In R. L. Koegel & L. K. Koegel (Eds.), *Pivotal response treatments for Autism: Communication, social and academic development* (pp. 3–30). Baltimore, MD: Paul Brookes.

Koegel, R. L., & Williams, J. A. (1980). Direct versus indirect response-reinforcer relationships in teaching autistic children. *Journal of Abnormal Child Psychology, 8,* 537–547.

Leaf, R., & McEachin, J. (Eds.). (1999). *A work in progress: Behavior management strategies and curriculum for intensive behavioral treatment of autism.* New York: DRL Books.

McGee, G. G., Krantz, P. J., & McClannahan, L. (1985). The facilitative effects of incidental teaching on preposition use by autistic children. *Journal of Applied Behavior Analysis, 18,* 17–31.

Neef, N. A., Walters, J., & Egel, A. L. (1984). Establishing generative yes/no responses in developmentally disabled children. *Journal of Applied Behavior Analysis, 17,* 453–460.

Newsom, C. B. (1998). Autistic disorder. In E. J. Mash & R. A. Barkley (Eds.), *Treatment of childhood disorders* (2nd ed.; pp. 416–467), New York: Guilford.

Sigafoos, J., O'Reilly, M., Hui Ma, C., Edrisinha, C., Cannella, H., & Lancioni, G. E. (2006). Effects of embedded instruction versus discrete-trial training on self-injury, correct responding, and mood in a child with autism. *Journal of Intellectual & Developmental Disability, 31,* 196–203.

Sindelar, P. T., Rosenberg, M. S., & Wilson, R. J. (1985). An adapted alternating treatments design for instructional research. *Education and Treatment of Children, 8,* 67–76.

Smith, T. (2001). Discrete trial training in the treatment of autism. *Focus on Autism and Other Developmental Disabilities, 16,* 86–92.

Sundberg, M. L. (2008). *Verbal behavior milestones assessment and placement program: The VB-MAPP.* Concord, CA: AVB Press.

Sundberg, M. L., & Partington, J. W. (1999). The need for both discrete trial and natural environment language training for children with autism. In P. M. Ghezzi, W. L. Williams & J. E. Carr (Eds.) *Autism: Behavior analytic perspectives* (pp. 139–156). Reno, NV: Context Press.

Williams, J. A., Koegel, R. L., & Egel, A. L. (1981). Response-reinforcer relationships and improved learning in autistic children. *Journal of Applied Behavior Analysis, 14,* 53–60.

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Appendix A. Questions to Ask When Developing a Game/Activity for Embedded DTT

1. What is the purpose of the program?
    (a) What is the target skill?
    (b) What should the terminal repertoire be? What would it look like when it's "mastered"?
2. If the program is already being taught, why is it not as fun or enjoyable as it could be?
    (a) Are the materials old or uninteresting?
    (b) Is there little variation in the program?
    (c) Is the reinforcement schedule too lean? Are the consequences still preferred?
    (d) Might the prompts be aversive?
3. Would a game/activity be an appropriate way to target this skill?
    (a) How much additional time and money must be invested to acquire the materials and develop the game/activity?
    (b) What highly preferred items or activities could be incorporated into the game/activity?
    (c) How can the skill be targeted in the context of a game/activity? How will the game/activity allow for the target response to occur after the discriminative stimulus?
    (d) How will the delivery of the reinforcer play a part in the game/activity? Will the game/activity be interrupted to deliver the reinforcer or will the reinforcer be a part of the game/activity?
    (e) What additional play skills or social skills could be targeted within the context of the game/activity?
    (f) What prerequisite skills need to be taught for the learner to be able to play the game/activity?
4. Is embedded DTT working well for this learner and this skill?
    (a) Is the learner acquiring the skills at least as quickly as other similar skills taught with different instructional procedures (e.g., traditional DTT, naturalistic teaching procedures)?
    (b) Is the duration of the game/activity appropriate for the number and type of target skills being acquired?
    (c) Does the learner seem to enjoy or prefer embedded DTT?