Comparison of Traditional and Embedded DTT on Problem Behavior and Responding to Instructional Targets

Shaji S. Haq¹ · Jenna Aranki²

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Abstract

Embedded discrete trial training (DTT) involves the presentation of instructional targets in an activity-based situation, and serves as an alternative to traditional, table-top instruction (Geiger, Carr, LeBlanc, Hanney, Polick, et al. *Behavior Analysis in Practice* 5, 49–59, 2012). The current study compared the effects of Traditional and Embedded DTT on responding to instructional targets and problem behavior for one child with autism. Although the results showed similar levels of accuracy for instructional targets across both conditions, there were more target exposures and no problem behavior during Embedded DTT. The results are discussed along with future directions for research and clinical practice.

Keywords Antecedent interventions · Embedded discrete trial training · Problem behavior · Skill acquisition · Traditional discrete trial training

Discrete-trial training (DTT) is a highly efficacious and empirically validated treatment for individuals with autism spectrum disorder (ASD; Lerman, Valentino, & LeBlanc, 2016). The approach is designed to teach specific units of behavior (e.g., listener response and tact) using a sequence of steps, including the presentation of an antecedent stimulus, a controlling prompt (if relevant) to occasion a target response, and a reinforcing consequence (e.g., praise) that is contingent on correct responding. The simplified procedure described previously has been the subject of ongoing research in the field of applied behavior analysis (ABA) with the aim of enhancing its effectiveness and efficiency to teach critical life skills to individuals with ASD.

With a naturalistic approach to DTT, instruction is embedded into ongoing routines and includes materials the learner encounters daily. For example, when the learner enters the bathroom, the instructor may teach the learner to tact “bathroom,” or when the learner reaches for a toy inside a bin, the

instructor may teach the relevant preposition (i.e., “inside”). Moreover, skills are taught following initiations from the learner (i.e., the interaction is child directed; Cowan & Allen, 2007); thus, learners may respond more readily because they are presumably interested in the items they seek independently. This approach is not only effective but also associated with high levels of maintenance and generalization to novel settings (Mirenda-Linne & Melin, 1992). However, one drawback is that opportunities for teaching other important skills not relevant to the immediate context may be lacking. For example, it might be difficult to teach listener responding (LR) for community helpers while sitting in the living room of participants' homes if the relevant stimuli are not already present.

An alternative is the traditional format of DTT (T-DTT), which typically involves being seated at a table. The therapist leads both the pace of instruction and the types of skills that are targeted during the lesson (Cowan & Allen, 2007). Thus, teaching targets can be “noncontextual” and include other skills that are important for learning (e.g., LR or tacting community helpers) but are not immediately relevant for the setting in which the lesson takes place. Some of the main benefits of T-DTT are that an instructor can conduct numerous teaching trials in a short period of time and teach important skills the individual is less likely to encounter daily. However, a drawback is that the learner may be less motivated to respond to instruction and engage in problem behavior to escape the learning task.

✉ Shaji S. Haq
shajishaq@gmail.com

¹ Center for Behavioral Sciences, Inc., 17911 Sky Park Circle, Suite E, Irvine, CA 92614, USA

² Present address: Easterseals, 19750 S. Vermont Ave., Suite 140, Torrance, CA 90502, USA

In a blended approach, Geiger et al. (2012) evaluated the efficacy of embedded DTT (E-DTT) in which the authors affixed pictures of animals to a train set (e.g., tracks and coach) or board game. Participants were taught to select animals as LR during “play.” Thus, noncontextual teaching targets were incorporated into activities the participants presumably enjoyed. This approach was compared to T-DTT in which targets were presented in a three-stimulus array at a work table. The results showed that both instructional formats were equally effective and efficient for each participant, and E-DTT was associated with more positive affect for one participant.

Sigafoos, O'Reilly, Ma, Edrisinha, Cannella, et al. (2006) compared both approaches on correct responding and problem behavior for an individual with ASD in school. In E-DTT, targets were presented while the participant played on a swing, walked on a footpath outside, or listened to music; the participant was taught to sign “more” when the motion of the swing was stopped and when the footpath was blocked and to press a switch on a device to play music. In the T-DTT condition, instruction for imitation tasks and LR occurred at a classroom table. Lower percentages of correct responding and more self-injury were observed during T-DTT compared to E-DTT. Despite these results, key differences across both conditions (i.e., pace of instruction and types of skills targeted) limit the conclusions that may be drawn from this study.

In the present study, we evaluated the effects of T-DTT and E-DTT on correct responding and problem behavior displayed by one individual with ASD. The limitations of past research were addressed by presenting the same number and type of targets at the same pace in both conditions. Furthermore, the evaluation occurred in the participant's home during his regularly scheduled ABA therapy.

Method

Participant, Settings, and Materials

Dante was a 7-year-old male diagnosed with ASD who received in-home ABA therapy on 4 days of the week for 3 h per appointment. Dante's communication skills were consistent with a Level 1 learner on the Verbal Behavior Milestones Assessment and Placement Program (Sundberg, 2008). Dante had a history of problem behavior, including elopement and aggression (e.g., hitting with open hands), hypothesized using the Questions About Behavioral Function (Matson & Vollmer, 1995) and direct observations to be maintained by escape and attention; the parent had declined consent to complete an experimental functional analysis. Due to Dante's problem behavior, the emphasis of ABA programming was shifted from skill acquisition to increasing compliance and reducing problem behavior during therapist-delivered instructions. Sessions

for T-DTT took place in the living room at a 60.98 cm × 60.98 cm table, and sessions for E-DTT occurred anywhere in the home (e.g., living room and bedroom). Session materials included two-dimensional picture stimuli presented on index cards, toys (e.g., action figures, cars, balls), data sheets, and a timer.

Dependent Variables, Interobserver Agreement, and Procedural Integrity

Problem behavior was recorded as a frequency and expressed as a rate (i.e., response per minute, RPM). In T-DTT, elopement was recorded if Dante moved ≥ 0.9 m from the therapist. In E-DTT, elopement was recorded if Dante moved that same distance from the therapist within 10 s of the presentation of an instructional target; the exception for E-DTT was if Dante had already emitted a correct response during that trial. Hitting was defined as contacting another person with enough force to produce a sound. An independent response was recorded if the participant emitted the target response within 5 s of the discriminative stimulus. A correct prompted response was recorded if the participant emitted a correct response within 5 s of an initial prompt.

Interobserver agreement was calculated using the trial-by-trial method by determining whether both data collectors' records were identical for each trial. The total number of agreements across trials were added, and the sum was divided by the total number of agreements plus disagreements. The product was then multiplied by 100 to obtain a percentage. Procedural integrity was assessed during each trial across both conditions.

A second observer collected data during 41% of Dante's total sessions. Mean agreement for independent responses was 99.3% (range 90%–100%) and for problem behavior was 97.1% (range 80%–100%). Dante's therapists implemented the procedures with 97.9% integrity (range 80%–100%).

Experimental Design and Procedure

Both conditions were evaluated using a reversal A-B-A-B design (Baer, Wolf, & Risley, 1968). Sessions for each condition were 10 min in duration, and targets were presented once approximately every 60 s. There were 10 mastered targets in all, including imitation, LR, and tacts, and the same 10 targets were presented in both conditions. Each target was presented using a constant 5-s time delay in which the therapist presented the instruction and waited up to 5 s for a response. Independent correct responses produced enthusiastic praise and reinforcement for the remainder of the 60-s interval. If the participant emitted an error or no response for a tact target, the therapist presented a model prompt every 5 s until the participant emitted a correct response. For imitation and listener targets, a physical prompt was used if the model prompt did not occasion

the target response. Error correction was conducted by reinitiating the trial by presenting the same target. However, only the first response to each target is depicted in Fig. 1.

T-DTT The session began when Dante was continuously seated at the table for 30 s. Highly preferred toys, identified using a multiple stimulus without replacement (DeLeon & Iwata, 1996) preference assessment and that were only available in this condition, were located on or next to the table opposite the participant. One of the toys selected at random was delivered contingent on an independent correct response. These toys were otherwise stored in a locked box in the garage of Dante's home outside of therapy appointments. No other toys were available around the room for him to engage with in this condition. The therapist provided continuous attention, modeled appropriate vocal behavior, and/or played with Dante during each reinforcement interval. If elopement occurred, a statement to return to the table for work and toys (e.g., "Go back to the table so we can work and play with toys.") was presented every 30 s; thus, instructional targets were not presented if Dante engaged in elopement. Aggression and dangerous acts were blocked, if they occurred, but there were no comments for those topographies.

E-DTT Sessions occurred anywhere in Dante's home and began at any point while he roamed his home or interacted with toys; he had free access to all toys except those in the T-DTT condition. Therapists continuously followed and provided Dante with attention by modeling appropriate vocal behavior and/or playing throughout the session. The exception was

when the therapist was scheduled to present an instructional target. At the onset of the instructional trial, which was signaled by a timer, the therapist stopped (if in motion), paused a video or placed a hand on the toy Dante interacted with to secure attending, and then presented the instructional target using the procedure described previously. Following an independent correct response, the therapist resumed play by removing his or her hand from the item and/or starting the video. However, if the participant moved away before emitting the relevant response, an instance of problem behavior was recorded, and the therapist initiated an instructional trial during the next scheduled presentation.

Results and Discussion

Dante's results for treatment are depicted in Fig. 1. Problem behavior is represented by closed circles and corresponds to the primary y-axis; the open circles represent Dante's percentage of independent correct responses and corresponds to the secondary y-axis. During T-DTT, Dante's problem behavior was on an increasing trend; he engaged in an average of 0.5 instances of problem behavior per minute (range 0.1–0.8 RPM). There were two sessions in the initial T-DTT phase in which targets could not be presented due to elopement. However, in Session 2, Dante engaged in 100% correct responses when seven targets were presented, and in Session 3, Dante could only be presented with one target and he did not respond. Thus, Dante had limited exposure to instruction due to problem behavior during this phase.

Fig. 1 Dante's problem behavior (closed circles; primary y-axis) and percentage of independent correct responses (open circles; secondary y-axis) during traditional (T-DTT) and embedded (E-DTT) discrete-trial training

Dante's behavior was markedly different when E-DTT was introduced; he did not engage in any instances of problem behavior, and he responded correctly to all targets presented in this phase. In the reversal to T-DTT, problem behavior increased again, albeit to a lower level compared to the initial T-DTT phase; mean problem behavior was 0.2 RPM (range 0.1–0.4 RPM). Correct responding averaged 90% during two out of three sessions that were conducted in this phase, and there were no opportunities for targets to be presented in Session 10 due to elopement that lasted the entirety of that session.

In the final E-DTT phase, problem behavior did not occur, and Dante engaged in an average of 75% correct responses during the first four sessions of this phase (i.e., Sessions 11–14). Dante's overall performance was similar to the initial E-DTT phase with the exception of a lower level of correct responding. It was hypothesized that Dante's mastered tasks may have lost their novelty, and this could have impacted his attending during instruction. As a result, five of the original targets were replaced with unmastered stimuli, and Dante displayed an increasing trend for correct responses in the remaining sessions. Thus, problem behavior was elevated across both T-DTT sessions, and there were minimal differences in accuracy across both conditions.

Dante had a history of engaging in other forms of problem behavior (e.g., jumping down a full flight of stairs in his home, biting paint chips off the wall, standing on kitchen counters), which competed with his opportunities for instruction. It was hypothesized based on a functional behavior assessment that problem behavior was jointly maintained by escape and his mother's attention. Several antecedent and consequence strategies, such as demand fading, providing differential attention and tangibles for sitting at the table during work time versus during break times, and having his mother stay out of the work area to reduce the likelihood that she would reinforce problem

behavior with attention, were employed with Dante; however, his mother was observed to enter the room and engage with him at the height of his tantrums. An exclusive focus on treatment of problem behavior required skill-acquisition programming to be put on hold for him indefinitely until problem behavior could be reduced. Reformatting instruction to E-DTT allowed therapists to continue to emphasize skill-acquisition programming for Dante while reducing additional opportunities for him to further develop a history of reinforcement for engaging in problem behavior.

Important to note was that Dante's elopement impacted the number of opportunities for therapists to present targets in the T-DTT condition. Figure 2 displays the total frequency of target presentations in Sessions 1 through 14. Overall, targets were presented a total of 17 times in the T-DTT condition compared to 77 times in the E-DTT condition. In other words, therapists were only able to conduct an average of 2.4 trials (range 0–7 trials), including error correction, per session in the T-DTT condition, compared to an average of 11 trials (range 10–12 trials) in the E-DTT condition. Fewer opportunities for instruction in the T-DTT condition are attributed to the requirement for Dante to sit at the table before an instructional trial was initiated. In other words, there were no opportunities to present teaching targets if Dante engaged in elopement; thus, removing this requirement in E-DTT allowed therapists to continue to engage with him in a playful manner and provide instruction.

One limitation is that E-DTT may be a teaching format that is less feasible in certain settings, such as schools, where students are expected to sit and engage in tabletop instruction. Not only is T-DTT more practical when multiple students are receiving instruction simultaneously from one or more teachers, but learning to sit at a table and respond to instruction is an important prerequisite to access other leisure and

Fig. 2 Total frequency of target exposures, including error correction, across both conditions in Sessions 1 through 14

work-related activities. Thus, E-DTT could be viewed as an intermediate step for individuals who may not readily sit at a table and respond to teacher-led instruction.

The inclusion of only mastered targets may be a limitation. The rationale was to hold the difficulty of instruction constant and eliminate that aspect as a variable that could impact his performance. In other words, we were concerned the inclusion of unmastered targets would alter the properties of each condition because targets would be mastered through multiple exposures based on the reversal A-B-A-B design. Conducting the evaluation using an adapted alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985) may have helped overcome this potential issue. Researchers should consider using an alternative experimental design and including unmastered targets in future evaluations of E-DTT and T-DTT.

Given the inextricable link between problem behavior and skill deficits for individuals with developmental disabilities, there continues to be a need for research evaluating ways to target the reduction of problem behavior while continuing to emphasize skill acquisition in early intervention programs.

Implications for Practice

- Problem behavior poses challenges to making progress on skill acquisition goals (e.g., communication and adaptive behavior) for individuals with ASD.
- Antecedent interventions that reduce the likelihood of problem behavior may allow for continued emphasis on skill acquisition goals.
- E-DTT during otherwise free-operant periods may eliminate some less desirable aspects of traditional tabletop instruction (e.g., sitting at a table, responding to instructions, tolerating the removal of preferred stimuli) for learners with ASD.
- E-DTT may be considered an intermediate step for individuals with ASD who are not yet ready for DTT that is conducted at a table.

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Compliance with Ethical Standards

Conflict of Interest Shaji Haq and Jenna Aranki declare they have no conflicts of interest.

Ethical Approval All procedures were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from the guardian of the participant in this study.

References

- Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*, 91–97. <https://doi.org/10.1901/jaba.1968.1-91>.
- Cowan, R. J., & Allen, K. D. (2007). Using naturalistic procedures to enhance learning in individuals with autism: A focus on generalized teaching within the school setting. *Psychology in the Schools, 44*, 701–715. <https://doi.org/10.1002/pits.20259>.
- DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29*, 519–533. <https://doi.org/10.1901/jaba.1996.29-519>.
- Geiger, K. B., Carr, J. E., LeBlanc, L. A., Hanney, N. M., Polick, A. S., & Heinicke, M. R. (2012). Teaching receptive discriminations to children with autism: A comparison of traditional and embedded discrete trial teaching. *Behavior Analysis in Practice, 5*, 49–59. <https://doi.org/10.1007/BF03391823>.
- Lerman, D. C., Valentino, A. L., & LeBlanc, L. A. (2016). Discrete trial training. In R. Lang, T. B. Hancock, & N. N. Singh (Eds.), *Early intervention for young children with autism spectrum disorder* (pp. 47–83). Cham, Switzerland: Springer International Publishing.
- Matson, J. L., & Vollmer, T. R. (1995). *Questions about behavioral function*. Baton Rouge, LA: Disability Consultants.
- Mirenda-Linne, F., & Melin, L. (1992). Acquisition, generalization, and spontaneous use of color adjectives: A comparison of incidental teaching and traditional discrete-trial procedures for children with autism. *Research in Developmental Disabilities, 13*, 191–210. [https://doi.org/10.1016/0891-4222\(92\)90025-2](https://doi.org/10.1016/0891-4222(92)90025-2).
- Sigafoos, J., O'Reilly, M., Ma, C. H., Edrisinha, C., Cannella, H., & Lancioni, G. U. (2006). Effects of embedded instruction versus discrete-trial training on self-injury, correct responding, and mood in a child with autism. *Journal of Intellectual and Developmental Disability, 31*, 196–203. <https://doi.org/10.1080/13668250600999160>.
- Sindelar, P. T., Rosenberg, M. S., & Wilson, R. J. (1985). An adapted alternating treatments design for instructional research. *Education & Treatment for Children, 8*, 67–76.
- Sundberg, M. L. (2008). *VB-MAPP Verbal behavior milestones assessment and placement* Program Concord, CA: AVB Press.

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