Behavior Analysis in Practice (2023) 16:307–311
https://doi.org/10.1007/s40617-022-00731-7

BRIEF PRACTICE

Using Computer-Based Instruction to Teach Implementation of Discrete Trial Instruction: A Replication and Extension

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Accepted: 12 July 2022 / Published online: 26 August 2022

Abstract
Evidence-based procedures, such as computer-based instruction, have been used to train staff to implement behavioral technologies with high treatment integrity. The purpose of the present study was to address the gaps in Romer et al. (2021) by assessing the same computer-based instruction module to train relevant staff to implement discrete trial instruction. Results suggest computer-based instruction is effective, efficient, and a socially valid procedure to use to teach relevant staff to implement discrete trial instruction.

Keywords Computer-based instruction · Discrete-trial instruction · Staff training

Discrete-trial instruction (DTI) is an effective and widely used training strategy to teach individuals with autism spectrum disorder (ASD) and related disabilities a wide variety of skills (e.g., Green, 1996). DTI is a structured behavior analytic teaching method that typically involves an antecedent, prompt (if necessary), response, consequence, and intertrial interval (Smith, 2001). If DTI is not implemented with high treatment integrity, it can lead to faulty stimulus control, prompt dependency, and evoke problem behavior (Geiger et al., 2018). Evidence-based procedures, such as behavioral skills training (BST) and computer-based instruction (CBI) have been used to train staff to implement behavioral technologies with high treatment integrity. CBI, which is typically criterion-based, and includes a combination of video modeling, and performance feedback to teach specific learning objectives (Amador et al., 2021).

Marano et al. (2020) demonstrated the effectiveness of using observations and ratings embedded in CBI to teach staff to implement a paired-stimulus preference assessment. Romer et al. (2021) extended the results of Marano et al. by demonstrating the effectiveness of a similar CBI training module to teach staff to implement DTI. Even though the procedures used in Romer et al. were effective, relevant staff were not trained (i.e., participants did not hold a position as a behavior therapist, had little to no experience working with individuals with disabilities, and had no experience with applied behavior analysis prior to the study), and no social validity measures were collected. Therefore, the purpose of the present study was to address the gaps in Romer et al. (2021) by assessing the same CBI module to train relevant staff to implement DTI. In addition, the present study collected social validity measures to evaluate the degree to which the procedures were socially significant.

Implications for Practice 1. Evaluates effectiveness and efficiency of computer-based instruction to teach relevant staff to implement discrete trial instruction.
2. Evaluates the social validity of computer-based instruction across participants and board-certified behavior analysts.
3. Demonstrates the effectiveness, efficacy, and social validity of computer-based instruction to teach discrete-trial instruction.
4. Provides asynchronous training strategies to clinicians to increase the likelihood of effective training strategies across human service settings.

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Method

Participants

Six participants (hereafter referred to as *trainees)*, between the ages of 24 and 37 years who held a bachelor's degree in psychology, or a related field participated. All trainees served in a senior behavior therapist role at the clinic and had the responsibilities of supervising learner programming, and training staff under the supervision of a BCBA™ (board certified behavior analyst). Baylee was a 24-year-old Caucasian female, Charlotte was a 25-year-old Caucasian female, Maya was a 24-year-old Caucasian female, Mark was a 37-year-old Caucasian male, Maggie was a 26-year-old Caucasian female, and Diana was a 27-year-old Caucasian female. All trainees reported receiving some training to implement DTI, classes in applied behavior analysis, and previously worked with individuals with ASD (see supplementary material for questionnaire and comprehensive participant demographic information). The trainees administered DTI with a confederate consumer (i.e., the primary experimenter).

Setting and Materials

All sessions were conducted in a room consisting of a table and chairs. Session materials included a written protocol, confederate scripts, data sheets, a pencil, a foam board, putative reinforcers (i.e., edibles), stimulus cards, a computer, and headphones. Sixteen groups of three stimulus cards were selected from a variety of categories (e.g., animals, clothing, colors). Stimulus cards were used for auditory–visual conditional discrimination (AVCD), visual–visual conditional discrimination (VVCD), and tact trials (see supplementary material for examples of all materials used for the study).

Confederate Consumer Scripts

The confederate consumer followed one of four scripts in a random order without replacement during DTI sessions. The scripts specified which response the confederate consumer engaged in for each trial (i.e., correct, incorrect, no response), and when the confederate consumer engaged in disruptive behavior (e.g., stereotypy). Half of the responses in the script contained correct responses and half of the responses included incorrect responses, no responses, and disruptive behavior.

Experimental Design and Response Measurement

A nonconcurrent multiple baseline across participants design was used to evaluate the effects of CBI to teach DTI. Like previous research, the dependent variable was the accuracy in which the trainee implemented DTI with the confederate consumer (Romer et al., 2021). Data were collected on trainee's implementation of each step of DTI. Steps included (1) establish/wait for ready behavior; (2) present stimuli; (3) consumer attends to stimuli before delivering the instruction; (4) deliver instruction; (5) deliver reinforcer for correct response within 3 s; (6) deliver correct prompt type; (7) deliver prompt within 2 s of no response or incorrect response; (8) refrain from delivering reinforcer for incorrect/no responses; (9) remove stimuli and record consumer response after each trial; (10) rearrange stimulus cards after each trial; and (11) ignore/block problem behavior. A correct step was defined as the trainee implementing the step identical to the definition of the step across all opportunities in a session. An incorrect step was defined as the trainee implementing the step differently than the definition, or not implementing the step at all one or more times in a session. A step was scored as not applicable if there was no opportunity to implement that step during a trial. Data were summarized as the percentage of steps implemented correctly (i.e., the sum of correctly implemented steps were divided by the sum of correctly and incorrectly implemented steps, and then converted into a percentage) . In the CBI module, we collected data on the trainee's accuracy of responses to the questions in the module, number of times trainees replayed any videos, and module duration.

Interobserver Agreement and Procedural Integrity

A second independent observer scored performance for 33% of sessions across experimental phases for interobserver agreement (IOA) purposes. IOA was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100 (i.e., step-by-step agreement). Mean IOA was 100% across trainees during experimental phases and the CBI module.

Procedural integrity was collected on the confederate consumer responses for 33% of experimental sessions in each phase via a procedural integrity checklist. All procedural integrity scores indicated 100% of steps were implemented correctly. In addition, IOA of procedural integrity was collected by a second independent observer on approximately 33% of sessions in which procedural integrity was collected. Mean IOA of procedural integrity was 100% across trainees.

Procedure

The following procedures are based on those described by Romer et al. (2021). Trainees had a maximum of 8 min to perform all components of DTI in the absence of correct responding. Sessions were terminated after 8 min in the absence of a correct response, the trainee completed all 12 trials, or the trainee indicated they were finished. Baseline and posttraining probes assessed the same skill taught in the CBI module (i.e., AVCD). Pre- and posttraining generalization probes assessed acquisition of untrained skills that might also be taught using a DTI framework (i.e., VVCD and tacts). The instruction for AVCD, VVCD, and tact sessions were the name of the stimulus (e.g., "Red"), "Match," and "What is it?" respectively.

Baseline

Trainees were given up to 10 min to review the written protocol, data sheet, and examine applicable stimuli. Following the opportunity to review materials, the experimenter initiated a DTI session by saying:

> Do your best to perform discrete-trial instruction. I will be playing the role of a child with autism spectrum disorder. I cannot answer any questions at this time. Please let me know when you are finished.

Trainees then implemented DTI with the confederate consumer. No questions were answered, and no feedback was provided.

Computer-Based Training Module

The experimenter brought the trainee into a quiet room and set up the CBI module on a computer, and read the following:

> You will have as much time as you need to complete the interactive training module. The first part will show you how to go through the module. The second part will require you to watch videos and answer questions, and it will tell you if your answers are right or wrong. Please let me know when you are finished.

The entire module was administered via Qualtrics (a free web-based survey tool). Following a tutorial explaining how to navigate the module, trainees were required to respond to multiple exemplars of accurate and inaccurate implementations of DTI procedures. There was a minimum of three video clips per step including at least one instance of accurate implementation and one instance of inaccurate implementation. The videos depicted a confederate behavior therapist implementing the steps of DTI with a confederate consumer. Following each video clip, trainees were required to read the question, "Was this step performed accurately or inaccurately?" and had the opportunity to select "accurately" or "inaccurately." If the trainee selected a correct answer for an accurately performed video, they were brought to a screen saying, "Good job!" or some variation. If the trainee selected the correct answer for an inaccurately performed video, they were brought to a screen with a follow-up question asking, "Why was the step implemented inaccurately?" including three potential answers. If the trainee chose the correct answer to any questions, they were brought to a screen saying, "Good job!" or some variation. If the trainee responded incorrectly to any questions, a screen saying "Try again" appeared and the trainee had another opportunity to watch the video and respond to the question. Trainees had unlimited attempts to answer each question correctly (see supplementary materials for detailed description of the training modules).

Post-training

Posttraining procedures followed those of baseline. If posttraining implementation of DTI was less than 100% for three consecutive sessions, the experimenter would have provided brief performance feedback; however, this was not necessary for any participant. Mastery criterion was three consecutive sessions with 100% of steps implemented correctly.

Generalization

Generalization sessions were conducted during baseline and post-training to assess generality of the training procedure with untrained skills (i.e., VVCDs and tacts), and followed the same procedures as baseline.

Social Validity

Trainees were asked to complete a modified version of the Intervention Rating Profile-15 (IRP-15: Martens et al., 1985) via Qualtrics survey. The modified IRP-15 consisted of six items asking the trainees to rate the acceptability of the training procedures. Responses were rated on a six-point Likert-type scale ranging from 1 (i.e., strongly disagree) to 6 (i.e., strongly agree).

In addition, BCBAs were recruited to rate the quality of trainee DTI implementation from videos depicting three DTI trials in baseline and posttraining sessions. Responses were rated on a six-point Likert-type scale ranging from 1 (low quality) to 6 (high quality). In addition, BCBAs watched a 5-min video clip created by the primary experimenter outlining the CBI module content and were asked if they would use these procedures to train their supervisees (see supplementary materials for specific survey questions).

Results

Figure 1 depicts the results for all trainees. During baseline, all trainees implemented a moderate percentage of DTI steps correctly (mean across trainees 57%; range: 36%–82%). Specific trainee performance: Maya (*M* = 44%, range: 36%–55%), Charlotte (*M* = 66%, range: 55%–72%), Baylee (*M* = 62%, range: 55%–70%), Mark (*M* = 70%, range: 60%–82%), Maggie (*M* = 42%, range: 27%–60%), Diana (*M* = 57%, range: 45%–64%). Percentage of steps implemented correctly increased following the completion of the DTI CBI module across all trainees. Following training, all trainees implemented the steps of DTI 100% correctly across the first three posttraining probes

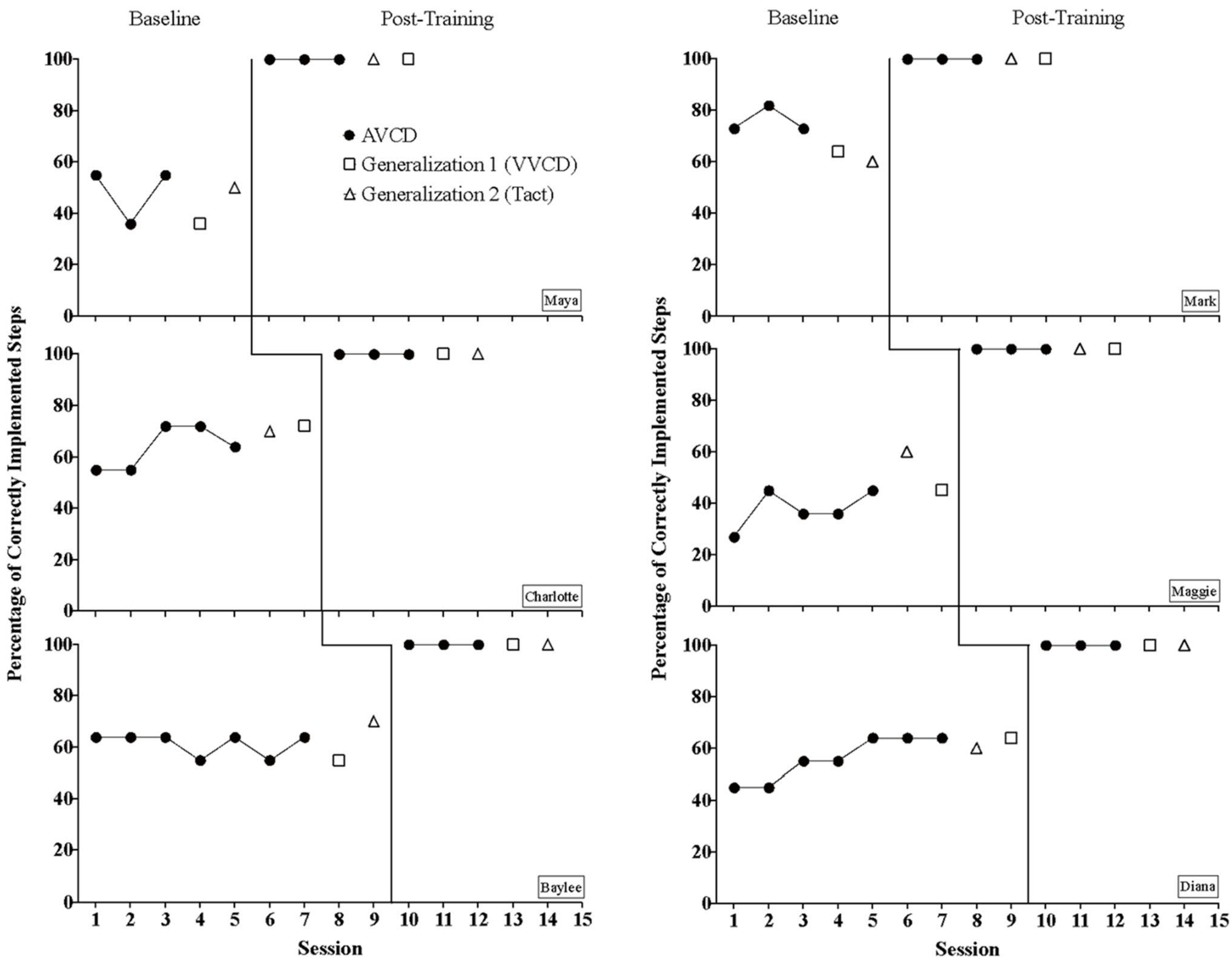

Fig. 1 Percentage of correctly independent steps. AVCD auditory-visual conditional discrimination, VVCD visual-visual conditional discriminations

and implemented the steps of DTI 100% correctly for both generalization probes. In addition, we calculated a between-case effect size using the web-based single-case design hierarchical linear model application (Pustejovsky et al., 2021; Valentine et al., 2016). Model parameters for included restricted maximum likelihood as the estimation method, level as the type of time trend for baseline (i.e., fixed and random effects) and treatment phases (i.e., fixed effects only). Results demonstrated a large effect size between baseline and posttraining performance (BC-SMD estimate = 3.99; 95% confidence intervals = 2.58–5.4).

Trainees completed the training module in a mean of 41 min 22 s (range: 31 min 24 s–46 min 24 s). Trainees engaged in a mean of 94% (range: 90%–98%) correct responses to questions in the training module. In addition, trainees rewatched videos in the module a mean of 6 times (range: 2 times–8 times).

Trainees found the training program was an acceptable way to train new staff (*Mdn* = 5.5, range: 5–6) and was informative and helpful in learning how to implement DTI (*Mdn* = 6, range: 5–6). In addition, trainees believed the procedures helped them implement DTI (*Mdn* = 6, range: 5–6) and others would find the training program beneficial (*Mdn* = 6, range: 5–6). All trainees enjoyed the training program (*Mdn* = 6, range: 5–6), and thought CBI was an acceptable way to train new staff (*Mdn* = 6, no range). In addition, BCBA respondents scored baseline videos as low- to moderate-quality implementation of DTI (*Mdn* = 2, range: 1–4), and scored posttraining videos as high-quality implementation of DTI (*Mdn* = 6, range: 4–6). BCBAs also reported they would be likely to use similar CBI procedures to train their staff to implement DTI (*Mdn* = 6, no range).

Discussion

The results of the present experiment replicated and extended the findings of Romer et al. (2021) by demonstrating CBI can be effective and efficient for teaching relevant trainees to implement DTI with high levels of treatment integrity across related skill types. The positive results of social validity measures in the present experiment further extend the results of Romer et al. (2021) by demonstrating positive social validity results of both trainees and BCBAs. Future research should continue to examine not only the effectiveness and efficiency of training procedures, but also continue to collect data to ensure these procedures are socially valid. Therefore, the results demonstrate the CBI training modules were not only effective but also a socially valid procedure to train staff to implement DTI.

Mean duration of DTI module completion was approximately 8 min longer for trainees in the present experiment compared to trainees in Romer et al. (2021) with the same level of accuracy. Longer training time may be attributed to trainees in the present experiment rewatching videos an average of approximately six times per training session as opposed to Romer et al. where trainees watched videos an average of approximately one time per training. This difference may be attributed to the fact that nonrelevant individuals were trained in Romer et al. (2021), as opposed to relevant individuals being trained in the present experiment. The value of correctly responding to module questions and learning the relevant features of the step in which the trainees responded incorrectly to module questions may have served as an establishing operation in which rewatching the videos increased in value.

DTI is a commonly used behavioral technology when teaching new skills to children with ASD (Karsten et al., 2015). In some cases, if DTI is not implemented correctly, the learners' progress could remain stagnant, or problem behavior may develop (Geiger et al., 2018). To ensure high treatment integrity when implementing DTI and other behavioral technologies, it is pertinent to train staff efficiently and effectively. Although the present study did not assess trainee responding with actual consumers, we programmed for generalization through the use scripts encompassing variable responding a trainee may see when implementing DTI in a real-world scenario. Future research should continue this line of research by assessing the generality of behavioral technologies mastered in a training scenario with actual consumers.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s40617-022-00731-7.

Acknowledgments This article is based on a dissertation submitted by the first author, under the supervision of the second author, at Caldwell University in partial fulfillment for the requirements of a Ph.D. in Applied Behavior Analysis. The authors thank Theresa M. Campanaro for her help with various aspects of this manuscript. Alexandra Campanaro is now at North Jersey Behavioral Health Services.

Declarations

Conflicts of Interest All other authors declare they have no conflicts of interest.

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