University of Messina

ISSN 2612-4033

Journal of Clinical & Developmental Psychology

Journal homepage: http://cab.unime.it/journals/index.php/JCDP/index

Instructing University Students to Conduct Discrete-Trials Teaching with Video-Modeling and Feedback during Role-Playing Sessions

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ABSTRACT

Introduction. Using video modeling to teach discrete trial teaching (DTT) to professionals is a practice present in literature. In this study, we wanted to verify if viewing a video with embedded instructional materials, combined with descriptive feedback on performance during the intervention phases, could increase the accuracy of DTT execution in university students during role-playing sessions.
Methods. The participants in this study were 16 students enrolled in the last year of educational courses at an Italian university. The study took place during two lectures held in a university classroom lasting five hours. We used a pre and post-video-modeling design to measure the participants' performance by evaluating the percentage of steps composing a discrete trial completed correctly.
Results. The results showed that all participants rapidly improved their performance through video modeling. We also measured social validity.
Conclusion. The implications for Italian professionals working in autism spectrum disorder therapy regarding job skill acquisition are examined. Limits and suggestions for future research are discussed.

Keywords: *Discrete-trial teaching, Job skill acquisition, University students, Video-modeling.*

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http://10.13129/2612-4033/0110-3720

Introduction

Professionals can use discrete trial teaching (DTT) to promote the acquisition of a target behavior (Higbee et al., 2016). It is used in early intensive interventions to teach numerous skill categories to children with autism spectrum disorder (ASD). DTT teaches verbal behaviors, functional life skills, academic skills, adaptive behaviors, and social and communication skills. This strategy has received empirical support to promote the acquisition of social and communicative behaviors (Radley & Dart, 2022). This strategy includes some specific phases: preparing the materials before starting the instruction, providing the appropriate discriminative stimulus (SD), presenting the necessary prompts, and finally providing the correct consequences in case of correct or incorrect answer by the learner (Fazzio & Martin, 2011). Several studies have focused on identifying strategies for teaching DTT to participants who had never used this procedure, specifically professionals or university students (Arnal et al., 2007; Fazzio et al., 2009; Pollard et al., 2014). The procedures used included studying written materials, video modeling strategies, and interacting computer training (ICT) strategies, which combined the first two strategies reported thanks to interactive training (IT) tools. Video modeling (VM) is a potentially low-cost and time-efficient learning method available in geographically isolated areas (Pollard et al., 2014). Video modeling is a strategy used to teach different skills, from social and communicative to motor and athletic (Bellini & Akullian, 2007), skills in the autonomy of daily life (Park et al., 2019), and to teach professionals how to implement the discrete trial teaching procedure properly.

Arnal and colleagues (2007) conducted two experiments with seven participants to compare the effectiveness of using an instruction manual and the same manual combined with video modeling. The video showed an expert tutor administering discrete trial teaching. The results of these experiments showed that the most effective strategy to increase mastery in the presentation of discrete trial teaching was the one that involved the use of the manual combined with video modeling. The authors reported the need to identify additional rapid and effective training modalities to be added to the educational strategies examined in their experiments. These modalities are needed to compensate for the significant turnover of tutors in education programs for children with autism, considering the great demand for tutors and parents to learn discrete trial teaching procedures. Fazzio and colleagues (2009) evaluated the effectiveness of an intervention package using a self-instruction manual (Arnal et al., 2007), combined with contingent feedback from experimenters on the implementation of the procedure. The authors report as a starting point for future research to evaluate the effectiveness of watching videos that show the procedure of implementing discrete trial teaching on participants' performance in the same task. Catania and colleagues (2009) used video modeling to teach new staff members of a learning center to implement discrete trial teaching. The results show that participants increased their accuracy in discrete trial teaching. The authors suggest replicating the work, using experimental designs that guarantee greater experimental control, and evaluating different types of videos. Vladescu and colleagues (2012) replicated Catania and colleagues (2009) to verify the effectiveness of various voiceover instruction videos in teaching DTT to three new staff members of a learning center. After a role-playing phase, the authors measured the generalization of participants' learning by measuring their performance with two children with autism. The authors report the need to understand the adequate length of the video and the latency between watching the video and implementing discrete trial teaching, suggesting conducting the training using a single video. Pollard and colleagues (2014) and Higbee and colleagues (2016) used Interactive Computer Training (ICT) for university students and support teachers. ICT is a procedure that combines, using technology, instruction manuals, and videos. The authors report the need to identify ways to facilitate the learning of these procedures by an increasing number of professionals.

There are many turnovers among professionals who work with autistic children; for this reason, it is critical to find efficient methods of teaching the techniques needed for professional practice. (Novack & Dixon, 2019). In this study, we partially replicated Fazzio and colleagues (2009) to evaluate the effectiveness of a video modeling procedure instead of using the self-instruction manual. In order to teach how to use accurately discrete trial teaching among Italian university students during role-playing sessions, we intended to assess the efficacy of a procedure that involved watching a video with embedded instructional materials, together with descriptive feedback on performance.

Method

Participants

The participants in this study were 16 students (13 females and three males) enrolled in the last year of the degree courses in Primary Education Sciences (SFP) and Pedagogical Sciences (SPED) at an Italian university. These courses have among their objectives the preparation of future teachers and coordinators of kindergartens and the first cycle of the primary school of the Italian school system. Participants had an average age of 23 years (std. dev: 1,09) and had no previous experience using the discrete trial teaching strategy. Participants were selected as a result of their voluntary adherence to the study. All students signed informed consent for participation in the study.

We conducted a priori sample analyses to determine the required sample size using GPower (Faul et al., 2007). Considering we had more than two measures, we opted for the *F*-test family and selected "ANOVA: repeated measures, within factors" as the statistical test. Following the procedures used in psychological and behavior research (Aberson, 2019), we set α at .05 and power at .80. Further, we entered an effect size of $f = .40$ since we were interested in a large effect size since it is crucial that the DTT has relevant practical implications and can be adopted in real-life.

The analyses indicate that at least 12 participants were required for the analyses. However, according to Lehmann (1998), when non-parametric tests are used instead of parametric tests, the output of a sample size calculation analysis should be increased by 15%. Hence, at least 16participants were required for the analyses.

Design and phases

We compared the performance of the same 16 participants on the execution of trials during pre and post-intervention measurements. The study was divided into four phases: pre-Video modeling measurements on Task 1 (Pre-VM), video-modeling (VM), post-Video modeling measurements on Task 1 (Post-VM1 and feedback), and post-Video modeling measurements on a new task (post-VM2 and feedback). We measured each participant's performance on two trials during the pre-VM, post-VM1, and post-VM2 phases.

Pre-VM - The study's initial phase occurred during the first lesson. The experimenters briefly described the discrete trial teaching strategy and its rationale and explained the study's phases to the participants. Subsequently, the experimenters divided the participants into groups, positioned them remotely within the classroom with the necessary materials, and instructed them to train for 30 minutes to teach a pointing response. The participants had to follow the indications on the sheet that described the task and alternate roles at each trial (teacher, student, and person in charge of recording the trial with the smartphone). The participant with the role of the teacher had to place the flashcards on the table, present a correct antecedent (i.e., Name, indicates the pizza), give prompts (if necessary), and wait for the response of the confederate, present the correct consequence. In case of a correct answer, he had to make accessible an object identified as a reinforcer; in case of an incorrect answer, he had to proceed with the correction procedure. Finally, he had to record whether the confederate produced a correct or incorrect response on the datasheet. The experimenters did not provide feedback on the performance of the participants who impersonated the teacher. Before each trial, they only instructed each confederate to respond correctly or incorrectly, to have a fair number of trials for the correct and incorrect responses.

VM - In the second lesson, the video-modeling phase took place. The experimenters projected the video in the classroom twice and answered the students' questions and doubts for 20 minutes at the end of the viewing. The experimenters gave the participants a 20-minutes break at the end of this phase.

Post-VM1 and feedback - This phase began at the end of the 20 minutes break. The procedures used were the same as in the pre-VM phase. At the end of each trial, the experimenters provided feedback to participants who had the role of the teacher: descriptive praise for the steps completed correctly and corrections and explanations for the incorrectly completed steps.

Post-VM2 and feedback - This phase began about an hour and a half after the participants viewed the video; the procedures used were the same as in the post-VM1 phase, but they were applied to a matching response: participants had to match one image to the identical one by choosing from three images placed on the table. The experimenter provided feedback as described above.

Setting and Materials

We conducted this study in a university classroom equipped with chairs with desks for students, a workstation for the teacher, and a video projector to see slides and videos. Procedures took place during two consecutive lectures for a total duration of about five hours. The participants were seated before the experimenters during the first study phase. During the intervention phases, the participants were divided into four groups of three people and a group of four, positioned at various classroom points and organized with desks and chairs.

The video used during the video modeling phase showed role-playing between two professionals. It illustrated the phases of the discrete trial teaching procedure, with embedded instructional materials accompanying the images to describe the various phases (i.e., short descriptions to explain the various steps). The first author prepared the video following the indications of Fazzio and Martin (2011). It describes the various phases of discrete trial teaching: (1) what to do before starting trials, (2) how to present SDS, (3) the use of any prompts, and (4) the consequences to be provided in case of the correct answer, and (5) the consequences to be provided in case of incorrect answer by the student. The video is currently available at https://www.youtube.com/watch?v=iv5yPta0N3k&t=39s. We made the video available only from the beginning of the studio. It is in Italian and has a duration of 2:09 min.

Each group had four flashcards set, a sheet with printed indications of the task to be performed, the datasheet to be used during the trials, and a smartphone used to record each trial. Photos of a dog, a ball, a banana, and a pizza were printed on the flashcards. The sheet with printed instructions described the tasks to be performed: the description of the setting, the steps to perform a discrete trial, and the description of a pointing response. The experimenters used a checklist to collect data on the accuracy of discrete trial teaching presentation; the checklist was structured into 19 points to measure the steps required to present a discrete trial. We used the materials produced by Arnal and colleagues (2007) after having translated them into Italian to promote a better understanding of the text by the participants.

Target behaviors and data collection

The dependent variable measured in this study was the accuracy with which participants conducted DTT trials during role-playing sessions. All DTT trials were videotaped to allow experimenters to measure the accuracy of the participants' behaviors using the checklist. At the end of the sessions, we collected data by observing the participants' performance on the videos. We collected data on two trials for each of the 16 participants during each experimental phase (one correct answer and one wrong answer for each phase). We scored each item in the checklist as correct (+), incorrect (-), or not applicable (/). Not applicable (/) was used when the participant did not emit the behavior (i.e., when the confederate produced a correct answer, "not applicable" was used for all points related to the correction procedure). We used an Excel worksheet to obtain the mean value of items performed correctly by each participant and converted the result to a percentage.

Inter-observer agreement (IOA)

Before the start of the study, the first and second authors viewed 15 videos of the administration of discrete trial teaching to children with autism by an experienced tutor. Both measured the performance independently until reaching a 100% agreement rate for two consecutive measurements, achieved after the seventh viewing of the videos.

The inter-observer agreement was calculated for translating the materials provided to participants: the sheet with the instructions to follow and the checklist used to collect data on the accuracy of discrete trial teaching implementation. The first and second authors independently translated the materials and compared their permanent products. We defined an agreement when we translated the same sentence identically. A disagreement was defined as the same sentence translated differently. The percentage of agreements was 97%.

The inter-observer agreement (IOA) was calculated for 50% of the trials. An agreement was defined as the same score assigned to a checklist step by both experimenters. A disagreement was defined as a different score assigned to a step of the checklist by the experimenters. The IOA was calculated by dividing the total number of agreements by the total number of agreements and disagreements multiplied by 100 (Cooper et al., 2014). The mean value for the percentage of agreements between the various experimental phases was 91.76% (range 80%-100%).

Social validity

Finally, the students were given a questionnaire to assess social validity (see supplementary materials) because we wanted feedback on the training from the students. The questionnaire consisted of 10 items that wanted to investigate various areas: two questions on the perception of the effectiveness of the procedure used, two questions on the objectives, two questions on how to participate in the study, and finally, two questions to assess whether the participants believed that the procedure learned would be helpful in their future professional practice. Each question was evaluated on a 5-point scale with 1 indicating "no", 3 indicating "neutral," and 5 indicating "yes".

Treatment Integrity

We have calculated treatment integrity regarding the performance of the participants serving as a child with autism for all stages of the study. They were required to alternate a correct answer within each group with an incorrect one. We collected data for 75% of trials with a mean value of 98.5% (range 98%-100%).

The third experimenter used a checklist to measure the punctuality of feedback the first two experimenters provided during 50% of the trials (post-VM1 and feedback and Post-VM2 phases and feedback). The values obtained were equal to 100% of the feedback presented contingently.

Data Analysis Plan

Since we aimed to evaluate the participants' performance in the phases reported above, we were interested in a repeated measure test. We thus opted for a Friedman test, considering that we had more than two repeated measures. Further, we used the Bayesian Repeated Measures to quantify the strength of the evidence provided by the data (JASP Team, 2018; Morey & Rouder, 2018; Rouder et al., 2012). Indeed, in contrast to the Null-Hypothesis-Significance-Testing approach, the Bayesian approach can provide evidence in support of one hypothesis relative to another hypothesis. Suppose the likelihood of the alternative hypothesis (H1) is put at the numerator of the formula, and the likelihood of the null hypothesis (H0) is put at the denominator. In that case, we can report the Bayes Factor (abbreviated, BF)$_{10}$, where 1 refers to H1 and 0 to H0. If we reverse the two hypotheses, we can report the BF_{01}. According to Jeffreys (1961), in both cases, a BF value between 1 and 3 indicates weak evidence supporting the hypothesis put at the numerator; a value between 3 and 10 indicates substantial evidence, and a value between 10 and 20 indicates strong evidence. Values below 1 indicate that there is more evidence for the hypothesis at the denominator of the formula. Since we are interested in the presence of an effect (H1), we report BF_{10} and conclude that the experimental hypothesis is supported if the Bayes Factor values exceed 1.

Results

Table 1 shows the accuracy percentage in the administration performance of a DTT trial during the Pre-VM, Post-VM 1, and Post-VM2 phases.

Participant	Pre-VM	Post-VM1	Post-VM2
Student 1	60.00	80.00	73.33
Students 2	62.50	87.50	75.00
Students 3	40.00	88.89	80.00
Students 4	62.50	93.33	87.50
Students 5	53.33	86.67	73.33
Student 6	50.00	100.00	87.50
Student 7	62.50	87.50	100.00
Student 8	26.67	73.33	100.00
Student 9	53.33	94.12	87.50
Student 10	50.00	88.24	66.67
Student 11	26.67	100.00	87.50
Student 12	40.00	87.50	87.50
Student 13	57.14	87.50	80.00
Student 14	28.57	80.00	87.50
Student 15	37.50	73.33	73.33
Student 16	33.33	100.00	87.50
Mean	46.5	88.00	83.40
Median	50.00	87.50	87.50

Table 1 - Percentage of accuracy in administering a DTT trial during the study phases.

We conducted a non-parametric analysis of the data obtained on the entire sample (N =16) using the Friedman non-parametric repeated measures test (Pohlert, 2018). Since the *p*-value is less than the level conventionally used to determine significance ($p < .05$), we can conclude that time affects the participants' performance. Further, post hoc power analyses indicate that we achieved an observed power of 1.00. The performance of participants in the pre-VM phase is low (M: 46.5); performance increases in the Post-VM1 phase (M: 88.0) and then decreases slightly during the Post-VM2 phase (M: 83.4).

Table 2 shows the pairwise comparisons (Durbin-Conover). The results obtained support the effect of the intervention.

	χ^2	df	p
	26.80	2	<.001
		Statistic	p
Pre-VM *vs.* Post-VM1		12.12	<.001
Pre-VM *vs.* Post-VM2		8.66	<.001
Post-VM1 *vs.* Post-VM2		3.46	0.002

Table 2 - Pairwise Comparisons (Durbin-Conover) - Repeated Measures Non-parametric - Friedman

Table 3 reports the results of the Bayesian tests (JASP Team, 2018; Jeffreys, 1961; Westfall et al., 1997). The comparison between the pre-VM and post-VM1 phases confirms the effect, as it compares the Pre-VM and Post-VM2 phases. In both cases, the BF_{10} is way above 20, indicating strong evidence in support of H1. The comparison between the Post-VM1 and Post-VM2 phases does not confirm the effect, as the BF is below 1 (0.694). However, this result aligns with what was expected: the participants' performance is similar for both tasks.

Models	BF10
Null model (incl. subject)	1.00
Time	8.34×10^{12}
Post Hoc Comparisons – Time	BF10, U
Pre-VM *vs.* Post-VM1	1.09×10^{6}
Pre-VM *vs.* Post-VM2	22623.194
Post-VM1 *vs.* Post-VM2	0.694

Table 3 -Repeated Measures (Non-parametric) and Post Hoc Tests

Social validity

The 16 participants returned questionnaires about social validity. We assigned a score to each type of answer in order to compute the findings. The maximum score was 50 for each participant, which was determined by considering the "Yes" (5-point) response to each question. Out of a possible total of 800 points across participants, the participants' combined scores came to 711 points.

Discussion & Implications

In this study, we partially replicated Fazzio and colleagues (2009) to verify the vision of a video of the discrete trial teaching procedure lasting 2 min 09 s, with written indications inside and followed by a brief feedback phase. As Fazzio and colleagues (2009), our participants reached mastery in both tasks. The results show that the strategy used proved effective in both measurements made after watching the video, although the performance of some participants decreased for the second task. This result may be due to the nature of the proposed task (matching response), which differed from the initial task (pointing response). Watching the video even before the post-VM2 phase and feedback would have helped mitigate this effect of deterioration in performance. In addition, the video reported as an example only a pointing response. However, the intervention's effects are evident if the initial measurements are compared with those carried out in the two experimental phases conducted after watching the

video. The results obtained during the Post VM1 and Post VM2 phases confirm the effectiveness of the intervention despite the participants being engaged in two different tasks while deviating from the values of the initial measurements. The procedure used has proven effective in quickly teaching the discrete trial teaching strategy to many participants (Arnal et al., 2007; Pollard et al., 2014; Higbee et al., 2016).
The results obtained following a short video (2 min 09 s) demonstrate his effectiveness regarding duration and information provided (Vladescu et al., 2012). Therefore, watching a short video seems to predict an increase in performance for the people who have viewed it.
This study confirms and expands previous knowledge on the topic. Previously, different authors proved that discrete trial teaching could be teached using video modeling (Pollard et al., 2014), role-playing practice with a confederate (Fazzio et al., 2007), and feedback (Fazzio et al., 2009). In this study, we wanted to see if all these combined procedures could effectively teach the DTT procedure. We had a more significant sample than previous studies (Higbee et al., 2016). In particular, the study confirms that video modeling paired with a role-playing practice with a confederate plus receiving feedback from the authors led the students to learn how to implement the procedure correctly. This study had a high level of social validity, considering the heterogeneity of the participants, especially from the point of view of career objectives. Not all participants reported that learning to use the discrete trial teaching procedure could be helpful for the work areas they wanted. However, the questionnaire results showed that the procedure proved straightforward and enjoyable for the participants.

Limits and suggestions for future research

This study has some limitations. First, we did not use a control group to compare participants' performance with and without introducing the independent variable. Second, we replicated the effect of introducing the independent variable for only two tasks. Future studies conducted in settings with participants with similar characteristics could therefore measure the effectiveness of the intervention by comparing the results with those of a control group and by conducting three replications with different tasks after introducing the independent variable. Third, we did not consider a mastery criterion when evaluating the participants' performance. Future studies conducted in similar settings could therefore include this criterion to evaluate the effectiveness of the intervention. Fourth, the observation of the duration of the effects of video modeling is limited; students have acquired the skills of discrete trial teaching over the examined period, but long-term effects still need to be discovered. All the students increased the accuracy in discrete trial teaching implementation. However, we did not conduct follow-up sessions to measure learning retention: we measured the performance after 20 minutes and after an hour and a half after watching the video. Future studies with similar settings and participants could conduct follow-up sessions to measure the long-term effects of the training.
Fifth, the instructions given to the participants who impersonated the student were to alternate a correct answer with an incorrect one. This mode is insufficient to train a teacher to perform in real-life conditions. Future studies could use confederates with high levels of training in implementing discrete trials to alternate response modes.
Sixth, the participants' responses were observed after twenty minutes and an hour and a half after watching the video; furthermore, we have not conducted performance measurements with an actual client (e.g., a child with autism). Other studies have shown that high performance in the experimental session has reliably improved

performance in actual client sessions (Fazzio et al., 2009; Higbee et al., 2016; Vladescu et al., 2012). Future studies could introduce this condition to test the magnitude of the effects of rapid training using the same video with embedded instructional materials.

Finally, although these results are exciting and relevant, they are still preliminary due to the low numbers. Future studies should replicate this study with a more significant number of participants.

Despite the reported limitations, the effects of the intervention were positive. This procedure served to teach a skill necessary for job placement in a specific sector in a time equal to 5 hours to many participants. Therefore, the video-modeling procedure could be used in academic contexts to teach various types of activities, reduce teaching times, and encourage practical and group activities within the Italian university context to encourage the training of professionals in the field of treatments for autism spectrum disorder.

Conflict of Interest. No authors have a conflict.

Ethical Approval. All procedures performed in studies involving human participants followed 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. We obtained informed consent from all individual participants in the study.

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