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A Comparison of Constant Time Delay and Simultaneous Prompting Within Embedded Instruction on Teaching Leisure Skills to Children With Autism

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An adapted alternating-treatments design was used to compare the effectiveness and efficiency of constant time delay and simultaneous prompting procedures within an embedded instruction format on the acquisition of various leisure skills by four preschool students with autism. The results showed that both procedures were effective in promoting the acquisition of the skills and maintaining them over time by three students. Although the impacts of the procedures were evident for these three students, the results were not replicated with the fourth student. Furthermore, mixed results were obtained regarding the efficiency measures. However, the social validity findings of the study were positive overall. On the basis of an evaluation of the findings, implications and future research needs are discussed.

Keywords: *applied behavior analysis; intervention strategies; single-subject designs; experimental studies; research methodologies; autism spectrum disorder (ASD); disability populations*

Researchers and teachers of preschool-age students with disabilities always try to find "better" instructional practices for teaching their students. As a consequence, various effective instructional procedures have been developed to teach skills to young children with developmental disabilities. Response-prompting strategies are one example in which the errors that occur during the acquisition of new skills can be minimized by providing prompts. On the other hand, it has been emphasized in the literature that the effectiveness of any procedure should not be the only reason to use it. Efficiency and social validity aspects of instruction are other key factors when selecting appropriate instructional procedure (Schuster, Griffen, & Wolery, 1992; Tekin-Iftar & Kircaali-Iftar, 2004).

Constant time delay (CTD) and simultaneous prompting (SP) are response-prompting procedures that have been successfully used with students with various disabilities. CTD requires providing and fading prompts systematically in a time-lagged fashion, and stimulus control is transferred from prompt to discriminative stimulus in two main stages: (a) 0-second-delay trials and (b) delay-interval trials. In 0-second-delay trials, the instructor provides the prompt immediately after the task direction. After a predetermined number of 0-second-delay trials, the instructor inserts a fixed amount of duration (i.e., 4 or 5 seconds) between the task directions and the prompts (Browder & Snell, 2000; Schuster et al., 1998; Wolery, Ault, & Doyle, 1992). A considerable number of research studies has shown that CTD is effective in teaching both discrete and chained skills to young

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children with various disabilities (e.g., Alig-Cybriwsky, Wolery, & Gast, 1990; Daugherty, Grisham-Brown, & Hemmeter, 2001; Halle, Bear, & Spradlin, 1981; Werts, Wolery, Vassilaros, & Billings, 1992; Wolery, Anthony, Caldwell, Snyder, & Morgante, 2002).

SP has been receiving attention as an alternative to CTD, with a growing number of evidence-based studies in the field. When using SP, the instructor provides the prompt immediately after providing the task direction. Because the student is never given an opportunity to respond independently to the task direction during instructional trials, test trials are conducted to examine the acquisition. Although the number of studies on teaching chained skills is limited compared with the number of studies on teaching discrete skills, research has shown that SP is an effective instructional procedure for teaching both discrete and chained skills to young children with disabilities (e.g., Dogan & Tekin-Iftar, 2002; Gibson & Schuster, 1992; MacFarland-Smith, Schuster, & Stevens, 1993; Parrott, Schuster, Collins, & Gassaway, 2000; Sewell, Collins, Hemmeter, & Schuster, 1998).

There are similarities between CTD and SP. Both procedures are (a) user friendly, (b) easy for instructors to implement, (c) cost efficient, and (d) associated with low error rates during instruction (Schuster et al., 1992; Tekin & Kircaali-Iftar, 2002). On the other hand, it has been argued that SP reduces the complexity of instruction and eliminates some potential problems associated with CTD. Therefore, SP might be perceived to be a more efficient instructional procedure for the following reasons (Morse & Schuster, 2004; Riesen, McDonnell, Johnson, Polychronis, & Jameson, 2003; Schuster et al., 1992; Tekin & Kircaali-Iftar, 2002). First, although CTD has two types of correct responses, SP has only one type of correct response. Therefore, when using SP, the instructor does not need to reinforce correct responses differentially. Second, CTD requires the instructor to shift teaching behaviors from 0-second-delay trials to delay-interval trials. However, the instructor performs one type of teaching behavior (0-second-delay trials) only. Third, unlike CTD, the student does not need to have waiting skills in SP. In addition to all of these, it has been observed that learning occurs during 0-second-delay trials during instruction with CTD. Thus, it may be argued that delay-interval trials in CTD may not be necessary to implement (Morse & Schuster, 2004; Schuster et al., 1992; Tekin & Kircaali-Iftar, 2002).

Few studies have been published comparing CTD and SP in terms of their effectiveness and efficiency on teaching discrete behaviors (Riesen et al., 2003; Schuster et al., 1992; Tekin & Kircaali-Iftar, 2002). Schuster et al. (1992) compared CTD and SP in terms of their effectiveness and efficiency in teaching sight words to four 10- to 11-year-old students with moderate mental retardation. The findings of the study showed that SP required fewer trials and sessions and less training time to criterion and resulted in fewer student errors during probe and training sessions. On the other hand, maintenance data showed mixed results across procedures. Tekin and Kircaali-Iftar (2002) compared the effectiveness and efficiency of CTD and SP delivered by sibling tutors in teaching receptively identifying animals to 7- to 10-year-old children with mild to moderate mental retardation. Their results showed that both procedures were effective in teaching receptively identifying animals. Efficiency data revealed that although differences between the two procedures were minimal, SP was more efficient than CTD in terms of the number of training errors and the length of training time to criterion. No differences were evident in maintenance data, and CTD resulted in more generalization. Riesen et al. (2003) compared the effectiveness of these two procedures delivered within embedded instruction in teaching reading and defining key concepts and terms of several subject areas to four middle school students. The study was conducted in general education classes. The results showed that CTD was more effective for two of the participants, and SP was more effective for the other two participants.

The results of these studies showed that both procedures promote the acquisition of target skills, and efficiency data indicated that the differences between the two procedures are minimal in favor of SP. Because only three studies have compared the two procedures, the existing data from these studies are far from generalizing the findings, even for the acquisition of discrete skills. On the other hand, a wide range of skills must be taught in chaining, such as self-help skills, leisure skills, and daily living skills. To teach chained skills, educators and researchers need to know various procedures. The existing literature on this issue provides no guidance regarding the comparison of CTD and SP on teaching chained skills. However, none of the above studies was conducted with young children with autism. Therefore, in this study, we aimed to extend the existing literature in terms of teaching chained skills to young children with autism.

Another research concern regarding the comparison of CTD and SP might be the instructional formats that have been used to implement these instructional strategies to date. Research studies showing the effectiveness of these procedures and other response-prompting procedures have been conducted mostly in a traditional massed-trial instruction format. The traditional use of response-prompting procedures (isolated from natural settings and contexts in which skills need to be performed)

promotes the acquisition of the skills. However, a failure to generalize the acquired skills into natural settings and contexts is a common problem (Bricker, Pretti-Frontczak, & McComas, 1998; Daugherty et al., 2001; Grisham-Brown, Schuster, Hemmeter, & Collins, 2000). Embedded instruction has been recommended as an alternative instructional strategy that could be used to address the generalization issue (Daugherty et al., 2001; Horn, Lieber, Li, Sandall, & Schwartz, 2000; McBride & Schwartz, 2003; Wolery et al., 2002). When using embedded instruction, target skills are taught during ongoing routines of natural performance settings. Embedding, the major component of embedded instruction, is defined as "a procedure in which children are given opportunities to practice individual goals and objectives that are included within an activity or event that expands, modifies or adapts the activity/event while remaining meaningful and interesting to children" (Bricker et al., 1998, p. 73). It is possible to use specific instructional strategies such as response-prompting procedures in embedded instruction. However, when response-prompting strategies are used in an embedded instructional format, instructional trials are distributed across the activities that typically occur in the natural settings instead of being presented repeatedly with very short intervals between trials (Johnson, McDonnell, Holzwarth, & Hunter, 2004; Riesen et al., 2003; Wolery et al., 2002).

Research studies have examined the utility of embedded instruction for both preschool-age and school-age children with disabilities (e.g., Daugherty et al., 2001; Johnson et al., 2004; Riesen et al., 2003; Venn et al., 1993; Wolery et al., 2002). To date, the majority of the studies examining the effects of embedded instruction on teaching various skills to students with disabilities have used CTD procedure. Therefore, there seems to be a research need to assess the effects of other response-prompting procedures within embedded instruction. Moreover, although CTD and SP are known to be effective and efficient instructional procedures to teach children with disabilities, only one published study compared these procedures within embedded instruction in teaching discrete behaviors: Riesen et al. (2003) compared CTD and SP within an embedded instruction format in teaching discrete academic skills to children with autism.

The existing literature seems to provide no guidance regarding the comparison of CTD and SP within embedded instruction in teaching chained skills to young children with disabilities. Therefore, the purpose of the present study was to compare the effectiveness and efficiency of CTD and SP procedures implemented within an embedded instruction format on the acquisition of chained leisure skills by young students with autism. Also, the social validity of the study was investigated. The following research questions were addressed: Which response-prompting strategy is more effective in teaching chained leisure skills to children with autism within an embedded instructional format? Which response-prompting strategy is more efficient regarding (a) the number of training sessions to criterion, (b) the number of training trials to criterion, (c) the percentage of errors to criterion, and (d) total training time to criterion? What do professors and instructors in the departments of special education at universities in Turkey think about delivering CTD and SP within an embedded instructional format?

Method

Participants

Students. Four Turkish children (all boys) with autism participated in the study. All participants were diagnosed at hospitals in Turkey by child psychiatrists. The ages of the students ranged from 6 to 8 years. All students attended the same special class of a preschool program at the Research Institute for the Handicapped at Anadolu University. Except for one student (Ferit), all participants were mainstreamed in preschool classes in different public schools on a half-time basis. The classmates in these preschool programs were younger than the participants, because the participants were delayed in their school status because of their disabilities. Two students (Faruk and Okan) had instructional histories with CTD and SP procedures. No adaptive scores were available for these students. However, the informal observations revealed that all of the students had age-appropriate fine and gross motor skills. All of the students were verbal and had autism. The students usually performed stereotypic behaviors when they were not engaged in activities. Parental consent was obtained prior to the study.

Baran was 7 years old during the study and was diagnosed with autism at the age of 2.5 years. No score was available for his level of cognitive ability. He could use two- to three-word sentences as needed and attend to an activity for 10 minutes. He had difficulty initiating and maintaining social interactions and communication.

Faruk was 8 years old and was diagnosed at a university hospital when he was 3 years old. He had an IQ of 60 as measured using the Stanford-Binet instrument at the Guidance and Research Center, a local facility. He could use two- to three-word sentences as needed, respond to simple questions (e.g., "Where are you going now?" "Who came to the class?") with two- to three-word sentences, and attend to an activity for 15 minutes.

He could count and name the basic colors (red, blue, and yellow).

Ferit was 6.5 years old during the study. He was diagnosed with autism at a university hospital. He had an IQ of 92 as measured using the Stanford-Binet instrument at the Guidance and Research Center. He could use two- to three-word sentences as needed, respond to simple questions with two- to three-word sentences, and attend to an activity for 15 minutes. He could count and name the basic colors. He could initiate communication and maintain it when needed.

Okan was 8 years old and was diagnosed with autism at the age of 5 years. He had an IQ of 74 as measured using the Stanford-Binet instrument at a hospital by a psychiatrist. He could use two- to three-word sentences as needed, respond to simple questions with two- to three-word sentences, and attend to an activity for 10 minutes. He could count and name the basic colors. No adaptive behavioral score was available for the participants.

Prerequisite skills for the students were as follows: (a) visual acuity, (b) following verbal directions, (c) attending to verbal and visual stimuli for 5 minutes, (d) having fine and gross motor skills, which are necessary for learning to turn on a CD player and take a picture with a digital camera. Because the first author was the teacher of the special class participating students had been attending, he had many opportunities to observe whether the participants had these prerequisite skills. Therefore, at different times and in different settings, it was noted that all participating students had the prerequisite skills for this study.

Staff. All experimental sessions were conducted by the first author, a research assistant and doctoral student in special education at Anadolu University. He had 8 years of experience in working with students with mental retardation and autism and in delivering instruction with the two procedures used in the study. He was the teacher of the special class the students attended. A research assistant, who was a graduate student in special education and familiar with the instructional procedures used in the study, served as an independent observer and collected the reliability data.

Settings and Materials

The study was conducted in different parts of the institute, such as the classroom, cafeteria, free-play area, and hall. The part of the unit to be used for each student was determined while planning the embedding process of the study. There were tables and chairs for students, cupboards in different sizes, and floor cushions in the classroom. There was a two-way observation mirror in the classroom as well. There were tables and chairs in the cafeteria, and the students went to the cafeteria during their meal and snack times. Besides the participants in the study, all students in the unit shared the cafeteria during meal and snack times. There were toys and materials in the play room, and students attending the unit shared the free-play room with other children as well. All of the classrooms, the cafeteria, and the play room were located on two sides of a large hall. Prior to the training or probe sessions, the teacher placed the materials where students could easily reach them. During training, a Turkish-brand digital camera and a CD player were used to teach leisure skills. A video camera and data collection forms were used in the study.

Task Analyses

Task analyses were developed for teaching chained target skills. The skills were to take a picture using a digital camera and to turn on a CD player. The leisure skill domain was selected for two reasons: (a) The students usually exhibited stereotypic behaviors during their free time, so they were in need of learning various leisure skills, and (b) teaching leisure skills was part of their individualized education programs. Independent and functionally similar skills were chosen in the study to make sound comparisons. The task analyses of the skills, which were validated by two special educators, are presented in Table 1.

Dependent Measures

Two dependent measures were considered in the study to compare the effectiveness and efficiency of CTD and SP procedures while teaching taking a picture using a digital camera and turning on a CD player. The first dependent measure was the percentage of correct responses during intermittent probe sessions, and the second dependent measure was the parameters of the efficiency. These parameters were the number of trials and sessions to criterion, the number and percentage of incorrect responses during probes and training sessions, and instructional time to criterion.

General Procedures

Taking a picture using a digital camera and turning on a CD player were taught to four students with autism. All experimental sessions were conducted in a one-on-one teaching arrangement in different parts of the unit, and 4-second response intervals were used in all sessions. All sessions were videotaped. One trial was conducted in each session. The researchers conducted a pilot study

Table 1
Task Analyses

Taking a Picture Using a Digital Camera	Turning On a CD Player
1. Gets the camera.	1. Goes near the CD player.
2. Opens the shutter cover.	2. Holds the suitable end of the power cable.
3. Turns the mode button for "photo" mode.	3. Plugs electricity socket into the CD player.
4. Turns toward the subject of the photo.	4. Plugs the other end of the cable into the outlet.
5. Holds the camera to his eye without closing the shutter with his hand.	5. Holds the desired CD with his finger tips.
6. Zooms in on the person or the party inside the camera screen.	6. Opens the CD player with his other hand.
7. Takes the picture by pressing the button.	7. Puts the CD inside the CD player.
8. Reviews the picture by turning the mode button to album mode.	8. Closes the CD player by the lid.
9. Closes the shutter cover.	9. Tunes the mode button to "CD" mode.
10. Leaves the camera to its place.	10. Presses the play button.

and decided to use a single-opportunity method as well as physical and verbal prompting during the intervention. Intermittent probe sessions, training sessions, and maintenance sessions were conducted in the study. Intermittent probe sessions were conducted to test the acquisitions. All experimental sessions were conducted in the embedded instruction format by embedding instruction into the natural daily routines of the students. While embedding instruction, the teacher created a need to teach the target skills or secure the students' attention toward the situations in which the students could perform the target skills.

Probe Sessions (Baseline and Intermittent Probe Sessions)

There were baseline and intermittent probe sessions in the study. Baseline sessions were conducted prior to teaching leisure skills to get stable data for at least three consecutive sessions. Correct responses were defined as performing a step of the task analysis correctly within 5 seconds, and incorrect responses were defined as performing a step of the task analysis incorrectly, not completing it in 5 seconds, or performing a different step of the task analysis. Correct responses resulted in verbal and social praise, whereas assessment was interrupted in the delivery of incorrect responses and the student received a negative grade for that particular step and the rest of the steps. Response definitions and behavioral consequences for students' responses were the same in baseline and intermittent probe sessions. The teacher stood near or next to the students in these sessions. A baseline session was conducted as follows: The teacher delivered a specific attentional cue to secure the student's attention (e.g., "Okan, would you like to listen to music while having breakfast?"), and after receiving an affirmative response from the student through either eye contact or a gesture, the teacher praised the student (e.g., "Great!"). The teacher then delivered the task direction (e.g., "Could you please turn on the CD player?"), waited 4 seconds for the student's response, and delivered appropriate behavioral consequences (e.g., "Great, you did it!").

Because students do not have the opportunity to respond to the task direction independently in SP, intermittent probe sessions are needed to standardize the condition across CTD and SP for testing acquisition. Intermittent probe sessions were conducted after conducting three training sessions in each skill. Intermittent probe sessions were preferred instead of daily probe sessions to decrease the probe errors and to provide more natural opportunities during the implementation of the study. Correct responses were counted toward the criterion, and the criterion was 100% correct responding for three consecutive intermittent probe sessions.

Training Sessions

The teacher stood behind or next to the student for physical prompting. Verbal and physical prompts were used for all students across the interventions. The instructional procedures, CTD and SP, were assigned to the skills randomly. The instructional procedures used to teach the target skills for each participant are presented in Table 2. The training was provided until 100% correct responses were obtained during at least three consecutive intermittent sessions. Three training sessions were conducted with each student per week to teach each skill. A total-task format with a one-on-one instructional arrangement was used to teach the target skills. Correct responses (before and after prompting) resulted in verbal and social reinforcement, and incorrect responses resulted in error correction. Incorrect responses were interrupted, and the teacher verbally explained the error and provided the task direction and controlling prompt

Table 2
Students, Instructional Procedures, and Target Skills

	Skill and Procedure	
Student	Turning On a CD Player	Taking a Picture Using a Digital Camera
Baran	Simultaneous prompting	Constant time delay
Faruk	Constant time delay	Simultaneous prompting
Ferit	Constant time delay	Simultaneous prompting
Okan	Simultaneous prompting	Constant time delay

again, whereas cooperative behaviors were reinforced verbally at the end of the sessions.

Constant Time Delay

After obtaining stable data during the baseline sessions, the teacher started to deliver training by creating a need to embed the instruction with CTD. The CTD was delivered with two delay intervals. The initial instructional session was conducted by using a 0-second delay interval, and in the subsequent sessions, the duration between the task direction and the prompt was increased to 4 seconds. Five types of student responses were possible in the instructional sessions. There were two types of correct responses, unprompted and prompted, and three types of incorrect responses, unprompted incorrect, prompted incorrect, and no response. *Unprompted correct responses* were defined as initiating a step of the task analysis before the prompt and completing the response correctly within 5 seconds. *Prompted correct responses* were defined as initiating a step of the task analysis 4 seconds after the prompt and completing it correctly within 5 seconds. *Unprompted incorrect responses* were defined as initiating a step of the task analysis before the prompt but performing it incorrectly or not completing it in 5 seconds or performing a different step of the task analysis. *Prompted incorrect responses* were defined as completing a step of the task analysis after the prompt incorrectly or not completing it in 5 seconds. Finally, *no responses* were defined as not initiating a response within 4 seconds. Both types of correct responses resulted in verbal reinforcement, whereas all incorrect responses resulted in error correction and providing the controlling prompts again.

The instructional trial with CTD was delivered as follows. The teacher created a need to start instruction by delivering an attentional cue (e.g., "Ferit, would you like to listen to music while having your breakfast?"). After receiving an affirmative response, the teacher verbally reinforced the student (e.g., "Very good, Ferit!") and delivered the task direction (e.g., "Ferit, please turn on the CD player."). The teacher immediately delivered physical and verbal prompts to the student (0-second delay interval). A correct response by the student was reinforced verbally and socially (e.g., "Good job, Ferit! You did it."). The subsequent instructional sessions were conducted using 4-second delay intervals between task directions and controlling prompts. If the student committed incorrect responses several times consecutively before the delivery of the prompts, the teacher warned the student to wait for the prompts. However, because incorrect responses before prompts occurred in limited circumstances, this type of warning took place rarely (three times) during the study.

Simultaneous Prompting

After obtaining stable data during the baseline sessions, the teacher started to deliver training by creating a need to embed the instruction with SP. The instructional trial with SP was delivered as follows. The teacher created a need to start instruction by delivering an attentional cue (e.g., "Ferit, look, Mr. Kapan is looking for you. He wants you to take his picture. Let's go and take his picture."). After receiving an affirmative response, the teacher verbally and socially reinforced the student (e.g., "Very good, Ferit!") and delivered the task direction (e.g., "Ferit, please take a picture of Mr. Kapan."). The teacher immediately delivered physical and verbal prompts to the student. A correct response by the student was reinforced verbally (e.g., "Good job, Ferit! You took a great picture."). Because the teacher provided physical prompts during instructional trials, the student did not have a chance to commit any incorrect responses.

Maintenance Sessions

Maintenance sessions were conducted 1, 2, and 4 weeks after the termination of the intervention. These sessions were conducted just like the baseline sessions, with the exception of thinning reinforcement. The reinforcement was delivered on the basis of the correct completion of the tasks. No instruction procedure was used during maintenance sessions.

Experimental Design

An adapted alternating-treatments design was used to examine the differential effectiveness, if any, of using CTD and SP procedures within an embedded instruction format on teaching two leisure skills, taking a picture using a digital camera and turning on a CD player, to four students with autism (Holcombe, Wolery, & Gast, 1994). The dependent variable was the percentage of

correct responses on the steps of the task analyses of the skills, and the independent variables of the study were CTD and SP. These particular leisure skills were chosen by conducting a difficulty analysis of the skills by considering the number of the steps in the task analyses. The sequence of intervention session was alternated across the sessions. The implementation of CTD and SP to the target skills was counterbalanced across four students. Rapid alternation of the interventions was administered by allowing at least 1 hour between the sessions. That is, CTD was implemented with one student, and at least 1 hour later, SP was implemented with the same student. The differential effectiveness of the procedures is demonstrated when the dependent variable assigned to one intervention is acquired faster than the dependent variable assigned to other intervention regardless of the sequence of the applications of intervention (Holcombe et al., 1994; Tekin-Iftar & Kircaali-Iftar, 2004).

Reliability

Dependent variable reliability and independent variable reliability data were collected during at least 20% of each experimental session for each participant from an independent observer. Dependent variable reliability was calculated by using the point-by-point method, dividing the number of agreements by the number of agreements plus the number of disagreements and multiplying by 100 (Tawney & Gast, 1984; Tekin-Iftar & Kircaali-Iftar, 2004).

Dependent variable reliability data for Baran indicated 100% agreement for turning on a CD player during baseline, intervention, and maintenance probe sessions and 90% (range = 90%) agreement during intermittent probe sessions. For Baran, 100% agreement was obtained for taking a picture using a digital camera during baseline and maintenance probe sessions, 83% (range = 70% to 100%) agreement was obtained during intervention sessions, and 80% (range = 80%) agreement was obtained during intermittent probe sessions. Dependent variable reliability data for Faruk and Ferit indicated 100% agreement for turning on a CD player during all the experimental sessions, except the intervention sessions. For Faruk and Ferit, 97% (range = 90% to 100%) agreement was obtained during intervention sessions. Dependent variable reliability data for Faruk and Ferit indicated 100% and 97% (range = 90% to 100%) agreement, respectively, for taking a picture using a digital camera during all the experimental sessions. Dependent variable reliability data for Okan indicated 100% agreement for turning on a CD player during all the experimental sessions. Dependent variable reliability data for Okan indicated 100% agreement for taking a picture using a digital camera during baseline and intermittent probe sessions and 85% (range = 70% to 100%) agreement during the intervention sessions.

Independent variable reliability was calculated by dividing the number of observed teacher behaviors by the number of planned teacher behaviors and multiplying by 100 (Billingsley, White, & Munson, 1980). The teacher showed 100% compliance with the steps of each experimental session across four students.

Social Validation

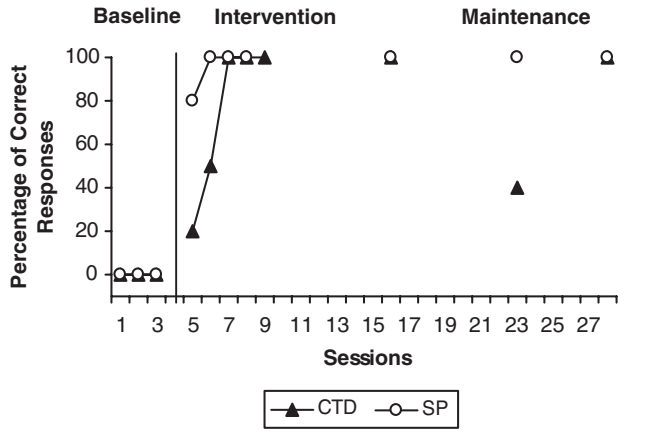
Social validation data were collected from 16 instructors and professors who teach a course in skill and concept teaching to children with mental retardation at universities (n = 8) with special education departments in Turkey. To determine which instructors and participants to include, the criteria were teaching the course for the past 5 years and holding at least an MA. At the end of the study, a packet including the social validity questionnaire, the video clips representing the implementation of CTD and SP within embedded instruction format, and information explaining the aims, methods, and findings of the study was mailed to each instructor. The social validity questionnaire had 10 Likert-type items to be answered "yes," "no," or "undecided" and three open-ended questions. The questionnaire was designed to collect data about the opinions of the instructors regarding the importance of the goals, the acceptability of the intervention procedures used in the study, and the importance of the results of the study.

Results

Effectiveness Data

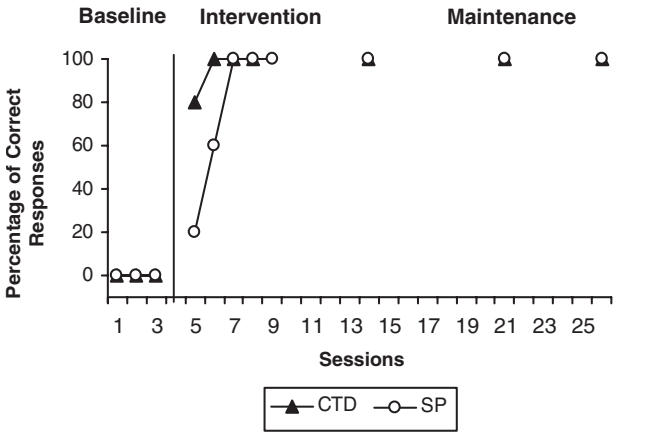
Figures 1 to 4 show the percentages of correct responses during the baseline, intervention, and maintenance probe sessions for Baran, Faruk, Ferit, and Okan, respectively, across instructional procedures delivered within the embedded instruction format. As seen in these figures, both CTD and SP were equally effective in teaching the leisure skills to three children with autism. In other words, three participants in the study acquired the skills with 100% accuracy with both procedures. However, these results were not replicated with the fourth student, Okan, who acquired 100% accuracy for turning on a CD player taught by SP but did not meet the criteria on the other skill taught by CTD. Because of summer break, the study was terminated with this student. Besides modifications in the task analyses, no

Figure 1
Percentage Correct Performance During Test Probes for Baran



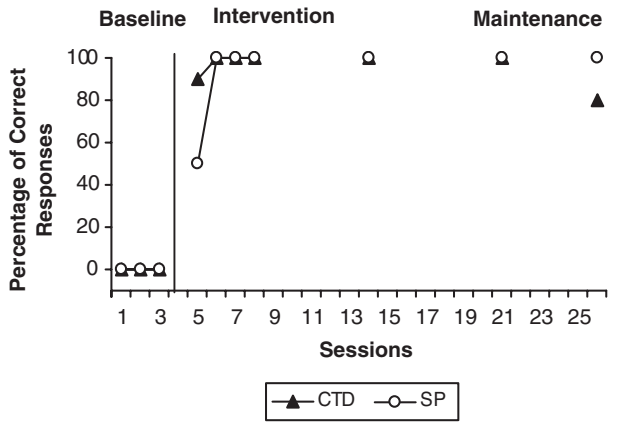
Note: CTD = constant time delay; SP = simultaneous prompting.

Figure 2
Percentage Correct Performance During Test Probes for Faruk



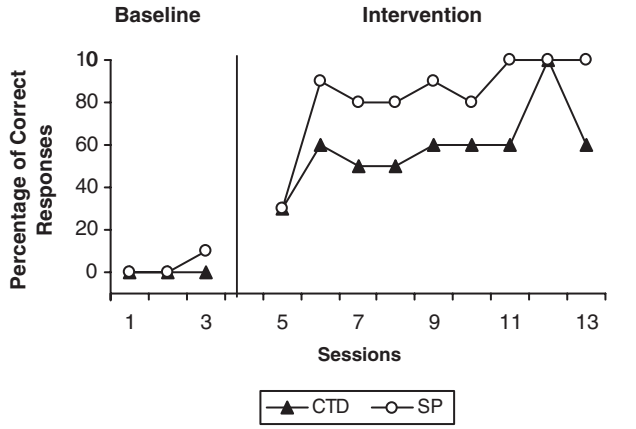
Note: CTD = constant time delay; SP = simultaneous prompting.

Figure 3
Percentage Correct Performance During Test Probes for Ferit



Note: CTD = constant time delay; SP = simultaneous prompting.

Figure 4
Percentage Correct Performance During Test Probes for Okan



Note: CTD = constant time delay; SP = simultaneous prompting.

procedural modification was needed during training. The data showed that the percentage of correct responses prior to instruction was almost zero for all students. The introduction of CTD and SP in the intervention sessions resulted in criterion-level responding on the target skills across all students except Okan. Furthermore, these three students maintained criterion-level responding during the maintenance probe sessions.

Efficiency Data

Efficiency data—the number of training sessions to criterion, the number of training trials to criterion, the percentage of errors to criterion, and total training time to criterion—for CTD and SP delivered within the embedded instruction format are presented in Table 3. Mixed results were obtained regarding the efficiency parameters. The CTD procedure delivered within the embedded instruction format seemed to be more efficient than SP procedure for two students (Faruk and Ferit). On the other hand, CTD seemed to be more efficient than SP regarding all parameters of efficiency in one student (Faruk) and the number and percentage of errors and total training time to criterion in the other student (Ferit). For the other two students (Baran and Okan), SP seemed to be more efficient in terms of the percentage of errors

Table 3
Efficiency Data

Student	Intervention and Skill	Number of Instructional Sessions To Criterion	Number of Trials of Instructional To Criterion	Number (%) of Errors to Criterion	Instructional Time to Criterion (h:min:s)
Baran	CTD, taking a picture	14	11	13 (9%)	00:58:47
	SP, turning on CD player	11	11	2 (2%)	00:33:18
Faruk	CTD, turning on CD player	11	11	2 (2%)	00:31:24
	SP, taking a picture	14	14	12 (9%)	00:49:48
Ferit	CTD, turning on CD player	11	11	1 (1%)	00:29:28
	SP, taking a picture	11	11	5 (5%)	00:37:48
Okan	CTD, taking a picture	22	22	36 (16%)	01:46:27
	SP, turning on a CD player	22	22	15 (7%)	00:59:26

Note: CTD = constant time delay; SP = simultaneous prompting.

and total training time to criterion. No differences were found in the efficiency measures of CTD and SP for these two students.

Social Validation

The participants in the social validation reported positive opinions regarding the aims, procedures, and results of the study. The return rate for the questionnaire was 69% (11 of 16 participants). Regarding the aims and results of the study, all participants reported that they would agree on the existence of a need to conduct research on teaching leisure skills to children with developmental disabilities. Nine of them stated that teaching leisure skills would contribute to the quality of life and life satisfaction of the children in the study. Regarding the acceptability of embedding instruction into daily routines, all participants reported that they would consider adding the topic of embedded instruction into their course contents. Ten participants reported that they would use an embedded instruction format when delivering instruction to their students with developmental disabilities and would advise practitioners in the field to do so. Ten participants reported that parents can deliver teaching via an embedded instruction format to teach various skills to their children in their daily routines. Nine respondents reported that skills taught in an embedded instruction format are associated with a high level of generalization. Seven respondents stated that teachers will not need to make major modifications in their classrooms when the classroom routines are used in an embedded instruction format. Last, seven respondents reported that an embedded teaching format would be a convenient practice in inclusion settings.

Discussion

This study was designed to compare the effectiveness and efficiency of CTD and SP procedures within embedded instruction format to teach leisure skills to young children with autism. The opinions of professors and instructors in the special education departments of universities in Turkey regarding delivering CTD and SP within embedded instructional format were also examined in the study.

Because the participants were delayed in their school status because of their disabilities, they were older than their classmates. But the study was conducted in a preschool context. As seen in the other studies mentioned below, our study is pertinent to instruction in preschool settings. The following conclusions can be drawn on the basis of the data.

First, the data revealed that both CTD and SP procedures were effective in teaching leisure skills to children with autism. The data are also consistent with the findings of previous studies that compared the effectiveness of CTD and SP (Riesen et al., 2003; Schuster et al., 1992; Tekin & Kircaali-Iftar, 2002). None of these studies reported differences between these two procedures in terms of effectiveness. The findings of this study enhance the existing literature regarding the effectiveness of CTD and SP. However, to our knowledge, no studies have compared these instructional procedures in teaching chained leisure skills. It could thus be stated that this study contributes to the current literature by examining the differential effects of both procedures on teaching leisure skills to young children with autism. The data are also consistent with previous studies that investigated the effects of various response-prompting

procedures within an embedded instruction format on teaching different skills to individuals with different learning characteristics (Daugherty et al., 2001; Johnson et al., 2004; McDonnell, Johnson, Polychronis, & Riesen, 2002; Sewell et al., 1998; Venn et al., 1993; Wolery et al., 2002). Considering these studies, it can be concluded that the results of the present study are consistent with the results of the previous studies regarding delivering instruction within an embedded format.

Second, the findings also showed that both procedures were equally effective not only at the acquisition level but also at the maintenance level. These findings are consistent with the findings of Tekin and Kircaali's (2002) study. They also found that both procedures were equally effective in producing maintenance. Mixed results were obtained in the study conducted by Schuster et al. (1992). The findings of their study showed that the skills taught by SP were maintained at higher rates than the skills taught by CTD for two students and at lower rates for the other two students. Riesen et al. (2003) did not investigate the maintenance effects of the procedures in their study. The findings of this study and Tekin and Kircaali-Iftar's study are promising, because maintaining acquired skills over time is a well-documented problem in teaching students with disabilities.

Third, analyses of the efficiency data did not result in a conclusion as to which procedure is more efficient. The results show that CTD within an embedded instruction format was more efficient than SP for two students, and SP within an embedded instruction format was more efficient than CTD for the other two students. Therefore, it can be concluded that there is no apparent difference between these two procedures. Tekin and Kircaali-Iftar (2002) stated that CTD seemed to be more efficient than SP in terms of the number of training sessions and trials to criterion, and SP seemed to be more efficient than CTD in terms of the percentage of errors and training time to criterion. Schuster et al. (1992) found out that the difference between the two procedures was minimal in favor of SP, because SP required fewer training sessions and resulted in lower levels of errors to criterion across all students. Riesen et al. (2003) found mixed results in terms of efficiency as well. On the basis of the results of the present and the previous studies, except that of Schuster et al., it could be concluded that efficiency differs across individual students. Knowing the possible sources of this difference is especially important when deciding which prompting strategy to use. Educators can be advised to consider the following factors when making a decision: the previous learning histories of their students (e.g., did one prompting procedure produce fewer errors than the other for the students) and the students' ability to wait for prompts.

Fourth, the findings regarding the social validity of the study showed that professors and instructors responded very positively in general. In the majority of the previous studies, social validity data were collected from parents or teachers, whereas they were collected from professors and instructors in this study (Horn et al., 2000; Tekin & Kircaali-Iftar, 2002). However, it should be kept in mind when interpreting the social validity findings of this study that the participants of the survey were informed about the aims and researchers of the study. Therefore, providing this information might have caused biases in the participants' opinions.

Besides these, several points observed during the study should be underlined. First, the findings showed that the teacher implemented both response-prompting procedures within the embedded instruction format with a very high degree of procedural reliability. Therefore, teachers and other practitioners in the educational setting could be encouraged to consider delivering instruction with both procedures within an embedded instruction format to their students. Second, all of the experimental conditions were conducted in various settings with different individuals in the daily routines of the students to promote generalization during the acquisition level of the study. Hence, it could be argued that conducting a separate generalization session was unnecessary because of the embedding nature of the study. On the basis of the data, it would not be wrong to say that by delivering instruction within the embedded instruction format, the instructional efficiency of the procedures was increased.

Although the findings of the study are very encouraging, the results should be interpreted cautiously for the following reasons. First, it was assumed that the tasks were equal in difficulty by considering the number of steps in the task analyses. However, it is evident that one skill (i.e., taking a picture) required more fine motor skills and could be interpreted as more difficult than the other skill. The reason for obtaining mixed results regarding efficiency could be explained by a weakness in establishing task difficulty.

Second, this study was limited to teaching leisure skills to four students with autism. Including a larger number of students with other types and degrees of disabilities is warranted in the future studies.

Third, a single-opportunity method was used to determine the performance levels of the students during baseline and probe sessions to reduce the chance of learning in these sessions. However, the students might have performed more steps if they had the opportunity to continue.

Therefore, the probe data could not be considered realistic indicators of the students' performances. Teachers or practitioners who do not need to show experimental control can be advised to choose a multiple-opportunity rather than a single-opportunity method.

Fourth, criteria were met in three of the four students in the study. With Okan, learning could be obtained to a certain extent for taking a picture using a digital camera with the CTD procedure, but the study had to be terminated because of summer vacation. However, he learned to turn on a CD player with SP with 100% accuracy. Instruction for teaching the skill of taking a picture was delivered with SP during the summer break to eliminate the ethical concerns, but Okan could not acquire the skill in this intervention. The following points could account for his failure to learn this skill. It could be explained by Okan's personal characteristics (e.g., he may not have liked the skill). Another possible explanation for his poor performance could be the difference between the difficulty levels of the target skills. We had assumed that these two skills were equal in terms of their difficulty levels when considering the number of steps in the task analyses. This assumption might not have been valid for Okan. Therefore, it could be stated that taking a picture using a digital camera might have been more complicated and difficult for Okan than turning on a CD player. The other possible reason for his failure could be the natural consequences of the two skills. The natural reinforcer for turning on a CD player occurs as soon as the student completes the skill; however, the natural reinforcer for taking a picture does not occur right after the student completes the skill. One more step must be performed to see the picture. Therefore, turning on a CD player could have been more reinforcing for Okan, and this might have caused the difference in his performance.

Fifth, the task analyses were modified during implementation. For example, it was observed that Okan did not differentiate the correct button from others on the CD player to turn it on; therefore, a colored sticker was placed on the power button for him. The other modification was performed for taking a picture, and physical prompting was provided to the students to switch the mode from album to camera or vice versa.

Sixth, intermittent probe sessions were conducted to test the acquisition to standardize the conditions. However, CTD does not require conducting probe sessions for testing acquisition, as does SP. Conducting intermittent probe sessions for testing the skill taught by CTD might have prevented the researchers from seeing the error pattern in CTD.

Seventh, a pool-out strategy was used to establish experimental control in the study. However, embedded instruction should be used in a pull-in strategy, and teachers and other practitioners are recommended to use it in a pull-in strategy.

The following research suggestions can be made when the conclusions and the limitations of the study are taken into consideration. Future research should be conducted to examine the effects of similar implementation in different settings (e.g., inclusion settings, the home) by different implementers (e.g., paraprofessionals, peers). The students were isolated from their groups, and instruction was provided on a one-to-one basis because of the need to establish experimental control. Future research should be conducted to examine the effects of embedded instruction in the group without pulling out the students. Future researchers are advised to collect social validity data from primary consumers, such as students and parents, in implementations. Future research should be conducted to find out ways to increase instructional efficiency by adding instructional feedback stimuli or observational learning. The effects of and differences between other response-prompting strategies within an embedded instruction format can be examined in future studies. This study is the first to compare the effectiveness and efficiency between CTD and SP on teaching chained skills. Replication studies can be designed to compare both procedures in teaching different chained skills.

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