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Does Treatment Integrity Matter in Promoting Learning Among Children With Developmental Disabilities?

Serhat Odluyurt, PhD¹, Elif Tekin-Iftar, PhD¹, and Iclal Adalioglu, MSc¹

Abstract

The purpose of this study was to compare the effects of simultaneous prompting instruction with high and low treatment integrity on the learning of children with developmental disabilities. Low treatment integrity was defined as not delivering a controlling prompt during 30% of the teaching trials. Three preschool children with autism and intellectual disabilities were taught to identify objects and professions in the study. An adapted alternating treatments design was used to compare the effectiveness and efficiency of simultaneous prompting instruction conducted with high versus low treatment integrity. The results showed that both conditions were effective in promoting learning. However, consistent data were not obtained for efficiency measures across children. The results, implications, and future research are discussed.

Keywords

autistic spectrum disorders, mental retardation, treatment integrity, simultaneous prompting, applied behavior analysis

Systematic and controlled manipulations in the environment have a vital role when establishing empirical demonstration of measurable changes in behavior in the field of applied behavior analysis. In this field, changes in the dependent variable should be explained by introducing or delivering the independent variable in a systematic way. Otherwise, the changes in behavior cannot be explained scientifically. Researchers have both ethical and professional responsibilities to assess and report measures of treatment integrity (TI; Wheeler, Baggett, Fox, & Blevins, 2006). TI is described as the degree to which the independent variable is implemented as planned, designed, or intended (Billingsley, White, & Munson, 1980; Peterson, Horner, & Wonderlich, 1982). It is also known as procedural reliability or treatment fidelity. It is an important parameter from a research-minded perspective in terms of establishing a high level of external validity and replication of the procedures used. Assessment of TI has usually been realized by directly observing teachers/trainers during plan implementation and calculating the percentage of intervention steps implemented correctly (e.g., Billingsley et al., 1980; Holcombe, Wolery, & Snyder, 1994).

Simultaneous prompting (SP) is one of the promising response-prompting procedures for teaching various types of learners. It has been successfully used to teach a wide range of skills to individuals of various ages and disabilities (Fetko, Schuster, Harley, & Collins, 1999; Maciag, Schuster, Collins, & Cooper, 2000). It is relatively a newer procedure

among other response-prompting procedures and was first described as a systematic form of antecedent prompt and test procedure. In SP, the learners are prompted with a controlling prompt after discriminative stimulus and are expected to respond correctly during instructional trials. Since learners are always given the controlling prompt during instruction, daily probe sessions are needed to test the transfer of stimulus control from controlling prompts to discriminative stimulus. The SP has the following three main characteristics: (a) the prompt should be the same or constant throughout the instruction, (b) the final form of the target stimulus should be used during instruction, and (c) acquisition should be tested with probe trials.

Research projects examining the effectiveness of SP are conducted to teach identification of professions presented on picture cards (Dogan & Tekin-Iftar, 2002), object identification (Reichow & Wolery, 2009), expressive identification of environmental words (Tekin-Iftar, 2003), receptive identification of animals (Tekin & Kırcaali-Iftar, 2002), academic skills (Akmanoglu & Batu, 2004; Birkan, 2005; Gursel, Tekin-Iftar, & Bozkurt, 2006; Parker & Schuster, 2002; Rao & Kane, 2009; Rao & Mallow, 2009), and

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language skills (Waugh, Fredrick, & Alberto, 2009). It has also been successfully used to teach chained skills such as self-care skills (Parrott, Schuster, Collins, & Gassaway, 2000), vocational skills (Maciag et al., 2000), play skills (Colozzi, Ward, & Crotty, 2008), community skills (Tekin-Iftar, 2008), and daily life skills (Batu, 2008).

Morse and Schuster (2004) conducted a comprehensive review of research on SP procedure. They analyzed 18 published studies and concluded that it has been used successfully for teaching various skills to individuals with various disabilities and ages. Besides its effectiveness, they also reported that instruction with SP was delivered with high treatment integrity that ranged from 96.7% to 100% across these studies. In other words, SP in these studies occurred with almost perfect implementation.

Within the past 7 years, 16 more studies (Akmanoglu & Batu, 2004; Akmanoglu-Uludag & Batu, 2005; Batu, 2008; Birkan, 2005; Colozzi et al., 2008; Gursel et al., 2006; Kurt & Tekin-Iftar, 2008; Rao & Kane, 2009; Rao & Mallow, 2009; Reichow & Wolery, 2009; Riesen, McDonnell, Johnson, Polychronis, & Jameson, 2003; Tekin-Iftar, 2003, 2008; Tekin-Iftar, Acar, & Kurt, 2003; Tekin-Iftar, Kurt, & Acar, 2008; Waugh et al., 2009) were designed to examine the effectiveness of SP in teaching both discrete and chained skills to children with developmental disabilities. In four of these studies, instruction was delivered by peers, siblings, parents/caregivers, and paraprofessionals (Batu, 2008; Colozzi et al., 2008; Tekin-Iftar, 2003; Tekin-Iftar, 2008). The authors of these studies reported that teaching the above-mentioned paraprofessionals to use SP was time efficient. Furthermore, the instructors in these studies mentioned that delivering SP instruction was easy. In two studies, SP was the sole independent variable. In these studies, the effectiveness and efficiency of SP were compared to constant time delay. All, except Riesen et al.'s study, reported the analysis of TI. TI ranged from 91% to 100%, with a mean of 98.3% across instructional sessions in all 16 studies.

The aforementioned research outcomes establish the effectiveness and reliable use of the SP. However, it should be kept in mind that all are experimental studies. The researchers in these studies had to build experimental control to answer their research questions. Therefore, they controlled the possible external variables, which may have effects on the dependent variable and the delivery of the instruction with high TI during their studies. However, in a natural classroom setting, as stated by Holcombe, Wolery, and Snyder (1994), one can easily guess that providing instruction with high TI may not always be possible for several reasons. First, the dynamics of the classrooms such as the number of students in the classroom, the heterogeneity of the classrooms in terms of students' demographics, and the content to be taught might be considered as possible sources of factors that may affect TI. Second, the absence of a reliability observer might be regarded as another factor. Teachers or other instruction

providers may feel much more comfortable and may ignore correct implementation if there is no external evaluation. Third, teachers in the educational system may have less training about both the concept and importance of providing instruction with TI and the instructional procedure itself. Therefore, the authors of this study believe that it is important to find out the effectiveness of instruction with SP with low TI. Besides these possible barriers, the findings of the research about SP raised a question about whether the procedure is effective if used with low TI.

Holcombe, Wolery, and Snyder (1994) used an adapted alternating treatments design to compare the effects of constant time delay delivered with two different TI levels in teaching discrete skills to six children (ages 4–5) with mental retardation and developmental delays. Low TI was achieved in the study by not delivering a controlling prompt on a mean of 44% of the teaching trials. The participants of the study were taught receptive and expressive identification and expressive signs. The results showed that the two levels of TI seemed to produce differential effects on the effectiveness and efficiency of instruction. The results showed that five of the six children and four of the six children met the criteria via instruction delivered with high and low TI level, respectively. The efficiency of instruction was analyzed by considering the data from the four children and showed that in three of the four, instruction with high TI resulted in more efficient learning.

Considering the possible stated barriers that may negatively affect TI of instruction in a real classroom and the findings of the above research, we designed this study to compare the effectiveness of the SP instruction with high and low TI. Low TI was defined as not delivering a controlling prompt in 30% of the teaching trials since a higher level for not delivering controlling prompt did not produce a favorable outcome in the above-mentioned study. The present study was designed to answer the following research questions: (1) Is there a difference between the effectiveness and efficiency of SP instruction provided with high and low TI in teaching discrete skills to three children with developmental disabilities? (2) Is there a difference in maintaining and generalizing the acquired discrete skills in favor of the instruction with one TI level (high or low)?

Method

Participants

Subjects. Three children with developmental disabilities participated in the study. Prerequisite skills for the students were as follows: (a) having visual acuity, (b) following verbal direction, and (c) attending to verbal and visual stimuli for 5 minutes. All the students were enrolled in a special class at the Developmental Disability Unit in the Research Institute for the Handicapped at Anadolu University in

Turkey. No adaptive scores were available for the participants. All children had the experience of receiving instruction with SP.

Ege was a 5-year-3-month-old boy with autism. He has an IQ of 62 on the *Wechsler Intelligence Scale for Children-Revised* (WISC-R; Savasir & Sahin, 1994). He was diagnosed at a public hospital by a child psychiatrist. He could perform basic self-help skills such as eating, toileting, and dressing with verbal prompting. He could also perform many fine motor skills and gross motor skills with prompting. Ege had difficulty in communication skills. Learning receptive and expressive identification of objects was included as a goal in his Individualized Education Program (IEP).

Erol was a 5-year-1-month-old boy with Down syndrome. No test was administered successfully to Erol for measuring his IQ level. He could perform basic self-help skills such as toileting, dressing, and eating. Erol could manage many fine motor skills such as holding a pencil, drawing a picture, coloring a given shape, and gross motor skills such as walking up and down the stairs independently. Teaching receptive and expressive identification of objects was included in his IEP.

Lale was a 4-year-6-month-old girl with Down syndrome. WISC-R (Savasir & Sahin, 1994) was administered to Lale and she had an IQ of 50. She was able to perform basic self-help skills. She had age-appropriate fine and gross motor skills. Using two or more word sentences was her main strength in communication skills. She could initiate and complete a short conversation. Teaching receptive identification of vehicles was included in her IEP.

Trainer and observer. All experimental sessions were conducted by the third author. She is a special education class teacher with 11 years of experience in teaching children with disabilities. Reliability data were collected by a graduate student in special education, and she was informed about the collection of the reliability data.

Settings

All sessions were conducted during lunch and play time in a classroom of the third author. The classroom had four square desks for students, six child-size chairs, four cupboards, a table and a chair for the teacher, a chalkboard, and an observation mirror. The child and the trainer sat at a table facing each other and all sessions were conducted in a 1:1 instructional arrangement. Generalization sessions were conducted in another classroom by a teacher-aide.

Materials

Two training sets were formed for each participant. There were five picture cards for each participant for each training set and all of them were taught receptive identification. Ege was taught to receptively identify the professions, Lale was

Table 1. Target Behavior Sets

Students	Training set for HTIC	Training set for LTIC
Ege	Sweeper Waiter Baker Cook Tailor	Hairdresser Policeman Grocer Butcher Fireman
Lale	Fire engine Ambulance Police car Helicopter Garbage conveyor	Trolley Engineering vehicle Tractor Pickup truck Bulldozer
Erol	Peacock Bear Giraffe Snake Zebra	Elephant Camel Leo Monkey Deer

Abbreviations: HTIC, high treatment integrity condition; LTIC, low treatment integrity condition.

taught to receptively identify the vehicles, and Erol was taught to receptively identify the animals. The picture of each target behavior was pasted on a 10- × 15-cm card. Target stimuli are presented in Table 1. Also, reinforcement, a handycam camera, and data collection forms were used in the study.

Experimental Design

An adapted alternating treatments design (Holcombe, Wolery, & Gast, 1994; Tekin-Iftar & Kircaali-Iftar, 2006) was used to compare the effectiveness of SP instruction with high and low TI in teaching two sets of stimuli to children with developmental disabilities. In this design, two treatments (high and low TI) were applied to independent sets. Each set was randomly assigned to SP instruction under high and low TI conditions. The dependent variable was the percentage of correct responses on each set, and the independent variables of the study were SP instruction with high and low TI conditions. The sequence of the TI condition was alternated across sessions, and the introduction of high and low TI conditions were counterbalanced across the three children. At least a 1-hr break was given during rapid alternation between high and low treatment conditions. Experimental control was established when the dependent variable assigned to the independent variable was acquired faster than the dependent variable assigned to another independent variable, regardless of the sequence of intervention.

General Procedure

Receptively identifying objects and professions on picture cards were taught to three children with developmental disabilities. The experimental procedure consisted of screening,

baseline, intervention (high and low TI conditions), intermittent probe (for testing acquisition), maintenance, and generalization sessions. All sessions were conducted in a 1:1 instructional arrangement and were videotaped. There were five discrete skills in each set of stimuli and each stimulus in the sets was asked twice in a session with a total of 10 trials. A pilot study was conducted to modify the planned intervention. Social and edible reinforcers were given to the students at the end of each experimental session to ensure cooperative and attentive behavior during the sessions.

Screening Sessions

Two screening sessions were conducted with each student in a 1:1 instructional arrangement to identify unknown stimuli. Two sets of stimuli (training sets) were formed and then counterbalanced across two instructional conditions. Each student had five stimuli in his or her sets. Topographical similarities of the stimuli and stimuli least known by the student were used as criteria while counterbalancing the stimuli to the sets. Screening sessions were conducted in the same manner as the baseline sessions (see explanation below). The only difference was that no reinforcement was delivered during screening sessions.

Probe Sessions (Baseline and Intermittent Probe Sessions)

Baseline sessions were conducted prior to intervention. Baseline trials were conducted as follows. The teacher secured the child's attention by delivering an attentional cue such as "Ege, are you ready to work?" After receiving an affirmative response, the teacher immediately delivered a task direction, such as "Point to zebra." The teacher waited for 4 s for the children to respond. Correct responses merited social reinforcement cues such as "Bravo!" and incorrect responses were ignored. Then, the next trial was delivered after 4 s in the same manner.

During SP instruction, a controlling prompt is always provided. Therefore, children do not have the chance to respond independently of the task direction. For this reason, intermittent probe sessions were conducted twice a week. These sessions were always conducted prior to instruction.

Intervention Sessions

SP was used to teach two sets of stimuli consisting of picture cards. One set of stimuli was taught with SP instruction with high TI and the other was taught with SP instruction with low TI. High TI was defined as the teacher's 100% compliance with all the planned steps of intervention, whereas low TI was defined as the teacher's 100% compliance with the planned steps of intervention, except for the delivery of the controlling prompt. The controlling prompt

was delivered with at most 70% accuracy during the teaching trials. During training sessions, the task direction and the controlling prompt were delivered simultaneously. Model plus verbal prompting were used as controlling prompts for all children. Training sessions were continued until the criterion was met—least 90% correct response for three consecutive intermittent probe sessions for all children. The following trial sequence was used during instruction. The teacher secured the child's attention by delivering an attentional cue, such as "Ege, are you ready to work?" and, after receiving an affirmative response, the teacher delivered the task direction, for example, "Point to zebra." The teacher then immediately delivered the controlling prompt by both pointing and saying "This is zebra" together. If the child modeled his or her teacher and pointed to the target stimuli, the child was reinforced verbally, such as "Good boy!" The incorrect responses of the children were ignored and the teacher delivered the next trial.

SP instruction with high TI condition. SP instruction with high TI was implemented by delivering a controlling prompt with 100% accuracy during all teaching trials. All teacher behaviors in the SP procedure were implemented as described above in this condition.

SP instruction with low TI condition. SP instruction with low TI was implemented by delivering a controlling prompt with at most 70% accuracy during these sessions. The trials in which the teacher was expected not to deliver controlling prompts were determined by the second author randomly. The cell for "providing a controlling prompt" in the data collection form was marked black to remind the teacher not to deliver a prompt. Except for the delivery of a controlling prompt, the other steps were conducted just like the SP instruction with high TI.

Maintenance and Generalization Probe Sessions

Two maintenance sessions were conducted with Ege and one with Lale after they met the criterion. Because of the summer break, no maintenance session had been conducted with Erol. Maintenance sessions were conducted in the same way as the baseline sessions.

Generalization of the acquired skills across settings and across trainers was tested by pretest–posttest measures. The pretest session was conducted after the baseline session and the posttest session was conducted after each student had met the criterion. During generalization sessions, correct responses were reinforced verbally and incorrect responses were ignored.

Reliability

Reliability data were collected in at least 20% of all the sessions randomly for both dependent and independent variables. Dependent variable reliability data were calculated by

dividing the number of agreements by the number of agreements plus disagreements multiplied by 100 (Tawney & Gast, 1984; Tekin-Iftar & Kircaali-Iftar, 2006). TI was calculated by dividing the number of teacher behaviors observed by the number of teacher behaviors planned multiplied by 100 (Billingsley et al., 1980; Tekin-Iftar & Kircaali-Iftar, 2006). The following teacher behaviors were observed for the purpose of collecting reliability data: (a) have ready materials, (b) secure attention, (c) deliver task direction, (d) deliver/not deliver controlling prompt (only in intervention sessions), (e) wait for the 4-s response interval, (f) deliver behavioral consequences, and (g) wait for intertrial interval.

Results

Reliability

The dependent variable reliability data collected for the three children indicated 98% agreement during baseline and intervention sessions with training sets taught with high TI and 100% agreement during maintenance and generalization sessions. A 95% agreement was obtained during baseline and maintenance sessions, and 98% and 100% agreement during intervention and generalization sessions, respectively, were observed in all children with training sets taught with low TI.

The percentages of treatment steps implemented under high and low treatment conditions by the teacher showed that, except for delivering appropriate consequences, all planned steps were delivered with 100% compliance during baseline and intermittent probe sessions with all children. The step of delivering appropriate consequences was conducted with a mean of 90% compliance across all children (range = 67–100%). For both intervention conditions, the remaining steps, except for providing a prompt and appropriate behavioral consequence, were delivered with 100% compliance for all children. The steps of providing a prompt and providing behavioral consequences were conducted, with a mean of 99.3% (range = 98–100%) and 97.5% (range = 95–100%) compliance across children, respectively.

Effectiveness of Acquisition, Maintenance, and Generalization

Figures 1 through 3 show the effectiveness of SP instruction with high and low TI conditions on skill acquisition and maintenance of the acquired skills for Ege, Erol, and Lale, respectively. The data indicated that SP instructions with high and low TI both were equally effective in teaching receptive identification to three children with developmental disabilities without any procedural modification. It was also evident that both conditions were equally effective at the maintenance phase. The children maintained the acquired skills over time.

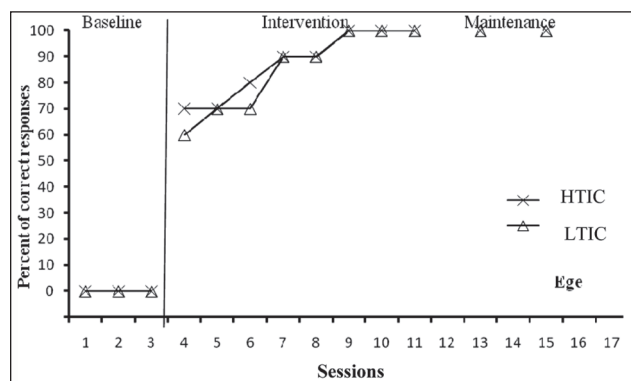


Figure 1. Percentage of correct responding for Ege during baseline, SP instruction with high and low TI conditions, and maintenance probe sessions.

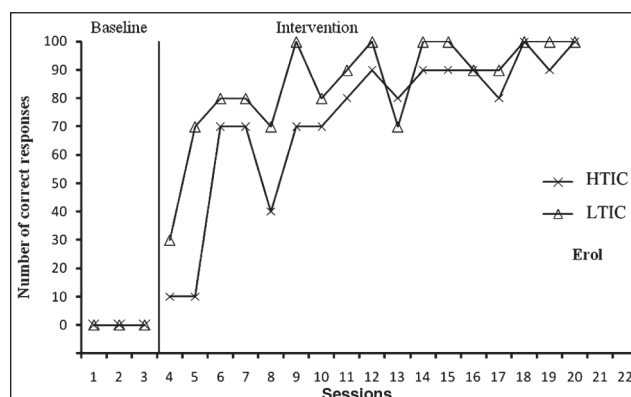


Figure 2. Percentage of correct responding for Erol during baseline and SP instruction with high and low TI conditions.

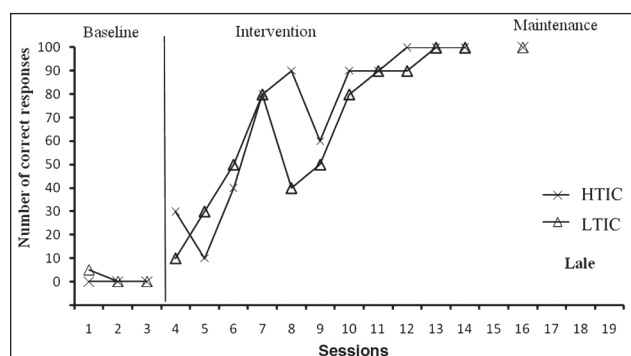


Figure 3. Percentage of correct responding for Lale during baseline, SP instruction with high and low TI conditions, and maintenance probe sessions.

Pretest generalization data indicated that prior to intervention, no student could receptively identify the objects asked by their teacher-aid or asked by their teacher in a variety of settings. Posttest generalization data collected after the training intervention showed that all children were able to respond with 100% accuracy across persons and settings.

Table 2. Measures of Efficiency Through Criterion Across Training Sets and Students

Student/condition	Training sets	No. of training sessions and trials	No. (%) of training errors	Training time (hour : minute : second)
Ege				
HTIC ^a	Set I	8/80	12 (15)	22:38
LTIC ^b	Set II	8/80	10 (13)	22:06
Erol				
HTIC	Set I	16/160	24 (15)	43:12
LTIC	Set II	16/160	45 (28)	42:35
Lale				
HTIC	Set I	11/110	38 (34)	56:02
LTIC	Set II	11/110	37 (34)	52:23
Total				
HTIC	Set I	35/350	74	1:57:4
LTIC	Set II	35/350	92	2:1:52

Abbreviations: HTIC, high treatment integrity condition; LTIC, low treatment integrity condition.

Efficiency

Efficiency data were analyzed by considering the number of training sessions and trials to criterion as well as the percentage of errors to criterion and total training time to criterion for SP instruction with high and low TI (Table 2). Inconsistent results were obtained for efficiency and we could not, therefore, make a general conclusion regarding which condition is better in terms of overall efficiency parameters. Simultaneous prompting instruction with high and low TI seemed to be equally efficient in terms of number of training sessions and trials across the participants. Simultaneous prompting procedure with high TI seemed to be more efficient than low TI condition in terms of number and percentage of errors and total training time across the participants.

Discussion

This study was designed to compare the two levels of TI with SP instruction in teaching receptive identification of objects and professions to children with developmental disabilities. Maintenance and generalization effects of both instructional conditions were compared in the study as well. In addition, the efficiency of both conditions was also tested. The following conclusions can be drawn on the basis of the data obtained.

First, the data showed that SP instruction was effective in teaching discrete skills to children with developmental disabilities. These findings are consistent with those of previous studies (Dogan & Tekin-Iftar, 2002; Reichow & Wolery, 2009).

Second, when the first research question of the study is taken into consideration, the data showed that SP instruction with high and low TI showed no difference in terms of teaching discrete skills to children with developmental disabilities at the acquisition phase. In other words, instructional

conditions of high and low TI both seemed to be equally effective. Regardless of the TI issue, it can be concluded that SP instruction was effective in teaching discrete skills to children with disabilities.

Third, the data showed no difference not only at the acquisition level but at the maintenance and generalization levels as well. The data indicated that both instructional conditions were equally effective in maintaining the acquired skills over time and in the generalization of the acquired skills across settings and trainers.

Fourth, the data revealed that SP instruction conditions with high and low TI were equally efficient in terms of the number of training sessions and trials to criterion across the three children. However, SP with low TI seemed to be slightly more efficient in terms of other efficiency measures in two of the three children. These inconsistent results can be explained by individual differences and further research is warranted.

Fifth, when considering the TI findings, the teacher implemented SP procedure with high compliance. These results are consistent with the findings of the previous studies. There are research studies investigating whether SP can be used reliably by siblings, peers, parents, and/or caregivers (Batu, 2008; Tekin-Iftar, 2003, 2008; Tekin & Kırcaali-Iftar, 2002). As in this study, all these studies showed that the SP procedure can be used with high TI. The findings of the current study enhance the existing literature regarding the reliable use of SP.

The following limitations should be considered in evaluating the findings of the study. First, the study was conducted with three children whose ages were between 4 and 5 years and who have mental retardation and autism. Therefore, the results should be interpreted cautiously. The delivery of reinforcement was planned at the end of each experimental session. However, a fixed ratio schedule (FR5) was used for Erol since it took time for him to meet

the criterion. The social validity of the study was not examined in the study. Another limitation was the use of a pull-out strategy to ensure experimental control. Lastly, in Turkey early childhood special education is in its crawling stage. Therefore, the recommended practices (Sandall, Hemmeter, Smith, & McLean, 2005) are not fully functional yet. This study is closely related with two main strands of recommended practices: child-focused intervention and personnel preparation. The only violation could be delivering services in segregated classrooms. It should be kept in mind that this study was conducted in an experimental unit, where only children with disabilities attend.

The following research suggestions can be considered when the conclusions and limitations of the study are assessed. First, future research should examine the differential effects of instruction with SP with high and low TI in teaching different discrete skills as well as chained behaviors to children with developmental disabilities. Also, the same study should be replicated with children at various ages and having various disabilities. Second, future research should also focus on examining the differential effects of high and low TI with different response-prompting strategies. Promising outcomes were obtained with other response-prompting procedures such as most to least prompting, least to most prompting, or graduated guidance. The effects of instruction with low TI on any of these procedures should be investigated. Third, the effects of providing TI in varying degrees should be examined to obtain the best outcomes. Fourth, other procedural parameters such as providing a task direction, waiting for a response interval, delivering appropriate behavioral consequences, etc. can be considered as variables for defining low TI. Future research should be designed to compare the differential effects of the procedures in terms of these variables. Fifth, additional research should be designed to examine the social validity aspects of a study. Teachers' and/or teacher candidates' opinions regarding the comparison between high and low TI should be solicited. Sixth, different assessment techniques such as teacher reports can be used in future research. Finally, whether lower level of treatment integrity in simultaneous prompting would lead to desired outcomes on children learning should be investigated in the future research.

Although future research is needed, in general, the findings of this study allow for the recommendation to use SP. Teachers/practitioners of early childhood education should be made aware of some factors affecting TI negatively, such as number of students and expertise levels of teachers, and are also recommended to use SP when planning to teach discrete skills to their students.

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