Received: 11 August 2021 | Revised: 18 March 2022 | Accepted: 29 April 2022

DOI: 10.1002/bin.1887

RESEARCH ARTICLE

WILEY

# Response prompting procedures delivered within embedded teaching trials for teaching chained skills

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**Funding information**
This study was supported by a Grant from Anadolu University Research Fund, Grant/Award Number: 092741

## Abstract

Simultaneous prompting and graduated guidance procedures have been used successfully in teaching various academic and functional skills; however, there is a scarcity of research that directly compares these two procedures delivered within embedded teaching trials while teaching chained skills. The researchers used an adapted alternating treatments design to compare the efficacy of simultaneous prompting and graduated guidance procedures delivered within embedded teaching trials for teaching two chained skills (i.e., snap fastening and buttoning up skills) to three young children with developmental disabilities. They also examined the generalization and maintenance effects of both procedures in the study. Last, the researchers examined the social validity of the study through social comparison. Results indicated both instructional procedures delivered within embedded teaching trials produced the acquisition of targeted chained skills in all children. Also, both produced maintenance and generalization of the acquired chained skills. However, a consistent finding was not obtained for the efficiency of the procedures in favor of one procedure. Finally, social validity findings were highly promising. The participating children reached the performance of their peers after the intervention. Future research is needed to support these findings.

**KEYWORDS**
developmental disabilities, embedded instruction, evidence-based practices, graduated guidance, simultaneous prompting

## 1 | INTRODUCTION

Presently, there are numerous response-prompting procedures (e.g., simultaneous prompting (SP), time delay (TD), most-to-least prompting (MLP), and graduated guidance (GG) that can be effectively used with children with developmental disabilities (DD). All response-prompting procedures depend on a transfer of stimulus control for teaching functional skills to children with DD (Browder, Wood, Thompson, & Ribuffo, 2014; Courtade, Test, & Cook, 2014; Tekin-Iftar, Olcay-Gul, & Collins, 2019; Tekin-Iftar & Kırcaali-Iftar, 2018). These procedures have been developed under the conceptualization of the antecedent-behavior-consequent contingency principle (Collins, 2021). Prompting, which takes place in the antecedent part of this contingency, is used to occasion correct responses in learners.

Effectiveness and efficiency of a procedure are highly important parameters when deciding which procedure to use while teaching skills to children with DD (Olcay-Gul & Tekin-Iftar, 2016; Seaver & Bourret, 2014; Tekin-Iftar, Acar, & Kurt, 2003; Wolery, Ault, Gast, Doyle, & Griffen, 1991) due to the gap between children with DD and their peers with typical development. The best way of closing this gap is to deliver efficacious teaching. Therefore, to suggest these efficacious prompting procedures, researchers have conducted studies comparing the effectiveness and efficiency of these procedures in teaching various skills to children with DD (e.g., Cengher et al., 2016; Kurt & Tekin-Iftar, 2008; Libby, Weiss, Bancroft, & Ahearm, 2008; Tekin & Kircaali-Iftar, 2002).

Over the past few decades, researchers and educators have provided careful attention to naturalistic teaching practices and approaches. During naturalistic teaching practices teaching occurs in a low-structure teaching environment, a teacher follows a child's lead, employs naturally occurring antecedents and consequences, and attends to the child's preferences and choices (Pretti-Frontzack & Bricker, 2004; Rule, Losardo, Dinnebeil, Kaiser, & Rowland, 1998; Wolery & Hemmeter, 2011). As indicated in a systematic review study on naturalistic teaching by Synder et al. (2015) naturalistic teaching approaches have emerged as a comprehensive concept to describe several intervention approaches embedding teaching trials into the natural settings of young children and early childhood educators have started to use them in educating young children DD. For example, a teacher can provide teaching trials to teach colors and shapes during lunch at the school. The teacher asks a student to “give the red napkin to his friend” or “give round plate to herself” and when necessary, delivers prompts to the student for a correct response and reinforces the correct response accordingly.

Embedding teaching trials throughout the children's teaching program is an integral part of naturalistic teaching approaches and generally resulted in higher generalization. By doing so learning children's goals and objectives are included in an activity or event and learning trials are provided in the context of ongoing, naturally occurring, activities, routines, and transitions in the children's learning environments (Sandall, Hemmeter, Smith, & McLean, 2005; Synder et al., 2015). There are studies examining the differential effects of traditional mass teaching trials and embedded teaching trials (e.g., Haq & Aranki, 2019; Ledford, Chazin, Harbin, & Ward, 2017; Sahin & Ozen, 2021) in teaching young children with DD and a consistent finding in favor of one teaching trial presentation has not been identified. Both teaching trials resulted in learning in the participating children in these studies and some of the participants in these studies have preferred embedding teaching trials over the massed trials. So further research to examine embedding teaching trials while providing teaching through response-prompting procedures is warranted. To date, researchers investigated the effectiveness of several instructional procedures within the embedded instruction approach such as time delay (e.g., Grisham-Brown, Pretti-Frontczak, Hawkins, & Winchell, 2009; Johnson, McDonnell, Holzwarth, & Hunter, 2015; Venn et al., 1993), SP (Sewell, Collins, Hemmeter, & Schuster, 1998), and MLP (Rakap & Balikci, 2017). However, there are only a few comparison studies that aim to compare these instructional procedures to promote learning in children with DD (e.g., Kurt & Tekin-Iftar, 2008; Riesen et al., 2003) during

embedded instruction. Among the aforementioned research, the majority of the studies are conducted to examine the effects of embedded instruction in teaching language, social interactions, and cognitive skills. With the exception of Sewell et al. (1998), there is no study investigating the effects of embedded instruction in teaching self-care skills to young children with DD. Self-care skills are important skills to teach children with and without disabilities, as they need to perform them throughout their lives. Though, there are many chained skills (e.g., buttoning up, snap fastening) that need to be acquired before starting to teach self-care skills. The researchers should seriously consider finding out the efficacious procedures for teaching these chained skills.

The SP and GG are two response-prompting procedures, which have been used successfully when teaching various academic and functional skills to young children with disabilities (e.g., Akers, Higbee, Pollard, Pellegrino, & Grenser, 2016; Denny et al., 2000; Dogan & Tekin-Iftar, 2002; Sewell et al., 1998). However, due to scarcity in research directly comparing these two procedures, less is known about which one is more effective and efficient in teaching either discrete or chained skills. During the SP trials, the instructor delivers a controlling prompt immediately followed by a discriminative target stimulus, and students are expected to model the prompt. The SP procedure requires teachers to use a single prompt (the same prompt such as model or prompts such as model and verbal together) throughout teaching. Because, the controlling prompt is delivered during each training trial, daily probes are needed to assess the acquisition. Daily probes consist of test trials used to establish baseline performance, assess acquisition of a targeted skill once instruction begins, and assess maintenance of previous instruction. Although the majority of studies were conducted to test its effectiveness in teaching discrete skills, there are also studies showing its effectiveness across different ages, levels, and types of disabilities, and chained skills including self-care skills in different complexity (i.e., Batu, 2008; Hudson, Hinkson-Lee, & Collins, 2013; Sewell et al., 1998; Tekin-Iftar, 2008; Tekin-Iftar, Olcay-Gul, & Collins, 2019).

GG procedure, a variation of the least-to-most prompting procedure (Cengher, Kim, & Fienup, 2020; Collins, 2021; Duker, Didden, & Sigafos, 2004; Wolery, Ault, & Doyle, 1992), is also known as manual prompting or manual guidance. It has not been given the same amount of research attention as the SP procedure, nor has it consistently been defined in research studies. Wolery et al. (1992) defined GG procedure as providing physical prompts as needed and fading them immediately as the student begins to respond correctly. As opposed to SP procedure, GG procedure requires teachers to use multiple prompts and fade them during teaching. Fading can be conducted with moment-to-moment. The instructor should shadow the student's movements, allowing for immediate corrections as necessary. The instructor usually does not follow any predetermined learning criterion for the learner to fade the prompt; he/she makes moment-to-moment decisions based on the child's performance and decrease or increase prompting support. Research studies have shown that it is effective in teaching chained skills including self-care skills to children with various disabilities (e.g., Bennett, Reichow, & Wolery, 2011; Cicero & Pfadt, 2002; Gruber & Poulson, 2016; Reese & Snell, 1991; Sisson, Kilwein, & Van Hasselt, 1998; Soluaga, Leaf, Taubman, McEachin, & Leaf, 2008; Young, West, Howard, & Whitney, 1986).

When the research on the effectiveness of both procedures is considered individually, research needs regarding comparing the effects of these two particular procedures (a) in a traditional structured teaching setting, (b) in a naturalistic teaching environment, and (c) in teaching discrete, as well as chained skills, still continue in this field of research. The researchers particularly selected these two procedures for three reasons: First, a recent meta-analysis on SP (Tekin-Iftar et al., 2019) and extant literature on GG (e.g., Drasgow, Halle, & Ostrosky, 1998; Kurt, 2011) procedures showed that they been delivered effectively in early childhood settings via massed teaching trials. Second, when the literature reviewed it is seen that the acquisition of the target skills is fast, usually occurred during the initial training sessions, in both procedures (e.g., Cattık & Odluyurt, 2017; Gibson & Schuster, 1992; Jimenez & Alamer, 2018). Third, the SP procedure requires using a single prompt whereas the GG procedure requires using multiple prompts throughout the teaching, and considering the children's outcomes it would be important to provide a suggestion in terms of using single versus multiple prompts. In addition to that, today's major challenge regarding which instructional procedure to use when utilizing embedded teaching trials needs to be considered to provide suggestions to the educators and researchers in the field. Moreover, acquiring self-care skills in general and skills

which are served as prerequisite for performing several self-care skills (e.g., buttoning up, snap fastening) are important for all children, and the need for finding effective and efficient procedures to teach these skills to young children through embedded teaching trials still exists. Last, but not least, the social validity of the applied research on these topics is ignored, while the studies measured the social validity used heavily the subjective evaluation method. As a rather objective method, the researchers in this study used the normative comparison method to evaluate the social validity of these procedures in the study. Therefore, this present study was planned to compare the effectiveness and efficiency of SP and GG procedures delivered within embedded teaching trials in teaching self-care related chained skills, buttoning up and snap fastening skills, to three young children with DD. The answers for the following research questions were sought in the study: (1) Which procedure, SP or GG delivered within embedded teaching trials is more effective in teaching buttoning up and snap fastening skills to young children with DD? (2) Which procedure is more effective in maintaining and generalizing the acquired buttoning up and snap fastening skills in young children with DD? (3) Which procedure is more efficient in teaching buttoning up and snap fastening skills to young children with DD? and, (4) Do the buttoning up and snap fastening performance of young children with DD become closer to the performance of their peers with typical development after receiving intervention via SP or GG delivered within embedded teaching trials?

## 2 | METHOD

### 2.1 | Participants

#### 2.1.1 | Children

Three 4-year-old preschool children with DD participated in this study. Two of them (Ersin and Yaman) were male and had autism spectrum disorder, and the other one (Zerrin) was a female with Down Syndrome. They attended a half-day university unit for 5 days a week at a local university in central Turkey. Their teacher (the second author of the study) taught various skills from different developmental areas (i.e., fine and gross motor skills, cognitive skills, adaptive skills, social-communicative skills, and play skills). The prerequisite skills for the children in this study were the ability to (a) attend to visual and/or audio stimuli for 5 min, (b) have turn-taking skills, (c) follow simple verbal instruction (e.g., “Come here”), and (d) have fine and gross motor skills necessary to perform the targeted self-care skills. The researchers identified these skills as prerequisites because the first three skills are foundational skills that let the learners be successful during systematic instruction and the last skill, having fine and gross motor skills, is a required skill while teaching any self-care skills to the children. As a teacher of these children, the second author had many opportunities to observe and assess these prerequisite skills. All children could count to 10, show shapes and colors when asked, and had some concepts such as big, small, long, and near. They could imitate when prompted; say their names, their friends' names, and their teachers' names; and produce one-two word sentences. Ersin and Yaman needed prompting to initiate and maintain conversations with others. Each participating child had a learning history with both procedures. Prior to this study, their teacher had delivered instruction via both SP and GG procedures to teach discrete as well as chained skills to the participants during their routine classroom teaching activities. For example, she had taught the names of animals and objects, throwing ball to the basket, and completing puzzles via the SP and matching and/or discriminating objects, hand washing, and assembling Mr. Potato Head with the GG successfully earlier. They had a learning history with chained skills in general, too. Their teachers had taught them to use a fork and spoon, fold napkins and paper, wipe hands and mouth with a napkin, etc. Yaman and Ersin could use a fork and spoon while eating and child-size scissors during art activities. Zerrin needed some help to use them. Ersin and Yaman were diagnosed by child psychiatrists based on behavioral observations; however, no test scores for their adaptive behaviors and intellectual functioning were available for the researchers due to regulations in Turkey. As their special education teacher, the second author suggested including these particular students in this study based on their needs

and programs. They had objectives from the self-care domain in their individualized educational plans. Although they were able to dress independently, they could not manage regular size buttons and snaps on their own clothing. The researchers selected teaching buttoning up and snap fastening skills for two reasons: (a) their teacher required them to take out some materials (e.g., crayons for art activities, a doll for play activities, edibles for snack time) from boxes with buttons or snap fasteners during their daily activities and (b) they would start inclusive preschool in the coming year so learning these skills would contribute their independence (e.g., put on her/his jackets independently) in the classroom.

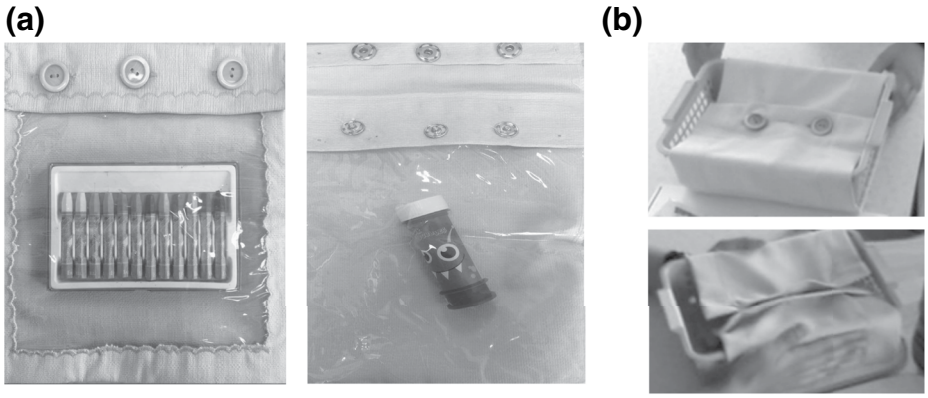
### 2.1.2 | Research staff

The second author who was a research assistant and doctoral student in special education in a local university in Turkey with teaching experience with both instructional procedures, conducted all experimental sessions. The first and third authors planned the intervention and made necessary modifications during the course of the intervention. Both had over 25 years of experience as researchers in this field. A doctoral student (in special education at the same university) who had experience in using both procedures and collecting reliability data served as a reliability observer. Therefore, the second author informed her about the purpose of the study in general and shared data collection forms that they were going to use in the study.

## 2.2 | Settings and materials

The sessions were conducted in different settings throughout the study in the university unit, such as the classroom, cafeteria, play area, and television (TV) room, during different routines and activities (e.g., breakfast, singing time, drawing time). In addition to the children and teachers, professional staff (i.e., special education teacher aides) were present during the sessions. The setting in the unit to be used for each participating child was determined based on the child's activity plans and routines. The teacher prepared some of the materials, and others were obtained commercially. The researchers observed that children had difficulty operating normal-sized buttons and snaps on the clothing they wore and could not clearly see the buttons and snaps on their clothing when they looked down. Therefore, hand-made pouches to hold a variety of items that were to be used during the planned activities and/or routines (e.g., for drawing time activity a pouch prepared holding paper, colored pencils, and eraser) were created to provide children instruction with buttoning buttons and snapping fasteners. During the study, the pouches, a video camera, and data collection forms were used. Two kinds of pouches (one with three snap fastens 5 cm apart from each other and one with three buttons 5 cm apart from each other) were used during the training and probe sessions. Figure 1 displays the pouches (see panel A).

The pouch, which was used for buttoning skills instruction, was sewn from thick green linen (see the left column in Panel A in Figure 1) and measured 25 × 30 cm (approximately 9 × 11 inches). The top of the pouch had three buttonholes with buttons 5 cm apart from each other, each having a diameter of 3.5 cm. The lids (sewn above the buttonholes) were 4 cm in length, covering the buttoned portion of the pouch. On the flaps, three flat, bone buttons were sewn just across each of the buttonholes. The buttons were big enough for the participating children to hold and insert easily into the buttonholes. The upper surface of the pouch was sewn with transparent thick nylon, allowing for the student to see the object inside. The pouch used in the snap fastening skills training measured 35 × 30 cm (approximately 13 × 11 inches). It was sewn from thick yellow linen (see the right column in panel A Figure 1) with three metal male halves of snap fasteners on the top portion of the pouch and three metal female halves of snap fasteners measuring 4 cm apart on the bottom portion of the pouch flap. This made it easier for participants to handle them. Underneath the flaps, three metal female halves were sewn just across the male halves. The upper surface of the pouch was sewn with transparent nylon, enabling the student to see the object inside. The researchers used




*Note.* Panel A shows the pouches used for teaching button up and snap fastening skills during baseline, intervention, and maintenance sessions. Panel B represent the materials used for assessing the generalization of button up and snap fastening skills.

**FIGURE 1** The materials used during baseline, intervention, maintenance and generalization sessions. *Note*. Panel A shows the pouches used for teaching button up and snap fastening skills during baseline, intervention, and maintenance sessions. Panel B represent the materials used for assessing the generalization of button up and snap fastening skills

**TABLE 1** Activities and materials used during baseline and intervention sessions

| Activities | Materials in the pouch |
|---|---|
| Breakfast | Milk, cake, fruit juice, napkin, spoon, fork |
| Art class | Papers for painting, various paints, scissors, play dough and molds, glue, colored papers |
| Singing time | 2 or 3-D visuals or puppets, which are applicable to the songs |
| Drawing activities | Paper, colored pencils, eraser |
| Reading | Children books, story telling cards |
| Leisure time activities | Cartoon CDs, balloons, ball, toy car, lego, clothespin, doll, toy duck, jigsaw puzzles |
| Teaching concept | Concept cards (i.e., geometric shapes, male-female) |
| Token reinforcement | Smileys |

these pouches during all experimental sessions except generalization sessions. The activities and materials needed during these sessions are presented in Table 1.

Generalization sessions were conducted in a one-on-one instructional arrangement by another teacher during different activities with different material sets in a different classroom location of the unit. A plastic box was used for testing generalization. A fabric-covered box measuring 25 × 15 cm (approximately 9 × 6 inches) with three buttonholes measuring 3 cm wide and another fabric-covered box with snap fasteners of similar dimensions were used for testing generalization. Three buttons and buttonholes were provided for children to perform buttoning skills, and three snap fasteners of the same size were provided for children to perform snap fastening. Buttons, buttonholes, and snap fasteners were no different than the ones used during teaching. Figure 1 displays the boxes with buttons and snaps used during generalization too (see panel B).

## 2.3 | Experimental design

An adapted alternating treatments design (AATD) was used to compare the effects of SP and GG procedures delivered within embedded teaching trials (Wolery et al., 2010). Regardless of the sequence of intervention, experimental control was established when the dependent variable assigned to one independent variable was acquired more quickly than the dependent variable assigned to another independent variable. Researchers were interested in investigating the effectiveness and efficiency of procedures using nonreversible behaviors within the context of the AATD design. This design allows for the comparisons of procedures when teaching different behaviors with equal difficulty. Multitreatment interference is possible when using the ATTD design. Due to possible sequence effects, both interventions were delivered with an unpredictable sequence with each intervention delivered first for no more than three consecutive sessions (i.e., when an intervention was chosen randomly three times in a row, the researchers chose to use the other procedure as the first one in the fourth session). The researchers also conducted the initial sequence of the intervention sessions differently across participants (i.e., initial implementation of the SP procedure for one participant and the GG procedures for the other participant). In other words, when the SP procedure was chosen randomly as the first intervention with a participant, then the researchers planned to deliver the intervention with the GG procedure as the first intervention with the other participant initially. Table 2 presented how the researchers sequenced the procedures across sessions and participants. At the same time, the researchers also initially counterbalanced intervention conditions to the dependent variables with each participant (e.g., if fastening was taught with the SP procedure in one participant, then fastening was taught with the GG procedure in the other participant). The researchers conducted two intervention sessions (one session with each procedure) in a day and a rapid alternation was realized between SP and GG intervention conditions for each participant with the administration of at least a one-hour break between procedures. The separation of treatment effects was addressed using two target behaviors that were independent yet equally difficult. The researchers used intermittent probe data to determine the criteria was reached, not daily intervention data.

## 2.4 | Dependent and independent variables

The researchers developed task analyses for both skills. The percentages of correct responses on task analyses steps of button up and snap fastener skills were the dependent variables of the study. There were three snaps and three buttons in each pouch and each snapping and fastening attempt was counted as a trial. Therefore, three trials were conducted in each session. The SP procedure does not allow the researchers assess the acquisition during intervention sessions therefore, the researchers conducted intermittent probe sessions to assess the acquisition occurred during SP and GG conditions. In other words, students' prompted responses were not scored as correct responses. Correct responses were defined as correctly performing a step of the task analysis within 4-s, whereas incorrect

**TABLE 2** Examples of the sequence of the procedures across sessions and participants

| | | Intervention days | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Participant** | **Session** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| Yaman | First session | SP | SP | SP | GG | GG | SP | GG | GG |
| | Second session | GG | GG | GG | SP | SP | GG | SP | SP |
| Ersin | First session | GG | GG | SP | SP | GG | SP | SP | GG |
| | Second session | SP | SP | GG | GG | SP | GG | GG | SP |
| Zerrin | First session | GG | SP | GG | SP | SP | GG | GG | SP |
| | Second session | SP | GG | SP | GG | GG | SP | SP | GG |

Abbreviations: GG, graduated guidance; SP, simultaneous prompting.

responses were defined as (a) incorrectly performing a step of the task analysis, (b) not completing the step in 4-s, or (c) performing a different step of the task analysis. The teacher collected data using a plus (+) to indicate the child performed a step correctly and a minus (−) to indicate the child incorrectly performed a step or failed to perform a step. Then, the researchers calculated the percentage of correct steps (responses) in the task analysis from the number of possible steps (responses) to plot the data in the graph. The number of possible steps in a session were 21 (7-steps per trial X 3 trials) for "button up" and 15 (5-steps per trial X 3 trials) for "snap fasten." The criterion was 100% correct responses for three intermittent probe sessions with both procedures. In addition to collecting effectiveness data for the dependent variables (i.e., correct and incorrect responses), the researchers also collected data for the durations of the interventions with both procedures. When the teacher started to conduct an intervention (i.e., SP), she used a stopwatch and recorded the total duration the session lasted while conducting three trials. The researchers conceptualized a trial within the antecedent-behavior-consequence sequence. The antecedent part included the task direction and prompting during the teaching trials and task direction only during the intermittent probe sessions.

The independent variables of the study were the SP and GG procedures delivered within embedded teaching trials. The participants spent three class periods (40 min each) per day in the university unit. If the teacher delivered an intervention with the SP procedure during the first-class period, then she delivered the GG procedure in the last class period. As explained later, the teacher created a need for a student to fasten or snap during the natural class routine by giving them the pouch including the materials needed at the moment and providing a task direction to perform these skills. She considered this as the beginning of a session, and the session was ended after performing the steps of task analyses with each snap and fasten on the pouches. In other words, because there are three snaps and fastens on the pouches, the researchers conducted three trials in each session with each procedure. The researchers used hand-made pouches to teach buttoning and snap fastening skills for several reasons mentioned earlier. The teacher developed task analyses for teaching buttoning (7-step task analysis) and snapping fasteners (5-step task analysis) by observing a child while performing these skills and personally performing the tasks independently. The task analyses were sent to two researchers, and they approved them without making suggestions or modifications. Task analyses are presented in Table 3.

The difficulty level of skills was assumed to be the same by (a) conducting experimental analysis and (b) considering the difficulty level of the steps in the task analyses. Prior to the study, the researchers taught these two skills via SP procedure to a 3-year-old child with typical development who did not have these skills. She acquired the steps of the button up skill in 3 min 30 s and snap fasten skill in 3 min 42 s. Her performance made the researchers think that these two skills are almost at the same difficulty level. In addition, the number of steps in the task analysis is quite close to each other. Skills were assumed functionally independent because they were selected from the same domain, and the same data collection technique was used. The researchers randomly assigned the independent variables to these skills to minimize possible bias in the study. The instructional procedures and target skills for each participating child are presented in Table 4.

**TABLE 3** Task analysis for buttoning up and snap fastening

| Buttoning up | Snap fastening |
|---|---|
| 1. Hold button with thumb and index finger of right hand | 1. Hold male part of snapper on clothing with left hand |
| 2. Hold buttonhole with thumb and index finger of left hand | 2. Hold female part of snapper with right hand |
| 3. Put button into buttonhole | 3. Approach both parts of snapper together |
| 4. Hold button with left hand as it passes through buttonhole | 4. Bring male part of snapper in left hand and female part of snapper in right hand |
| 5. Release button from right hand | 5. Fasten snapper parts together |
| 6. Hold buttonhole with right hand | |
| 7. Pull button through buttonhole with left hand | |

**TABLE 4** Participants, instructional procedures, and target skills

| Zerrin | | Ersin | | Yaman | |
|---|---|---|---|---|---|
| SP | GG | SP | GG | SP | GG |
| Button up | Snap fastener | Button up | Snap fastener | Snap fastener | Button up |

*Note*: GG = graduated guidance; SP = simultaneous prompting.

## 2.5 | General procedures

All experimental sessions were conducted and videotaped in a one-on-one instructional arrangement in different locations of the unit. The teachers delivered one teaching session consisted of three trials with each procedure in a school day with a total of three sessions per week. The teacher vocally reinforced correct performance toward criterion during intervention sessions and thinned reinforcement during maintenance sessions. Moreover, regardless of the correct performance, the teacher delivered social reinforcers for participation and collaboration throughout the study. All experimental sessions were conducted in an embedded instruction format by embedding teaching trials into children's natural daily activities. While embedding the trials, the teacher created a need for targeted skills to be taught and secured the children's attention towards the activity in which they could practice the targeted skills three times during a session. As said earlier, there were three snap fasteners and buttons on each pouch and each snap fastener and button counted as one trial. So, a total of three trials took place during teaching and probe trials. The teacher counterbalanced the activities to the instructional procedures and used 4-s response intervals throughout the study.

### 2.5.1 | Baseline sessions

Prior to the intervention, baseline sessions were conducted to acquire stable data for at least three consecutive sessions. The teacher collected baseline data using the single opportunity method. The assessment was terminated at the first incorrect response of the participants. The researchers preferred to use the single opportunity method over the multiple opportunity method while assessing the performances of the children due to three reasons: (a) the researchers did not want to spend instructional time by assessing the child on the same skill multiple times, (b) the trials are embedded into each child's routine throughout the study and the researchers did not want to interrupt the routine by continuing to conduct the assessment, and (c) they wanted to prevent the possibility of learning by observing the teacher performing the step that the child did not perform correctly. These sessions were conducted in the activities (determined by the teacher) where the participating child was expected to perform the targeted skills. The teacher delivered the task direction (e.g., "button the pouch") during baseline sessions. There were correct and incorrect responses during these sessions. Correct responses resulted in verbal praise, whereas incorrect responses terminated the delivery of the assessment. The teacher collected data as explained under the definition of dependent variable.

### 2.5.2 | Intermittent probe sessions

The researchers conducted intermittent probe sessions to assess the acquisition of the skills because prompting was in effect during intervention sessions with both procedures. Intermittent probe sessions were conducted in the same manner as baseline sessions to test the acquisition. These sessions were conducted after every three intervention sessions which included a total of nine intervention trials. In other words, just before every four intervention sessions with each procedure the researchers conducted intermittent probe sessions and plotted data collected in

these sessions in the graphs. Intermittent probe sessions were conducted instead of daily probe sessions to prevent possible incorrect responses of the children, eliminate the possible threads of testing, increase the instructional time, and make the data collection more feasible. The criterion was 100% correct responses for three intermittent probe sessions with both procedures. The teacher collected data as explained under the definition of dependent variable.

### 2.5.3 | Intervention

Intervention sessions were initiated with both procedures as soon as stable data were obtained in the baseline condition and a total task format (i.e., instruction on all steps of the task analysis per trial) was used to teach target skills. Three intervention sessions (each having a total of three teaching trials) were conducted with each child per week to teach each skill (e.g., Monday, Wednesday, and Friday). The sessions were continued until 100% correct responses were obtained in at least three intermittent probe sessions (there were no intermittent sessions during the first week but for the remaining weeks the teacher conducted intermittent probe session on every Monday prior starting to the training sessions). Vocal praise was provided for correct responses, while error correction was provided for incorrect responses. Incorrect responses were interrupted, the teacher provided error correction, and re-provided the task direction and a controlling prompt. Vocal praise was provided at the end of the sessions for their cooperative behaviors. The researchers did not use error correction during intermittent probe sessions to prevent the possibility of learning the skills in probe sessions. The teacher collected the data using the same data collection procedure during intervention sessions as was used during baseline and intermittent probe sessions.

**Simultaneous Prompting Procedure Sessions.** The children in SP procedure intervention sessions were provided physical prompting throughout the study. The teacher presented task direction and controlling prompt simultaneously. Depending on the child's response, the teacher provided an appropriate behavioral consequence (i.e., the teacher reinforced correct responses vocally and incorrect response was not possible due to using physical prompting during these sessions plus they had a learning history with the SP procedure). A teaching trial with SP procedure was embedded during the child's snack time in the following manner. The teacher and the child sat next to each other. The teacher delivered an attentional cue (e.g., "Are you hungry? We need to get a spoon from this pouch and then we will button the pouch. Are you ready?") to secure the child's attention. She provided a vocal reinforcer to his/her attention (e.g., "Great!"). After the child took a spoon from the pouch, the teacher delivered the task direction (e.g., "Button the pouch, please.") and the controlling prompt (e.g., providing hand over hand physical prompt) simultaneously. While providing physical prompting, the teacher put her both thumbs and her index and middle fingers together on the child's thumbs and index and middle fingers by slightly pushing them to perform the step correctly. Because the teacher used full physical prompting, the child did not need error correction during teaching trials. In addition to that they did not resist, but rather cooperated with physical prompting. The teacher delivered the above-mentioned behavioral consequences depending on the child's response.

**Graduated Guidance Procedure Sessions.** The following prompt hierarchy was used in the GG procedure intervention sessions with all children throughout the study: The teacher provided full physical prompting (i.e., hand over hand full physical prompting by getting the child back and then gently pushing the thumb and index and middle finger of both hands of the child towards each other to hold buttonhole and button) during a teaching trial. If the student did not resist and performed the step, the teacher immediately faded full physical prompting and started to provide partial physical prompting (i.e., gently touching both hands – close to wrists – of the child) to orient her/his to perform the steps of the task analysis; if the student resisted or performed the step incorrectly the teacher started to provide full physical prompting to shape their hand to perform the steps. If the student did not resist and performed the step, the teacher immediately faded partial physical prompting and started to provide shadowing within the same trial; if the student resisted to the teacher or performed the step incorrectly, the teacher immediately started to provide full physical prompting. During shadowing the teacher held her hand close to the child's forearm first, then elbow without touching to shape their hands to perform the steps of the task analysis. The teacher presented a vocal reinforcer (e.g.,

"You did it!") to each correct response during each prompt hierarchy. A teaching trial with GG procedure was embedded in the following manner while the child watched a cartoon. The teacher and the child sat next to each other in front of the TV set. The teacher delivered an attentional cue to secure the child's attention such as "Are you ready to watch a movie? We need to get a DVD from this pouch and then we will fasten the snaps on the pouch." She vocally reinforced his/her attention (e.g., "Great!"). After the child took the DVD from the pouch, the teacher immediately delivered the task direction (e.g., "Fasten the snaps on the pouch, please."). The teacher waited for 4-s for the child's response and delivered a controlling prompt (e.g., hand over hand full physical prompting from the child back by gently pushing the thumb and index and third finger of the child towards each other to hold buttonhole and button). The intensity of prompts was faded on a moment-to-moment decision based on the child's performance as explained above. The teacher delivered the above-mentioned behavioral consequences depending on the child's response.

### 2.5.4 | Maintenance and generalization

Maintenance sessions were conducted for 1, 2, and 6 weeks after the intervention. Reinforcement was thinned and fixed ratio (FR) reinforcement schedules were utilized (for the button up FR7 and for the snap fastener FR5). Generalization in the study across persons, settings, and materials was assessed in a pretest-posttest measure. Generalization of the acquired skills was tested on fabric-covered plastic boxes (see Panel B in Figure 1). Pretest sessions were conducted during a baseline condition while posttest sessions were conducted after the child reached the criteria. Task analyses (originally developed for training sets) were modified according to the location of the boxes and the distance between buttonholes/snap fastens (the surface between the holes was shorter). The number of steps for the generalization probe were the same as in training sessions. Maintenance and generalization sessions were conducted in the same manner as the baseline sessions.

## 2.6 | Interobserver agreement and treatment integrity

Interobserver agreement and treatment integrity data were collected from at least 20% of the randomly selected sessions in each experimental condition. An independent observer collected both interobserver agreement and treatment integrity data for each participating child. Interobserver agreement data was calculated using a point-by-point method with the following formula: "the number of agreements divided by the number of agreements plus the number of disagreements were then multiplied by 100" (Erbas, 2012; Tawney & Gast, 1984). The interobserver agreement data for Ersin showed 100% accuracy for button up and snap fastener skills across all experimental sessions except the baseline session. During intervention conditions with both target behaviors, the interobserver agreement calculated a mean of 98.75% accuracy (range, 95%–100%). The interobserver agreement analyses for both target skills showed 100% accuracy during all experimental conditions for Yaman and Zerrin. Treatment integrity was calculated by dividing the number of observed teacher behaviors by the number of planned teacher behaviors multiplied by 100 (Billingsley, White, & Munson, 1980; Erbas, 2012). The following teacher behaviors were taken into consideration during the baseline, intermittent probe, maintenance and generalization probe sessions: (a) having materials ready, (b) embedding the testing trial into the planned activity, (c) securing the child's attention, (d) presenting task direction, (e) presenting appropriate behavioral consequences, and (f) waiting for an inter-trial interval. The observed teacher behaviors during SP and GG procedures were: (a) having materials ready, (b) securing the child's attention, (b) embedding the teaching trial into the planned activity, (c) presenting task direction, (d) providing a controlling prompt (for GG procedure the teacher provides level of graduated support (e.g., full physical prompting, partial physical prompting, shadowing) with moment to moment decision and error correction as needed and for SP procedure the teacher provides physical prompting (error correction was not planned due to using full physical prompting)), (e)

presenting appropriate behavioral consequences, and (f) waiting for an inter-trial interval. The treatment integrity was calculated as 100% compliance with the steps of each experimental session across all children.

## 2.7 | Efficiency of the procedures

The efficiency of both procedures was assessed by collecting data for the number of training sessions to criterion, the number of training trials to criterion, the number and percentage of errors to criterion, and the total training time to criterion. As indicated, the criteria for both procedures were 100% correct responses on three consecutive intermittent probe sessions in the steps of task analyses for each child. Sessions to criterion were calculated by counting the number of sessions conducted until the child performed 100% correct responses on his/her target skills in each procedure, trials to criterion were calculated by counting the number of trials presented in the sessions conducted (3 trials) until the child performed 100% correct responses on his/her target skills with each procedure. The number and percentage of errors were calculated by counting the number of errors in the probe sessions and then the percentage of incorrect steps (errors) in the task analyses from the number of possible steps in the probe sessions until the children met criterion in each procedure. We used the following formula to calculate the percentage of probe errors: "the number of total errors during probe sessions/the number of total steps during probe sessions X 100". Total training time was calculated by counting the duration of each training session with each procedure until children met criterion.

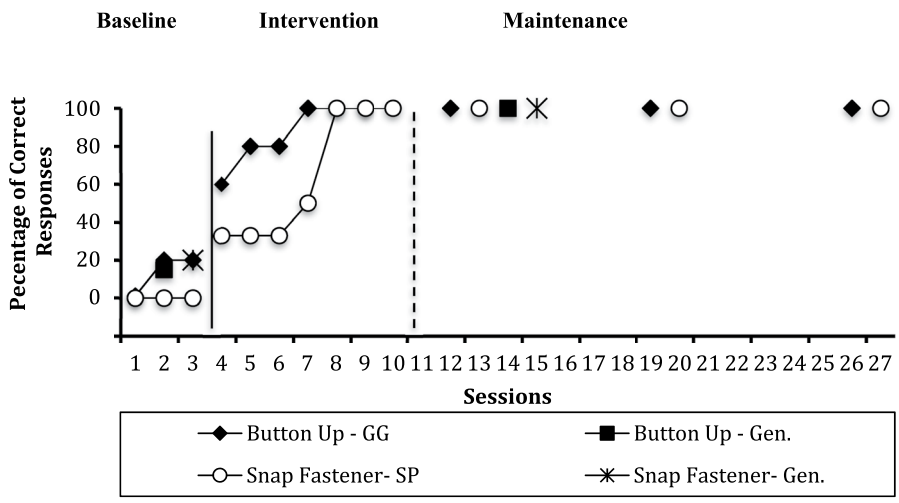
## 2.8 | Social validity

The researchers used normative comparison to examine the social validity of this study (Van Houten, 1979). In the normative comparison, the researchers compared the particular behaviors of a child with the performance of the reference sample of individuals (Kennedy, 2005). A reference group is chosen to serve as an exemplar of desirable levels for target behaviors. The focus of the normative comparison is to observe behavior change goals and outcomes for participants in a study against the normative group whose behaviors are considered typical. The researchers determined a normative group for this study from a private preschool with a total of nine children of the same age with typical development (1:3 ratio) with the participating children of the study. The authors informed the school administrator and received their permission to assess these children. The first author interviewed teachers regarding their students' performances on the study's target skills. After the interview, she conducted pretest and posttest sessions with the children who were chosen at random by the teachers. The materials developed for teaching buttoning and snap fastening skills were used during the assessment. The researchers conducted these sessions in the same manner as the baseline sessions of the study. Normative group data were collected and videotaped during art and playground activities. The researchers conducted a pretest session during the baseline condition of the study and a posttest session after the intervention had terminated with the participating children in the study. The researchers used the same procedural steps used for baseline sessions during the pretest and posttest measures and collected and analyzed their data in the same way then, compared to the performance of the participating children in the study.

# 3 | RESULTS

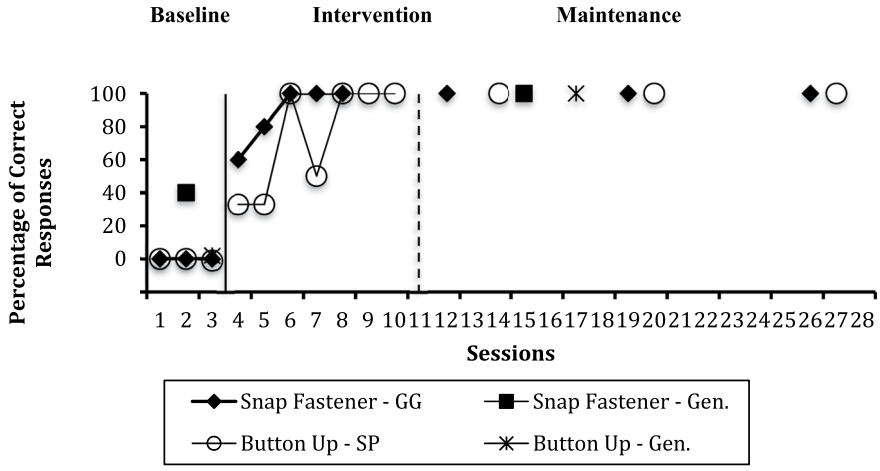
## 3.1 | Effectiveness findings: Acquisition, maintenance, and generalization

Figures 2–4 show the percent of unprompted correct responses during baseline, intervention, and maintenance probe sessions for Ersin, Yaman, and Zerrin respectively across SP and GG procedures delivered within embedded



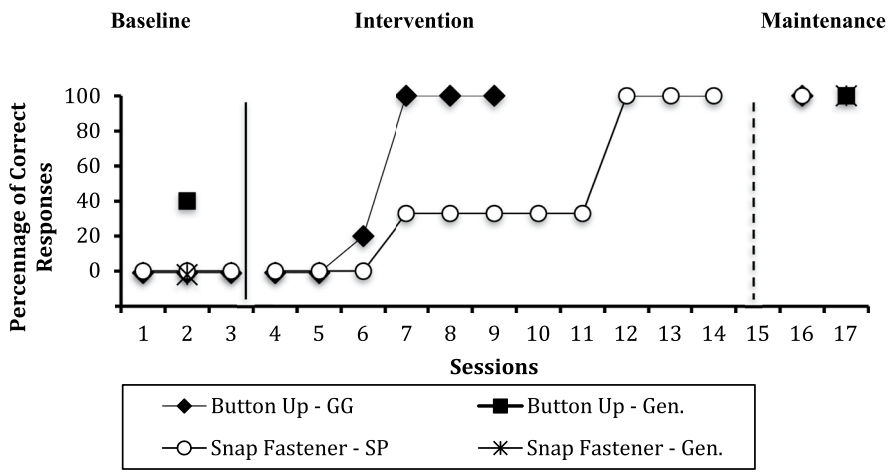

*Note.* Data collected during intermittent probe sessions were plotted as intervention data. Each data point represent percentage of steps completed correctly by the participant. GG = graduated guidance; SP = simultaneous prompting.

**FIGURE 2** Percentage of correct performance on buttoning up and snap fasten skills during baseline, intervention and maintenance sessions for Ersin. *Note*. Data collected during intermittent probe sessions were plotted as intervention data. Each data point represent percentage of steps completed correctly by the participant. GG = graduated guidance; SP = simultaneous prompting




*Note.* Data collected during intermittent probe sessions were plotted as intervention data. Each data point represent percentage of steps completed correctly by the participant. GG = graduated guidance; SP = simultaneous prompting.

**FIGURE 3** Percentage of correct performance on buttoning up and snap fasten skills during baseline, intervention and maintenance sessions (data collected during intermittent probe sessions were plotted as intervention data) for Yaman. *Note*. Data collected during intermittent probe sessions were plotted as intervention data. Each data point represent percentage of steps completed correctly by the participant. GG = graduated guidance; SP = simultaneous prompting




*Note.* Data collected during intermittent probe sessions were plotted as intervention data. Each data point represent percentage of steps completed correctly by the participant. GG = graduated guidance; SP = simultaneous prompting.

**FIGURE 4** Percentage of steps correctly completed on buttoning up and snap fasten skills during baseline, intervention and maintenance sessions for Zerrin. *Note*. Data collected during intermittent probe sessions were plotted as intervention data. Each data point represent percentage of steps completed correctly by the participant. GG = graduated guidance; SP = simultaneous prompting

teaching trials. Data collected during intermittent probe sessions were plotted for intervention conditions. As can be seen in Figure 2, Ersin performed with a mean of 13% (range, 0%–20%) correct responses (range, 0%–20%) on snap fastening skill aimed to teach with the SP procedure and did not have correct responses on the buttoning skill aimed to teach with the GG procedure. There was an immediate increase in the percentage of correct responses (40% with the GG (last data point – 20% in the baseline and first data point in intervention – 60% and 35% with the SP (last data point – 0% in the baseline and first data point in intervention – 35%)) and introduction of the SP and GG procedures resulted in criterion level responding, the level and trend of his data increased, and no variability was found in his data. Following the intervention, Ersin independently completed 100% of the steps of both skills and maintained the acquired skills with 100% correctly in the maintenance sessions. Ersin's pretest generalization data indicated Ersin completed 15% and 20% of the steps correctly in his target skills taught by the SP and GG procedures respectively while he performed both of his target skills with 100% correctly during posttest.

Figure 3 displayed that Yaman did not have correct responses for any of her target skills during his baseline sessions either. There was an immediate increase in the percentage of correct responses (40% with GG (last data point – 20% in the baseline and first data point in intervention – 60% and 35% with the SP (last data point – 0% in the baseline and first data point in intervention – 35%)) and introduction of the SP and GG procedures resulted in criterion level responding, the level and trend of his data increased, and no variability was found in his data either. Following the intervention, Yaman independently completed 100% of the steps of both skills and maintained them with 100% correctly in maintenance sessions. Yaman's pretest generalization data showed that Yaman performed 40% correct responses on the skill to be taught them with the GG procedure and did not have any correct responses on the skill to be taught with the SP procedure. The posttest data revealed that Yaman completed 100% of the steps of both skills correctly.

Figure 4 showed that Zerrin did not have correct responses for any of her target skills during her baseline sessions. No immediate effects were obtained with both interventions; however, the introduction of the SP and GG procedures resulted in criterion level responding, the level and trend of her data increased, and no variability

was detected in her data. Following the intervention, Zerrin independently completed 100% of the steps in both task analyses and maintained them with 100% correctly in the maintenance sessions. Zerrin's pretest generalization data showed that she completed the steps with 40% correctly on the skill taught with the GG procedure and did not provide any correct responses on the skill taught with the SP procedure, while Zerrin completed the steps with both skills with 100% correctly during the posttest.

## 3.2 | Efficiency findings

Efficiency data (the number of training sessions, the number of training trials, the number and percentage errors, and total training time to criterion) for SP and GG procedures delivered within embedded teaching trials when teaching buttoning up and snap fastening skills to three children are presented in Table 5. A general conclusion regarding which procedure is best (in terms of overall efficiency parameters) was not made due to inconsistent findings across the children. The GG seemed to be more efficient than the SP across all efficiency parameters in Zerrin. The GG seemed to be more efficient in terms of number of sessions and trials to criterion in Ersin however the SP found to be more efficient for the rest of efficiency parameters. Last, the number of sessions and trials to criterion in Yaman were equal however, the GG seemed to be more efficient than the SP for the remaining parameters of efficiency.

## 3.3 | Social validity

The researchers evaluated social validity of the study via normative comparison. They collected pretest and posttest data from the normative group. Except for Ersin, none of the children had any correct responses prior to inter vention on the target skill associated with SP procedure. Ersin performed with a mean of 13% (range, 0%–20%) correct responses in the snap fastening skill. However, 100% correct responses were obtained from the normative group during the pretest. There was a noticeable difference in the percentage of correct responses in the pretest measures of the participating children and their peers in the normative group. Posttest measures obtained from both groups showed the gap between these two groups no longer existed. Participating children showed 100% correct responses after receiving intervention with both procedures.

**TABLE 5** Efficiency data for target skills for children through criterion for simultaneous prompting and graduated guidance procedures

| Children | Instructional procedure | Number of training session | Number of training trials | Training time (min:s) | Number and % of probe errors |
|---|---|---|---|---|---|
| Ersin | SP | 12 | 36 | 04:31 | 4/13% |
| | GG | 9 | 27 | 08:35 | 15/35% |
| Yaman | SP | 6 | 18 | 06:30 | 11/26% |
| | GG | 6 | 18 | 04:56 | 3/12% |
| Zerrin | SP | 24 | 72 | 13:03 | 38/57% |
| | GG | 9 | 27 | 06:52 | 14/46% |
| Total | SP | 42 | 126 | 24:04 | 57 |
| | GG | 24 | 72 | 20:23 | 42 |

*Note*: GG = graduated guidance; SP = simultaneous prompting.

## 4 | DISCUSSION

The researchers designed this study to compare the effectiveness and efficiency of SP and GG procedures delivered within embedded teaching trials in teaching buttoning up and snap fastening skills to three children with DD during acquisition, maintenance, and generalization. Furthermore, the social validity of the procedures was tested via social comparison. The following conclusions can be drawn on the basis of the data.

First, data indicated that both SP and GG procedures delivered within embedded teaching trials were equally effective in teaching buttoning up and snap fastening skills to three preschool children with DD. The findings of this study are consistent with the previous studies aiming to investigate the effects of either SP (Batu, 2008; Hudson et al., 2013; Sewell et al., 1998; Tekin-Iftar, 2008) or GG (Bennett et al., 2011; Cicero & Pfadt, 2002; Gruber & Poulson, 2016; Reese & Snell, 1991; Sisson et al., 1988; Soluaga et al., 2008) as the standalone independent variable. Moreover, this study contributes to the current naturalistic teaching literature examining the effectiveness and efficiency of both procedures in teaching self-care related chained skills to children with DD. On the other hand, this is the only study comparing both instructional procedures in teaching relatively long-chained responses. Therefore, the findings of this study arguably not only contribute to the naturalistic teaching literature but also enhance the evidence-based practice and response-prompting literature.

Second, the findings of this study showed these procedures were not only equally effective at the acquisition level, but were equally effective during maintenance and generalization levels. The target skills generalized and maintained with both procedures with criterion level over time and across materials, settings, and persons. When the maintenance and generalization findings of each procedure were individually considered, it is noted findings of this study be consistent with the previous studies examining maintenance and generalization effects of SP procedure (Batu, 2008; Hudson et al., 2013; Tekin-Iftar, 2008) and GG procedure (Bennett et al., 2011; Cicero & Pfadt, 2002; Sisson et al., 1988; Soluaga et al., 2008). The findings of the present study enhance the literature regarding the maintenance and generalization effects of these procedures. These findings are crucial, with regard to promoting maintenance and generalization of the acquired skills, which can be a significant problem for teachers, parents, and researchers. As an anecdote, after the study, the second author probed participating children's performance for buttoning up and snap fastening skills by asking them to put on their vest with button holes and snap fastens and saw that they were able to perform these skills on their own clothing.

Third, efficiency findings of the study showed both SP and GG procedures delivered within embedded teaching trials in teaching buttoning up and snap fastening skills were inconsistent. The GG was more efficient in one child (i.e., Zerrin) across all efficiency parameters. The GG found to be more efficient in one child (i.e., Ersin) only in terms of the number of session and trials to criterion. The SP seemed to be more efficient for the remaining parameters in the same child. These findings were not replicated with Yaman. The number of sessions and trials were equal in both procedures and the GG seemed to be more efficient than the SP in terms of total training time and errors during intermittent probe sessions. The characteristics of participating children in this study might have caused inconsistencies in the efficiency finding.

Finally, the social validity findings of the study were highly promising. After instruction, the findings of the study showed performance of participating children with DD was identical to the performance of their peers in the normative group. For this reason, it can be argued behavioral goals and procedures used to teach them were appropriate. In addition, learning these target skills following the interventions has had an indelible impact in their life, as their performances were similar to their peers' performances. The first author conducted an informal interview with the teachers of the normative group as anecdotal support to the social validity findings indicating their preferences for using naturalistic teaching approaches when teaching various skills.

This study has several strengths. First, this study was the only study investigating the differential effects of the SP and GG procedures delivered within embedded teaching trials when teaching self-care related chained skills to preschool aged children. Second, no difference was found between the procedures in terms of their effectiveness. Therefore, the researchers recommend educators use either procedure depending on the ease and/or their

experiences with the procedures. At this point, it is important to discuss the steps required in both procedures. The main difference between these two procedures can be considered in terms of the instructor's behavior on providing and fading prompts. In the SP procedure, there is only one type of instructor behavior during prompt fading. Instructors provide the single prompt throughout the intervention and test the acquisition via a probe session. However, instructors use a prompt hierarchy and make moment-to-moment decisions for fading the prompt in the GG procedure based on the children's performance. Therefore, with crowded classrooms and inexperienced teachers who are not well-versed with making moment-to-moment decisions, the researchers highly recommend using the SP procedure while teaching chained skills. Third, both procedures were found equally effective in promoting maintenance and generalization of the acquired skills. One of the major concerns of the educators in children with disabilities is a failure in generalization and maintenance of the acquired skills (Alberto & Troutman, 2009). The experimental design used in the present study requires that the dependent variables be independent of each other but at the same time of equal difficulty. Generally, researchers decide whether the dependent variables are in the same difficulty level by examining the difficulty levels of the dependent variables and the number of steps in the task analysis. The researchers in the present study conducted an experimental analysis to test objectively whether the target skills that were going to be taught were in equal difficulty. Fourth, the researchers did not obtain consistent findings regarding the efficiency of the procedures. In other words, no remarkable difference was found between the efficiency of the procedures. This being said, we recommend that teachers use the procedure they are comfortable with. The results this study led the researchers to recommend educators to use either procedure when planning generalization and maintenance too. The social validity of the applied research has been generally ignored. The majority of researchers have used a subjective evaluation approach by asking participating consumers regarding social acceptability and applied importance of goals, procedures, and the results of the study (Wolf, 1978). Social validity was used to analyze qualitative aspects of the study that were not objectively measured by treatment effects. Although obtaining data for the qualitative aspects of the intervention can be argued as the main advantage of subjective evaluation, obtaining the opinions of only a small number of people through the use of a questionnaire (usually without psychometric prerequisites), is a high possibility of bias towards the study - arguably the main disadvantages of subjective evaluation. The researchers in this study used a more objective approach (social comparison) to analyze social validity of the study. There was consistently high treatment integrity among the children in the study, so it could be argued that experimental validity was high in the study. Additionally, the researchers provided reinforcement for the steps correctly completed during baseline sessions in order to build a strong experimental control in the study. In other words, the researchers delivered reinforcement so that the effectiveness of both procedures emerged without being affected by the reinforcement during intervention conditions. Therefore, the researchers suggest that the improvements obtained in the study with both procedures could only be explained only by implementation of these procedures. Finally, when the researcher, their teacher, requested the participating children to perform button up and snap fasten skills on their own clothing shortly after the study, they were able to perform the steps of these skills after the study was completed. This anecdote made us think that they were able to generalize these skills in their self-care repertoires.

## 4.1 | Limitations

Although the overall results of this study were very positive, several limitations of the study are worthy of further discussion. First of all, this study was limited to three children and teaching two dependent variables. Therefore, the study could be considered limited in terms of building experimental control since in two children the same dependent variables was planned to teach by the same independent variables. It would be highly desirable to conduct this study with at least four children to balance the association of dependent and independent variables. This study was limited in teaching buttoning up and snap fastening skills to three preschool children with DD. These skills were taught in the study by using pouches. The researchers would have planned to teach these skills during the child's daily routines (e.g., arriving and leaving school) in their own clothing, however, participating children were not able to practice these

skills with their own clothing (they were unable to see them by looking down and hold buttons and snap fastens on their clothing they were wearing). Therefore, in order to create a natural learning environment, activities requiring the practice of these skills with the child's lead were planned. In addition, all children were taught at the same time in the study. To strengthen experimental control and determine differential effects (if any) between procedures; we could have conducted interventions in a delayed manner (i.e., teach the first child and reveal the acquisition data and then start to teach the next child) across the children. We were unable to make these arrangements in the study due to time constraints as the study was conducted during the spring semester. A third self-care related skill (independent - yet functionally similar - and of equal level of difficulty), could have been selected as a control behavior, and baseline data on this skill could have been collected to establish stronger experimental control and determine possible carryover and sequence effects in the study (Wolery et al., 2010). But due to the intensity and busyness of the children's school schedule (as it was a half-day program), the researchers were unable to arrange additional assessment time to uncover a possible increase in the control behavior. Another limitation of the study is the use of the single opportunity method to assess the baseline performance of the participating children for several reasons mentioned above. Therefore, their realistic performance may have not been captured. The researchers, could not make any arrangement for the children to discriminate the SP procedure from the GG procedure during training to control for carryover effects. Another important limitation of this study could be related to collecting intermittent probe data. Collecting intermittent probe data may mask which skill reached criterion first. Finally, the researchers did not conduct an analysis of interobserver agreement and treatment validity data for the data collected from children with typical development for social validity.

## 4.2 | Suggestions for future research and implications for practice

Considering the results and limitations of the present study, the following recommendations can be made. First, this is the only study that compares these two procedures in teaching buttoning up and snap fastening skills. Replication studies are needed to make a conclusive recommendation for the use of these procedures during naturalistic teaching practices. In addition, future research involving the same study could be planned in the inclusive classrooms. Research studies can be designed to investigate the comparative effects of these procedures in teaching self-care skills during small group instruction. Future research on observational learning and instructive feedback stimuli could be added as instructional parameters to replicate the findings. Researchers may conduct the same study using the same experimental design in a delayed manner to support experimental control. Finally, future research studies could select a third self-care related skill and collect data (on this skill) to control the possible effects of extraneous variables. A consistent finding regarding efficiency could not be obtained across participating children in the study, as characteristics of the children could be the source of this inconsistency. Therefore, the effects of children's characteristics on the efficiency of these procedures can be compared experimentally in future research. Because these results are promising, early childhood professionals are recommended to use both SP and GG procedures, delivered within embedded teaching trials, when teaching chained self-care related skills to their students with DD. Peers, siblings, and parents are also encouraged to use these response-prompting strategies within an embedded instructional format in the children's natural settings. This study was not able to consistently determine which procedure worked better depending on the characteristics of the participants. Therefore, teachers and therapists are advised to select the procedure based on their experiences and fluency in its use. Researchers can conduct the same study by designing an arrangement for the children to differentiate the SP procedure from the GG procedure during training to see the possibility of carryover effects. Researchers are advised to design a study in which participants' baseline performance is assessed using the multiple opportunity method to obtain powerful results regarding the effects of the procedures. Finally, researchers can design a study assessing the acquisition during daily probe sessions on each skill instead of intermittent probe sessions.

## 5 | CONCLUSION

In conclusion, the results of this study suggest that both procedures can be used although future research is needed. This is because this study suggests that SP and GG procedures are equally effective procedures for teaching chained skills within an embedded teaching trial format to preschoolers with DD. Teachers and early childhood practitioners who are confident in making moment-to-moment decisions about providing the necessary prompt hierarchy might prefer the GG procedure, and those teachers who want to use single prompt throughout the training might prefer the SP procedure. Last, teachers and practitioners must ask themselves this question: Which procedure is best for teaching what to whom? At the same time, they also need to consider their students' preferences as well as their preferences.

### ACKNOWLEDGMENT

Authors would like to Miss Dulce Castillo for her insightful proofreading. This study was supported by a Grant from the Anadolu University Research Fund (Project No: 092741).

### ETHICS STATEMENT

All procedures performed in studies involving human participants were in accordance with the ethical standards of the Anadolu University Scientific Research Projects and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The data that support the findings of this study are available from the corresponding author upon reasonable request.

### CONFLICT OF INTEREST

The authors declared that they have no conflict of interest.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

### CONSENT TO PARTICIPATE

Informed consent and assent were obtained from the parents of participants included in the study.

### CONSENT FOR PUBLICATION

The authors have the consent for the authors byline and publication of this study.

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**How to cite this article:** Ozen, A., Genc-Tosun, D., & Tekin-Iftar, E. (2022). Response prompting procedures delivered within embedded teaching trials for teaching chained skills. *Behavioral Interventions*, 1–22. https://doi.org/10.1002/bin.1887