Comparing Simultaneous Prompting and Constant Time Delay to Teach Leisure Skills to Students with Moderate Intellectual Disability

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Abstract: We compared the effects of simultaneous prompting and constant time delay in teaching two solitaire card games to five high school students with moderate intellectual disability. An adapted alternating treatments within a multiple probe design was used to evaluate the effectiveness and efficiency of the procedures. Both procedures were effective with four of five students, while simultaneous prompting alone was effective with the remaining student. Simultaneous prompting was more efficient in sessions through criterion for three of four students, and constant time delay required fewer sessions for one student. Simultaneous prompting produced a lower percentage of training errors, and constant time delay produced a lower percentage of probe errors. Independent and dependent variable reliability, maintenance, and generalization measures showed no substantial differences.

Recreation and leisure are important to the quality of life of most people, including individuals with disabilities. Leisure time is used to provide relief from stressful work, pursue new interests and skills, maintain fitness, develop friendships, and relax (Westling & Fox, 2008). Individuals with significant disabilities need to engage in leisure and recreation activities for these same reasons. Often these individuals have large blocks of free time that may be used inappropriately because the opportunities and skills needed for leisure activities are not present (Demchak, 1994; Westling & Fox). Solish, Perry, and Minnes (2010) surveyed parents of children and adolescents with typical development, intellectual disability, and autism spectrum disorder. They found that across all age levels, the children with disabilities had fewer friends and participated in significantly fewer social and recreational activities than children without disabilities.

Two fundamental reasons exist for teaching leisure skills to students with moderate and severe disabilities: Leisure skills are functional and optional. First, because people of all ages engage in leisure activities on a regular basis, age-appropriate leisure skills are immediately useful. This fact, and the fact that a caregiver cannot perform a leisure activity for an individual (this defeats the purpose of leisure), makes leisure a highly functional skill. Second, leisure activities are optional. That is, individuals choose what leisure activities to do or not to do (Bambara, Browder, & Koger, 2006). For an activity to be optional, the individual must have a repertoire of activities from which to choose. Limited experiences and skill sets equal limited choice. In order for teachers to provide students with a choice, and effectively teach functional leisure skills, the research literature must present effective procedures and sample skills.

Most leisure skills are chained tasks. Two response prompting procedures that have shown promise in effectively teaching chained skills to students with various disabilities are the constant time delay (CTD) and simultane-
ous prompting (SP) procedures. Both of these procedures are considered errorless learning strategies, meaning that students learn new skills with a low number or zero errors. Errorless learning is important for students with significant disabilities as it provides high level of reinforcement during instruction and results in more efficient learning (Snell & Brown, 2011).

Time delay, first described by Touchette (1971), is a method for transferring stimulus control by systematically inserting an interval of time between the target stimulus and the controlling stimulus (i.e., a controlling prompt). In the initial trials, the target stimulus is immediately followed (i.e., 0 s delay) by presentation of the controlling prompt. In subsequent trials, an interval of time (e.g., 4 s) is inserted between delivery of the target stimulus and the prompt until stimulus control is transferred from the prompt to the target stimulus (Wolery, Ault, & Doyle, 1992). This procedure has been studied extensively in teaching chained tasks to students with mild to profound disability (Schuster et al., 1998). These studies involved various age groups (preschoolers, elementary school students, adolescents, and adults), settings (public school, home, and the community), and targeted skills (cooking, eating, dressing, cleaning, leisure, and vocational tasks; e.g., Bozhurt & Gursel, 2005; Branham, Collins, Schuster, & Kleinert, 1999; Graves, Collins, Schuster, & Kleinert, 2005; Godsey, Schuster, Lingo, Collins, & Kleinert, 2008; Morse & Schuster, 2000; Wall & Gast, 1997; Wall, Gast, & Royston, 1999).

SP, described by Gibson and Schuster (1992), is a systematic form of antecedent prompt and test (Wolery et al., 1992) used to transfer stimulus control. On all trials, the presentation of the target stimulus is immediately followed by the controlling prompt. These trials are identical to the 0 s trials in the CTD procedure and are used throughout all subsequent training trials. Because the student is not given the opportunity to respond independently, daily probe (or test) trials are presented immediately prior to training trials to assess the transfer of stimulus control to the target stimulus. SP has received less attention from researchers than CTD (Morse & Schuster, 2004), and is different in that the prompts are abruptly faded from training to test trials.

In the recreation and leisure domain, researchers have used CTD to teach a variety of skills. Zhang, Gast, Horvat, and Dattilo (1995) used CTD to teach adolescents with severe to profound intellectual disability bowling, throwing, and putting skills. Vandercook (1991) used a decreasing assistance procedure with CTD to teach bowling and pinball skills to adolescents with severe intellectual disability. Two studies used CTD to teach adolescents (Wall et al., 1999) and young adults (Wall & Gast, 1997) to putt, listen to music, and play games. To date, only one published study has employed SP to teach a leisure skill. Kurt and Tekin-Iftar (2008) taught children with autism in a preschool setting to play a CD player and use a digital camera. With the limited investigation of CTD and SP to teach leisure skills, further research in this area is warranted.

Teachers must make wise decisions in selecting instructional procedures that are not only effective in teaching skills to their students, but that also result in the most efficient learning. Efficiency can be defined as those instructional procedures that result in “better learning” (Wolery et al., 1992), which can be conceptualized as learning that occurs in less amount of time, with
fewer errors, with less amount of effort, and that results in better generalization and maintenance, more observational learning, and more learning of additional non-targeted information (Wolery, in press). Studies comparing instructional strategies can provide guidance to teachers in determining those procedures that will result in the most efficient learning. Although both CTD and SP may be considered errorless learning strategies, the manner in which the prompts are faded differ. If one way prompts are applied and faded results in more efficient learning than another way, this will provide valuable information for teachers in selecting strategies that work the best for individual students. In addition, although several comparison studies have evaluated CTD and SP with discrete tasks (i.e., Head, Collins, Schuster, & Ault, 2011; Riesen, McDonnell, Johnson, Polychronis, & Jameson, 2003; Schuster, Griffen, & Wolery, 1992; Tekin & Kircaali-Iftar, 2002), the only published study comparing CTD and SP when teaching chained tasks is the aforementioned Kurt and Tekin-Iftar investigation. More comparative research is needed to determine the effectiveness and efficiency of these procedures in teaching chained skills to students with developmental disability.

Therefore, this study sought to answer the following research questions: (a) Is CTD an effective way to teach a chained leisure skill (i.e., solitaire card games) to high school students with moderate intellectual disability? (b) Is SP an effective way to teach a chained leisure skill to high school students with moderate intellectual disability? (c) Which procedure is more efficient on measures of procedural fidelity, and sessions, errors, and time through criterion? (d) Do CTD and SP produce skill maintenance? (e) Do CTD and SP produce skill generalization across settings? and (f) Which procedure is more efficient in terms of maintenance and generalization? The experimental research focus is on the effectiveness and efficiency of the instructional procedures, while the generalization and maintenance questions are analyzed descriptively.

Method

Participants

Five students enrolled in a self-contained classroom for students with moderate and severe disability in a public high school participated. All students attended a self-contained classroom for students with moderate to severe disability, were included in some general education classes, and participated in community-based instruction. The students ranged in age from 15 to 20 years. Michael (20 years 2 months) was identified with moderate intellectual disability. He could identify coin combination values, count with correspondence to 50, write and type from a model, and independently care for personal needs and complete some domestic skills. He had a history of systematic instruction, with both CTD and SP. During his leisure time he typically watched TV, looked at the sports page in the newspaper, and talked with family members.

Chasti (16 years 10 months) was identified with moderate intellectual disability. She had dysfluent speech but could generally make herself understood when she spoke. Her teachers and peers described her as shy. She wore glasses to correct mild myopia. She could identify numbers, count with correspondence to 50, write a check, and access the Internet. Her leisure activities included watching TV, taking pictures and scrapbooking, playing basketball, and playing computer games. She had a history of at least 6 months of systematic instruction with both CTD and SP.

Holley (14 years 3 months) had Down syndrome and was identified with moderate intellectual disability. She had a communication disorder and her speech was difficult to understand, but she generally could make herself understood when the subject matter was known to the communication partner. She was unable to write her name. She could follow picture recipes, count with correspondence to 12, follow one-step direction, and independently care for her personal needs. Her leisure skills included coloring, playing basketball, listening to music and dancing, and playing computer games.

Samuel (17 years 7 months) had spina bifida, a communication disorder, physical disability, and was identified with moderate intellectual disability. He independently used a manual wheelchair within the school. He was verbal and made himself understood to friends and strangers. His vision was corrected with glasses. He could count with correspon-
To identify the lower of two prices under 10 dollars, type from a model, use a calculator, and access the Internet. He required assistance with personal care needs. His leisure activities involved watching TV, playing computer games, playing UNO, and talking with friends.

Daniel (16 years 8 months) was identified with mild to moderate intellectual disability. He had a history of using inappropriate language and destruction of property. He took medication to control hyperactivity, impulsivity, and agitation. He was able to count with correspondence to 50, write and type from a model, follow two-step direction, and identify coin combination values. For leisure time, he watched TV, played UNO, and drew pictures.

Each student demonstrated the following skills prior to the study: (a) visual and auditory acuity (with correction) within the normal range, (b) attention to stimuli for at least 10 minutes during instruction, (c) motor imitation of simple hand and arm movements, (d) counting with one-to-one correspondence, (e) matching of different colored and sized numbers and letters, (f) identified reinforcers, (g) history of at least 90% school attendance, and (h) identified leisure skills as a priority. All students had a history of systematic instruction with CTD and SP.

Setting and Stimulus Materials

Probe and training sessions occurred in the students’ self-contained classroom that consisted of two adjoining rooms: one room with desks and tables for the students and adults and one home economics room with a kitchen and two tables. All sessions occurred at a table in one of the two rooms. In the 1:1 arrangement, the student and trainer both faced the table with their backs to any other students in the room.

This study required a variety of standard sized decks of playing cards, one laminated adaptive device for each game, task analyses of two solitaire card games, data sheets, a timer, and a box of tangible reinforcers (e.g., stickers, key chains, lip gloss) for Holley. Playing cards sampled the range from standard playing cards to novelty cards that included pictures surrounding each card’s value (number or letter), and the cards’ values written in various font types and sizes. The trainer used approximately 20 different card decks, with one deck selected at random for each game. Two games were played: a clock solitaire game (Spadaccini, 2005) that included 21 task-analyzed steps and a row solitaire game that included 25 task-analyzed steps. The task analyzed steps are shown in Table 1. Students completed the games using a low-tech adaptive device that consisted of a laminated template for laying out the cards for the game. Figure 1 shows the adaptive devices used for each game. The actual size of the clock adaptive device was $48 \times 56$ cm and the actual size of the row adaptive device was $44 \times 56$ cm.

General Procedure

The trainer implemented the following sequence of experimental conditions for each student: (a) screening procedures, (b) baseline probe sessions for both tasks, (c) generalization pretests for both tasks, (d) intervention phase for both tasks, (e) generalization posttests for both tasks, and (f) maintenance probe sessions for both tasks. Intervention began with the first three students when they achieved stable baseline performance. The trainer conducted weekly baseline probe sessions for both tasks with each student not yet in the intervention phase. She initiated intervention with the remaining two students when they demonstrated stable baseline data and at least two of the preceding students had achieved at least 75% independence on both tasks. Each day of intervention, each participant received SP with one task and CTD with the other task. Both the SP and CTD condition included a multiple opportunity probe session. The trainer separated the training sessions by at least 2 hours. She counterbalanced the tasks and procedures across students and time of day the session was conducted. For example, Holley, Christi, and Daniel learned the row solitaire game using CTD and the clock solitaire game using SP, while Michael and Samuel learned the row game using SP and the clock game using CTD. Additionally, Holley, Christi, and Michael received CTD in the morning sessions and SP sessions in the afternoon while the opposite occurred for the other participants.
Skill Selection and Task Analyses

All students reported that they enjoyed indoor leisure activities requiring fine motor movements, spent much leisure time at home without peers, and their independent active leisure activities were limited. Based on these findings, the trainer selected two games for training that were considered to be equally difficult to learn based on “a logical analysis of the universe of items, consideration of baseline performance, and post hoc verification” (Sindelar, Rosenberg, & Wilson 1985, p. 72). The trainer developed task analyses of the two functionally independent card games by observing two general education peers’ repeated performance of the games (Table 1). The two

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Task Analyzed Steps of the Clock and Row Solitaire Games</th>
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<tr>
<th>Clock Solitaire Steps</th>
<th>Row Solitaire Steps</th>
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<tbody>
<tr>
<td>1. Deal tableau; 4 cards face down in circle of 12 piles.</td>
<td>1. Deal tableau; 6 piles of 6 cards, face up.</td>
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<tr>
<td>2. Deal stock pile; 4 cards, face down.</td>
<td>2. Deal foundation pile; one card, face up.</td>
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<tr>
<td>3. Turn up top card from stock pile.</td>
<td>3. *Identify foundation card value (number or letter name).</td>
</tr>
<tr>
<td>4. *Identify card value (number or letter name).</td>
<td>4. *Point to card value on list.</td>
</tr>
<tr>
<td>5. *Identify correct place on tableau.</td>
<td>5. *Identify card above/below foundation card.</td>
</tr>
<tr>
<td>6. Place card, face up under correct pile or in King’s pile.</td>
<td>6. Scan tableau for appropriate card.</td>
</tr>
<tr>
<td>7. Turn up top card from tableau or stock pile.</td>
<td>7. a. If possible, move card from tableau to foundation.</td>
</tr>
<tr>
<td>8. *Identify card value (number or letter/name).</td>
<td>7. b. If not available, move card from hand to foundation.</td>
</tr>
<tr>
<td>9. *Identify correct place on tableau or stock pile.</td>
<td>8. *Identify foundation card value.</td>
</tr>
<tr>
<td>10. Place card, face up under correct pile or in King’s pile.</td>
<td>9. *Point to card value on list.</td>
</tr>
<tr>
<td>11. Turn up top card from tableau or stock pile.</td>
<td>10. *Identify card above/below foundation card.</td>
</tr>
<tr>
<td>12. *Identify card value (number or letter name).</td>
<td>11. Scan tableau for appropriate card.</td>
</tr>
<tr>
<td>13. *Identify correct place on tableau.</td>
<td>12. a. If possible, move card from tableau to foundation.</td>
</tr>
<tr>
<td>14. Place card, face up under correct pile or in King’s pile.</td>
<td>12. b. If not available, move correct card from hand to foundation.</td>
</tr>
<tr>
<td>15. Turn up top card from tableau or stock pile.</td>
<td>13. *Identify foundation card value.</td>
</tr>
<tr>
<td>16. *Identify card value (number or letter name).</td>
<td>14. *Point to card value on list.</td>
</tr>
<tr>
<td>17. *Identify correct place on tableau.</td>
<td>15. Identify card above/below foundation card.</td>
</tr>
<tr>
<td>18. Place card, face up under correct pile or in King’s pile.</td>
<td>16. Scan tableau for appropriate card.</td>
</tr>
<tr>
<td>19. Repeat steps 15-18 until stock pile is empty.</td>
<td>17. a. If possible, move card from tableau to foundation.</td>
</tr>
<tr>
<td>20. Identify “lost” or “won.”</td>
<td>17. b. If not available, move correct card from hand to foundation.</td>
</tr>
<tr>
<td>21. Gather all cards in one pile, facing the same way.</td>
<td>18. *Identify foundation card value.</td>
</tr>
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<td></td>
<td>19. *Point to card value on list.</td>
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<tr>
<td></td>
<td>20. *Identify card above/below foundation card.</td>
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<tr>
<td></td>
<td>21. Scan tableau for appropriate card.</td>
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<td></td>
<td>22. a. If possible, move correct card from tableau to foundation.</td>
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<td></td>
<td>22. b. If not available move card from hand to foundation.</td>
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<tr>
<td></td>
<td>23. Repeat steps 18-22 until no cards in hand or on tableau.</td>
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<tr>
<td></td>
<td>24. Identify “lost” or “won.”</td>
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<td></td>
<td>25. Gather all cards in one pile, facing the same way.</td>
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</table>

Key: * = nonessential step.
Figure 1. The top panel shows the adaptive device used for the clock solitaire game, and the bottom panel shows the adaptive device for the row solitaire game.
students rated the games as “equally difficult”. In the logical analysis, the trainer found the two games to have a similar topography, reinforcement value, total number of steps (21 and 25 steps) and number of steps that demanded a functional order. Each of the two task analyses had 13 essential steps. The essential steps were those that the students had to complete in order to move through the game. To demonstrate baseline performance, each student completed a total task, multiple opportunity baseline probe session (Snell & Brown, 2011) with both skills on 3 consecutive days. Once data remained stable and at equal levels for both chained tasks, those tasks were selected as targeted skills. Following the study, the trainer performed a post hoc analysis on the student performance data to determine equal difficulty of the tasks.

**Experimental Design**

We used a combination of a multiple probe design (Murphy & Bryan, 1980) and an adapted alternating treatments design (Gast, 2010; Sindelar et al., 1985) to evaluate the effectiveness of SP and CTD and compare their relative effectiveness. Intervention was introduced to students in a time-lagged fashion, in which two of the first three students achieved at least 75% independence on both tasks before the following two students received the intervention. The purpose of this was to demonstrate experimental control if both procedures produced similar data paths with overlap. Having a time-lagged element would indicate experimental control when the dependent variables increased only after the application of the independent variables and demonstrate the effectiveness of the instructional procedures. The adapted alternating treatments design was used to evaluate the relative efficiency of the two procedures.

**Probe Procedures**

**Baseline sessions.** A graduate student in special education (first author) served as the trainer and primary data collector. To demonstrate baseline performance, the first three students scheduled to receive the intervention completed a total task, multiple opportunity baseline probe session (Snell & Brown, 2011) on both skills for 3 consecutive days or until data were stable. The second two students received baseline probe sessions for both skills at least once per week per student, until immediately prior to entering the intervention phase, when they completed a minimum of three consecutive probe sessions until data were stable. All sessions were conducted in a 1:1 format.

At the beginning of each probe session, the trainer placed the laminated adaptive device for the targeted game (Figure 1) and one shuffled deck of playing cards (unwrapped, without jokers) on the table in front of the student. She then secured the attention of the student, issued the task request, and waited 5 s for the student to initiate the response. A student had 5 s to initiate each step of the task and 20 s to complete each step (except for selected steps that required a longer duration). The completion of one step began the 5 s allowed to initiate the next step. If the student completed the step within the allotted time, the trainer recorded a correct response and delivered verbal praise. Verbal praise was delivered in probe sessions to determine if trial and error instruction was sufficient to teach the skills to the student, and to lessen the number of variables changed from baseline to intervention conditions. If the student made no response or an incorrect response (a duration, topographical or sequence error), the trainer interrupted the error, completed the step out of sight of the student, and redelivered the task request. This multiple opportunity probe method was selected so that every step in the chain could be assessed, actual student performance was not deflated, and the most accurate measure of student performance on the entire chain was obtained (Snell & Brown, 2011). At the end of each probe session, the trainer provided verbal praise for attending behavior. Because verbal praise alone was not a strong reinforcer for Holley, she received verbal praise and selected a tangible reward (e.g., pencil, lotion, lip gloss).

**Daily probe sessions.** During intervention, the trainer conducted a daily probe session immediately prior to each training session on the skill that was scheduled to be taught immediately after the daily probe session. The procedures for conducting daily probe sessions were identical to the baseline sessions.
Criteria for mastery was based on student performance on these daily probe sessions and consisted of 100% correct responses during one session with a continuous reinforcement schedule (CRF) of verbal praise, one session with praise delivered after every second step (FR2), one session with praise on a variable ratio of every third step (VR3), and one session with praise (praise/tangible for Holley) only at the end of the session (FR21 or FR25). Although intervention data were collected, it was the daily probe data that were graphed and that determined criterion level performance of the students.

**Intervention**

**Simultaneous prompting.** The SP independent variable included a daily probe session immediately followed by a training session on the solitaire game assigned to the procedure and student. The SP training sessions were essentially CTD sessions at a 0 s delay interval. The trainer secured the attention of the student, delivered a task direction, and immediately delivered a controlling prompt (i.e., a verbal description with a gesture on the student’s deck of cards). The trainer allowed the student 5 s to initiate imitation of the step and 20 s to complete the step (unless otherwise noted). When the student completed a step, the trainer delivered descriptive verbal praise, recorded a correct response, and immediately provided the controlling prompt for the next step. If the student failed to imitate a step, the trainer repeated delivery of the prompt and allowed the student a second chance to respond. The trainer recorded the initial incorrect response. At the end of each training session, the trainer delivered praise for attending behavior. Holley also received a tangible reinforcer.

**Constant time delay.** The CTD independent variable included one daily probe session, conducted as in the SP condition, immediately followed by the training session on the solitaire game assigned to the procedure and student. The initial training session included a 0 s time delay (identical to SP training sessions). If the student was successful in imitating all steps in the 0 s session, the next and all subsequent CTD training sessions included a 5 s time delay. During 5-s delay sessions, the trainer delivered the task request and allowed the student 5 s to initiate a response. Two types of correct responses were recorded. First, if the student initiated a step, the trainer waited 20 s (unless otherwise noted) for the student to complete the step. If the student correctly completed the step, the trainer delivered descriptive verbal praise for that step and waited 5 s for the student to initiate the next step in the task analysis (correct response before the prompt). Second, if the student did not respond within 5 s of the task request or correctly completing a previous step, the trainer delivered the controlling prompt and waited 5 s for the student to initiate an imitation of the step. If the student initiated an imitation within 5 s and completed the step within 20 s (unless otherwise noted) the trainer delivered verbal praise and waited 5 s for the student to initiate the next step (correct response after the prompt).

The trainer recorded three types of student errors. If the student made an incorrect response before the prompt was delivered, the trainer interrupted the student, said, “No, wait if you are not sure,” and delivered the controlling prompt (incorrect response before the prompt). If the student responded incorrectly after the prompt had been delivered (incorrect response after the prompt) or did not respond within 5 s after the prompt was delivered (no response after the prompt), the trainer delivered the controlling prompt again and allowed a second chance to imitate the response. Regardless of the student’s response after the second controlling prompt, the trainer recorded the students’ first response. The trainer provided verbal praise (and a tangible for Holley) at the end of each session for attending behavior.

**Skill Maintenance and Generalization Procedures**

To encourage maintenance, the schedule of verbal praise during daily probe sessions was faded from CRF to FR2 to VR3 to FR21 or FR25. The trainer also assessed skill maintenance by conducting at least one probe session with each student at 2-week intervals after skill mastery (except with Samuel, who reached mastery at the end of the school year). The procedures were identical to those used during regular probe sessions.
Programming for generalization was built into the study by using multiple training exemplars of the deck of cards (Stokes & Baer, 1977). The trainer also assessed skill generalization across a novel setting (i.e., library) with a pretest and posttest. She conducted these sessions identically to other probe sessions. In addition, at the end of the school year (1 to 3 weeks after mastery) each student made his or her own adaptive posters and completed a generalized probe session on each game using their personalized adaptive device.

**Interobserver Agreement and Procedural Fidelity**

An independent observer collected reliability data on student responses and procedural fidelity during at least 20% of all sessions (at least once per student per condition). The trainer calculated interobserver agreement using the point-by-point method: number of agreements divided by the number of agreements and disagreements, multiplied by 100 (Gast, 2010). Interobserver agreement on student responses was, for all types of sessions, above 99%. Three CTD training sessions included three disagreements on student responses; all remaining sessions resulted in 100% agreement.

The trainer calculated procedural fidelity by dividing the number of trainer behaviors observed by the number of trainer behaviors planned, and multiplying by 100 (Billingsley, White, & Munson, 1980). The planned teacher behaviors included having materials ready, securing student attention on each step of the task analysis, delivering the task direction, waiting the correct delay and response interval, delivering the prompt, and implementing the correct consequences (reinforcer or error correction as appropriate). Procedural fidelity for CTD ranged from 98 to 100% accuracy during probe sessions and 97 to 100% accuracy during training sessions. Procedural fidelity for SP ranged from 98 to 100% accuracy during probe sessions and 97 to 100% accuracy during training sessions.

**Results**

**Efficacy**

Figure 2 shows the students’ performance data on each solitaire game. Four of the five students achieved mastery on both games and one student achieved mastery on one game. Daniel, Michael, Christi, and Samuel demonstrated 0% correct responding during baseline conditions, and after intervention they had 100% correct responding for 4 days on each skill. Holley demonstrated 0% correct responding on both games during baseline conditions. After intervention she consistently achieved 92% independence on the clock solitaire (taught with SP). This score reflects her completing all steps of the task analysis except dealing the cards. Due to the approach of the end of the school year, the criterion was changed for her to exclude the dealing of the cards beginning on session 32. This meant deleting the first two steps of the task analysis, so the discriminative stimulus now became a deck of cards dealt on the adaptive device along with the task request. Practically, if Holley needed assistance from a friend or family member to deal the cards, she would still have the opportunity to play the game independently. On the row solitaire, Holley achieved stable performance at 15% independence by the end of the study. To keep conditions equal for both games, the criterion also was changed for the row solitaire, deleting from the task analysis the first two steps of dealing the cards. The intervention phase for this skill stopped due to the end of the school year, so Holley did not acquire the skill of independently playing row solitaire.

**Maintenance and Generalization**

Due to time constraints, Samuel completed no maintenance probe sessions, but the remaining students completed at least one probe session after mastery of each skill. For skills taught with SP, Daniel, Michael, Holley, and Christi maintained 100% accuracy. For Daniel, this occurred 2 and 4 weeks after mastery. For Michael, it occurred 2 and 3 weeks after mastery. For Holley, it occurred 2 weeks after mastery and for Christi, probe sessions occurred 2 weeks and 18 calendar days after mastery. For skills taught with CTD, Daniel maintained the skill with 100% accuracy and Michael maintained the skill with 92% accuracy 2 weeks after mastery and with 100% accuracy 18 calendar days after mastery.
Christi maintained the CTD skill with 100% independence 2 weeks after mastery.

For all mastered skills, all students responded with 0% accuracy during generalization pretests in the school library and 100% accuracy during generalization posttests in the

Figure 2. Percent correct responses during baseline, daily probe, and maintenance sessions. Closed circles represent skill taught with SP. Open squares represent skill taught with CTD.
same novel setting. In addition, students generalized the acquired skills with 100% correct responding to their own personalized adaptive devices.

**Efficiency**

Overall, for these students, SP appeared to be more efficient in terms of sessions and percent training errors through criterion, whereas CTD was more efficient in terms of training time, probe time, and probe errors through criterion. All students acquired the skills taught using SP; 4 of the 5 students acquired those taught using CTD. Table 2 contains the efficiency data for each procedure in measures of sessions, probe time, training time, percent of probe errors, and percent of training errors through criterion for students who acquired both skills. In terms of sessions through criterion, three of four students acquired the skills in less sessions with SP than with CTD. One student, Holley, acquired only the skill taught using SP. One student, Samuel, acquired the skill with CTD in fewer sessions through criterion than the skill taught with SP. Measures of probe time and training time through criterion were consistently associated with the skills rather than the procedures. For all students, the clock solitaire game required less probe and training time through criterion than did the row solitaire game indicating that this skill may have been easier to learn, however there was some differences in efficiency related to the skills in that the row game was learned in less sessions through criterion for Michael, and the row game had less percent of probe errors for Daniel and Christi.

**Discussion**

This study compared CTD and SP in teaching leisure tasks to five high school students with moderate intellectual disability. Results indicate that both procedures were effective. Although ideally a multiple probe design would contain three demonstrations of effect lagged across time, the design used here presents five students’ data, but at only two different points in time. However, given that both SP and CTD have been well documented as effective instructional strategies and that nine of the demonstrations of effect were strong, there is compelling evidence that both procedures were effective for all but one student, and the SP procedure was effective for Holley.

There were slight differences in the procedures’ efficiency measures, with three of five students acquiring the skills in fewer sessions
with SP, one of five students acquiring the skills in fewer sessions with CTD, and one of five students acquiring only the skill taught with SP. Because the CTD conditions included a daily probe session (not typical with CTD), the difference in sessions through criterion cannot be explained by the additional exposure provided by the daily probe session of the SP condition. There were no substantial differences in skill maintenance and generalization, and these data were analyzed descriptively, not experimentally. However, the study did not assess long-term maintenance. The longest duration of time between mastery and a maintenance probe session was 4 weeks.

CTD produced lower error percentages during probe sessions, and SP produced lower error percentages during training sessions. In terms of time through criterion, the data showed no effects related to the procedures; rather, the clock solitaire game consistently required less probe and training time through criterion than did the row solitaire game. These data indicate that the clock solitaire game may have been less difficult to learn than the row game. In comparative research using an adapted alternating treatments design, the instructor must predict a priori if two tasks are equally difficult to learn. Measures were taken to ensure that the task analyses were logically analyzed for equal difficulty, however a post hoc analysis must also be done to ensure equal difficulty. The post hoc data indicate that on some measures of efficiency, the clock game appeared to be more efficient regardless of the procedures used to teach it. However, the fact that the other efficiency measures had differential effects related to the procedures, and not the skills, indicates that this game may not have been easier to learn for all students across all efficiency measures.

These results are important because they indicate that teachers may have two effective procedures from which to choose, each procedure offering unique advantages and disadvantages. This study, together with the current body of literature (Morse & Schuster, 2000), demonstrates that CTD is effective in teaching chained tasks to students with moderate disability. This study adds to the emerging body of literature on SP with chained tasks to suggest that SP is effective in teaching chained tasks to students with disabilities (e.g., Bozhurt & Gursel, 2005; Maciag et al., 2000; Parrott et al., 2000; Schuster & Griffen, 1993). Teachers may add SP to their repertoire of effective response prompting procedures, with the caution that the study has limited external validity. This is valuable because the specific advantages and disadvantages of each procedure may match individual student characteristics. CTD requires a wait response, and students without this behavior may learn more efficiently with SP since a wait response is not required. CTD requires a wider range of student and teacher responses and a change in teacher behavior when increasing delay intervals. SP may, therefore, be easier for some teachers to implement. SP requires a daily probe session, which adds time and opportunities for errors; CTD requires no separate probe sessions. Some students may perceive a correct wait response during CTD (having to wait for the teacher’s prompt) as an error, whereas SP provides no opportunities for students to make errors on specific steps of the task analysis.

SP produced fewer errors during training sessions. Conversely, CTD produced fewer errors during daily probe sessions, which are not typically used with CTD. The error percentage patterns of the two procedures raise some points to consider. Wall et al. (1999) reported an overall mean error percentage of 8% for response chain skills, placing this study’s training errors below that (mean = 3.8%) and probe errors far above that (mean = 40.5%). The use of a daily probe session clearly increases students’ opportunities to emit errors. On the one hand, probe error percentages were lower with CTD than with SP. On the other hand, students in the CTD condition did, in essence, receive two probe sessions per day once the 5 s delay interval sessions were in place: one daily probe session and one built into the CTD delay training sessions. This means that students in the CTD condition were given two opportunities each day to respond independently (i.e., without the prompt), while students in the SP condition were able to respond independently only during the probe trial. This increased opportunity to respond may have affected error rates during probe trials.

Another concern for teachers when select-
ing a procedure is the efficient use of time. Although this study included a daily probe session with both procedures in order to equalize students’ exposure to the solitaire games, only SP requires a separate daily probe session to assess the transfer of stimulus control. Daily probe sessions added time spent in 1:1 sessions as well as opportunities for student errors. The training segment of the SP procedure is an errorless procedure, but as a package with a daily probe session, the procedure is not errorless. To reduce the time and errors associated with separate probe sessions, teachers may conduct single opportunity probe sessions (Parrott et al., 2000) instead of the multiple opportunity tests used in this study, or they may probe students intermittently rather than every day (Schuster & Griffen, 1993).

In addition to providing information on the procedures and their effect on acquisition of chained tasks, this study provides an example of two independent, active leisure skills with age-appropriate adaptations. This study adds to the current literature on leisure skills instruction for students with moderate intellectual disability by extending the list of skills and assistive devices. Teachers may use assistive devices to expand their students’ leisure skills repertoires, or they may use these adaptations as examples from which to create similar boards for card games popular among local student populations or families.

Although several studies have compared the effects of SP and CTD with discrete tasks (e.g., Head et al., 2011; Riesen et al., 2003; Schuster et al., 1992; Tekin-Iftar & Kircaali-Iftar, 2002), only one other study has compared SP and CTD with chained tasks, and that was in a preschool setting (Kurt & Tekin-Iftar, 2008). This is the first study to examine the differential effectiveness of the two procedures to teach high school students with mild to moderate disability leisure activities.

The study has some limitations. By itself, it has—like all single-subject research—no external validity. Replication and further research comparing SP and CTD would build such validity (Birnbauer, 1981). This study did not assess maintenance across time beyond 4 weeks after mastery. A more useful measure of maintenance would include data across longer periods of time, including maintenance in adult life. Additional valuable information would include observational data on students’ active engagement in free time activities and their choosing to play the taught games. Furthermore, this study did not assess whether students played the mastered games at home. Finally, the amount of probe and instructional time required by this study (a total of 61 h 22 min, or an average range of 12 to 31 min per session for the clock game and 13 to 43 min per session for the row game) makes it impractical to replicate in many classrooms. Future studies should investigate group instruction and less time in probe sessions as ways to increase efficiency in measures of teacher time.

Future research to add to the literature on SP and CTD with chained tasks should investigate (a) comparisons of CTD and SP in teaching chained tasks within different curricular domains and with different types of leisure skills; (b) a wider range of individual active leisure skills; (c) CTD with and without the daily probe session when compared to SP, and SP with various types and frequencies of probe sessions; (d) SP with individuals with more significant disabilities; (e) group formats that assess observational learning as a means to increase efficiency of teacher and student time; (f) combinations of leisure skills instruction and instructive feedback (e.g., Parrott et al., 2000) of information from academic and other curricular domains (e.g., card games with math skills or crossword puzzles with reading skills); and (g) parents, caregivers, novel teachers and instructional assistants as implementers.

References


Birnbauer, J. S. (1981). External validity and exper-


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