Effectiveness of Constant Time Delay on Teaching Snack and Drink Preparation Skills to Children with Mental Retardation

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Abstract: A multiple probe design with probe conditions across behaviors was used to evaluate effectiveness of constant time delay on teaching snack and drink preparation skills to children with mental retardation. In addition, generalization effects across settings, time, and materials, and maintenance effects were examined. Three students between the ages of 14 and 17 enrolled in a special education classroom served as subjects. Distributed trial format was used in the probe, maintenance, and generalization sessions to assess target behaviors. Results indicated that constant time delay was effective in teaching subjects to make a sandwich, to prepare a hot drink, and to serve these foods and drinks.

Currently, educational researchers are developing effective teaching methods based on information from experimental studies. Research based methods contribute to the quality of teaching by providing researchers and educators with insights into methods that are effective in teaching individuals displaying different learning abilities (Tekin & Kırcaali-Iftar, 2001).

There is a substantial body of research in relation to effective teaching. One method is errorless teaching (Schuster & Griffen, 1990; Schuster et al., 1998; Tekin & Kırcaali-Iftar, 2001). According to this teaching approach, acquisition of skill and concept is sourced from the positive responses and practices in which learners engage in, not from the errors committed (Tekin, 1999; Wolery, Bailey, & Sugai, 1998).

Tekin and Kırcaali-Iftar (2001) state that there are various instructional procedures in errorless teaching methods, one of them is known as constant time delay (CTD). CTD is considered to be one of the effective procedures that could be be used to teach individuals with mental retardation (Schuster et al., 1998; Wolery, Ault, & Doyle, 1992).

CTD procedure is conducted in two phases: (a) 0 s time delay trials, and (b) constant time delay trials (Ault et al., 1992; Schuster & Griffen, 1990; Tekin & Kırcaali-Iftar, 2001). In 0 s time delay trials, target stimulus and prompt are provided simultaneously. Following the provision of target stimulus, prompts are provided in order for the learner to respond correctly (Ault et al., 1992; Schuster & Griffen, 1990; Schuster et al., 1998; Tekin & Kırcaali-Iftar, 2001).

In 0 s time delay trials, target stimulus and prompt are provided simultaneously. Following the provision of target stimulus, prompts are provided in order for the learner to respond correctly (Ault et al., 1992; Schuster & Griffen, 1990; Tekin & Kırcaali-Iftar, 2001).

Constant time delay trials, on the other hand, is a phase in which the prompt is faded by inserting a fixed time such as 4 or 5 s between the target stimulus and prompt. For the following instruction sessions, this waiting time is inserted and these sessions are called constant time delay sessions (Tekin & Kırcaali-Iftar, 2001). There is a great deal of research demonstrating effectiveness of CTD procedures on teaching both discrete and chained skills to individuals with various disabilities.
and from different age groups (Schuster et al., 1998; Tekin & Kircaali-Iftar, 2001).

Miller and Test (1989) compared the effectiveness and efficiency of CTD and most to least prompting on teaching laundry skills. They reported that both procedures were equally effective, however, CTD was more efficient on training time to criterion and number of incorrect responses to criterion.

In another study conducted by Miller and Test (1989), the effectiveness and efficiency of decreasing prompt and CTD were compared. Both procedures were found to be equally effective, however CTD was found to be more efficient than decreasing prompt in terms of training time and student error rate (Schuster & Griffen, 1991; Schuster et al., 1998).

Researchers frequently rely on CTD when teaching chained skills. Among these are cooking skills (Hall, Schuster, Wolery, Gast, & Doyle, 1992; Schuster, Gast, Wolery, & Guiltinan, 1988), banking skills (Donnell & Ferguson, 1989), washing clothes (Miller & Test, 1989), leisure skills (Tekin-Iftar et al., 2001), housework skills (Wolery, Ault, Gast, Doyle, & Griffen, 1990, 1991), first aid skills (Gast, Winterling, Wolery, & Farmer, 1992) and personal skills (Ault et al., 1992; Schoen & Sivil, 1989; Schuster & Griffen, 1991; Schuster et al., 1998).

Schuster et al. (1998) reviewed 20 research reports utilizing CTD for teaching chained skills. In 13 studies, the focus was on effectiveness of CTD and in two studies upon delivering instructive feedback in which CTD is conducted. In the remaining five studies, most to least prompting and least to most prompting are compared with CTD. Of 81 subjects who participated in these studies, 65 met the criterion in skill teaching. With respect to measures of effectiveness, 19 studies reported efficiency measures, such variables as number and percent of errors, number of sessions, exact time of teaching and error types have also been examined. In studies, CTD was found to be effective in the teaching of chained skills to individuals with different disabilities between the ages of 2 and 48 (Schuster et al., 1998).

In comparison studies (McDonnell, 1987; Schoen & Sivil, 1989; Schuster & Griffen, 1991; Schuster et al., 1998; Wolery et al., 1990) it is reported that least to most prompting and CTD were effective, however, CTD was more efficient than least to most prompting in terms of training time, number of trials and sessions toward criterion and number and percent of incorrect responses.

Furthermore, Tekin and Kircaali-Iftar (2001) state that CTD provides learners with more opportunities for reinforcement. They also point out that this method requires less preparation on the part of the teacher and that, for this reason, it is considered to be more efficient.

As is clear that CTD is effective in teaching both discrete and chained-skill children with mental retardation. In Turkey, it appears that teachers experience difficulty in helping children with mental retardation to acquire both discrete skills and chained-skill. Tekin and Kircaali-Iftar (2001) compared the effectiveness and efficiency of CTD and simultaneous prompting on teaching receptively identifying animal names to children with mental retardation. In their study, the focus was upon teaching leisure-time activities. However, there is a lack of research investigating effectiveness of errorless teaching methods and CTD in the teaching of kitchen skills in Turkey.

In order to be able to lead an independent life, it is important for children with mental retardation to acquire kitchen skills. Children need to learn how to cook, how to preserve food and drink, how to clean the kitchen, the nutrition value of foods, and so on. It is important to teach independent living skills, and particularly cooking skills, to individuals with mental retardation.

The purpose of this study is to examine the effectiveness of CTD on teaching the skills ‘making a sandwich, preparing a hot drink and serving’ to three students with mental retardation. The research questions are: (a) Is CTD effective on the teaching of food and preparation and serving skills to three students with moderate mental retardation? (b) Are the students be able to maintain the acquired kitchen skills 2 and 4 weeks after the training? (c) Are the students be able to generalize the acquired kitchen skills across different contexts, time and materials?
Method

Participants and Setting

Three students with moderate mental retardation (2 female, 1 male) 14, 16 and 17 years old were participants. All participants attended a literacy class at a rehabilitation center for two years. Students in these classes take literacy, math, science, physical education, technical education, music, and art courses. None of the participants had a history with CTD.

Prerequisite skills for the participants were: (a) ability to recognize objects, (b) ability to follow verbal instructions, (c) ability to imitate prompts, (d) ability to use their two hands in cooperation, (e) ability to stand still at least 5 minutes during instruction, and (f) ability to wait for the prompts. In order to understand whether participants had the given prerequisite skills, the class teacher was interviewed, and the researchers conducted unstructured observations before the study.

Demet (14 years old) and Umut (17 years old) were diagnosed with moderate mental retardation. Tugce was a 16 year-old student with Down syndrome. These three students were able to behave independently as to self-care skills, gross motor and fine motor skills, psychomotor skills, and language skills. They were also able to understand and perform instructions consisting of three words and were able to read and write half-page texts. They were able to recognize such objects, food and drinks as dish, spoon, fork, plate, glass, pot, kettle, cheese, sugar, water and oralet. They were able to pour water into a jug and glass and to use a spoon and fork. Demet was given such responsibilities as tidying her room and cleaning in contrast to Tugce and Umut.

In the present study, the probe and instruction sessions were conducted between 11:00 and 12:00 on Monday, Wednesday and Friday. One session was conducted within a day. Maintenance sessions were carried out 2 and 4 week after training. These sessions were held between 11:00 and 12:00 at lunch time. With regard to the generalization sessions conducted immediately after the maintenance sessions, they were conducted between 2:00 and 3:00 p.m. All sessions were conducted in an individual teaching format.

Researchers

The first author of the study, a research assistant attending an MA programme, had five years experience teaching students with mental retardation. The second author of the study was an assistant professor in the field of special education. Reliability data was collected by two independent observers, the second author and a graduate student in department of special education.

Materials

In instruction sessions, two sets of materials were used, one for the student and one for the researcher. In probe sessions, only one set of materials was used for the student. Materials used in probe and instruction sessions were bread, cheese, sliced tomato, plastic plate and fork for the skill of making a sandwich; sugar, oralet, water, kettle, tray, plastic glass and spoon for the skill of preparing a hot drink, and a sandwich in a dish, a glass of hot oralet, tray and napkin for the skill of serving. In generalization sessions, students were given baguette, lettuce, sausage, glass dish and metal fork for the skill of making a sandwich; plate, sugar, sour-cherry oralet, water, kettle, glass and metal spoon for the skill of preparing a hot drink and a previously-prepared sandwich in a dish, a glass of hot oralet, a colorful tray and napkin for the skill of serving.

Analysis of the Skills

Task analyses for the target behaviors, making a sandwich, preparing a hot drink and serving, were developed by the authors as a forward chaining procedure, and the skills were taught simultaneously. After skills were analyzed, each step was recorded, experts in Special Education were consulted, and essential corrections were made. The skill of making a sandwich and serving consist of 11 steps and the skill of preparing a hot drink was 14 steps (see Table 1).

Experimental Design

A multiple probe design with probe conditions across behaviors was replicated across
subjects. Experimental control was built in when the subject was responding at or near baseline levels during full probe conditions before the intervention was introduced and criterion was reach of only after the intervention was introduced for each subject (Tekin & Kircaali-Iftar, 2001).

**General Procedures**

Probe, instruction, maintenance, and generalization sessions were held for each learner. Instruction sessions were an individual teaching format, and the skills of making a sandwich, preparing a hot drink and serving were taught simultaneously. The following task instructions were given to students: (a) For making a sandwich, ‘Please, make a sandwich.’ (b) For preparing hot drink, ‘Please, prepare a hot drink.’ (c) For serving, ‘Please, serve what you have prepared.’

Also, regardless of whether students correctly responded to the prompts, they were told that they could eat half of what they had prepared and that they could have all that they had prepared if they could successfully complete all skill steps alone.

**Probe Sessions**

Data was gathered by means of multiple opportunity method in a distributed trial format. In a multiple opportunity method, when the student incorrectly responded to the prompt, the researcher secretly completed the given step instead of the student. Data was collected for each basic skill. Students were not provided with any prompt to complete the skill steps, however, they were reinforced through continuous (CRF), variable ratio (VR3) and fixed ratio (FR12, FR14) schedules. Students’ incorrect responses were ignored. If the learner failed to respond to the prompts, this was considered an incorrect response. Students were observed as to whether or not they correctly completed each step after the target prompts.

Probe sessions were held as follows: To draw the student’s attention to the skill of making a sandwich, the researcher asked, ‘Now, we will make a sandwich together. Are you ready?’

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**TABLE 1**

Task Analysis of Making a Sandwich, Preparing Hot Drink and Serving

<table>
<thead>
<tr>
<th>Making a Sandwich</th>
<th>Preparing a Hot Drink</th>
<th>Serving</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. take the dish.</td>
<td>1. plug the socket of the kettle in.</td>
<td>1. get the tray.</td>
</tr>
<tr>
<td>2. take the bread.</td>
<td>2. open the lid of the kettle.</td>
<td>2. put the tray on the counter.</td>
</tr>
<tr>
<td>3. put the bread in the dish.</td>
<td>3. pour a glass of water into the kettle.</td>
<td>3. get the dish with the sandwich.</td>
</tr>
<tr>
<td>4. separate the bread in half.</td>
<td>4. shut down the lid of the kettle.</td>
<td>4. put the sandwich dish on the tray.</td>
</tr>
<tr>
<td>5. put the upper part of the bread in the dish.</td>
<td>5. push the button which reads 1 to start the kettle.</td>
<td>5. get the glass.</td>
</tr>
<tr>
<td>6. take the cheese.</td>
<td>6. open the lid of the oraelet jar.</td>
<td>6. put the glass on the tray.</td>
</tr>
<tr>
<td>7. put the cheese on the bottom part of the bread.</td>
<td>7. put two or three tea spoons of oraelet in the glass.</td>
<td>7. get napkins.</td>
</tr>
<tr>
<td>8. take the fork.</td>
<td>8. open the lid of the sugar jar.</td>
<td>8. puts the napkins on the tray.</td>
</tr>
<tr>
<td>9. get the tomato.</td>
<td>9. put two or three tea spoons of sugar in the glass.</td>
<td>9. get the tray on the counter.</td>
</tr>
<tr>
<td>10. put the tomato in the bread.</td>
<td>10. take the kettle when it is off.</td>
<td>10. get the tray on the table.</td>
</tr>
<tr>
<td>11. place the upper part of the bread on the bottom part of it.</td>
<td>11. pour the water in the kettle into a glass.</td>
<td>11. put the tray on the table.</td>
</tr>
<tr>
<td></td>
<td>12. leave the kettle where s/he taken it.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13. unplug the socket of the kettle.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14. stir the ingredients in the glass with a spoon.</td>
<td></td>
</tr>
</tbody>
</table>

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When the student said they were ready, the researcher verbally praised the student, ‘Great! You are ready’. The student was then given the skill instruction, ‘Please make a sandwich’. Following this instruction, the student was given 4 s, to complete the first step of the skill, s/he and the response was recorded. The student was then observed for completion of successive steps within 4 s. Once the student successfully completed all steps of the skill verbal reinforcement, ‘Thank you for your participation’ was given.

Baseline data were gathered until stable for each the student. Subsequent to this procedure, probe sessions were held to collect probe data. At least three probe sessions were conducted until stable data were obtained. This procedure was conducted for each skill and each student.

**Intervention Sessions**

Following above procedures, sessions with 0 s time delay trials were conducted until students were at 100% correct responses to the given prompts. Then, 4 s time delay trials were conducted until students were at 100% correct responses to the given prompts in at least three consecutive sessions.

For making a sandwich and serving skills, only one session was held with each student. For the skill of preparing a hot drink, one session was held with Demet and Umut and two sessions with Tugce. All sessions were 0 s time delay. As in probe sessions, the researcher asked, ‘Now, we will make a sandwich together. Are you ready?’ Once students said they were ready, they were told ‘Please make a sandwich’. The student was then provided with the correct response and asked to do the same. Correct responses resulted in verbal reinforcement. When students responded incorrectly they were interrupted and corrected. The researcher then completed the given step using verbal and model prompts. If the student was unable to respond to the prompt, this was considered an incorrect response. The researcher completed the given step using verbal and model prompts. Once the students successfully completed all steps of the skill, they were verbally reinforced.

The same procedures were followed in the 4 s time delay sessions. The student’s attention was secured and given the skill instruction. The researcher waited 4 s for the student to complete the first step. If the student correctly completed the step within 4 s (unprompted correct response), verbal praise was given. If the student incorrectly responded (unprompted incorrect response), the researcher helped the student respond correctly with simultaneous verbal and model prompts. If the student was unable to respond within 4 s, the researcher provided simultaneous verbal and model prompts. If the student than correctly responded (prompted correct response), verbal praise was given. If the student incorrectly responded despite the given prompts (prompted incorrect response), the researcher completed the given step and explained what he was doing. If the student did not respond (no response), this was considered an incorrect response. The researcher completed the step for the student and moved on to the following step. Other steps of the skills were completed in the same way. When students completed all steps of the skill, they were verbally reinforced, ‘Thank you for your participation’. In addition, they were allowed to eat what they had prepared (FR12, FR14).

The same procedures were followed for each different skill and each student.

Students’ unprompted and prompted correct responses were reinforced with CRF, VR3, FR12, and FR14 schedules. When students incorrectly reached the unprompted response, they were told to wait for the prompt, and the instruction was repeated. When they incorrectly reacted to the prompted response, they were interrupted and corrected. Students’ no responses were ignored, and they were given the prompted correct response.

**Maintenance and Generalization Sessions**

After 2 and 4 weeks effects of instruction were examined. Maintenance and generalization sessions were conducted the same way as probe sessions. Steps completed successfully, were reinforced on FR11 and FR14 schedules. Participation was reinforced on a VR3 schedule. Reinforcements were faded in maintenance sessions. In the first session, the students were given food and verbally praised. In
the second session, they were verbally praised.

Generalization sessions were held immediately after maintenance sessions. Sessions were the same as probe sessions except different context and different materials were used. Sessions were conducted at the personnel kitchen of the special education center between 2:00 and 3:00 p.m. Materials used were glass dishes, bread, sausages, lettuce, fork, glass, plate, tea spoon, sugar, oralet, water, kettle, and napkin. Students were continuously reinforced via verbal and tangible reinforcement.

Reliability Analysis

Two observers watched all videorecorded sessions and collected data as to both procedural and interobserver reliability.

Reliability data was gathered at least across 20% of all sessions. Interobserver reliability was 100% for skills of making sandwich and preparing a hot drink in probe sessions and between 97%-100% for the skill of serving. In instruction sessions, reliability was between 91%-100% for the skills of making sandwich and serving and 100% for the skill of preparing a hot drink. In maintenance and generalization sessions 100% agreement was found for the skills of making sandwich and preparing a hot drink, and 91%-100% for the skill of serving.

In order to ensure procedural reliability one observer checked whether the researcher: (a) had materials ready, (b) secured attention, (c) gave task direction, (d) provided prompted correct response, (e) gave correct response, and (f) waited 4 s. Procedural reliability was 100%.

Results

Effectiveness Data

Results indicate that CTD was effective in teaching students how to make a sandwich, how to prepare a hot drink, and how to serve what they had prepared. Figures 1, 2, and 3, present the results of the instruction for each participant on each of the skills in each session.

Maintenence and Generalization

Maintenance sessions infer a more permanent effect of the instruction on students’ acquired skills. Demet and Umut achieved 100% retention for each skill, while Tugce achieved 100% retention only for preparing a hot drink and serving in two maintenance sessions. With regard making a sandwich, she achieved 100% retention in the first maintenance session and 91% in the second.

In generalization sessions, each of the students was able to generalize skills across different contexts and materials. For making a sandwich, Demet and Tugce achieved 73% generalization and Umut 100%. For preparing a hot drink, Demet and Umut were 100% and Tugce 93%. For serving, all students were at 100% generalization.

Discussion

The present study examined effectiveness of CTD on teaching snack and drink preparation, and serving skills to children with mental retardation.

Findings indicated that CTD was effective in teaching these skills. In probe sessions, each of the students successfully achieved the steps in each skill. Similarly, in maintenance sessions, permanent effects of the instruction were observed. Further, all subjects were able to generalize skills across different contexts with different materials. These findings concur with those in other similar studies. Harden and Zane (as cited in Schuster et al., 1998), Tekin-Iftar et al. (2001) and Wolery et al. (1992); for example, found CTD to be effective in the teaching of various skills to children with mental retardation. Schuster et al., in their review of 20 research articles, concluded that all studies demonstrated effectiveness of CTD.

In order to teach the skills, 0 s and 4 s time delay trials were conducted. These two procedures were included in the study due to the chained-skill instruction. Although participants correctly responded 100% to the skill direction in the 0 s time delay sessions, they could not display similar performance in sessions with 4 s time delay. In these sessions, they could not give correct responses to the target stimulus, but only to prompted correct
responses. What this implied was a higher number of sessions and longer instruction time. Participants’ correct responses before and after the prompts were reinforced in the same way, and responses given before the prompt were considered to be correct. It
Figure 2. Percent of correct responses for Tugce across chained skills taught with constant time delay.
could be that reinforcing both types of correct responses in the same way lengthened instruction time and that differential reinforcement would be appropriate for correct responses preceding prompts in order to meet the criterion within a shorter period of time. Along
with use of reinforcements for correct responses, the incorrect responses were corrected, and arguably, error correction prevented participants from giving incorrect responses. Also, none of the participants were given wait training instruction. This might be one of the reasons for a short period of instruction.

Future studies could undertake research into the effectiveness of CTD in different settings with a focus upon teaching different chained skills, with use of different prompts, and with instruction sessions in which different 0 s and 4 s time delay procedures are employed. Also, future studies might tackle the question of whether forward chaining, backward chaining and the total skill format are effective. Another segment of future studies could focus upon effectiveness of instruction sessions in which participants are given ample time to complete each step of the skills and compare CTD with another errorless instruction procedure. Further studies could also deal with the use of CTD for the teaching of one-step skills and error types emerging both in discrete skills and chained skills. In conclusion, in view of this study and previous studies, it could be argued that CTD is effective in teaching chained skills to individuals with mental retardation and is a procedure that is easily applied.

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