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# Using Constant Time Delay to Teach Self-Feeding to Young Students with Severe/Profound Handicaps: Evidence of Limited Effectiveness

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*This paper describes an investigation to determine the effectiveness of a constant time-delay procedure used in a total task format to teach chained self-feeding skills to two preschool children with severe handicaps. Training was conducted during snacktime using a 3-sec delay interval with a controlling prompt of physical guidance. Both children learned spoon use; in addition, one child learned cup use. These behaviors maintained over time. Although there was not adequate time to teach additional behaviors to establish experimental control, results indicate that the constant time-delay procedure merits further investigation as an effective means of teaching self-feeding tasks.*

**KEY WORDS:** constant time delay; self-feeding; preschool children; severe handicaps.

## INTRODUCTION

The goal of education for students with severe disabilities is to promote independent functioning in the least restrictive environment. Acquisition off self-help skills fosters independence and constitutes a major portion of the curriculum for young children with severe handicaps. Thus,

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identification of efficient and effective procedures for teaching those skills is desirable.

Self-feeding skills are chained tasks and several instructional procedures have been reported in the research literature for teaching them. These include: verbal and physical prompts with 2-sec delay and graduated guidance to teach spoon use (Albin, 1977); graduated guidance with "mini-meals" to teach napkin, utensil, and glass use (Azrin & Armstrong, 1973); graduated guidance with "mini-meals" to teach spoon use (Stimbert *et al.*, 1977); modeling, physical guidance, and error correction to teach utensil use (Nelson *et al.*, 1975); verbal instruction, modeling, and physical guidance to teach utensil and napkin use (Sisson & Dixon, 1986a,b); physical guidance with restraint to teach spoon use (Song & Gandhi, 1974); and the system of least prompts to teach utensil, cup, and napkin use (Wilson *et al.*, 1984). Skills related to self-feeding which have been reported in the research literature include: small group setting to increase utensil use (Hendrickson *et al.*, 1986); physical guidance with smaller portions to decrease pace of eating (Knapczyk, 1983); shaping with vacuum cup to teach cup use (Peterson & Ottenbacher, 1986); and self-monitoring to increase amount of food consumed (Ridley, 1986).

None of these studies used a time delay procedure to fade controlling prompts. Albin (1977) and Wilson *et al.* (1984) were the only two investigations to specify a set delay interval before delivery of a prompt. The time delay procedure is a near errorless procedure that has been effective and efficient with a broad array of discrete (Browder *et al.*, 1981; Kleinert & Gast, 1982; McIlvane *et al.*, 1984) and chained tasks (McDonnell, 1987; Schuster *et al.*, 1988; Wolery, *et al.*, 1990). In the time delay procedure, the controlling prompt is systematically faded across a dimension of time, allowing the student to correctly perform the target response following the delivery of a controlling prompt until he/she is able to correctly perform the target response within the specified time interval before the controlling prompt is delivered.

Schuster *et al.* (1988) taught cooking skills to four adolescents with moderate mental retardation using a constant time delay procedure in individual instructional sessions. A model paired with verbal description was the controlling prompt and was presented following a 0-sec delay during the first two sessions and a constant delay of 5 sec was used in all subsequent sessions. Verbal praise was provided following all correctly completed steps. Cooked food was available for consumption by the subject when 90% of the steps in the chain were performed correctly. Errors were followed by a model and verbal description of the correct response. A multiple probe across tasks design replicated across the four subjects established experimental control. The procedure was found to be an effective

means of teaching cooking skills in a total task presentation, with a high percentage of both interobserver and procedural reliability. In addition, the target behaviors generalized to the home setting and maintained at 85% when checked in a 3-month follow-up.

McDonnell (1987) taught four adolescents with severe mental retardation to purchase snack food from a convenience store and a fast food restaurant. A multielement design was used to compare a constant time delay procedure with the system of least prompts. During the system of least prompts procedure, the subject was provided with prompts from a hierarchy (verbal, gesture, physical guidance) following an incorrect response. Controlling prompts in the constant time delay procedure varied according to steps and were presented before an error was made. When three correct responses were completed at the 0-sec delay interval, it was increased to 2 sec for all subsequent trials of that step. Thus, steps of the chain had both varying prompts and intervals during training. Constant time delay and the system of least prompts were both effective. However, the constant time delay procedure resulted in fewer errors, trials, and sessions to criterion.

In summary, previous research shows that a constant time delay procedure has been an efficacious and efficient procedure in teaching chained tasks. It also reveals that a prompt of physical guidance has been used most often in teaching self-feeding tasks, but that the prompt has not been systematically faded across the dimension of time. Since the delay procedure has been effectively used to fade physical guidance as a controlling prompt with low-functioning subjects, a constant time delay procedure should serve as a systematic means of fading physical guidance during self-feeding instruction for individuals with severe handicaps. The present investigation attempted to answer the following question: Will a constant time delay procedure be effective in teaching chained self-feeding tasks to individuals with severe or profound handicaps?

## METHODS

### Subjects

Participants were two 3-year-old preschool children with severe handicaps; they were enrolled in two different preschool programs. Each had multiple handicaps and, with the exception of finger feeding, were being fed by staff at school and by parents or caregivers at home. The children demonstrated the motor ability to raise finger foods to their mouth; thus, self-feeding was considered an appropriate goal by parents and staff.

Sabrina was a 3-year-8-month-old female with cortical blindness and hypotonic cerebral palsy. She was nonambulatory, nonverbal, and nonimitative. She received occupational, physical, and speech and language therapy. On the *Early Learning Accomplishment Profile for Developmentally Young Children* (E-LAP) (Glover *et al.*, 1978), she scored 12 months or below across skill areas: fine motor—12 months; cognitive—12 months; language—10 months; and gross motor—9 months. Prior to the study, the staff had attempted to use a cup with a lid, but she was most often given fluids through a bottle. No attempt had been made to teach other self-feeding skills.

Victor was a 2-year-10-month-old male with cerebral palsy. He was also nonambulatory, nonverbal, and nonimitative. Victor had a severe visual impairment for which he wore corrective lens. He received physical and speech therapy. On the *Developmental Profile II* (Alpern *et al.*, 1980) and the *Battelle Developmental Inventory* (Newborg *et al.*, 1984), Victor scored 13 months or below across skill areas: fine motor—13 months; cognitive—3–9-months; gross motor—6–8 months; personal /social—3–6 months; adaptive/self-help—3–6 months; and communication—2 months. Prior to the study, the staff had worked with Victor in shaping his behavior to accept the presence of a cup on his tray and allow it to touch his lips. No attempt had been made to teach other self-feeding skills.

### *Trainers*

Three trainers participated in this study. Training for Sabrina was conducted by a graduate student (fourth author) majoring in Early Childhood Education for the Handicapped. Training for Victor was conducted by the director of Victor's preschool (fifth author), who held an M.S. degree in the education of students with Severe/Profound Handicaps. The constant time-delay procedure was taught to both trainers by the investigator (first author) through role playing to a criterion of 100%.

## Setting

Training was conducted at snacktime in the student's respective preschool classroom. Training occurred in a group setting with the child positioned within a circle of 2 to 10 peers who were also having a snack. Training for Sabrina occurred at 2:00 p.m., 2 hr following lunch. Under the direction of the physical therapist, she was positioned in her wheelchair with a clear attached tray or in a Rifton chair with a wooden tray. Training for Victor occurred at 10:00 a.m., 2 hr following breakfast. Under the

direction of the physical therapist, he was positioned in a Rifton chair with a wooden tray. Both children were strapped into optimal positions (lap straps, foot straps) before sessions began. The trainer sat in a chair opposite the child while conducting training. Teachers and aides present in the classrooms conducted snacktime for peers.

Generalization probe sessions for Sabrina were conducted during lunch at 11:00 a.m. in the same setting used for training; peers were also present. Generalization probe sessions for Victor were conducted during breakfast at 8:00 a.m. in the same setting; peers were present, but not eating.

## Materials

To facilitate generalization, multiple exemplars of snack foods were used throughout the study. Foods and liquids were selected with the following considerations: preference testing, food allergies, and food given to peers at snack time. Foods and liquids varied daily according to availability and acceptance by the child, as determined by offering the child tastes before the session began. For Sabrina, training foods and liquids included strawberry and peach yogurt, applesauce, banana pudding, water, milk, apple juice, and fruit punch. Attending (raising head up for eating) was reinforced with small pieces of finger foods, which included cereal, crackers, cookies, and chocolate or peanut butter chips. Generalization at lunch was assessed using mashed potatoes, green beans, and crushed pineapple. For Victor, training foods and liquids included applesauce, chocolate pudding, mashed banana, diced pears, fruit cocktail, strawberry jello, chocolate cake, strawberry yogurt, water, apple juice, apricot nectar, and apple cider. Performance and attending were reinforced with miniature marshmallows, raisins, pretzels, orange slices, or small pieces of oatmeal cake. Generalization at breakfast was also assessed using applesauce.

Multiple exemplars of materials were also used throughout the study. Sabrina was exposed to spoons which ranged in size from infant to toddler to normal size (varying bowl size and handle length) and ranged in composition from plastic to metal with plastic coating to all metal. Because of her bite reflex, the plastic-coated spoon was used most often. Sabrina's food was placed in a red plastic bowl with a raised lip for scooping and held in place by a suction cup on the bottom. Sabrina also used cups with training lids varying in color (clear, white, red, yellow, blue) and size (nontip cup with handles, small child's cup, tall training cup). The preferred type of cup was a small child's cup, varying in color. Napkins used during probe trials included heavy paper towels, dishcloths, and wet cloths, with the

paper towels used most often. Victor was also exposed to a variety of spoons which included a heavy plastic spoon, a spoon with a curved handle, a spoon with a round handle in which the entire hand could be inserted, and a normal-sized spoon. The bowls ranged from toddler to regular size. The preferred spoon was a metal spoon with a curved handle, adapted to Victor's grasp with foam rubber on the handle. Victor's food was placed in a yellow or blue bowl, otherwise identical to the one used with Sabrina. Victor was also exposed to the same types of cups used with Sabrina; a preferred cup was not identified. Napkins used included thin paper napkins, heavy paper towels, terry cloth towels, and wet cloths, with paper napkins used most often during training. Victor's tray was also covered with blue dycem (a plastic non-skid material) to decrease the ease with which materials could be pushed away or knocked over. Both children wore bibs to protect clothing during all sessions.

## Dependent Variables

Three behaviors (identified through prescreening) were chosen for intervention for both participants: spoon use, cup use, and napkin use. The task analyses for these behaviors can be found in Table I.

### *Probe Sessions*

During probe sessions, the stimuli (bowl and spoon, cup, or napkin) were placed in front of the child on the tray and an attentional cue was given. Because Sabrina was blind, her cue was "Touch"; Victor was given the cue "Look." When the child performed the attentional response (touched or made eye contact with the material), the appropriate direction ("Eat," "Drink," "Wipe") was presented. The trainer then waited 3 sec for the child to initiate the first step of the chain. If the child responded correctly, praise was given and the trainer waited 3 sec for the next step to be initiated. Each completed step served as the discriminative stimulus ($S^d$) for the step which followed. If the child responded incorrectly, the trainer removed the material and set up the $S^d$ for the next step. For example, if the child did not scoop, the trainer took the spoon, scooped food with the spoon, then replaced the spoon in the child's hand and waited for the child to raise the spoon to his/her lips. This prevented teaching the child the target skill during the probe condition, but allowed the child to complete those steps which were known. At the end of each probe session, the child was praised for attending and given finger food. Five probe trials were conducted on a single target behavior each session. Three responses were

**Table I.** Task Analyses

| Behavior | $S^d$ | Response |
|---|---|---|
| Spoon | "Eat" | Grasp spoon |
| | Spoon in hand | Scoop food |
| | Food in spoon | Raise spoon to lips |
| | Spoon touching lips | Open mouth |
| | Mouth open | Put spoon in mouth |
| | Food in mouth | Remove spoon |
| | Spoon out of mouth | Lower spoon |
| | Spoon on table | Release grasp |
| Cup | "Drink" | Grasp cup |
| | Cup in hand | Raise cup to lips |
| | Cup touches lips | Tilt cup to mouth |
| | Liquid in mouth | Close mouth and drink |
| | Liquid swallowed | Lower cup to table |
| | Cup on table | Release grasp |
| Napkin | "Wipe" | Grasp napkin |
| | Napkin in hand | Raise hand to face |
| | Napkin touching face | Wipe face |
| | Face wiped | Lower napkin |
| | Napkin on table | Release grasp |

possible during the probe trial: unprompted correct, unprompted incorrect, and no response. As shown in Table I, the chains for spoon, cup, and napkin contained 8, 6, and 5 steps, respectively. Probe sessions were conducted once per week for those behaviors not in training. These behaviors were intermixed with training trials (e.g., the child received a cup probe trial following every two training trials with the spoon) since this was considered the most natural manner of eating. In addition, this probe strategy prevented repetition of an unknown skill. Probe sessions were conducted prior to training to establish experimental control and following training to criterion as a measure of maintenance. Although probe trials were conducted at mealtime rather than snacktime, generalization probe sessions were conducted in the same manner as all other probe sessions.

### *Training Sessions*

A constant time delay procedure, in which the controlling prompt was physical guidance was used to teach the target behaviors. Instruction occurred in a total task presentation format with 10 spaced trials each session. As in probe sessions, an attentional cue was given at the beginning of each trial ("Look" or "Touch") and the attentional response was praised by the trainer. During the first session, the presentation of the

direction ("Eat," "Drink," or "Wipe") was followed by a 0-sec delay, in which the teacher immediately guided the child on each step of the chain. If the child did not resist, descriptive verbal praise was delivered for each step (e.g., "Good, you scooped"). Each step in which the child cooperated was scored as a prompted correct response; each step in which the child resisted physical guidance was scored as a prompted incorrect response after the prompt. Training continued at 0-sec delay until the child showed no resistance for an entire session (i.e., 10 consecutive trials). During all subsequent sessions, the controlling prompt was delivered following a 3-sec delay interval for the child to initiate and a 3-sec delay interval for the child to complete the target response for each step of the chain. Correct steps were followed by descriptive verbal praise. Incorrect steps or failure to respond within the 3-sec interval resulted in physical prompts for that step and were followed by descriptive verbal praise if there was no resistance. During training sessions, four possible responses were recorded: (1) correct response before the prompt, (2) incorrect response before the prompt, (3) correct response following the prompt, and (4) incorrect response following the prompt (resistance to physical guidance). Between trials and following the session, students' attending was reinforced with small pieces of finger food. For Sabrina, this consisted of the verbal prompt, "Head up," followed by the deliver of a small edible. For Victor, this consisted of verbal praise (e.g., "Good, you are trying") paired with a small edible. When each child reached criterion (90% of all steps or 9 out of 10 independent trials), reinforcement was systematically thinned to the end of the chain.

## Data Summary

The use of multiple trials for each step of the response chain presented problems in graphic display of the data. To present an accurate display of the data for decision-making, data were summarized in three visual displays. First, the data were graphed to show the total percentage of correct steps performed before the prompt and the total percentage of correct steps performed after the prompt. While this allowed progress to be seen, it did not show whether an entire trial was completed independently. To portray this, data were also graphed to show the total number of correct trials. Finally, the percentage of correct trials on each step were displayed in a table beneath each graphed session to determine individual steps on which criterion was met.

### Design

A multiple probe design across behaviors (Tawney & Gast, 1984) with replication across two subjects was used to evaluate experimental control. The behaviors to be trained were scheduled to be trained in the following order: spoon use, cup use, and napkin use. Prior to training, probe sessions were conducted on the behavior to be trained for a minimum of three days or until data stabilized. To measure the acquisition of similar steps across behaviors, weekly probe sessions were conducted for behaviors not in training. Training was implemented in a time-lagged fashion across behaviors.

## RESULTS

### Reliability

Both interobserver and procedural reliability data were collected across conditions. Reliability data were collected on both trainers and on the investigator who occasionally acted as trainer. Reliability scores were obtained by diving the total number of agreements by the total number of agreements plus disagreements and multiplying by 100.

Interobserver reliability data for Sabrina were collected on 26% of all sessions. Man interobserver reliability data was 94% for spoon (range = 84-100%), 91% for cup (range = 78-100%), and 97% for napkin (range = 89-100%). Disagreements across steps on spoon ranged from 1% to 15% with the greatest number of disagreements occurring on removal of the spoon from the mouth (14%) and lowering of the spoon to the table (15%). Disagreements concerned whether Sabrina bit down on the spoon (incorrect after the prompt) or waited for its removal (correct after the prompt) and whether Sabrina lowered the spoon to the front (correct before the prompt) or lowered the spoon off center (incorrect before the prompt). Disagreement across steps on cup ranged from 0% to 27%, with the greatest disagreement over whether Sabrina voluntarily released her grasp on the cup to the trainer (correct before the prompt) or waited until the cup was removed by the trainer (correct after the prompt). Disagreements across steps on napkin ranged from 0% to 13% with the only disagreements occurring on whether the napkin was raised all the way to the face.

Procedural reliability data for Sabrina were also collected on 26% of all sessions. The mean percentage procedural reliability was 98% for spoon (range = 91-100%), 98% for cup (range = 90-100%), and 97% for napkin (range = 89-100%). Procedural errors included failure to (1)

give the direction (<1%), (2) reinforce at the end of the chain (<1%), (3) give the attentional cue (3%), and (4) reinforce the attentional response (9%).

Interobserver reliability data for Victor were collected on 28% of all sessions. The mean percent interobserver reliability was 94% for spoon (range = 83-100%), 98% for cup (range = 90-100%), and 91% for napkin (range = 76-100%). Disagreements across steps on spoon ranged from 0% to 11% with the greatest number of disagreements occurring on the lowering of the spoon to the table (10%) and the release of the grasp (11%). Disagreements related to whether Victor lowered and released the spoon (correct before the prompt) or dropped or threw the spoon (incorrect before the prompt). Disagreements across steps on cup ranged from 0% to 8%, with the greatest disagreement over whether Victor raised the cup to drink from it (correct before the prompt) or to throw it (incorrect before the prompt). Disagreements across steps on napkin ranged from 0% to 22% with the greatest number of disagreements occurring on whether Victor voluntarily released his grasp on the cup to the trainer (correct before the prompt) or waited until the cup was removed by the trainer (correct after the prompt).

Procedural reliability data for Victor were also collected on 28% of all sessions. The mean procedural reliability data was 99% for spoon (range = 89-100%), 99% for cup (range = 96-100%), and 98% for napkin (range = 84-100%). Procedural errors included failure to give the Sd (<1%), failure to give the attentional cue (<1%), failure to reinforce at the end of the chain (8%), and failure to reinforce the attention response (9%).

## Dependent Variables

During the 114 days in which Sabrina was a participant in this investigation, she learned two skills to 90% criterion which maintained. It was determined that if Sabrina could independently perform steps on 9 out 10 trials, she had acquired a functional self-feeding skill. Sabrina acquired independent spoon use in 63 sessions and independent cup use in 47 sessions. Due to the end of the school year, she was not taught to use a napkin. Sabrina's data are presented in two formats. In Fig. 1, a bar graph shows the mean percentage of correct independent steps performed across the three target behaviors during each month that the investigation was conducted. Figure 2 shows the daily percentages of correct trials on each step of the chain for each behavior with the points of condition changes and procedural adaptations designated.

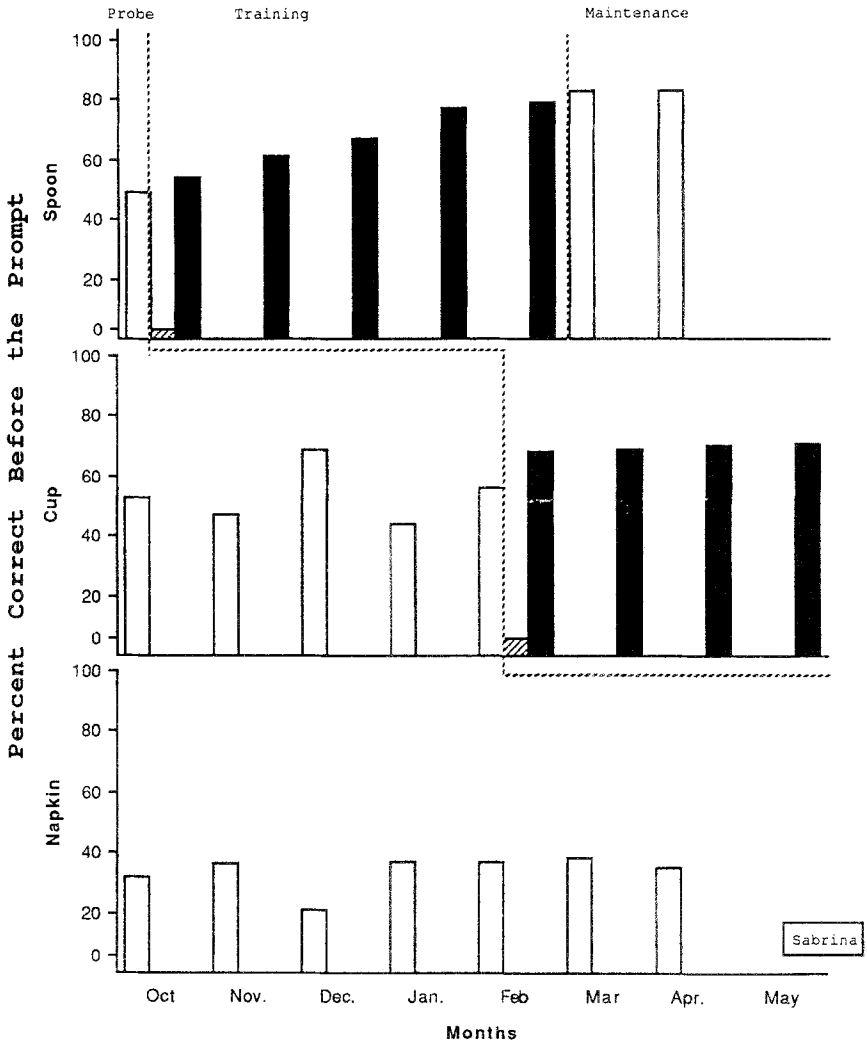


**Fig. 1.** Data for Sabrina. The open bars indicate the mean number of correct unprompted responses per month during probe sessions. The diagonal bars indicate the mean number of correct unprompted responses per month during 0-sec delay training sessions. The closed bars indicate the mean number of correct unprompted responses per month during 3-sec delay training sessions.

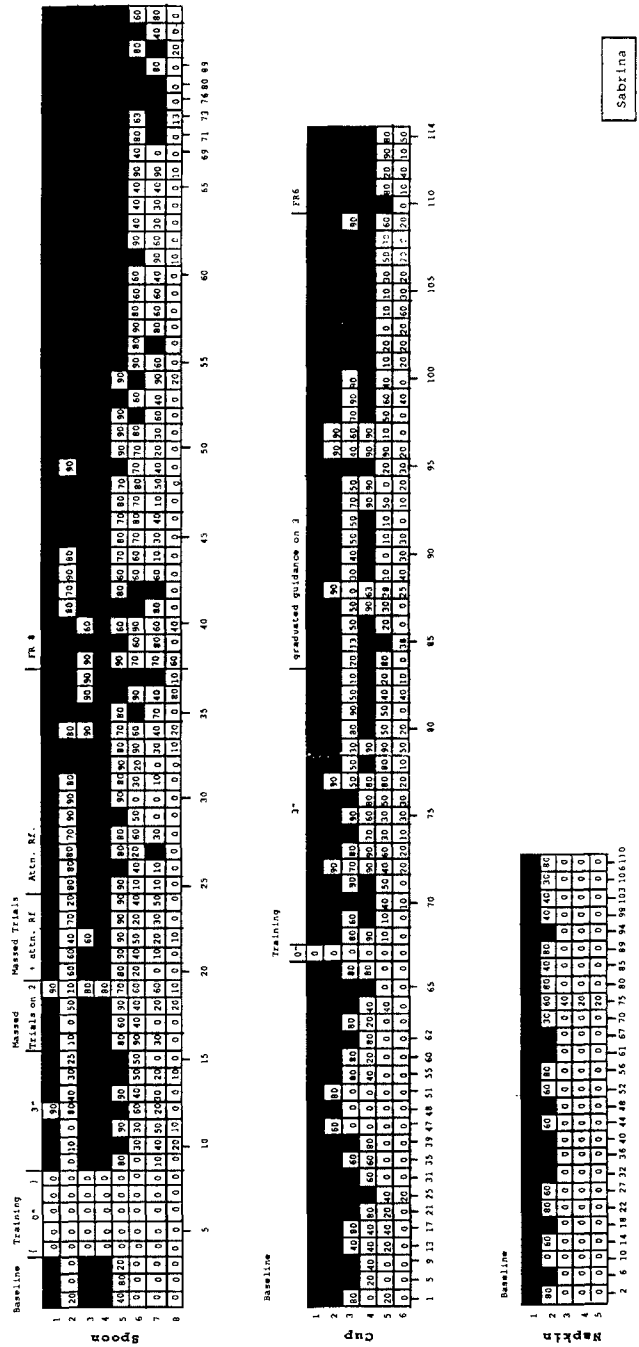


**Fig. 2.** Data for Sabrina. The numbers in each square indicate the percentage of correct unprompted trials on each step per session. Closed squares indicate 100% correct responses on all trials.

Prior to training with the spoon, Sabrina was able to independently complete the following steps: grasping the spoon, raising the spoon to her lips, and opening her mouth. She inconsistently displayed the ability to correctly scoop and insert the spoon in her mouth. When the 0-sec delay procedure was initiated, Sabrina required five sessions until she demonstrated compliance with the physical prompt on all steps. When the 3-sec delay procedure was initiated in session 6, Sabrina showed a slow, but steady increase in performance across all steps but the final grasp release. Because the scooping step was considered critical for self-feeding and failed to reach criterion, several adaptations were systematically implemented in the instructional procedure.

Beginning on session 16, Sabrina was given five massed trials on scooping using a 0-sec delay prior to training and 5 massed trials following training. When a tendency to let her head flop over her food began to interfere with training, compliance with the command "Head up" was reinforced with small edibles between trials beginning on session 20. Because no change in the scooping was apparent, the massed trials were discontinued on session 25; reinforcement of "Head up" remained in place throughout the remainder of the investigation. On session 36, Sabrina's overall performance was at 90% or above on all steps except the grasp release, which was not considered critical due to her blindness. Thus, on session 37, reinforcement (verbal praise) was faded on all steps except the grasp release. By session 60, Sabrina was demonstrating consistency in performance of all steps except removing the spoon from her mouth, lowering it to the table, and releasing her grasp. Taking into account the possibility of prompt dependency on this step, graduated guidance was implemented on removing the spoon from the mouth and lowering it to the table.

On session 66, Sabrina reached criterion performance of 90% or better on all steps except grasp release with verbal reinforcement faded. Periodic maintenance checks revealed that her overall performance maintained at 80% or better, with the exception of one session, throughout the remainder of the investigation. In the initial probe for generalization at Sabrina's lunch prior to training, Sabrina performed 50% of the steps. A generalization probe at the end of the investigation revealed that Sabrina performed 59% of the steps during trials using vegetables and meat and 89% of the steps during trials using dessert (fruit).

Sabrina's probe performance on cup use showed a great deal of variability while she was being taught spoon use. Prior to training with the cup, Sabrina independently grasped the cup. She inconsistently displayed the ability to perform all other steps. When the 0-sec delay procedure was initiated in session 67, Sabrina immediately complied with the physical

prompt. When the 3-sec delay procedure was initiated in session 68, Sabrina began to show consistency in responding across steps, but did not surpass her highest probe performance until and adaptation was made in the procedure. Based on her performance in spoon use training, graduated guidance was implemented in session 84 on the tilting step on the assumption that she had become prompt dependent on that step. At this time, she was presented with only a small amount of liquid in her cup on each trial to discourage drinking for longer than the three second interval allowed for criterion performance. As with the spoon, the grasp release step was not considered critical, so no adaptation was made on that step. In session 109, Sabrina performed all steps except the grasp release step with 100% independence. Thus, in session 110, reinforcement (verbal praise) was faded on all steps except the grasp release. In session 113, Sabrina again demonstrated criterion performance on all but the final step, therefore, training was discontinued. A maintenance check at 2 weeks following training revealed that her overall performance was still evident in a generalization session. In the initial probe for generalization at Sabrina's lunch prior to training, Sabrina performed 60% of the steps; a generalization probe at the end of the investigation revealed that Sabrina performed 59% of the steps during trials using vegetables and meat and 89% of the steps during trials using fruit and dessert.

Probes on Sabrina's napkin use conducted throughout the investigation showed a relatively stable probe performance. Sabrina was again able to consistently grasp the napkin. She inconsistently raised it to her mouth. With the exception of one session, she failed to perform all other steps.

Efficiency data were collected on Sabrina's performance throughout training. Sabrina first met criterion for spoon in 34 sessions for all steps except grasp release; total training was conducted for 63 sessions. Sabrina had an error rate of 4% in the first 34 sessions and a total error rate of 2% for the duration of training. As training continued, there was a steady decrease in errors with all but one error occurring prior to session 22. Of the total number of errors, 41% occurred before the prompt (e.g., picking up the spoon at the wrong end) and 59% occurred after the prompt (e.g., noncompliance, such as biting the spoon as the trainer guided its removal from the mouth). Direct instructional time for the first 34 sessions was 412 min (6 hr 52 min) with an average of 12 min per session (range of 7 to 18 min); direct instructional time for the duration of training was 603 min (10 hr 3 min) with an average of 9 min per session (range of 4 to 18 min). Probes on other behaviors were interspersed with spoon training trials at least one session per week, accounting for the disparity in session length.

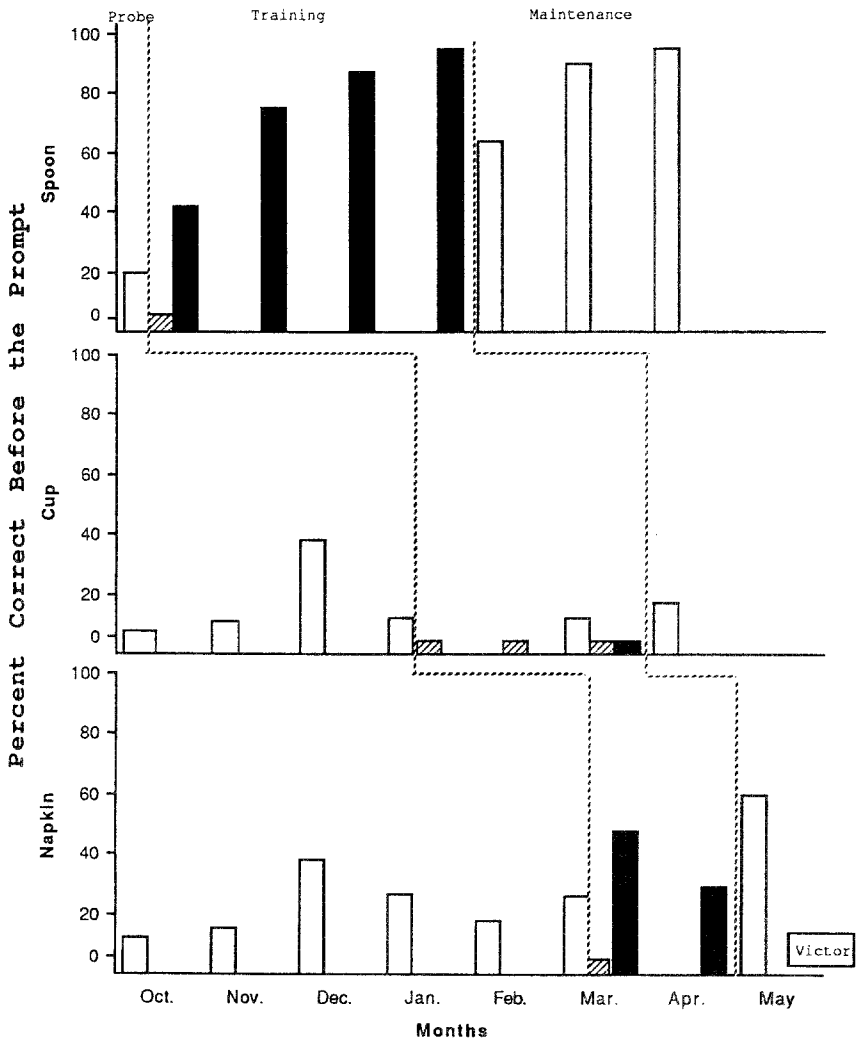


**Fig. 3.** Data for Victor. The open bars indicate the mean number of correct unprompted responses per month during probe sessions. The diagonal bars indicate the mean number of correct unprompted responses per month during 0-sec delay training sessions. The closed bars indicate the mean number of correct unprompted responses per month during 3-sec delay training sessions.

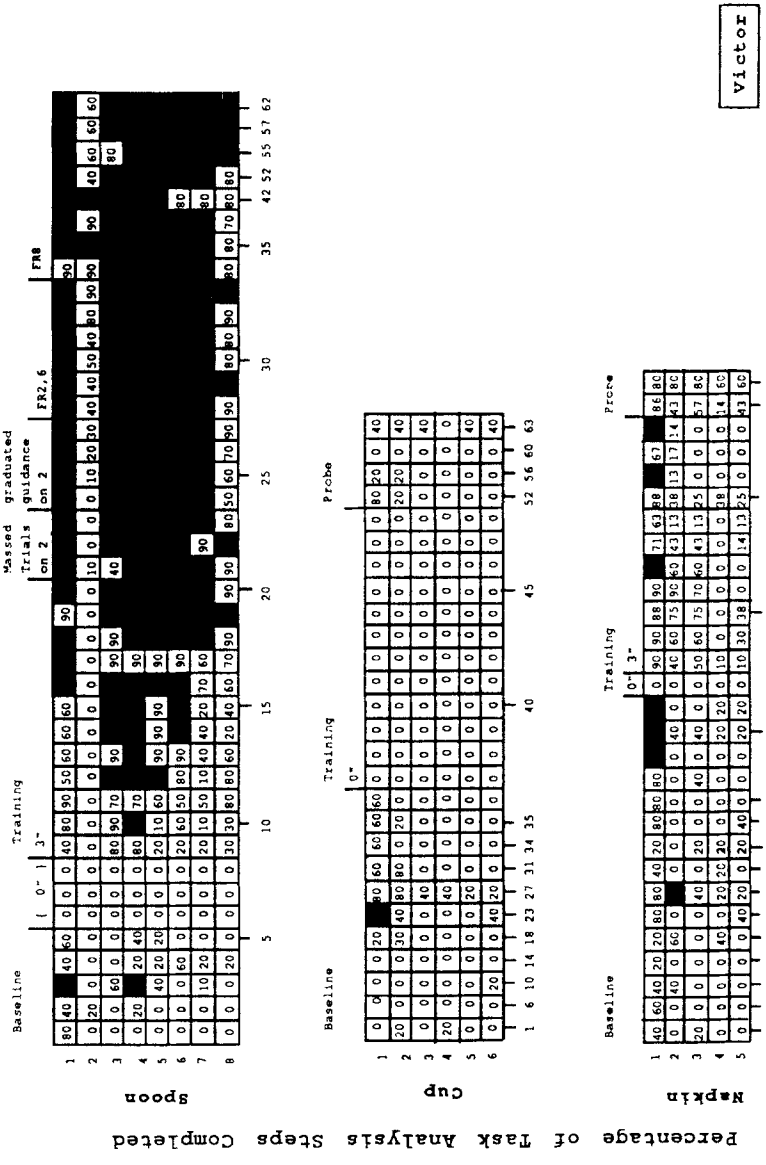


Fig. 4. Data for Victor. The numbers in each square indicate the percentage of correct unprompted trials on each step per session. Closed squares indicate 100% correct responses on all trials.

Sabrina met criterion for cup in 42 sessions. Her total percentage of errors was 2%; of the total number of errors, 60% occurred before the prompt (e.g., turning cup upside down) and 40% occurred after the prompt (e.g., refusal to release grasp). Direct instructional time for cup training was 351 (5 hr 51 min) with an average of 8 min per session (range of 3 to 15 min). Again, probes on other behavior were interspersed with cup training trials at least one session per week.

During the 65 days in which Victor was a participant in this investigation, he learned one skill (spoon use) in 31 sessions; this maintained until the end of the investigation. While an attempt to teach cup use and napkin use were implemented, training on both of these behaviors was discontinued due to noncompliance. Victor's data also are presented in two formats. In Fig. 3, a bar graph shows the mean percentage of correct independent steps performed across the three target behaviors during each month that the investigation was conducted. Figure 4 shows the daily percentages of correct trials on each step of the chain for each behavior with the points of condition changes and procedural adaptations designated.

Prior to training with the spoon, Victor was unable to consistently complete any of the steps of the chain, although he performed each step on occasion. When the 0-sec delay procedure was initiated, Victor required three sessions until he demonstrated compliance with the physical prompt. (Compliance on the first day was disregarded due to its passive nature.) When the 3-sec delay procedure was initiated in the ninth instructional session, Victor showed a steady increase in performance across all steps but the scooping step. Because this step was considered critical for self-feeding, several adaptations (like those used with Sabrina) were systematically implemented in the instructional procedure. Beginning on session 21, Victor was given five massed trials on scooping using a 0-sec delay prior to training and five massed trials following training. When no change in the scooping data was apparent, the massed trials were discontinued on session 24 and graduated guidance was implemented on the scooping step. On session 27, Victor's overall performance was at 90% or above on all steps except the scooping, so reinforcement (verbal praise) was faded on all steps except scooping and the end of the chain. In session 33, Victor reached criterion performance of 90% or better on all steps, so verbal reinforcement faded to the end of the chain only. Periodic maintenance checks revealed that his overall performance maintained at 90% or better throughout the remainder of the investigation. In the initial probe for generalization at Victor's breakfast prior to training, Victor performed 15% of the steps; a generalization probe at the end of the investigation revealed that Victor performed 91% of the steps.

Intermittent baseline data (with three consecutive sessions prior to intervention) which displayed a great deal of variability were collected on Victor's ability to use a cup while Victor was in training on the spoon. Prior to training with the cup, Victor inconsistently displayed the ability to perform all steps. When the 0-sec delay procedure was initiated in session 37, Victor failed to comply with the physical prompt for 11 sessions. Thus, training on cup use was discontinued in lieu of napkin training, although weekly probes were conducted on cup use throughout the remainder of the investigation.

Intermittent probes (with five consecutive sessions prior to intervention) on Victor's napkin use also showed variable baseline performance across steps prior to intervention. Because Victor complied with the physical prompt during the first 0-sec delay session (session 52), the 3-sec delay was implemented during session 53. In the subsequent sessions, Victor's data showed a gradual decrease with a high error rate, although Victor was observed to independently perform the napkin behavior outside of a training session. Thus, training was again discontinued and weekly probes conducted in which Victor's napkin use increased to 81% across steps.

Efficiency data also were collected regarding Victor's performance throughout training. Victor met criterion for spoon in 27 sessions. He had a total error rate of 1% during training, with all errors (i.e., noncompliance after the prompt) occurring within the second training session. Direct instructional time was 353 min (5 hr 53 min) with an average of 13 min per session (range of 5 to 20 min). As with Sabrina, probes on other behaviors were interspersed with spoon training trials at least one session per week, accounting for the disparity in session length. Because training on other behaviors was discontinued, efficiency data for those behaviors are not reported.

## DISCUSSION

Because critical steps were learned which resulted in a functional skill, the present investigation was successful in teaching two self-feeding skills to one child and one self-feeding skill to the other child. Data for both children at the end of the intervention condition were above baseline levels. Although further replications would strengthen the arguments for the effectiveness of the procedure, the findings indicate that the constant time delay procedure was effective in teaching the skills introduced during the investigation. Throughout the investigation, several issues worthy of discussion became apparent. These issues involve prerequisite skills, instructional

variables, and materials in the use of the delay procedure with self-feeding tasks.

## Prerequisite Skills

Certain skills may be prerequisite to training (e.g., compliance, tolerance of materials, identification of reinforcers). It was anticipated that Victor's tolerance to the cup and napkin could be shaped during training in spoon use. While progress was made, an extended illness during which time Victor received all nourishment from a bottle resulted in a return to his previous lack of tolerance of cups and napkins. Since oral desensitization procedures were used throughout the investigation, it is possible that Victor's lack of tolerance was a noncompliant behavior. Solid foods were preferred by Victor over liquids and no reinforcing liquids could be identified to make cup use a more desirable activity. In addition, the continued use of the bottle in other settings worked in opposition to cup training. In regard to the delay procedure, the ability to wait for a prompt is a prerequisite skill. The children in this study were nonimitative, nonverbal, and had no experience in waiting. Thus, errors were more frequent.

## Instructional Variables

With the children who participated in this study, it was necessary to extend the number of 0-sec delay sessions until compliance was achieved. The immediate increase to 3-sec intervals allowed errors to occur until the child learned that a prompt was forthcoming. Over time, a decrease in errors before the prompt was noted. It is probable that a progressive time-delay procedure which slowly and systematically increased the delay interval would have resulted in a lower error rate. In the present study, it was necessary to use graduated guidance on steps which were not learned for both Victor (scoop) and Sabrina (lower). As the children became familiar with the procedure, it is possible that they became dependent on the physical guidance prompt. Fading the physical proximity of this prompt allowed both children to acquire the target steps. It should be noted that Sabrina did not acquire the final step of grasp release. Because she is blind, it is probable that this is a nonfunctional step for her; releasing the spoon meant that she would have to relocate it for the next trial. As both children became fluent in spoon use, the grasp release was not scored if they did not release the spoon but initiated a new self-feeding chain immediately following the lowering of the spoon in the preceding trial.

While an attempt was made to explain the procedure to staff and family members and to coordinate efforts (e.g., positioning techniques) with service delivery personnel, no direct training was provided to anyone other than the trainers of the children. In the case of Sabrina, a lack of understanding with the occupational therapist resulted in the use of splints at other meals which prohibited any attempt she might have made to self-feed at those times. Coordinating goals with other service delivery personnel (e.g., physical therapists, occupational therapists, speech therapists) is essential to the continuity of instruction.

Also worthy of discussion are variables related to the delivery of reinforcement. Because a self-feeding chain taught with the constant time delay procedure moves rapidly (especially when some steps are mastered), it is difficult to provide descriptive praise for each step. Over time, it was necessary to decrease praise statements from "Good, you picked up the spoon!" to "Good" or "Okay" until the entire chain met criterion. A better means of fading reinforcement might be to fade across steps as they are mastered. Reinforcement was eventually faded on all steps but grasp release for Sabrina and scoop for Victor to prevent impeding the fluidity of chain performance.

In the present study, it was necessary to use preferred foods during training to make task completion naturally reinforcing. For example, marshmallows were added to Victor's food and were slowly faded by size; crackers were used to reinforce Sabrina's head control and also were faded by size. During the follow-up generalization session conducted at lunch, Sabrina discriminated between vegetables and the fruits, demonstrating a higher level of spoon use with the fruits. In allowing children to self-feed, it should be expected that they will make choices as to which foods they will feed themselves. Those preferred foods can be used to facilitate training, but an effort should be made to provide experience with a variety of food types. The food should be reinforcing, but it should vary. It may be necessary to begin instruction with sticky textures; however, training is not complete until the child can manipulate coarser, nonsticky textures as well. Training across meals may result in generalization to a broader array of food types (e.g., vegetables, meats, fruits) than was possible in the snacktime training used in this investigation.

## Materials

The selection of materials for self-feeding should be an ongoing process for self-feeding tasks. While multiple exemplars were used in this investigation, those utensils and adaptations which were "best" for each

child became evident over time. It was possible to vary noncritical variables, e.g., color), while maintaining critical variables, such as adaptations for optimal grasp and scooping. It is important that the assessment proces for adaptations be ongoing. For example, as the child's grasp improves, the size of the handle can be decreased. It may be possible to shape this behavior by systematically decreasing the size of the piece of foam used to adapt the handle. Periodic probes using different materials (one at a time) can indicate when material changes are justified.

## CONCLUSION

The current investigation provides a case study of how self-feeding tasks were taught to two nonimitative children with multiple handicaps. While the constant time delay procedure was effective in teaching one behavior in one child and two behaviors to the other child, it is not clear if it was the most effective procedure which could have been used or if the children would have learned the remaining targeted behaviors if instruction had been implemented on all meals or continued over time. These issues are questions for future research. However, this investigation was successful in identifying variables (e.g., prerequisite skills, materials, data collection) which should be considered by those who teach self-feeding tasks, especially if the recipients of instruction are young and have severe handicaps.

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