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# Teaching Young Adults with Developmental Disabilities and Visual Impairments to Use Tape-Recorded Recipes: Acquisition, Generalization, and Maintenance of Cooking Skills

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*Three young adults with developmental disabilities and visual impairments were taught to prepare three different recipes using tape-recorded instructions. Following instruction on each trained recipe, generality probes to untrained recipes were conducted. A multiple baseline across behaviors (recipes) design was used to determine the extent to which each student's preparation of untrained recipes improved as a function of being trained to prepare related recipes by using a self-operated audio prompting system. Results showed that students' cooking skills acquired through instruction on the trained recipes generalized (a) to untrained recipes requiring similar skills (simple generality) and (b) to more complex untrained recipes requiring a combination of skills learned during the instruction of two trained recipes (complex generality).*

If special education is to contribute to meaningful life-style changes for the students it serves, it must develop a technology of instruction that ensures the acquisition and generality of a wide variety functional skills.

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Successful transition to post-school environments by secondary students with disabilities requires a repertoire of functional self-care, social, domestic, vocational, and leisure skills. From a curriculum and habilitative perspective, a behavior is functional if it increases an individual's interaction with and self-sufficiency within relevant environments (e.g., Guess et al., 1978). From a purely behavioral perspective, however, a functional behavior is one that produces reinforcement often enough to maintain its occurrence at some relevant rate. Students who participate in instructional programs that focus on helping them learn and become fluent with skills frequently required and reinforced in post-instruction environments are likely to maintain those skills over time and use them in various settings (Horner, Dunlap, & Koegel, 1988).

In order to learn skills involving long chains of responses, students with severe disabilities typically require intensive instruction over many trials and sessions. Acquiring a functional skill in a training setting — even a skill like food preparation for which naturally occurring, regularly available, and generally powerful contingencies of reinforcement exist — does not guarantee its generality across time and settings (Stokes & Baer, 1977). The stimulus controls in effect in the instructional setting are often not present in the generality setting. For example, some students with disabilities become "prompt-dependent," performing a learned task in the presence of the teacher (or some other stimulus idiosyncratic to the instructional setting) but not in the generality setting when the teacher is absent (Wolery, Ault, & Doyle, 1992). The stimulus controls for the target behavior must then be shifted from the teacher to some other stimulus in the natural environment (Demchak, 1990; Doyle, Wolery, Ault, & Gast, 1988; Snell & Gast, 1981).

A proven strategy for promoting generalized outcomes is to begin with a stimulus that is — or can be contrived to be — common to both the instructional and the natural settings. During instruction this contrived stimulus is made functional for the target behavior and is then transported by the learner to the various settings and situations in which generality is desired (Baer, 1981). Numerous studies have demonstrated programming a common stimulus to promote the generality of a learner's response across various situations and settings (Anderson-Inman, Walker, & Purcell, 1984; Sprague & Horner, 1984; van den Pol et al., 1981; Wacker & Berg, 1983; Wacker, Berg, Berrie, & Swatta, 1985). In addition, the general case strategy — selecting teaching examples that sample the full range of stimulus and response requirements in the natural environment — has been supported by several studies for promoting generalized responses (Horner & McDonald, 1982; Horner, Sprague, & Wilcox, 1982; Sprague & Horner, 1984).

Food preparation skills are critically important for independent living and involve a highly functional repertoire of behaviors. There is a sizable and growing body of literature reporting various strategies for teaching cooking skills to individuals with disabilities (for two recent reviews see, Marchand-Martella, Windham, Wyse, & Martella, in press; Schuster, 1988). A significant portion of this literature consists of descriptions and evaluations of modified cookbooks and other specially-designed instructional materials. Because they require reading and measuring skills, most cookbooks written for children are ineffective with learners with moderate and severe disabilities. An additional concern is that children's cookbooks are not age-appropriate for secondary students or adult learners. A number of specially adapted cookbooks using pictorial sequences are available for individuals with limited reading skills (Kahn, 1974; Lurio, 1982; Steed, 1977; Sudol, 1985). Because they require a sight-word vocabulary and number recognition skills, most modified cookbooks are also ineffective for many students with severe and multiple disabilities. Another difficulty with many of the recipes in cookbooks adapted for nonreaders is that one picture is used to cue the execution of multiple steps (Robinson-Wilson, 1977).

An alternative to published cookbooks is the use of teacher-made picture prompts, which have been shown to be effective in the instruction of food preparation skills (Book, Paul, Gwalla-Ogisi, & Test, 1990; Johnson & Cuvo, 1981; Martin, Rusch, James, Decker, & Trytol, 1982). Johnson and Cuvo (1981) successfully taught four adults with mild and moderate disabilities to cook simple recipes independently by using picture prompts. Various degrees of skill generalization to untrained tasks occurred with three of the four participants, yet no extensive generalization to untrained food items was shown. Further support for the benefit of using picture-card recipes with adults with mental retardation was found by Martin et al. (1982). Although generalization and maintenance were not directly measured, the authors reported the participants in their study continued to use the picture cues during a 9-month follow-up check. Bergstrom, Pattavina, Martella, and Marchand-Martella (in press) used modified recipe cards with visual prompts in the form of number- and color-codes to teach food preparation skills to a 12-year-old with severe disabilities.

Although picture prompts have proven effective in teaching a variety of daily living and vocational tasks to students with mental retardation (Frank, Wacker, Berg, & McMahon, 1985; Gaule, Nietupski, & Certo, 1985; Nietupski, Clancey, & Christiansen, 1984; Nietupski, Welch, & Wacker, 1983; Wacker & Berg, 1984; Wacker, Berg, Berrie, & Swatta, 1985), visual stimuli are ineffective cues for learners with visual impairments who cannot benefit from a system of visual-based instruction. Auditory prompts may be a viable alternative for these learners. In contrast to picture prompts which often require the performance of several steps in response to one picture (Robinson-Wilson, 1977), audio-taped instructions can be created to provide precise, step-by-step, individualized instructions (Alberto, Sharpton, Briggs, & Stright, 1986; Briggs et al., 1990) or to provide additional prompts for increased accuracy and fluency (Davis, Brady, Williams, & Burta, 1992).

Alberto et al. (1986) examined the use of a self-operated auditory prompting system to teach daily living and vocational skills to four adolescents with severe disabilities. Stimulus control of the tasks was quickly shifted from teacher-provided verbal prompts and/or physical assistance to the self-operated audio prompts. Even though the participants performed the tasks without use of the audio prompts by the end of the study, perhaps the most important outcome was the rapid transfer of stimulus control from the teacher to the self-operated prompting system. This shift in stimulus control enabled the students to perform complex tasks without the direct assistance of others. Whether or not the self-operated prompting system is subsequently withdrawn, the quickly-acquired independence it affords is socially significant (Martin et al., 1982). Briggs et al. (1990) extended the research on self-operated prompting systems with individuals with moderate and severe disabilities by demonstrating that such a system can facilitate generalized outcomes to different settings and tasks. After being trained at home to perform certain domestic tasks (e.g., operate a clothes washer, clean a toilet) using a self-operated audio-prompting system, students in the Briggs et al. study successfully performed those tasks in other settings (e.g., community laundromat, school). The students also used the audio prompting system to successfully perform related tasks without any additional training in use of the prompting system.

The current study was designed as a systematic replication of Briggs et al. (1990). We wanted to find out if three young adults with developmental disabilities and visual impairments could (1) learn to prepare three recipes with the aid of a self-operated audio-prompting system, (2) prepare untrained recipes which required preparation steps similar to the trained recipes (simple stimulus generality) without additional training on use of the audio-prompting system or the untrained recipes themselves, and (3) prepare untrained recipes which required combinations of preparation steps taught in the three trained recipes (complex stimulus generality) without additional training on use of the audio-prompting system or the untrained recipes themselves.

# METHOD

## Participants

Three students enrolled in the developmental handicaps program at a state-run residential school for students with visual impairments participated in the study. Each of the students was living in a supervised on-campus apartment and was selected for the study by their teachers and group home staff based on their IEP goals, deficits in daily living skills, and desire to learn cooking skills. Although none of the students had any functional vision, all three could hear and respond to simple auditory instructions.

Lisa was a 21-year-old female who scored 72 on the *Perkins–Binet Test of Intelligence for the Blind* (Form N). No scores from the *WRAT* or other standardized tests were available for Lisa. Lisa displayed some braille reading skills when presented in isolation, however, she had no history of using functional braille in everyday living skills. Lisa was highly verbal but would often keep repeating a statement or phrase unrelated to the task at hand (e.g., an instruction a teacher had told her a week earlier). This perseveration negatively affected her performance in most leaning situations.

Steve was a 20-year-old male with an IQ score of 64 on the Perkins–Binet (Form N). Steve's grade-level scores on the *Wide Range Achievement Test* (WRAT) were: reading, K-9; spelling, 2.9; and arithmetic, 3.1. Steve had no functional braille skills and required verbal prompts from others to complete daily living skill tasks.

Carl was a 17-year-old male who 3 years prior to the study had scored 72 on the *Perkins–Binet* IQ test and had obtained the following grade-level scores on the *WRAT*: reading, Primer .7; spelling, 3.3; and arithmetic, 2.5. Since those tests were administered, however, a degenerative neurological disease had caused Carl's motor, self-help, social, and academic skills to deteriorate significantly. Carl wore a helmet to protect him from injuries caused by seizures or his frequent loss of balance. Carl had no braille skills and required physical assistance with dressing and personal hygiene tasks.

## Setting

The study was conducted in two kitchens. Kitchen 1 used for the first 6 weeks of the study was located in the on-campus apartment. The students were familiar with the basic layout of Kitchen 1 since they had lived in the apartment for at least one semester. Kitchen 2 located in another building on campus, was used for the remainder of the study because continued use of Kitchen 1 interfered with the programming needs of other students. The students had no previous experience in Kitchen 2 and prior to resuming the study they were given an opportunity to discover the location of the cooking utensils and kitchen's layout. The same cooking utensils and equipment were used in both kitchens. The first author, a teacher at the school but who was not the students' regular teacher, served as experimenter. Most instructional sessions were conducted after school hours, with some sessions conducted on weekends, during hours when typical snack foods or items for dinner needed to be prepared. Sessions were conducted with one student at a time and lasted from 1 to 1-1/2 hours. One to three recipes were prepared each session, depending on the student's proficiency and the complexity of the specific food item(s) prepared. Each time a student prepared a recipe was counted as one trial, regardless of how many steps were completed.

## Definition and Measurement of the Dependent Variable

The number of steps from nine task-analyzed recipes that each student performed correctly without assistance from the experimenter was the primary dependent variable measured in the study. The recipes used in the study represented student preferences, items that normally serve as snack foods or drinks before dinner, and items that could be incorporated into a dinner menu. Prior to the study, the first author, other teachers at the school, and students with visual impairments who were not developmentally disabled prepared all nine recipes following the steps stated by the manufacturer to determine the most functional number and sequence of steps. Recipes used in the study were: (1) microwave french fries, (2) microwave pizza, (3) microwave popcorn, (4) automatic drip coffee, (5) automatic drip tea, (6) instant pudding, (7) instant cheesecake, (8) microwave brownies, and (9) microwave cake. Table I shows the task analysis for microwave cake, one of the two untrained recipes representing complex generality. The experimenter recorded whether or not each recipe step was completed correctly by the student. A step was recorded as correct if it was performed accurately by the student with no verbal or physical prompting from the experimenter. A step performed out of sequence was scored as correct if it produced no negative effects on the recipe's outcome. Partial responses, prompted responses, and/or experimenter-assisted responses were recorded as incorrect responses.

**Table I.** Task Analysis for Microwave Cake

1. Put cake mix box and oil on counter.[2,3]
2. Open cake mix box.[1,3]
3. Take out the plastic square pan.[1,3]
4. Take out the large cake mix bag and the small frosting bag.[3]
5. Get cake mix package (big bag) and gently tear open the bag.[3]
6. Empty the cake mix into the plastic pan.[3]
7. Get the size 1/4 measuring cup from the drawer.[3]
8. Fill the measuring cup with water from the sink.[2,3]
9. Pour the water in the 1/4 measuring cup into the pan with the cake mix.[2,3]
10. Again, fill the 1/4 measuring cup with water from the sink.
11. Pour the water from the measuring cup into the pan with cake mix.[2,3]
12. Fill the size 1/4 measuring cup with oil.[3]
13. Pour the oil from the measuring cup into the pan with the cake mix and water.[2,3]
14. Get an egg from the refrigerator.[3]
15. Crack the egg open and empty it into the pan.
16. Get a spoon from the drawer.[3]
17. Stir the cake mixture about 40 times.[3]
18. Using your spoon, spread the cake mix evenly around the pan.[3]
19. Take the pan of cake mix to the microwave oven and open the microwave oven door.[1]
20. Put cake mix in the middle of the oven.[1]
21. Close the microwave oven door.[1]
22. Push the #6 button (with X) and wait for bell to ring.[1]
23. After bell rings, push button #6 (with X) again and wait for bell to ring.[1]
24. After bell rings, get oven mitt from top of oven and put on your hand.[1]
25. Open microwave oven door, take out cake and put on top of microwave.[1]
26. Close microwave oven door.[1]
27. Take off oven mitt and put back next to microwave.[1]

Superscript numbers indicate the trained recipe(s) that required a topographically similar preparation skill.

[1] Pizza for Lisa and Carl; french fries for Steve.

[2] Coffee for all students.

[3] Cheesecake for all students.

## Interobserver Agreement

A second observer was present during approximately one-half of the sessions across all phases of the study. The second observer independently recorded the number of recipe steps correctly completed on 185 (56%) of the study's 324 trials. An agreement was scored when both observers recorded either an independently completed step or an incorrect response/no response by the student. Agreements and disagreements were determined on a step-by-step basis. Percent agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. Overall interobserver agreement for each student was: Steve, 97.1%; Lisa, 94.6%; and Carl, 95.2%.

## Materials

### *Cassette Tape Recorder with Remote On/Off Switch*

A small battery-operated cassette tape recorder was used to play the tape-recorded recipes (Radio Shack's Realistic Minicassette-20 Compact Cassette Recorder, Cat. No. 14-1055A). The tape recorder was carried in the pocket of the cooking apron worn by the students. Students tuned the tape recorder on and off by pushing down and releasing with the palm a remote switch carried in a second pocket on the cooking apron and connected by wire to the tape recorder (Radio Shack's Realistic Cassette Recorder Remote Foot Switch, Cat. No. 44-610B). The remote switch enabled students to stop the tape after listening to the instructions for a single step in the recipe and to re-start the tape to hear instructions for the next step.

### *Tape-recorded Recipes*

Step-by-step verbal instructions on how to prepare each of the nine recipes used in the study were recorded on individual cassette tapes. Each step of the task-analyzed recipe was followed by a "beep" which signaled the end of that step and cued the student to stop the tape and perform the step (e.g., "Place the popcorn in the middle of the microwave oven." *Beep*). Some of the recipe tapes were recorded with the experimenter's female voice and some tapes were recorded by a male staff member at the school.

### *Cooking Apron*

A smock from the school's vocational classroom was used as a cooking apron. Two pockets were added to the apron to hold the tape recorder and remote switch. In this way the student was able to carry the tape-recorded instructions to any location in the kitchen.

### *Hi-Marks*

A tube of "Hi-Marks" liquid plastic was used to make raised marks on two buttons on the microwave oven. The students used these marks as tactual stimuli (a dot [·] and an "X") to identify which button(s) to depress in the various recipes. Marks were also used to distinguish between the various measuring cups.

## Experimental Design

A multiple baseline across behaviors (recipes) design was used to determine the extent to which each student's preparation of untrained recipes improved as a function of being trained to prepare related recipes by using a self-operated audio prompting system. Three recipes were designated as the trained recipes. Each trained recipe was paired with an untrained recipe requiring similar preparation skills (simple generality). Generality of each student's cooking skills was also assessed by probing his or her ability to prepare two additional untrained recipes requiring a combination of skills learned from two of the trained recipes (complex generality). After instruction was completed for one recipe, generality probes were conducted on all other trained and untrained recipes. After these generality probes were completed, instruction was begun on the next trained recipe. Table II shows the relationship between specific trained recipes and the two classes of untrained recipes used to assess the generalized outcomes of instruction.

## Procedure

### *Baseline Without Tape-Recorded Recipes*

The initial baseline trial for each recipe was conducted to determine how many steps each student could complete without any prompts, feedback, or assistive equipment. The experimenter instructed the student to prepare the recipe by himself/herself the best he/she could. To ensure that

**Table II.** Relationship Between Trained Recipes and Two Classes of Untrained Recipes Used to Assess Generalized Outcomes of Instruction

| Simple generality | Trained recipes | Complex generality |
|---|---|---|
| French fries (11)[a] ← | Pizza (13) [Lisa & Carl] | |
| Pizza (13) ← | French fries (11) [Steve] | Brownies (26) |
| Popcorn (10) [Lisa & Steve] | | → |
| | | Cake (27) |
| Tea (10) ← | Coffee (10) | |
| Pudding (13) ← | Cheesecake (21) | |

Trained recipes — these recipes were taught directly.

Simple generality — preparation of these recipes required the same food preparation skills as trained recipes.

Complex generality — preparation of these recipes required a combination of the food preparation skills learned in two of the three trained recipes.

[a] Numbers in parentheses indicate number of steps in task analysis.

failure to find or select the right box/food item did not preclude a student from demonstrating his or her ability to prepare the recipe, assistance in locating the needed food item was provided if needed. Each trial ended when the student said he/she was finished, completed all the steps in the task analysis, said repeatedly and emphatically he/she did not know what to do, or did not advance to the next step within 5 min of completing the previous step. The experimenter always complimented the student on working hard and provided intermittent social praise for participation (e.g., "Lisa, you are working very hard! I like that.").

### *Baseline With Tape-Recorded Recipes*

The experimenter used verbal instructions and physical guidance to show the student how to operate the cassette player by holding down and releasing the remote switch. Each student learned to independently start and stop the tape recorder in less than 1 min. The experimenter then placed a cassette tape in the tape recorder, and instructed the student to prepare a specified recipe using the tape-recorded instructions for directions. No prompts or feedback were provided during these trials. Students were shown where to locate the food item if needed, told to do the best they could by themselves, and to let the experimenter know when they were finished. A trial ended according to the same criteria used for baseline trials without the tape-recorder.

### *Instruction*

Instruction began with the experimenter explaining the significance and use of the tape-recorded recipes. The students were told the taped recipes specified exactly what to do and where to ind needed food items and utensils. The students were told to turn the tape recorder off by releasing the remote switch each time they heard a "beep." They were then to perform the food preparation step just stated on the tape. After completing the step, the student depressed the remote switch to play to the next step, and so on.

If the student did not begin performing a step correctly after playing the taped instructions, the experimenter initiated a least-to-most prompt hierarchy (Doyle et al., 1988). The prompt sequence began with a verbal prompt (e.g., "Tear open the top of the box."). If the verbal prompt proved ineffective, physical guidance was paired with a verbal prompt. If the student still did not emit the correct response, hand-over-hand manipulation of the step was provided concurrent with verbal prompting. Instruction on a given recipe continued until the student performed all steps correctly for at least two trials over two consecutive sessions.

### *Generality Probes*

Following a student's mastery of each trained recipe, generality probes on all untrained recipes were conducted. The student was given the tape recorder with the pre-recorded recipe instructions and asked to prepare the untrained recipe. The student was told to do the best he/she could; no other prompting or feedback was provided. As before, assistance in locating the unprepared food item was provided if needed.

### *Follow-Up Probes Without Tape Recorder*

Probes were conducted at 4-week (Lisa), 6-week (Steve) and 4-month (Steve and Carl) intervals following instruction. More extended follow-up probes could not be conducted with Lisa because she graduated and moved away. The students were asked to prepare a selected recipe without the use of tape-recorded instructions; no prompts or feedback was provided. Only one follow-up trial without the tape recorder was completed with each recipe. As in all the other conditions assistance was provided in locating the unprepared food items.

### *Follow-Up Probes With Tape Recorder*

If a student did not perform all steps correctly during the follow-up probe without the tape recorder, he/she was given another opportunity to prepare the recipe using the tape-recorded instructions. Procedures were identical to previous generality probes.

## RESULTS

### Trained Recipes

Figures 1-3 show the number of steps correctly completed by each student on each of the trained recipes before, during, and after instruction. During baseline no student successfully prepared any of the three trained recipes. During instruction with the tape-recorded recipes each student demonstrated a steady increase in the number of independently completed food preparation steps.

A total of 12, 35, and 19 instructional trials were required by Lisa, Steve, and Carl, respectively, to learn to prepare all three trained recipes. The high number of trials required for Steve to master the coffee and

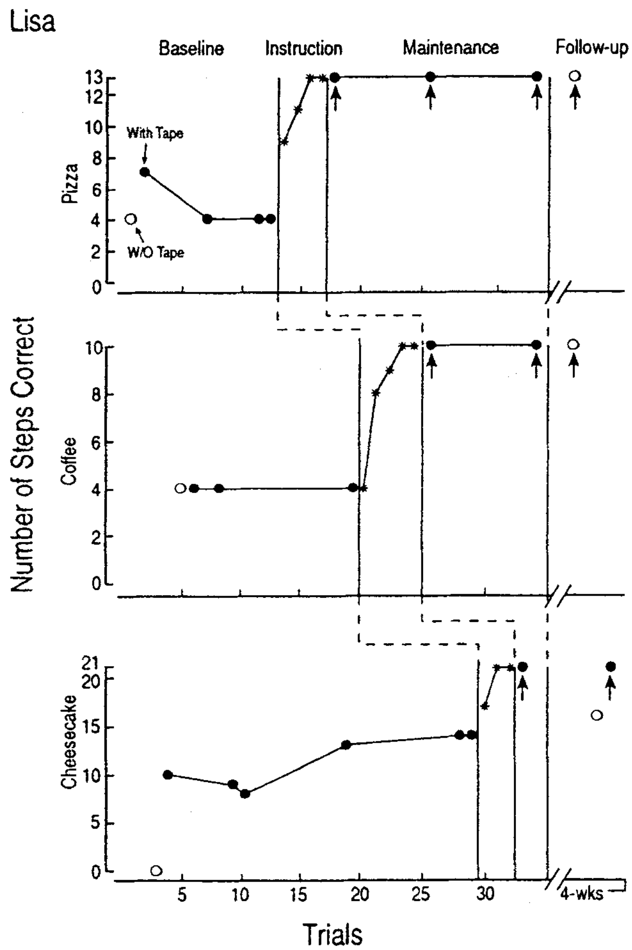


**Fig. 1.** Number of correct recipe steps completed by Lisa during baseline, instruction, maintenance, and follow-up probes for three trained recipes. Arrows indicate trials in which the prepared food was edible.

cheesecake recipes was caused by repeated mishaps when pouring liquids. All three students maintained their ability to prepare the trained recipes with tape-recorded instructions on both the maintenance probes after instruction and on the follow-up probes. No maintenance probe for cheesecake was conducted with Steve due to time constraints, however follow-up probes were conducted.

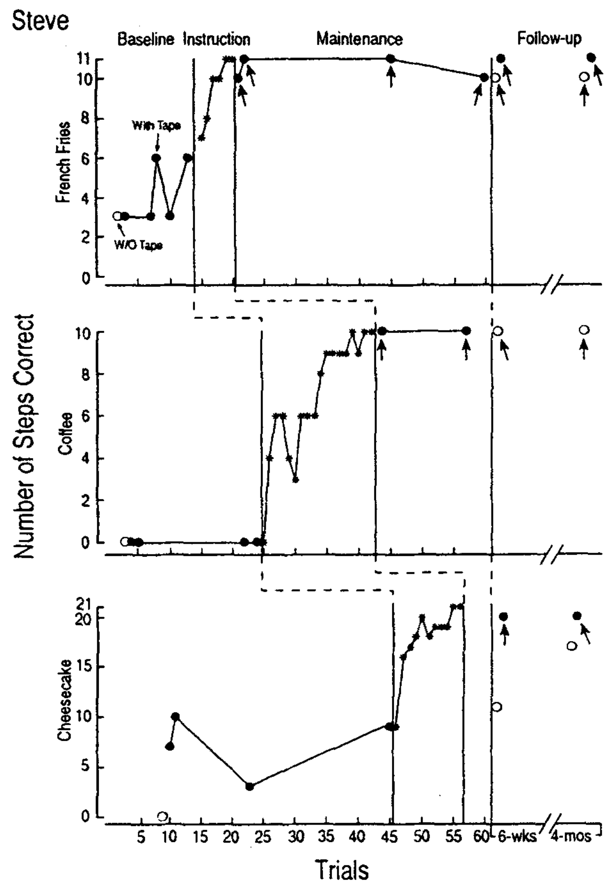


**Fig. 2.** Number of correct recipe steps completed by Steve during baseline, instruction, maintenance, and follow-up probes for three trained recipes. Arrows indicate trials in which the prepared food was edible.

## Untrained Recipes: Simple Generality

Figures 4-6 show each student's performance on the simple untrained recipes, each of which required preparation skills similar in topography and sequence to a corresponding trained recipe. None of the simple untrained recipes were prepared successfully by any of the students during baseline. Each student's preparation of each of the simple generality recipes improved immediately following instruction on the related trained recipe. Lisa successfully prepared four different simple

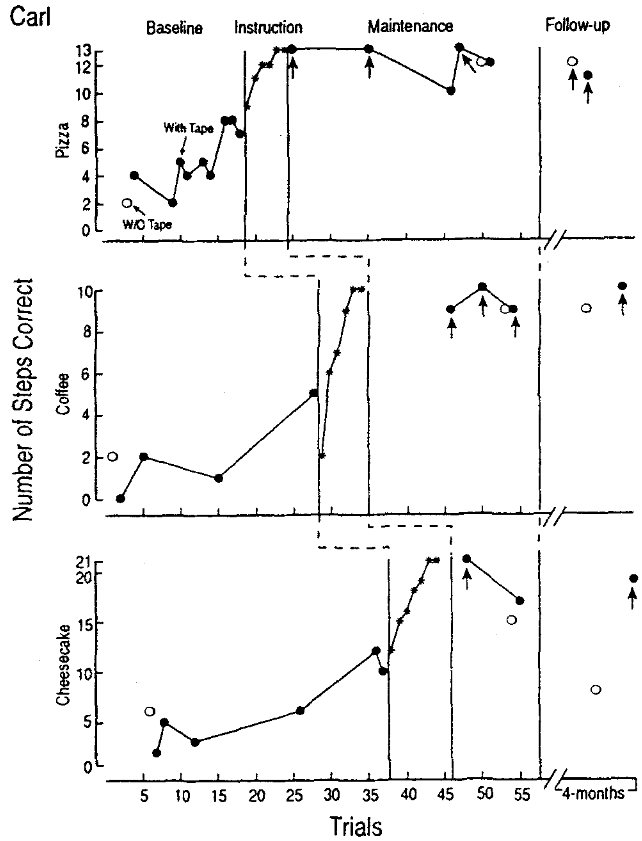


Fig. 3. Number of correct recipe steps completed by Carl during baseline, instruction, maintenance, and follow-up probes for three trained recipes. Arrows indicate trials in which the prepared food was edible.

generality recipes on all 10 trials following instruction on the corresponding trained recipes. On the 4-week follow-up probes Lisa correctly completed all of the preparation steps for french fries and pudding, and she successfully prepared popcorn and tea without the tape-recorded recipes. Following instruction on the trained recipes Steve was successful in preparing an edible product on 9 of 11 trials over four different simple untrained recipes. On his first two trials with pizza, Steve did not place the pizza in the microwave oven with the topping side up, resulting in an inedible pizza on each trial. Steve maintained his ability to prepare the simple untrained recipes at 6-week, and 4-

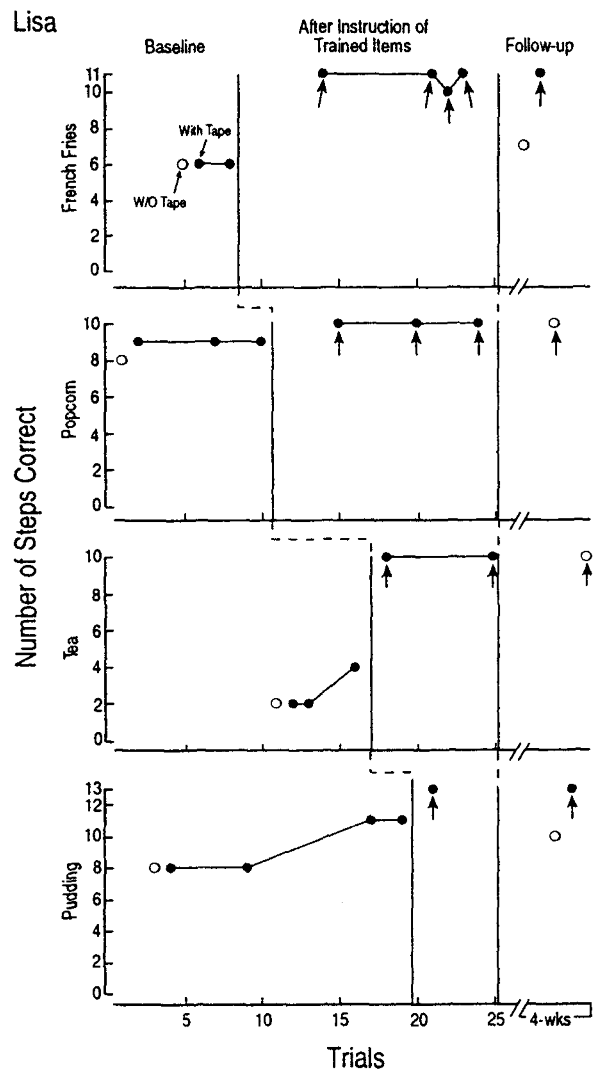


Fig. 4. Number of correct food preparation steps completed by Lisa during baseline, after instruction on trained items, and during follow-up for four untrained recipes representing simple generalized outcomes. Arrows indicate trials in which the prepared food was edible.

month follow-up probes with two exceptions. On the 6-week probe for pizza he again put the pizza in the microwave wrong-side-up, and on the

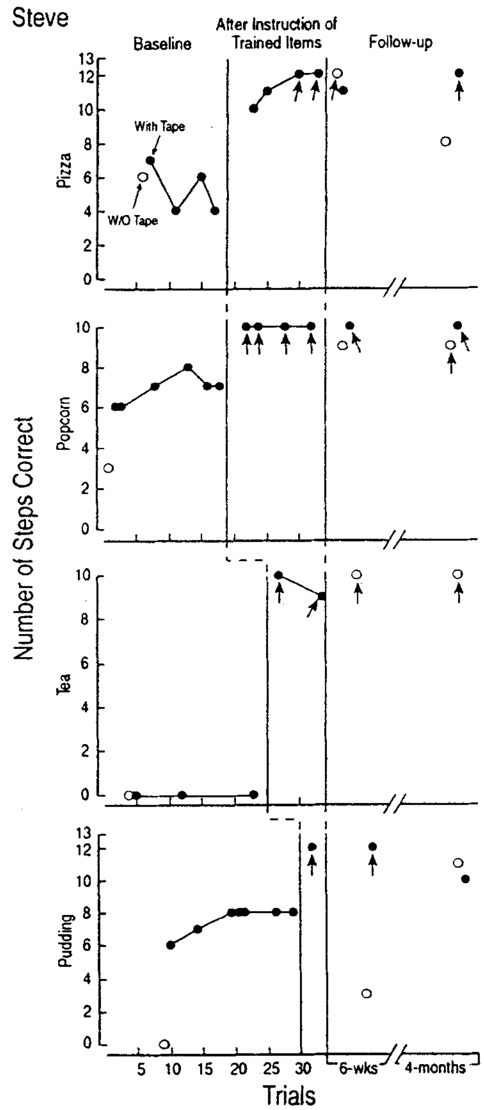


**Fig. 5.** Number of correct food preparation steps completed by Steve during baseline, after instruction on trained items, and during follow-up for four untrained recipes representing simple generalized outcomes. Arrows indicate trials in which the prepared food was edible.

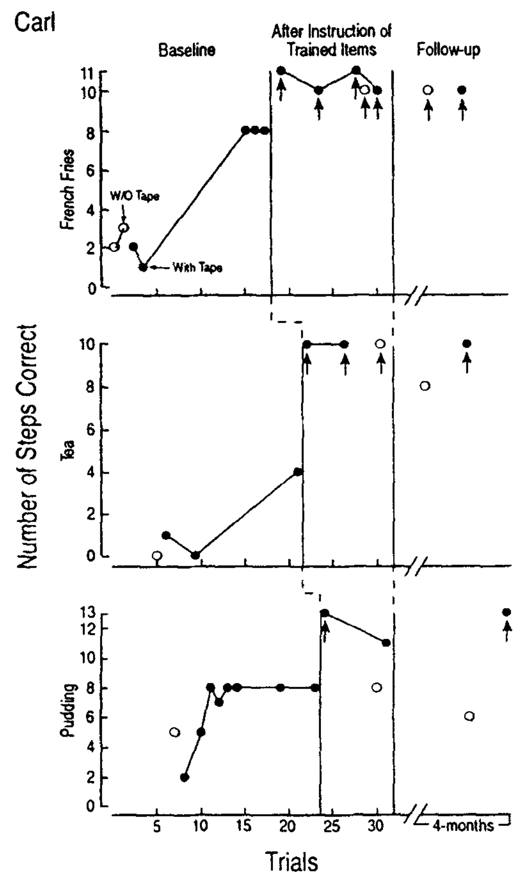


**Fig. 6.** Number of correct food preparation steps completed by Carl during baseline, after instruction on trained items, and during follow-up for three untrained recipes representing simple generalized outcomes. Arrows indicate trials in which the prepared food was edible.

4-month probe for pudding he discontinued using the tape-recorded instructions after the third step. Carl prepared an edible item on 7 of 8 probes of simple generality recipes following instruction on corresponding trained recipes. His lone failure was the result of not pouring all the milk into the pudding mix. On the 4-month follow-up probes, Carl successfully prepared all three simple untrained recipes when using the tape-recorder.

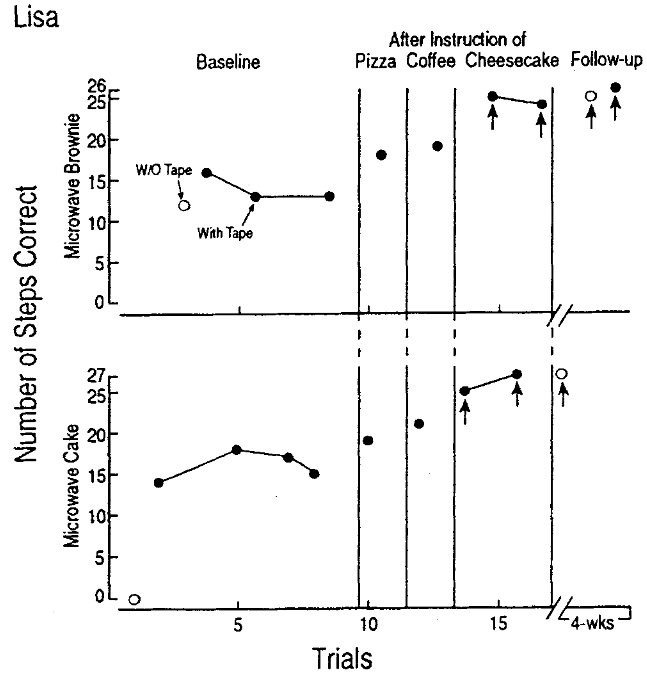


Fig. 7. Number of correct food preparation steps completed by Lisa during baseline, after instruction on trained items, and during follow-up for two untrained recipes representing complex generalized outcomes. Arrows indicate trials in which the prepared food was edible.

## Untrained Recipes: Complex Generality

Figures 7-9 show each student's performance on two recipes requiring a combination of skills learned from two of the trained recipes (french fries/pizza and cheesecake). No student was able to prepare either of the complex generality recipes until he or she had learned to prepare cheesecake, the second trained recipe which provided the remaining prerequisite skills for the two complex generality recipes. Both Lisa and Steve prepared both complex generality recipes on all post instruction and follow-up trials after they had mastered cheesecake. Lisa was able to prepare microwave cake without using the tape recorder. Carl successfully prepared the complex generality recipes on 3 of 5 trials after instruction on cheesecake. Although he completed 22 and 23 of the 26 required steps for brownies, his continued difficulty with pouring resulted in inedible food on 2 of the 3 attempts with the brownie recipe.

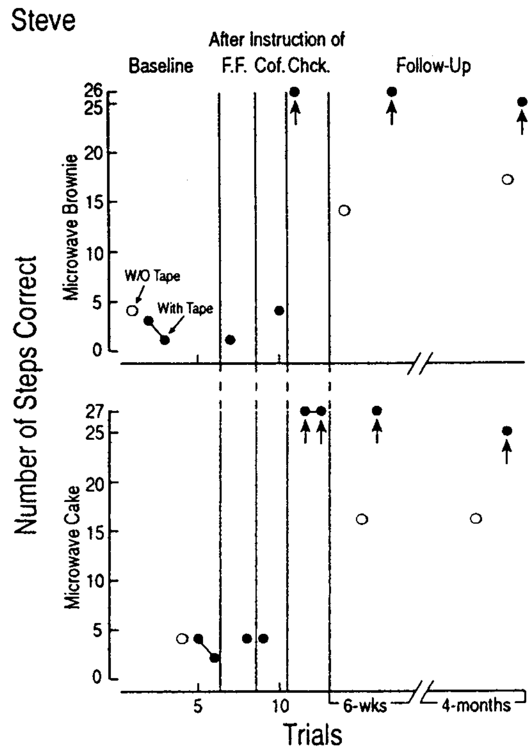


**Fig. 8.** Number of correct food preparation steps completed by Steve during baseline, after instruction on trained items, and during follow-up for two untrained recipes representing complex generalized outcomes. Arrows indicate trials in which the prepared food was edible.

### Preparation of Edible Food

A primary measure of social validity for cooking skills instruction is whether or not the food prepared can be eaten. Large increases in the number of correctly completed task-analyzed steps are insufficient if just one critical step is omitted or performed incorrectly. Table III shows the number and percentage of trials with the tape-recorded recipes in which each student prepared edible food during three phases of the study. During 120 baseline trials, the students never prepared any edible food. Following instruction the three students prepared edible food on 86% of the trials with trained recipes, 90% of the trials with simple generality recipes, and

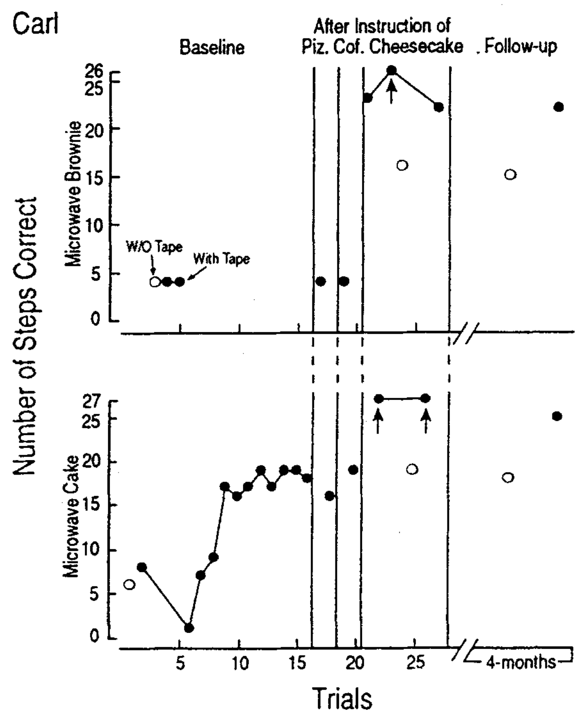


**Fig. 9.** Number of correct food preparation steps completed by Cal during baseline, after instruction on trained items, and during follow-up for two untrained recipes representing complex generalized outcomes. Arrows indicate trials in which the prepared food was edible.

83% of the trials with complex generality recipes. On follow-up trials conducted from 4 weeks to 4 months after instruction, the students prepared edible food on 100% of the trained-item trials, 82% of the simple generality trials, and 71% of the complex generality trials.

## DISCUSSION

The results of this study extend earlier research showing that students with developmental disabilities can learn to use a self-operated audio prompting system to promote the generalization and maintenance of functional skills (Alberto et al., 1986; Briggs et al., 1990). After being taught to prepare recipes with the use of tape-recorded instructions, all three students

**Table III.** Number and Percentage of Trials with Tape Recorder in which Edible Food Was Prepared During Three Phases of the Study

| | Trained recipes | | | Simple generality recipes | | | Complex generality | | |
|---|---|---|---|---|---|---|---|---|---|
| Students | B'lne | After inst. | F.U. | B'lne | After inst. | F.U. | B'lne | After inst. | F.U. |
| Lisa[a] | 0/13 | 6/6 | 1/1 | 0/12 | 10/10 | 2/2 | 0/7 | 4/4 | 1/1 |
| | (0%) | (100%) | (100%) | (0%) | (100%) | (100%) | (0%) | (100%) | (100%) |
| Steve[b] | 0/13 | 6/6 | 2/2 | 0/20 | 9/11 | 4/6 | 0/4 | 3/3 | 4/4 |
| | (0%) | (100%) | (100%) | (0%) | (82%) | (67%) | (0%) | (100%) | (100%) |
| Carl[c] | 0/19 | 7/10 | 3/3 | 0/18 | 7/8 | 3/3 | 0/14 | 3/5 | 0/2 |
| | (0%) | (70%) | (100%) | (0%) | (88%) | (100%) | (0%) | (60%) | (0%) |
| Group totals | 0/45 | 19/22 | 6/6 | 0/50 | 26/29 | 9/11 | 0/25 | 10/12 | 5/7 |
| Group mean % | (0%) | (86%) | (100%) | (0%) | (90%) | (82%) | (0%) | (83%) | (71%) |

[a] Lisa's follow-up probes were conducted at 4-weeks following instruction.
[b] Steve's follow-up probes were conducted 6-weeks and 4-months following instruction.
[c] Carl's follow-up probes were conducted at 4-months following instruction.

were able to prepare additional recipes without further training. The students' effective use of audio prompts suggests an alternative strategy to picture prompts for teaching cooking skills to students with developmental disabilities and/or visual impairments.

While some of the data paths for the recipes show ascending trends during baseline, careful examination of the figures shows that where a student's performance improved in baseline, either (a) the improvement ended prior to instruction (see Lisa's cheesecake in Figure 1, Steve's and Carl's pudding in Figures 5 and 6, and Carl's pizza and cake in Figures 3 and 9), or (b) a sharp increase in the data path coincided with implementation of training (see Cal's coffee and cheesecake Figure 3). Given that the students consistently omitted or incorrectly performed critical steps (e.g., pouring, mixing) during baseline, it was unlikely they would have successfully completed a recipe without direct instruction. In fact, the students never prepared an edible item in any of 120 baseline trials across all three classes of recipes used in the study.

The instructional effects of the system of graduated response prompts used in this study are fairly well documented and understood (e.g., Wolery, Ault, & Doyle, 1992). Moreover, demonstrating a functional relation between instruction and acquisition of the trained recipes was not central to the study's major purposes: to extend the use of a promising assistive device for persons with disabilities and to analyze the extent of generality to two classes of untrained recipes as a function of learning to prepare specific trained recipes. The students' successful preparation of untrained recipes with the aid of the audio prompting system is the study's most important outcome.

Four strategies for promoting generalized behavior changes most often advocated in the behavioral teaching literature (Horner, Dunlap, & Koegel, 1988; Stokes & Baer, 1977; Stokes and Osnes, 1986), were evident in this study. First, the target behavior chosen for instruction is one that meets a reliable and generally effective natural contingency of reinforcement, if performed with sufficient accuracy and fluency. Throughout the study the students ate the food they prepared. Another potentially powerful source of reinforcement was the social praise and attention provided on numerous occasions when the students took the food they had prepared home to share with roommates or friends. For example, Steve's girlfriend often joined him after a session to share the food he had prepared.

Programming common stimuli is a second strategy for promoting generalized outcomes used in the study. Programming common stimuli refers to efforts to make the teaching setting as similar to the generality setting(s) as possible. Programming common stimuli is most often accomplished by incorporating stimuli in the instructional environment that are likely to be present in the generality environment(s) such as the types of materials used, the presence or absence of people, the physical characteristics of the environment, etc. (Anderson-Inman, Walker, & Purcell, 1984; Horner, Eberhard, & Sheehan, 1986; van den Pol et al., 1981). All instruction used common cooking utensils and took place in two real kitchens complete with sinks, counters, workspace with drawers, overhead cabinets, dinette table and chairs, a refrigerator, etc. This method of programming common stimuli might be described as a general and passive means of promoting generalized outcomes.

A more specific and proactive method of programming common stimuli is to contrive a common stimulus. Baer (1981) suggests that a contrived common stimulus must be both functional and portable. In the present study the tape-recorded recipes were made functional for the students during instruction. Use of the tape-recorded recipes enabled the students to prepare food without the assistance of another person. The small size and portability of the "Walkman-type" cassette player makes it transportable anywhere. Upon graduation, students were able to take the tape-recorded recipes for use in their apartments or home.

Third, a general case strategy was used to select specific teaching examples (Horner & McDonald, 1986; Horner, Williams, & Stevely, 1987; Sprague & Horner, 1984). The recipes selected for instruction were chosen because they incorporated stimuli (food products, cooking utensils/equipment) and responses (opening boxes, stirring, pouring) that sampled the range of stimuli and response requirements in the generality setting (i.e., the untrained recipes). The results of this study contribute to the literature on general case instruction by demonstrating that the complex recipes were successfully completed by students who were taught the component skills within simpler recipes, even though no instruction on the complex recipe was provided.

A fourth strategy for promoting generalization used in the present study was described by Stokes and Baer (1977) as train loosely, the random variation of non-critical features of the teaching setting to reduce the probability that a non-essential stimulus only present during training (e.g., teacher's tone of voice) acquires unwanted control over the student's behavior. Although there are few experimental analyses of the effects of loose teaching (e.g., Campbell & Stremel-Campbell, 1982; Schroeder & Baer, 1972), it is conceptually consistent with the principles of stimulus control. Efforts to incorporate loose teaching in the present study included using a male voice on some recipe tapes and a female voice on other tapes, conducting training sessions in two different kitchens, conducting sessions on weekdays and weekends and at different times of the day, having other teachers/staff walking through the kitchen and talking to the experimenter and students, the presence of the second observer for approximately half of the sessions, and on a few occasions a student's friend sitting in the kitchen during part of the session. Since none of the students had any functional vision, varying purely visual features of the teaching environment was not relevant.

A self-operated audio prompting system such as the one used in the present study and those by others (Alberto et al., 1986; Biggs et al., 1990; Davis et al., 1992), offers numerous advantages from the complementary perspectives of programming for generalized behavior change as an intervention and normalization as a desired outcome and requisite characteristic of socially-valid practice. From an instructional viewpoint audio prompts can be tailored to the individual skills and curriculum needs of each student. Tape-recorded instructions can be as precise or as general as demanded by the known or probable tasks and environments to be faced by the learner. Vocabulary can be modified, the pacing of instructions speeded up or slowed down, and instructions for particularly difficult steps repeated or given in more detail. A self-management feature (another strategy for promoting generalized behavior change), in which the student self-records or self-evaluates his performance of each step before activating the tape for the next step, could easily be added (Briggs et al., 1990). The student might use his own voice to record special prompts or reminders relevant to certain steps of the task (e.g., "Have I checked for spills?"). Verbal praise and encouragement from teachers, parents, friends, or the student himself could also be included in the tape-recorded instructions.

Individuals with disabilities are currently using a variety of prosthetic devices to increase their independence in domestic, community, and employment settings (Disabled can use technology to win jobs, 1992). However, some assistive devices may not be used in the natural setting by the learner — even though they are made functional during training and are clearly transportable. A student in a crowded restaurant, for example, may be hesitant to remove a laminated ordering card from her pocket or purse because it marks her as different. By contrast, the tremendous popularity of personal stereos is likely to mean the wearer of audio headphones goes unnoticed. The use of an audio prompting system allows the person with disabilities to listen to a series of self-delivered prompts in a private, unobtrusive, and normalized manner that does not impose upon or bother others. The self-operated feature of the system places the student in a position of control over his environment, thereby increasing the probability of independent functioning.

Although all three students successfully prepared one or more of the trained or simple generality recipes without using the tape-recorded instructions during the maintenance or follow-up probes, and Lisa prepared both complex generality recipes without the tape recorder during 4-week follow-up probes, preparation of the recipes without the audio prompts was not the objective of the study. As noted by Briggs et al. (1990) accurate performance of complex skills or chains, especially those that occur infrequently in the natural environment, is typically maintained through the use of a readily available set of prompts or instructions. For example, we look up the telephone number of an infrequently called relative, we read instructions for operating a seldom used power tool or appliance, and we use a recipe to guide the preparation of a special holiday dish made just once a year. On 19 of the 35 follow-up trials without the tape recorder the three students did not prepare edible food. The students were then asked to prepare the failed recipe again, this time using the tape-recorded audio prompts. Students' performance was better on 18 of these 19 trials; and edible food was prepared 16 times. These data are evidence that the tape-recorded recipes could be used by the students to effectively remediate declining performance.

The positive results found in this and two previous investigations of self-operated audio prompts (Alberto et al., 1986; Briggs et al., 1990) warrant additional research with this promising technology. Future research might: (a) determine the age and skill-levels of learners for whom self-operated audio prompts are most effective; (b) extend the use of audio-prompts across a variety of curriculum domains including social skills, academic tasks, and vocational tasks; (c) analyze the effects of variables such as the content, pacing, and inclusion of praise statements within the tape-recorded instructions; (d) analyze the effects of a systematic feedback and/or self-evaluation procedure following completion of each step or portion of a task; and (e) explore the extent of generalization that occurs to untrained simpler tasks as a function of students first using tape-recorded instructions with complex tasks. In the context of the present study, this last research suggestion would entail instructing students how to make microwave brownies or cake and probing for generalization on cheesecake, pudding, pizza, french fries, popcorn, tea, and coffee. Finally, an analysis of student errors within and across the task-analyzed recipes would contribute in both pragmatic and theoretical ways to this line of inquiry. Practically, an analysis of the frequency and types of errors committed by a student would help teachers individualize the audio prompts for maximum effectiveness. An error analysis would contribute to the theoretical understanding of generalized outcomes by identifying specific occurrences of generalization from one class of cooking responses to another.

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