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EFFECTS OF PICTURE PROMPTS ON THE ACQUISITION OF COMPLEX VOCATIONAL TASKS BY MENTALLY RETARDED ADOLESCENTS

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The effects of using picture prompts on the acquisition, generalization, and maintenance of complex vocational tasks were evaluated within a multiple baseline design across subjects and tasks. Five moderately and severely mentally retarded adolescents were first trained to use picture prompts to guide their performance on one or more complex tasks. Following training, posttesting with and without the picture prompts was conducted to evaluate the effects of training and to determine maintenance effects over a 2- to 4-week interval. Generalization of performance across tasks was assessed with three of the students who were provided novel tasks (with and without picture prompts) without training. Results indicated that picture prompts can be successfully used to promote both acquisition and generalization of performance, and that subsequent training time on a novel task was reduced when the use of picture prompts had been previously trained.

DESCRIPTORS: picture prompts, moderately and severely retarded adolescents, vocational performance, generalization

The use of picture prompts appears promising in modifying the performance of moderately and severely mentally retarded persons on complex daily living and vocational tasks (Johnson & Cuvo, 1981; Martin, Rusch, James, Decker, & Trtol, 1982; Sowers, Rusch, Connis, & Cummings, 1980; Spellman, DeBriere, Jarboe, Campbell, & Harris, 1978; Thinesen & Bryan, 1981). Picture prompts are used to facilitate the acquisition of performance by first showing the client a picture of each step of the task to be performed and then training the client to use the pictures to guide his or her performance on the task. The client is taught, through some combination of preinstruction, feedback, correction, and repeated practice, to imitate the performance depicted in the picture, turn to the next picture and imitate that performance and so forth until the task is completed.

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Connis (1979) and Sowers et al. (1980) used picture prompts to train mentally retarded clients to become more independent in vocational settings. Connis used picture sequences to train moderately mentally retarded clients to change work tasks independently. The clients were first taught to use photographs to sequence the completion of various work tasks, and then to change tasks independently throughout the workday. Similarly, Sowers et al. (1980) used picture prompts to train three moderately mentally retarded adults to go to and from work break and lunch independently. The clients were taught to respond to picture cues of clock faces that prompted the clients to leave and return from lunch and work breaks.

Johnson and Cuvo (1981), Thinesen and Bryan (1981), and Martin et al. (1982) used picture prompts to train mildly and moderately mentally retarded clients to become more independent in daily living skills. Johnson and Cuvo trained four clients to cook single food items independently, and Thinesen and Bryan taught three adults to initiate previously acquired grooming skills independently.

Martin et al. used a component analysis to isolate the effects of sequenced picture prompts in teaching three mildly to moderately retarded adults to prepare complex meals independently. During baseline, the clients were provided with preinstruction and instructional feedback to complete the meals. Although two of the three clients improved their performance during baseline, none were able to complete the meals independently. Following baseline, sequenced picture prompts were added to the training package and resulted in immediate improvement for all clients. In addition, a reversal to baseline conditions for one client further demonstrated that the picture prompts were controlling behavior. This investigation also demonstrated that picture prompts can be effectively used with relatively complex tasks (the meals required that the clients complete between 48 and 76 separate steps).

In each of the above investigations, the clients became more independent by using pictures to establish self-directed stimulus control (Martin et al., 1982). Rather than relying on supervisors to guide their performance, the clients used the pictures to guide their own behavior. A potential advantage, then, of training clients to use picture prompts is that the need for staff supervision is reduced when the clients learn to use picture cues to guide their own behavior (Martin et al., 1982, Thinesen & Bryan, 1981). In addition, picture prompts may promote maintenance of previously acquired behavior if the clients use pictures as a reference source (Spellman et al., 1978).

The present investigation was conducted to extend and replicate previous findings with picture prompts in four ways. First, are picture prompts as effective with moderately to severely mentally retarded clients as has been demonstrated for mildly to moderately retarded clients? Spellman et al. (1978) have reported, for example, that several of the clients trained to use picture prompts as part of the Model Education for Severely Handicapped (MESH) project either required extensive training time, or never acquired the necessary skills, to use picture cues. Second, are picture prompts effective and economical in training complex vocational tasks? For example, does the use of picture prompts eliminate the need for sequentially organizing parts? Third, do picture prompts promote generalization? Once clients learn to use picture prompts effectively to guide their performance on one task, do they require fewer training trials (or no additional training) on other tasks that also use picture prompts? Fourth, do clients maintain their performance across time when initially trained with picture prompts, and do picture prompts function as permanent prompts, or can they be removed following training? Thinesen and Bryan (1981) reported that the clients in their investigation stopped paging through their picture books following training. However, because the picture prompts were never removed, we do not know if the picture books continued to prompt performance. The present investigation, in addition to evaluating the effects of picture prompts on the acquisition of vocational behavior, also evaluated the effects of picture prompts on the generalization and maintenance of performance.

METHOD

Subjects

Participants were five moderately and severely retarded high school students. As part of their high school program, the students spent approximately half of their day in a work activity program located within the school. The students were selected because they were unable to complete the target tasks during baseline. None of the students had been trained to use picture prompts prior to the present investigation.

Bev was 18 years old with a measured IQ of 30 (all IQ assessments were conducted with the Stanford-Binet within 2 years of the investigation). Bev was essentially nonverbal and functioned in the severe range of mental retardation based on measures of her adaptive behavior

(Adaptive Behavior Scale; Nihara, Foster, Shellhaas, & Leland, 1974). She demonstrated no behavior problems and was very compliant to oral instructions.

Tom was 19 years old with a measured IQ of 36. Tom functioned within the moderate to severe range of mental retardation based on measures of his adaptive behavior and demonstrated very poor speech skills. Tom was also very compliant and demonstrated no behavior problems.

Jill was 19 years old with a measured IQ of 34. Jill's speech was clearer than the other students and she also functioned generally within the moderate to severe range of mental retardation based on measures of her adaptive behavior.

Joan was 19 years old with a measured IQ of 38. Joan was essentially nonverbal but had generally good oral receptive skills. Joan functioned in the moderate to severe range of mental retardation based on measures of her adaptive behavior and demonstrated infrequent, mild behavior problems in the form of crying and refusing to complete assigned tasks.

Fred functioned in the severe range of mental retardation, with a measured IQ of 31. Fred was 18 years old and had severely limited speech. He emitted frequent but mild behavior problems and needed almost constant supervision to remain on task.

All the students responded to oral instructions and all had several years of experience working on a part-time basis in sheltered or community vocational settings. Of these students, only Tom and Jill had been successful in these placements. The remaining students were not successful in these placements either because of poor social behavior (Joan and Fred) or because of poor work behavior (Bev and Fred). The students lived either with their parents or in community group homes, and were very familiar with the setting, type of tasks, and experimenters involved in the investigation. Bev, Jill, and Joan participated during all conditions of the investigation. Tom and Fred were trained on only one task (black valve). Tom had previously been trained on the other tasks and Fred was unavailable for training on the other tasks.

Tasks and Materials

Target tasks. Four target tasks were used in the investigation, two training tasks (a black valve assembly and a circuit board assembly) and two generalization tasks (a double red valve assembly and a packaging task). The black valve and circuit board were taken from the *Vocational Information and Evaluation Work Samples* (1977). Task analyses and part descriptions of the tasks are presented in Tables 1, 2, 3, and 4.

The black valve required 18 steps for completion and consisted of eight separate pieces (see Table 1). This task was difficult for the students for two reasons. First, during step 5, the students needed to learn to screw the female union into the valve body with a reversed (right to left) rotation (which is a common procedure in many plumbing fixtures). Previous experience with other materials, which usually require a left to right rotation, may result in negative transfer for many students on this step. Second, during steps 16, 17, and 18, the students needed to hold the prong onto the base of the wheel, place the wheel and prong onto the valve stem, and then place a screw into the wheel to hold the pieces together. Previous experience with this task indicated that the students generally experienced much difficulty with these steps.

All the parts for the black valve were placed in a single container in a random fashion and one sample of a completed valve was located next to the container. Pieces for multiple assemblies were available for all tasks.

The circuit board consisted of 30 steps and 15 different pieces. Pieces were separated into six containers (pieces were divided by shape, color, and size). Each container was marked with a different colored strip of paper. The color of the marker did not necessarily match the color or pattern of the pieces in the container (several pieces were the same color and pattern but differed in size; see Table 2).

Table 1
Task Analysis and Part Descriptions for the Black Valve Assembly

Step	*Behavioral Description*	*Part Description*
1	Pick up *female union**	3 cm in diameter
2	Pick up *male union*	2 cm in diameter
3	Silde male union into female union	
4	Pick up *valve body*	5.5 cm (length) × 5 cm (width) × 2.5 cm (diameter)
5	Screw female union into valve body	
6	Pick up *valve stem*	5.7 cm (length) × 1.2 cm (diameter)
7	Slide stem into opposite opening	
8	Pick up *bonnet*	1.6 cm (length) × 1.8 cm (diameter)
9	Slide bonnet over stem	
10	Screw bonnet into valve body	
11	Set unit down	
12	Pick up *wheel*	5 cm (length) with .5 cm hole
13	Pick up *prong*	3 cm (length) × 2.2 cm (width)
14	Place prong into base of wheel	
15	Invert wheel	
16	Place wheel on stem	
17	Pick up *screw*	.3 cm (length)
18	Twist screw into top of wheel	

*The part in italics corresponds to the part description.

In front of the containers, a stand (15 cm × 12 cm) was placed with an unassembled circuit board (grid) placed on the stand. Black line drawings on the grid (drawn to scale) indicated the correct placement of the pieces. A sample of a completed circuit board was placed next to the stand.

The double red valve assembly consisted of 43 steps and 22 pieces. The task required the assembling of two identical valves, joined together by a toggle bolt and held onto the toggle bolt with various washers and nuts (see Table 3). All pieces were placed in a single container with a completed sample assembly located next to the container.

The packaging task consisted of 41 steps and 20 pieces. The task required the assembly of two sets of washers on different kinds of bolts and the placement of the assemblies into plastic jars making them ready for shipping. All pieces were placed into a single container with a completed assembly located next to the container.

Picture prompts. The picture prompts consisted of pictures (13 cm × 18 cm) bound into separate books for each task. Pictures indicated the part to be selected by the client and, for both valve assembly tasks, how the parts fitted together.

For the black valve, the picture book consisted of 15 black-and-white 35-mm pictures (pages), increasing the number of steps in the task analysis to 30 when the picture book was used (turning to each page sequentially was considered a separate step). The first picture depicted the first piece the student was to select, and subsequent pages depicted either each new piece to be selected or how the new piece was to be assembled onto the previous pieces.

The picture book for the circuit board consisted of 15 pages. On each page, a black-and-white line drawing of an unassembled circuit board was depicted. The correct piece was shaded in with the color that corresponded to the colored strips attached to the containers. In addition, lines extending from the holes where the wires were to be inserted were drawn in to prompt the students to insert the wires correctly. When using the picture books, the circuit board consisted of 60 steps.

The picture book for the double red valve assembly was similar to the book used for the black valve; 35-mm black-and-white pictures depicting

Table 2

Task Analysis and Part Descriptions for the Circuit Board Assembly

Step	*Behavioral Description*	*Part Description*
1	Pick up *medium banded resistor* (MBR)*	1.5 cm (length) × .5 cm (diameter); brown with orange, gold, red, black, and light brown stripes, with 1.5 cm wires on both ends (pieces contained in green container)
2	Align wires on MBR with correct holes in *circuit board* and insert MBR wires into holes	14.5 cm (length) × 11.3 cm (width) with .2 cm holes; tan with black outlines drawing of pieces
3	Pick up second MBR	
4	Align and insert second MBR into board	
5	Pick up third MBR	
6	Align and insert into board	
7	Pick up fourth MBR	
8	Align and insert into board	
9	Pick up *orange resistor* (OR)	1.7 cm (length) × .7 cm (diameter) with wires on both ends (pieces kept in orange container)
10	Align and insert into board	
11	Pick up second OR	
12	Align and insert into board	
13	Pick up third OR	
14	Align and insert into board	
15	Pick up small *cylindrical capacitor* (SC)	1.5 cm (length) × .6 cm (diameter) with wires on both ends; gray in color (pieces kept in red container)
16	Align and insert into board	
17	Pick up second SC	
18	Align and insert into board	
19	Pick up *small banded resistor* (SBR)	1 cm (length) × .5 cm (diameter); same color as MBR (pieces kept in yellow container)
20	Align and insert into board	
21	Pick up second SBR	
22	Align and insert into board	
23	Pick up third SBR	
24	Align and insert into board	
25	Pick up fourth SBR	
26	Align and insert into board	
27	Pick up *large banded resistor* (LBR)	1.8 cm (length) × .8 cm (diameter); same color as MBR (pieces kept in blue container)
28	Align and insert into board	
29	Pick up *medium cylindrical capacitor* (MC)*	2 cm (length) × 1.3 cm (diameter); same color as SC (pieces kept in purple container)
30	Align and insert into board	

*The part in italics corresponds to the part description.

the selection of the correct piece and the assembly of the pieces were used. The picture book consisted of 43 pages, resulting in a total of 86 separate steps.

For the packaging task, the picture book consisted of both colored horizontal lines (7 cm in length) and black-and-white pictures. The colored lines corresponded to the color of the washers to be placed on a bolt. The black-and-white pictures depicted the remaining pieces (e.g., jars and lids) used in the task. No pictures depicting how to assemble the pieces were included. The picture book consisted of 26 pages, resulting in a total of 66 steps.

Table 3

Task Analysis and Part Descriptions for Double Valve Assembly

Step	*Behavioral Description*	*Part Description*
1	Pick up a *toggle bolt**	15.5 cm (length) × .4 cm (diameter) with black line 5 cm from left end
2	Pick up a *small washer*	1.5 cm (diameter) × .7 cm (diameter) hole
3	Slide small washer onto bolt	
4	Pick up a *large washer*	2.5 cm (diameter) × 1.1 cm (diameter) hole
5	Slide large washer onto bolt	
6	Pick up a *valve body*	4.2 cm (length) × 4 cm (width) × 2.5 cm (diameter)
7	Slide valve body onto bolt	
8	Pick up second large washer	
9	Slide washer onto bolt	
10	Pick up second small washer	
11	Slide small washer onto bolt	
12	Pick up a *toggle nut*	4.8 cm (length) × 1.8 cm (width)
13	Twist the toggle nut onto the bolt to the small washer	
14	Pick up a *valve stem piece*	7 cm (length) × 2.5 cm (diameter)
15	Screw the valve stem piece into the body	
16	Pick up second toggle nut	
17	Twist the toggle nut onto the bolt to the black line	
18	Pick up third small washer	
19	Slide small washer onto bolt	
20	Pick up third large washer	
21	Slide large washer onto bolt	
22	Pick up second valve body	
23	Slide valve body onto bolt	
24	Pick up fourth large washer	
25	Slide large washer onto bolt	
26	Pick up fourth small washer	
27	Slide small washer onto bolt	
28	Pick up a *square nut*	1.3 (diameter)
29	Twist nut onto bolt	
30	Pick up second stem piece	
31	Twist the stem piece into the valve body	
32	Pick up a *bonnet*	1.7 cm (diameter)
33	Screw the bonnet onto the stem piece of the first valve	
34	Pick up a *handle**	5 cm (diameter)
35	Set the handle on the stem piece of the first valve	
36	Pick up *round nut*	1 cm (diameter)
37	Screw the nut onto the stem piece of the first valve	
38	Pick up second bonnet	
39	Screw the bonnet onto the stem of the second valve	
40	Pick up second handle	
41	Set the handle onto the stem piece	
42	Pick up second round nut	
43	Screw the nut onto the stem	

*The part in italics corresponds to the part description.

These tasks were selected because they were the most complex assembly tasks available in the work activity center. All tasks were used routinely by the staff to teach the students various types of assembly operations. Most frequently, the pieces for the tasks were placed in a sequential order and into separate containers for the students, resulting in considerable staff time being devoted to setting up tasks. In addition, the double valve assembly and packaging task

Table 4

Task Analysis and Part Descriptions for Packaging Task

Step	*Behavioral Description*	*Part Description*
1	Pick up a *plastic bolt**	2.8 cm (length) × .9 cm (diameter) with .1 cm hole in top
2	Pick up a *black washer*	3.9 cm (diameter) × 1 cm (diameter) hole (same dimensions for all washers)
3	Set the black washer on the plastic bolt	
4	Pick up a red washer	
5	Set the red washer on the plastic bolt	
6	Pick up a green washer	
7	Set the green washer on the plastic bolt	
8	Pick up second black washer	
9	Set the black washer on the plastic bolt	
10	Pick up second red washer	
11	Set the red washer on the plastic bolt	
12	Pick up second green washer	
13	Set the green washer on the plastic bolt	
14	Pick up a metal washer	
15	Put the metal washer on the plastic bolt	
16	Pick up a *cotter pin*	4 cm (length)
17	Put the pin through the hole in the plastic bolt	
18	Put the plastic assembly down	
19	Pick up a *metal bolt*	4.3 cm (length) × .7 cm (diameter)
20	Pick up a third red washer	
21	Set the red washer on the metal bolt	
22	Pick up a white washer	
23	Set the white washer on the metal bolt	
24	Pick up a blue washer	
25	Set the blue washer on the metal bolt	
26	Pick up fourth red washer	
27	Set the red washer on the metal bolt	
28	Pick up second white washer	
29	Set the white washer on the metal bolt	
30	Pick up second blue washer	
31	Set the blue washer on the metal bolt	
32	Pick up second metal washer	
33	Set the metal washer on the metal bolt	
34	Pick up *nut*	1.2 cm (diameter) with .7 cm hole
35	Screw the nut onto the metal bolt	
36	Pick up *clear plastic jar*	8.3 cm (length) × 5 cm (diameter)
37	Place metal assembly into the plastic jar	
38	Pick up the plastic assembly	
39	Place the plastic assembly into the plastic jar	
40	Pick up *lid*	5.5 cm in diameter
41	Screw lid onto the plastic jar	

*The part in italics corresponds to the part description.

were usually conducted as part of a group assembly because these tasks were considered too complex for a single student to perform. The picture prompts were used to determine if the need for sequentially organizing the parts by staff could be eliminated, and to determine if picture prompts permitted each student to perform the entire task independently.

The four tasks comprised two pairs of tasks. Two of the tasks (black valve and double red valve assembly) involved similar operations (Walls, Sienicki, & Crist, 1981) and similar picture prompts. The picture prompts for the remaining two tasks involved color coding. Tasks in each pair were assigned either as a training (black valve and circuit board) or as a generalization (double red valve and packaging) task prior to the investigation. The training tasks and generalization tasks were the same across students. However, the order in which the students received the two training tasks and the two generalization tasks was counterbalanced across students.

Design

A multiple baseline design (across both subjects and tasks) was used. For the training tasks (black valve and circuit board), baseline was followed by training during which the students were taught to use the picture books to guide their performance. Following training, two, and if needed, three, posttest conditions were administered. During the first posttest (posttest 1), the students performed the tasks under baseline conditions (no reinforcement or correction), but with the picture books. During posttest 2, the picture books were removed. If accuracy of performance decreased during posttest 2, a return to posttest 1 was conducted. For the black valve task, a maintenance condition also followed the last posttest. Maintenance was the same as posttest 2 but occurred after a 2- to 4-week delay during which the students did not work on the black valve.

For the generalization tasks, training was not conducted immediately following baseline. Instead, the students received the posttest conditions, which were begun following the completion of training on both training tasks. In addition, training on the packaging task was conducted if performance during the posttest conditions was not at 100% accuracy.

This design was selected because it permitted analysis of: (a) the effectiveness of picture prompts on the acquisition of complex tasks (posttest 1 for the training tasks), (b) generalization across tasks (posttest 1 for the generalization tasks), (c) whether picture prompts function as permanent prompts (posttest 2 for all tasks), (d) maintenance effects (for the black valve), and (e) whether the use of picture prompts, once learned, reduces subsequent training time.

The black valve was selected for maintenance testing because it was the only task for which all five students received training. The packaging task was selected for training following generalization testing because two of three students performed more poorly on this task than on the double red valve task during the posttraining conditions.

Reliability

All data were collected by the two experimenters. During reliability probes, the experimenters recorded observations simultaneously and independently (the experimenters stood on opposite sides of the student to prevent the experimenters from observing each others' responses). An agreement occurred when the two experimenters recorded that the same step in the task analysis was performed either correctly or incorrectly by the student; a disagreement occurred when a step was not scored the same by both experimenters. Nonoccurrences were not scored. Reliability probes were taken at least 6 times for each task, and 35 times (12.6% of sessions) across all conditions. Reliability (interrater agreement) was calculated by taking the number of independent agreements divided by the number of agreements plus disagreements. Mean reliability was 99.5% for all tasks (circuit board, mean = 99.1%; double red valve,

mean = 99.2%; black valve, mean = 99.6%; and packaging task, mean = 99.8%). Within any given task, reliability ranged from a low of 93.3% to a high of 100%. Using the same procedures, reliability was also computed for the number of objects correctly assembled. No disagreements occurred.

Procedure

Baseline. During baseline on all tasks, the students were shown a sample object and told to assemble the remaining pieces to look like the sample. Students were told to assemble as many objects as possible. Each session continued for 15 minutes, during which no correction or contingent feedback was provided. Students were provided with noncontingent praise at the end of each session and intermittently within each session to keep the students on task. Data were collected on the number of steps correctly completed and the number of objects correctly assembled. Students did not have to complete the steps in the order specified in the task analysis to receive credit for correctly assembling an object.

A maximum of two sessions was conducted daily, two or three times per week. Length of baseline was varied across students for both training tasks and for both generalization tasks to achieve a multiple baseline across subjects and tasks. Length of baseline ranged from 3 to 9 sessions on the training tasks, and from 7 to 13 sessions on the generalization tasks.

Training. A three-step training sequence was used for both training tasks. During training step 1, the students were taught to turn the pages in the book in a sequential fashion. Each session consisted of the student turning each page in order, reaching the end of the book, and starting again at the beginning of the book. The students were required to go through the page-turning sequence twice to teach them to continue using the picture prompts to assemble more objects after completing their first assembly.

A demonstration of correct performance was provided prior to each training session during which the experimenter modeled turning the pages of the picture book. Verbal correction was provided following errors, and contingent praise was provided intermittently. Training step 1 continued until the student turned all the pages correctly on two consecutive sessions.

During training step 2, the students selected the piece depicted by the pictures. The picture books contained only pictures of each new piece of the task (not how the pieces were to be assembled) and the students were to turn each page, select the appropriate item, place it on the table, and then turn to the next page. Contingent praise and verbal correction (e.g., "That is the wrong piece. Look at the picture and get the piece that looks like the picture.") were provided and one demonstration preceded each session. To proceed to step 3, the student needed to select the correct piece with 90% accuracy on two consecutive sessions.

During step 3, all pages were again included in the book. The student turned each page, selected the appropriate item, and assembled the objects as shown. All other factors were the same as step 2. For the packaging task, training (if needed) was begun on training step 3. All sessions lasted 15 minutes.

Posttest 1 (Post 1). Posttest 1 was the same as training step 3, except it was conducted under baseline conditions (no demonstration, contingent correction, or contingent praise). The students were provided with a sample object, a container with the unassembled pieces, and the picture book, and told to assemble the pieces.

For the training tasks, posttest 1 was conducted the first session following training. For the generalization tasks, posttest 1 was conducted following the completion of training on both training tasks. If needed, posttest 1 was also readministered on all tasks following posttest 2 if decreases in accuracy were observed. Posttest 1 continued until two or three consistent sessions were recorded.

Posttest 2 (Post 2) and maintenance. Posttest 2 and maintenance were exactly the same as

baseline; the students were provided with a sample and a container of unassembled pieces, and were to assemble as many objects as possible during 15-minute ssesions. Maintenance testing on the black valve was begun 2 to 4 weeks following the completion of posttest 2.

RESULTS

The percentage of steps correctly completed by the students on the black valve is presented in Figure 1. All five students participated in all conditions of the black valve. During baseline, minimal if any improvement occurred across sessions. Only one student (Tom) accurately completed more than 50% of the steps, and none of the students correctly assembled a valve during any session. The number of valves attempted by the students within each session ranged from 1 to 12 (mean = 2.4).

No errors were made on training step 1 for the black valve, and only Fred required more than two sessions to reach the training criterion on step 2. Fred needed four sessions, but correctly selected at least 87% of the pieces during each session.

The results of training step 3 are presented in Figure 1. All students demonstrated immediate improvement with the picture prompts at accuracy levels higher than observed anytime during baseline, and all students continued to turn the pages independently. The number of sessions required to reach criterion during step 3 ranged from 4 (Tom) to 11 (Fred).

During posttest 1 and posttest 2, all students continued to perform errorlessly, correctly assembling a mean of 3.53 and 4.0 valves per session, respectively. Three of five students continued to perform errorlessly during maintenance, with only Fred not completing at least 98% of the steps correctly across sessions.

The results of the three students who participated on the remaining tasks are presented in Figures 2, 3, and 4.

All three students performed very similarly. During the second training task (circuit board), the three students made no errors on training steps 1 and 2, and required a maximum of nine sessions on training step 3 (mean = 6). All three students also turned the pages independently during training step 3. Bev and Jill continued to perform errorlessly during posttests 1 and 2, and Joan performed errorlessly during four of five sessions. These results, combined with those obtained from the black valve, indicate that the picture prompts can be removed following training without decreasing accuracy of performance. In addition, the students correctly completed a mean of 3.0 circuit boards per session during posttest 1, compared to no circuit boards being completed successfully during baseline.

Different results were obtained with the generalization tasks. All students improved their accuracy of performance substantially above baseline levels when picture prompts were included (posttest 1), but only Joan increased her performance to 100% accuracy. All students generalized their use of the picture books; each student turned the pages correctly and independently during both generalization tasks. During posttest 2, all three students displayed substantial decreases in performance, with Bev returning to baseline levels. A return to posttest 1 (picture prompts) again increased performance on both generalization tasks, with Joan again performing errorlessly.

Training step 3 was conducted for Bev and Jill on the packaging task. Both students required only three training trials, after which both performed errorlessly. The students again correctly completed a mean of 3.0 packages per session during posttest 1 (following training). However, for the double red valve assembly (on which no training was provided), only 1.0 valve was completed correctly during posttesting.

DISCUSSION

The results can be summarized as follows. Training with the picture prompts was effective

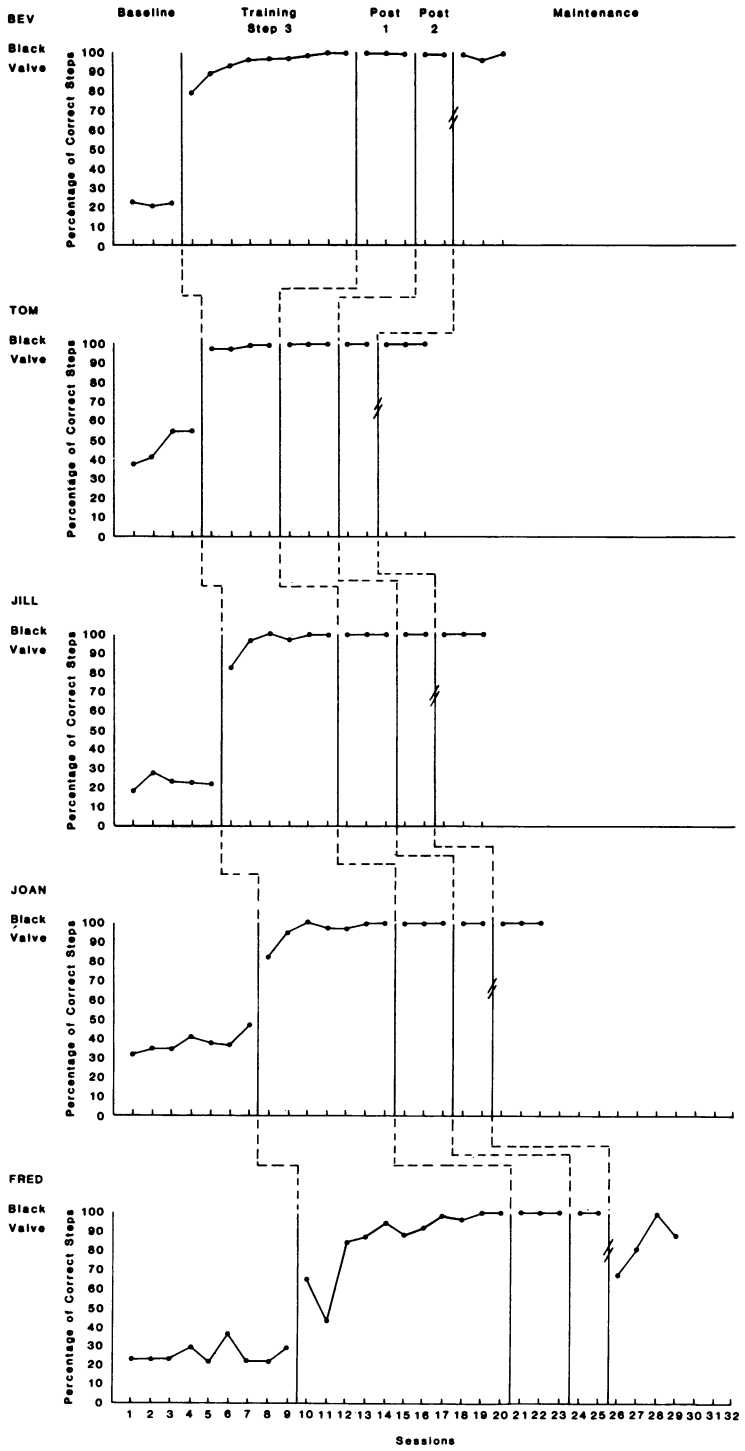

Fig. 1. Percentage of steps completed correctly on the black valve.

in teaching all students to assemble complex objects. Following training, all students were able to continue to perform errorlessly with and without picture prompts, and four of five stu-

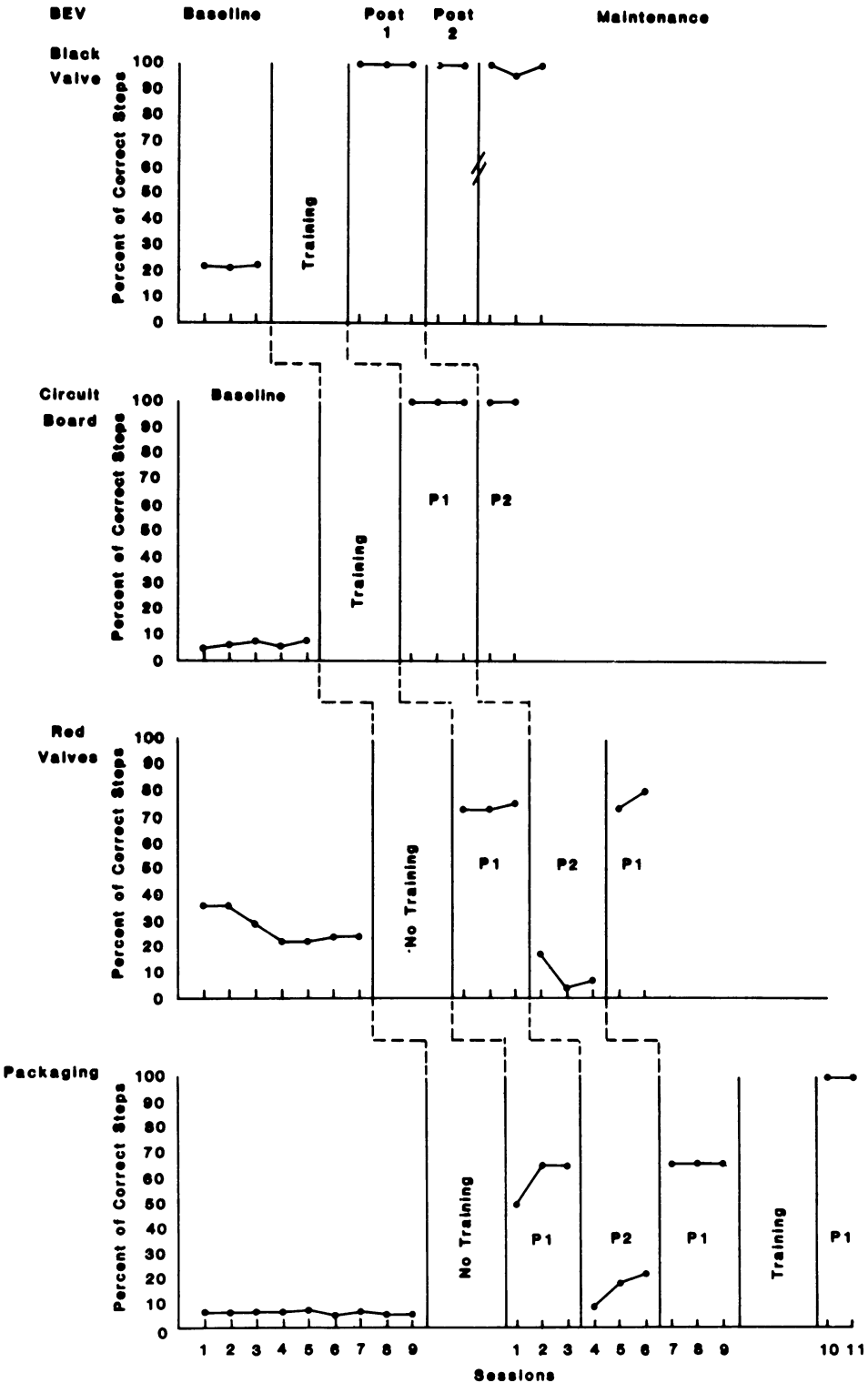

Fig. 2. Percentage of steps completed correctly by Bev on all tasks.

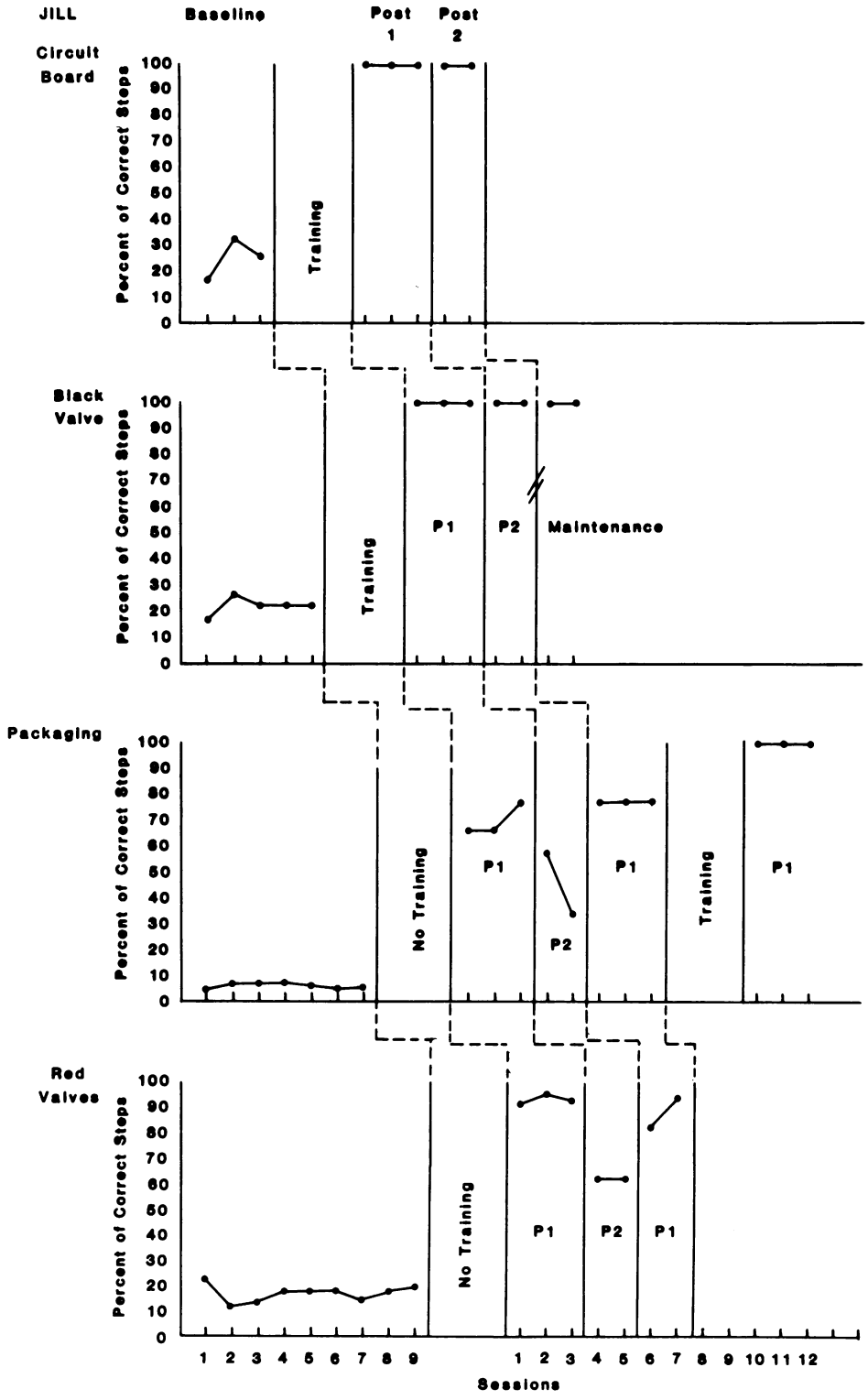

Fig. 3. Percentage of steps completed correctly by Jill on all tasks.

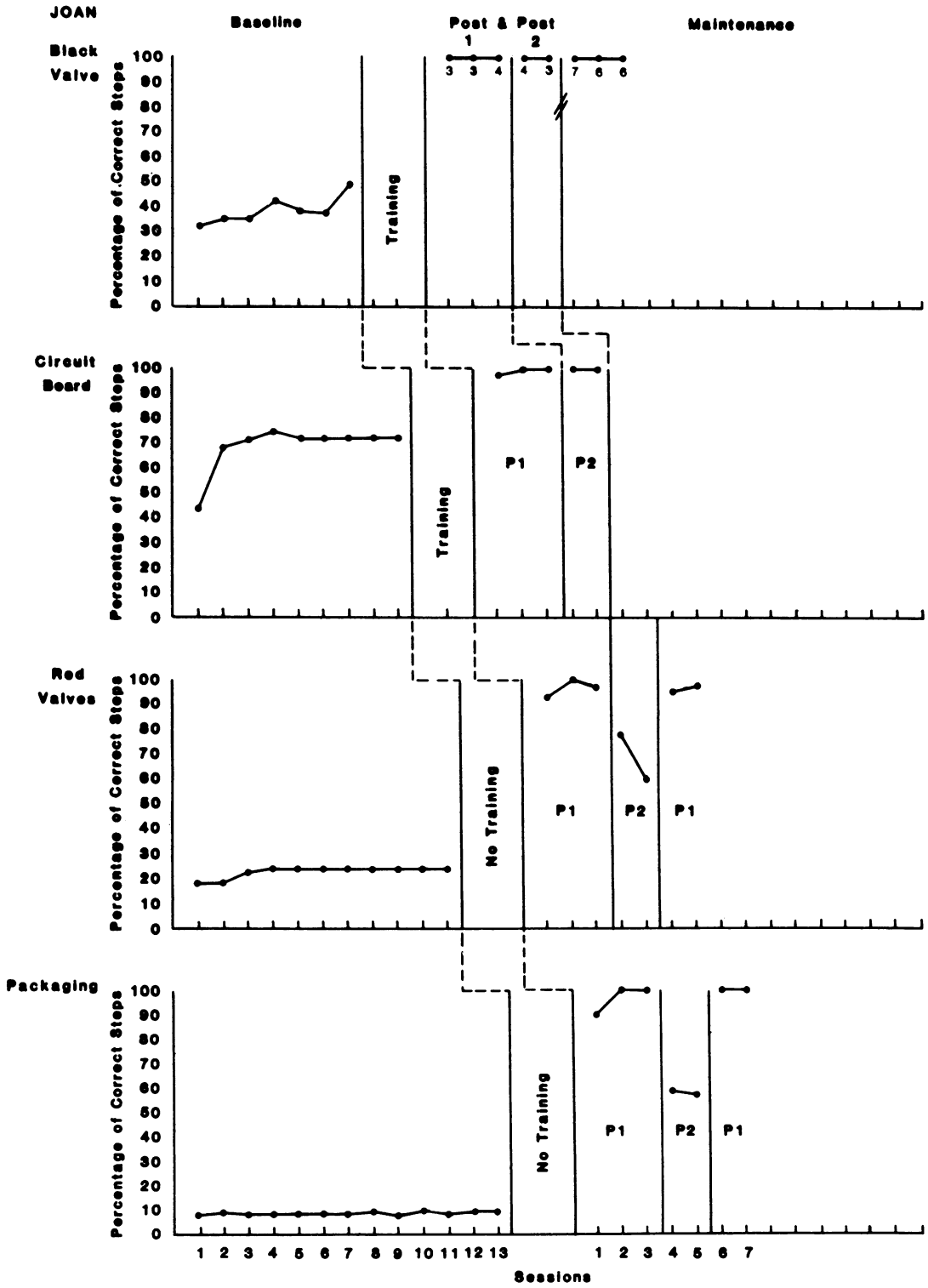

Fig. 4. Percentage of steps completed correctly by Joan on all tasks.

dents maintained their performance on the black valve with 100% accuracy over a 2- to 4-week interval.

Results of training generalized for all three students, improving the performance of one student to 100% accuracy on both generalization tasks. All three students also demonstrated substantial decreases in performance when the picture prompts were removed on the generalization tasks, but increased their accuracy of performance when picture prompts were again available. Finally, very brief training was needed to promote errorless performance on the packaging task when the picture prompts were available to guide performance.

The results indicate that picture prompts can be effective in promoting both the acquisition and generalization of complex vocational performance with moderately and severely retarded adolescents. Of particular interest was the finding that the picture prompts could be removed without fading following training, but not during generalization. This result suggests that picture prompts may or may not function as permanent prompts, depending on whether picture prompts are included as part of a training package. However, once students were trained initially to use picture prompts to guide their performance, fewer training trials were needed to promote errorless performance on the packaging task. This result suggests that once students learn to use picture prompts effectively, fewer training trials may be required on subsequent tasks that also use picture prompts.

These results replicate and extend those reported by previous investigators (e.g., Connis, 1979; Johnson & Cuvo, 1981; Martin et al., 1982; Sowers et al., 1980; Spellman et al., 1978; Thinesen & Bryan, 1981) in indicating that picture prompts can be effective in training complex vocational and daily living tasks. Martin et al. conducted a component analysis which isolated the effects attributable to picture prompts on a cooking task. These authors concluded that the antecedent picture prompts were the major controlling variable in establishing independent meal preparation skills with mildly to moderately mentally retarded clients. In the present investigation, the generalization tasks provided similar data, indicating that the picture prompts, separated from the other components of the training package, effected substantial changes in the performance of all three students who were moderately to severely mentally retarded.

The present findings, and those of previous investigators, indicate that picture prompts can effectively guide performance on complex tasks that are performed in a sequential fashion. The ability of moderately and severely retarded persons in performing complex vocational tasks has been documented repeatedly in the literature (e.g., Cuvo, Leaf, & Borakove, 1978; Gold, 1972; Irvin & Bellamy, 1977). However, in addition to being effective in the acquisition phase of training, the efficacy of instructional procedures must also be evaluated with respect to subsequent or concurrent generalization and maintenance of performance. Mentally retarded persons frequently do not generalize or maintain their performance (Stokes & Baer, 1977) and although many training procedures are effective, few are efficient in terms of the amount of training or supervisory time required of staff (Bellamy, Inman, & Yeates, 1978; Horner, Lahren, Schwartz, O'Neill, & Hunter, 1979). The use of picture prompts may prove to be satisfactory for both these requirements. Picture prompts may serve to maintain performance in the absence of other training stimuli, and to promote generalization of performance on novel tasks. In at least some cases, it appears that picture prompts might also be used as permanent prompts to continue to guide performance after other training stimuli have been removed.

Further analysis of the relative effectiveness of using picture prompts is needed. To be considered effective, training with picture prompts should be evaluated with respect to at least four criteria: (a) extensive training is not required to teach students to use pictures to guide their behavior, (b) once students learn to use picture prompts, the amount of training on other tasks

is reduced when pictures are available, (c) picture prompts promote generalization or maintenance of performance or both, and (d) supervision of students is reduced when picture prompts are available.

The students in the present investigation learned to use picture prompts relatively quickly; extensive training was not needed to teach them to turn the pages in the picture books sequentially (training step 1) or to match the pictures with the appropriate objects (training step 2). Spellman et al. (1978), however, reported that some of their students required etxensive training to learn picture-object matching, and that a few students never acquired the necessary skills to use picture cues effectively. Two aspects of the present study may account for why the students learned to use the picture prompts relatively quickly. First, the students were provided with a sample of the finished product for all tasks. Although the sample apparently had a minimal effect on the students' performance during baseline, it is possible the sample facilitated performance during training. Second, the pictures used depicted only one step of the task analysis (a recommendation previously made by Spellman et al.) and the pictures contained no potentially distracting stimuli (e.g., people or materials in the background).

The training data on the packaging task, generalization data, and maintenance data provide additional support that picture prompts can be effective, at least with the types of materials and tasks used in the present study. Future investigators may wish to determine the extent to which students independently use picture cues across diverse tasks and in the absence of other controlling stimuli. For example, when students are taught to use picture cues in a vocational setting, will they independently (without training) use picture prompts to facilitate their performance across different types of tasks (e.g., daily living tasks)? Also, will students independently use picture cues as a reference source after long intervals during which they have "forgotten" how to complete a task?

Martin et al. (1982) suggested that picture cues promote self-control by establishing antecedent stimuli (pictures) which the clients can independently manipulate to guide their performance. In other words, these authors suggested that picture prompts may establish a look-then-do sequence, which permits the clients to have greater control over their environments, and reduces the need for major changes of other environmental stimuli. The self-control established with picture prompts should facilitate generalization and maintenance of performance because they provide stable discriminative stimuli which the clients can use to guide their performance across diverse settings, tasks, and time. In addition, the use of picture prompts are potentially efficient because: (a) they are easily transported to novel tasks and settings, (b) they are more easily modified than many other environmental stimuli, and (c) they appear to reduce training time. The applicability of external cues such as picture prompts, which are controlled by the client and which can serve as unobtrusive and inexpensive permanent prompts, appears promising and deserves further analysis in the literature.

Since the completion of the study, the work training instructor has developed new picture books to aid students working in part-time jobs. Students working at community janitorial jobs were required to empty trash cans in various rooms on different floors or to clean several rooms in a different building. The students were able to perform each separate step of their job when prompted but frequently "forgot" the locations of the various tasks. The instructor reported that the use of picture books was successful in prompting the students to complete each area of the job sites. In addition, one student was able to remain on a job site for the remainder of the school year without staff supervision. These results provide additional support for the ecological validity of using picture prompts; i.e., picture prompts appear to be a pragmatic intervention strategy that is effective in promoting the acquisition, generalization, and maintenance of performance.

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