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DISCRIMINATION TRAINING FOR PERSONS WITH DEVELOPMENTAL DISABILITIES: A COMPARISON OF THE TASK DEMONSTRATION MODEL AND THE STANDARD PROMPTING HIERARCHY

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A comparison was made between two procedures for teaching persons with severe handicaps: (a) the task demonstration model, which is based upon a fading procedure and general case programming, and (b) the standard prompting hierarchy, a least-to-most intrusive prompting procedure commonly used to teach these individuals. Five phases were used in comparing the procedures: pretesting, training, two generalization tests, and a 6-month maintenance test. Eight students learned two discrimination tasks by each procedure, with each task involving two- or three-digit numbers. Results showed that under the task demonstration model all 8 subjects had more unprompted correct responses (about 1.5 times as many) in training, all 8 subjects had fewer errors (about 0.6 times as many) in training, all 8 subjects had more correct responding in the generalization test with untrained stimuli in the training room, 6 of 8 subjects had more correct responding with untrained stimuli in another room, a 7th had equivalent amounts, and 7 of 8 subjects had more correct responding on a 6-month maintenance test. Thus, the task demonstration model proved superior to the standard prompting hierarchy in 29 of 32 tests of correct responding. Results are discussed in terms of implications for stimulus control training strategies.

DESCRIPTORS: mentally retarded students, fading, prompting hierarchy, task demonstration model, discrimination learning

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During the past 10 years, several curriculum programs have been developed to teach basic life skills to learners with severe mental retardation (e.g., Brown et al., 1979; Falvey, 1986; Sailor & Guess, 1983; Wehman, Renzaglia, & Bates, 1985). These programs have allowed teachers to organize and implement instruction so that individuals with severe handicaps have the opportunity to acquire functional skills for community living. Although these are good curricula, educators and parents have been disappointed because these skills have not been maintained or generalized across stimuli and settings (Liberty, 1985; Voeltz & Evans, 1983).

An analysis of functional skills shows that most skills require correct discriminations among complex stimulus arrays; thus, the individual has to attend to multiple cues. Researchers have shown that persons with autism and mental retardation are often selective in their attention; that is, they often attend only to single components of a multiple-component stimulus (Koegel & Wilhelm, 1973; Lovaas, Koegel, & Schreibman, 1980; Lovaas, Schreibman, Koegel, & Rehm, 1971). Therefore, individuals with severe mental handicaps who do not respond to all the relevant components of a stimulus may make errors during training and generalization of functional skills.

An instructional procedure characterized by an extrastimulus prompt to guide the individual to the right choice is the least-to-most intrusive prompting hierarchy (Snell, 1987; Sternberg, 1988; Wolery, Bailey, & Sugai, 1988). It is commonly used to train persons with mental handicaps and is referred to as the standard (Mosk & Bucher, 1984) or traditional (Schreibman, Charlop, & Koegel, 1982; Steege, Wacker, & McMahon, 1987) teaching method. Although utilization data on this strategy are not available, its popularity is illustrated by an informal survey of 50 teachers of students with severe or moderate retardation. When asked how they would teach a simple discrimination, each

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teacher described some variation of a least-to-most intrusive prompting hierarchy. This instructional procedure is attractive to teachers because it is easy to implement and can be used across a variety of tasks.

Although some researchers have reported the success of extrastimulus prompts (e.g., Brown, Bellamy, Perlmutter, Sackowitz, & Sontag, 1972; Cuvo, Leaf, & Borakove, 1978; Gold, 1972, 1976; Koop, Martin, Yu, & Suthons, 1980), others have reported their ineffectiveness (Koegel & Rincover, 1976; Schreibman, 1975; Schreibman et al., 1982). The failure of extrastimulus prompts as a teaching strategy may be related to the selective stimulus control (Allen & Fuqua, 1985) exhibited by individuals with severe handicaps. The introduction of a single extraneous cue that is familiar to the student (i.e., a frequently used prompt) may overshadow the student's attention to the training stimulus (Mackintosh, 1977). As a result, functional control may never be transferred from the extraneous cue or prompt to the training stimulus (Schreibman, 1975; Schreibman et al., 1982; Sidman & Stoddard, 1966, 1967).

An alternative to an extrastimulus prompting system is a stimulus fading procedure in which the training stimuli are systematically changed so that the individual can respond correctly without the introduction of extraneous cues (Terrace, 1963a, 1963b). The manipulation of the training stimuli focuses the individual's attention on the essential stimulus components necessary for the final discrimination. Successful teaching procedures based on this type of stimulus manipulation have been described by Schreibman (1975), Rincover (1978), Mosk and Bucher (1984), and Allen and Fuqua (1985). However, they have not been widely adopted for classroom use. One reason may be that some of these procedures can be tedious and time-consuming to implement and, as a result, may not be the most parsimonious method for classroom instruction (Etzel & LeBlanc, 1979).

An alternative fading procedure, based on within-stimulus manipulations, has been developed and used in many teaching situations. Labeled the task demonstration model or TDM (Deitz, Rose, & Repp, 1986), it is based on a fading procedure (Terrace, 1963a, 1963b; Sidman & Stoddard, 1966, 1967) in which the S+ and S− are simultaneously presented while the S− becomes more like the S+ over trials. In addition to the fading procedure, irrelevant dimensions of S+ and S− are presented so that the discrimination is made only according to the relevant features of the S+. Based on general case programming (Horner, Bellamy, & Colvin, 1984; Horner, McDonnell, & Bellamy, 1986), this procedure presents multiple examples of S+ to ensure attention to the range of relevant dimensions that characterizes the positive stimuli. Because the irrelevant dimensions of S+ are varied across trials and are often found in both S+ and S−, the learner cannot misinterpret them as the relevant dimensions. General case programming has been used successfully to teach persons with severe retardation how to use a soap dispenser (Pancsofar & Bates, 1985), purchase groceries (McDonnell, Horner, & Williams, 1984), and cross streets (Horner, Jones, & Williams, 1985).

Although we have been using TDM to teach persons with severe handicaps in classrooms and community settings, we have made no formal test of its efficiency. The purpose of this paper, then, is to compare the task demonstration model with the standard prompting hierarchy (SPH), a procedure that is widely implemented by teachers across a variety of conditions.

Critical features of the TDM include multiple examples of S+ and S−, a sampling of the irrelevant dimensions, and a fading of the S− to be more like the S+ across trials. The critical features of the SPH include a constant S+ and S−, an extrastimulus prompting hierarchy progressing from least-to-most intrusive, modeling, and physical guidance. The test was made with 8 subjects, each of whom learned two number discriminations under the TDM and two under the SPH.

METHOD

Subjects and Setting

Two females and 6 males with moderate or severe retardation served as subjects in this experiment. They ranged in age from 16.2 to 21.0 years, and their I.Q. scores (Stanford-Binet or WAIS) ranged from 30 to 44. All were being educated in a self-contained school for individuals with developmental disabilities. Each student had sufficient attending and compliance skills to remain seated at a table for 20 min and to follow directions to look at and touch the training stimuli. None of the students possessed significant visual, hearing, or motor impairments.

Experimental Design and General Procedures

An alternating treatments design (Barlow & Hayes, 1979; Barlow & Hersen, 1984) was used to evaluate the effectiveness of the two teaching procedures. Training conditions were counterbalanced across subjects and tasks, with at least 1 day between treatment sessions. Tasks were randomly assigned to the two teaching procedures across the five conditions (pretesting, training, two generalization tests, and a 6-month maintenance test). Pretesting, training, and the first generalization test were conducted in the school's observation room. The second generalization and the maintenance tests were conducted in the students' classrooms. During all phases, the trainer and subject sat facing each other separated by a desk, while an observer recorded data. For 20% of the trials, a second observer recorded data for reliability purposes.

Stimulus Materials

Training Stimuli: TDM

There were two sets of training stimuli for each two- or three-digit number, one representing the S+ stimuli and one representing the S−. The S+ was always presented in its criterion format (shape and orientation), although there were multiple examples of the S+ that differed with respect to dimensions irrelevant to the discrimination, including size, script, color, texture, background, and location of S+ on the table used for training. In the TDM, each number appeared in various combinations of 7 colors (black, white, gold, blue, red, orange, pencil), 15 sizes ($\frac{3}{16}$ in. to $\frac{3}{8}$ in.), 5 scripts (handwritten, labels, newspaper, rub-on, printed stick-on), 3 textures (smooth, indented, elevated), 3 background sizes (1.5 by 2.5 in., 3 by 5 in., 4 by 6 in.), 6 background colors (pink, blue, yellow, orange, green, white), and 3 locations on the table (left, middle, or right third).

In the TDM, the S− stimuli were faded during training so that they became more and more similar to the S+ stimuli, until they differed only on the relevant dimensions. Initially, very different S−s were presented. These varied across the irrelevant dimensions and consisted of single letters, single digits, four-letter nonsense words and four-digit numbers. Then, a set of moderately different S−s was presented. These consisted of two- or three-letter nonsense words; two- or three-digit numbers judged by the experimenters to be moderately different in shape; and two- or three-place letter/number combinations, presented across the irrelevant dimensions (e.g., when S+ = 74, moderately different S−s were H7, HI, 7W, etc., on different backgrounds, with slightly different sizes, etc.). Finally, slightly different S−s were presented. These varied across the irrelevant dimensions and consisted of numbers similar to the S+ stimulus (e.g., when S+ = 345, slightly different S−s were 543, 346, 445, etc.). By the end of the last step, only the relevant dimensions (i.e., the shape and orientation of the numbers) distinguished the S+ and S−. The irrelevant dimensions were often identical on any single trial.

Training Stimuli: SPH

In this condition, the S− numerals included both higher and lower consecutive numbers to S+ (e.g., 51 and 53 for 52) and a single reversal of S+ (e.g., 25 for 52). All SPH materials (S+, S−) consisted of the number handwritten with a black marker pen on white cards (3 by 5 in.). We attempted to equate the task difficulty of TDM and SPH by selecting numerals that were similar in shape (topographical features), similar in sequential order, and similar in quantity of "easy" and "hard" numerical discriminations (3 and 8, 1 and 7, 6 and 9).

Procedures

Pretesting and Selection of Training Materials

Each subject was trained on four discrimination tasks of equal difficulty, each involving two- or three-digit numbers. These tasks were chosen from individualized educational program (IEP) goals designed to teach these students to identify addresses, grocery prices, and so on. The pretest was used to select two numbers to be taught by the TDM and two to be taught by the SPH for each person. Each subject was presented with 10 trials for each number in which one S+ (e.g., 92) and one S− (e.g., 91) were presented, and the subject was asked to "touch the number 92." There were no contingencies for correct or incorrect responses. If the subject passed the test (>50% correct) for a given number, a different number was tested; if the identification test was failed (≤50%), the number was selected as an S+ to be taught in an identification task.

From the pretest, four two-digit (92, 61, 49, and 76) or three-digit (345, 736, 341, and 643) numbers were chosen as the final or criterion S+ stimuli for training and generalization. Although the subjects may have had some exposure to these numerical sets, the pretest probes indicated that none had sufficient experience to help them identify the S+ at more than chance (50%) level. The criterion S− numerals were both the higher and lower consecutive numerals to each S+ (e.g., 91 and 93 when S+ was 92) and reversals of the S+ (e.g., 29 when S+ was 92).

Training

The second phase consisted of training each subject to identify four numbers, two of which were taught by each of the two procedures. Correct responses resulted in verbal praise (e.g., "Good," "That's right") for all subjects; 4 of the subjects also received pennies (which were used as reinforcers in the students' vocational tasks) for correct responding. This change was made because the first 4 students became less responsive as a session (typically 20 min) progressed.

Task demonstration model. During TDM, identification was taught in three steps that varied in the difficulty of the discrimination to be made. Initially, examples of the S− were characterized as very different and varied from the S+ in the one relevant dimension (shape of the stimulus; e.g., 92 vs. G) as well as four or five irrelevant dimensions (script, color of S+, color of background, texture of S+, and location on table). When criterion was met (correct responding on all of the last five and 9 of the last 10 trials), moderately different S−s were introduced. These usually varied on two or three irrelevant dimensions as well as the S+. Finally, slightly different S−s were introduced. In this set, the final discriminations were made between a very similar S+ and S− (e.g., 92 and 93) that had identical irrelevant dimensions (e.g., color, size, background).

For all trials, the same instruction was given to each student, that being "Touch the __." At first, the S+ was placed close to the student while the S− was placed farther away. Within a few trials, both stimuli were placed equidistant from the student. Each correct trial was followed by a change in either S+ or S−.

Any incorrect or delayed (10 s) response during TDM training was followed by a correction sequence that began with a verbal command ("No, touch the other one" or "No, touch the __") and physical guidance to the correct stimulus. This was followed by repeated instruction with the materials left intact. If the subject responded correctly, the stimuli were removed and then returned to the same position. A correct response was followed by another trial with the same stimuli but with their positions changed. Another correct response was followed by two more trials, with the position of the stimuli changed each time. Successful responses to the entire correction procedure resulted in a return to the next trial in the normal training sequence. Three consecutive errors or three errors with the same set of stimuli resulted in a return to the previous stimulus set on which the subject had responded successfully.

Standard prompting hierarchy. The SPH is a recommended teaching procedure (Snell, 1987; Sternberg, 1988; Wolery et al., 1988) that uses a hierarchy of least-to-most intrusive prompts to teach the student to make correct discriminations such as those made in TDM.

During training, the experimenter simultaneously placed one S+ and one S− card next to each other on a table directly in front of the student and asked the student to "Touch the __." A correct unprompted trial resulted in another trial, whereas an incorrect response resulted in the least intrusive prompt (pointing to the S+) and repetition of the instruction. If a correct response was not made at this level of prompting, successive levels were used until correct responding occurred. The full prompt sequence was as follows: (a) instruction only, (b) instruction plus pointing, (c) instruction plus modeling (the experimenter touched S+), (d) instruction plus physical prompt (the experimenter touched the back of the student's hand) and, finally, (e) instruction plus physical guidance (the experimenter provided the least amount of direct manual guidance needed to obtain a correct response).

Generalization and Maintenance

On the same day that a student reached criterion during the training phase, two generalization tests were given. The first test was conducted in the training room and used examples of the S+ and S− that differed from the numerals used in training along irrelevant dimensions (e.g., script, color, size). This test was repeated later in the day in the classroom. The generalization test in the classroom was repeated 6 months after training. No feedback (including prompts) was given during the 10 trials in either of the two generalization conditions or the maintenance test. Each trial ended after a correct response, an incorrect response, or 10 s in which no responding occurred.

Data Collection

Dependent Measures

All data were collected by an observer who was seated near the trainer and student. Dependent measures included unprompted correct responses (a correct response made within 10 s), prompted correct responses, and errors. These data also provided information on the number of training trials to criterion for each condition.

Interobserver Agreement on Dependent and Independent Measures

For 20% of the sessions, a second observer recorded data on student responding. Percentage agreement on the three categories of the dependent measures varied from 97% to 100% and averaged 99%.

To be certain that both the TDM and SPH were being used correctly, data were also collected in 20% of the sessions on the implementation of the independent variables. For the SPH, the observer marked whether a prompt was given and which of the four levels was used. For the TDM, the observer determined fidelity by recording whether the appropriate S+ and S− stimuli were used, whether the location of the items on the desk was correct, and whether the error-correction procedure was followed. Percentage agreement on the implementation of SPH was 100%. For the TDM, percentage agreement on implementation ranged from 98% to 100% and averaged 99%.

RESULTS

Figures 1 and 2 show the percentage of unprompted correct responses during training under the two teaching conditions for the 4 students who were praised (Figure 1) and the 4 who were praised and received pennies (Figure 2). Because there were 8 subjects, there were eight opportunities to make the comparison between the two teaching procedures. In each of the eight comparisons during training, the TDM resulted in more unprompted correct responses (UCR). For the first 4 subjects who were praised for unprompted correct responses, the means for the group under the TDM and SPH were 77% and 50%, respectively. For the other 4 students, who received praise as well as pennies, the group means were 75% and 51%. The mean percentages across the four discriminations learned by each subject under the TDM and SPH were, for Subject 1, 68% and 45%; for Subject 2, 91% and 59%; for Subject 3, 77% and 47%; for Subject 4, 71% and 48%; for Subject 5, 90% and 62%; for Subject 6, 67% and 52%; for Subject 7, 78% and 40%; and for Subject 8, 65% and 48% for TDM and SPH, respectively.

Figures 3 and 4 show the percentage of errors that occurred under these two procedures. Data from the training phase again showed clear differences between the two procedures. The overall means for the first and second set of four subjects for the

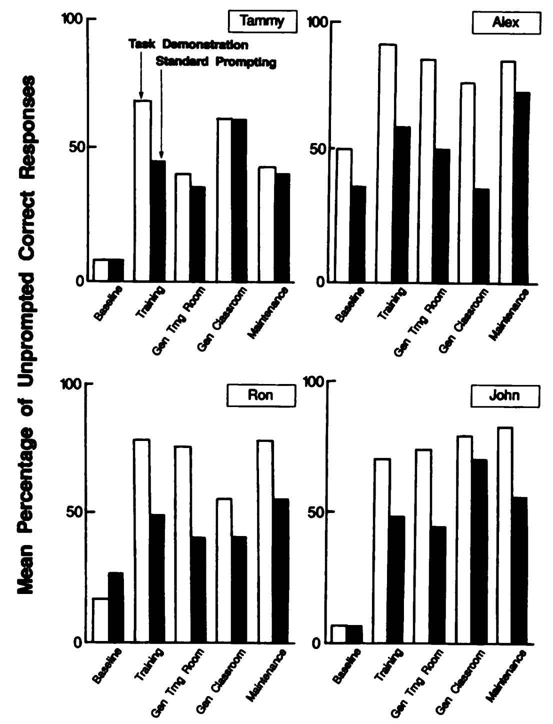

Figure 1. The percentage of unprompted correct responses by subjects under the task demonstration model and the standard prompting hierarchy. Phases were baseline, training, generalization in training room, generalization in classroom, and maintenance.

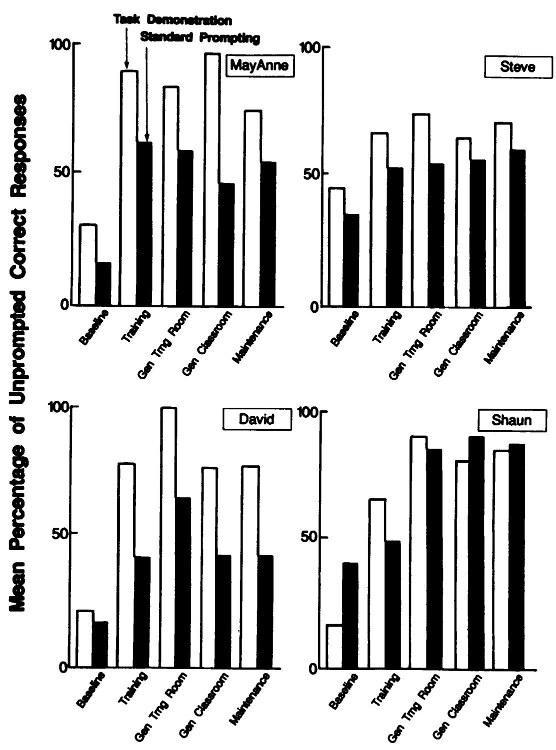

Figure 2. The percentage of unprompted correct responses by subjects who were praised and received a penny for each correct response during training under the task demonstration model and the standard prompting hierarchy. Phases were baseline, training, generalization in training room, generalization in classroom, and maintenance.

TDM and SPH were 12% (TDM) and 25% (SPH), and 16% (TDM) and 25% (SPH). Results from the individual subjects showed that every one of the eight comparisons favored the TDM. The error percentages for the 8 subjects during training were 15% and 27% for Subject 1, 4% and 20% for Subject 2, 11% and 27% for Subject 3, 16% and 26% for Subject 4, 6% and 20% for Subject 5, 23% and 24% for Subject 6, 13% and 30% for Subject 7, and 23% and 26% for Subject 8 for TDM and SPH, respectively. These four figures show that, during the training phase, the TDM produced a higher percentage of unprompted correct responses and a lower percentage of errors.

The data were then analyzed for the two generalization conditions, one that presented untrained examples in the training room (TG) and one that presented untrained examples in the classroom (CG). During both generalization phases, no feedback was given following correct or incorrect responding (i.e., no praise, pennies, or prompts). Thus there were only two categories of responding: unprompted correct responses and errors. Because these two numbers must sum to 100% (unlike the training data for which there were three types of responses: unprompted correct, prompted correct, and errors), only one category is reported. The data from Figures 1 and 2 show that in all eight cases, responding was superior in the training setting following the TDM condition. The overall means of correct responding across the 8 subjects for the TDM and SPH were 79% and 54%, respectively. Means for Subject 1 were 40% and 35%; for Subject 2, 85% and 50%; for Subject 3, 75% and 40%; for Subject 4, 75% and 45%; for Subject 5, 85% and 60%; for Subject 6, 75% and 55%; for Subject 7, 100% and 65%; and for Subject 8, 90% and 85% for

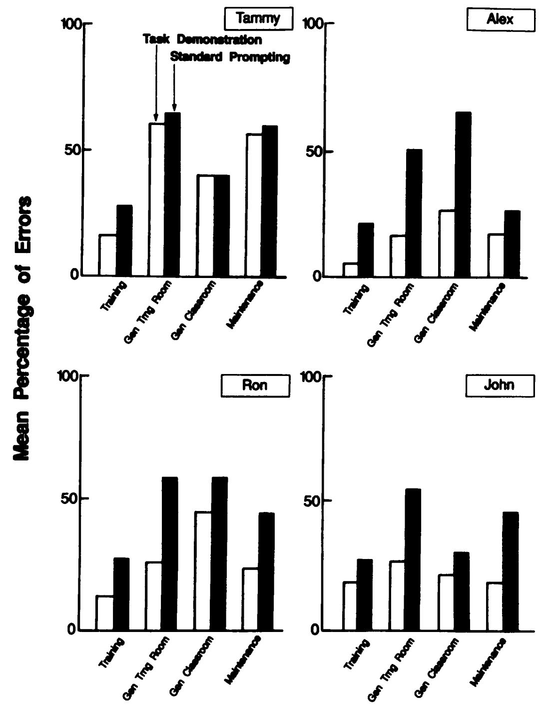

Figure 3. The percentage of errors by subjects taught discriminations under the task demonstration model and the standard prompting hierarchy. Phases were training, generalization in the training room, generalization in the classroom, and maintenance.

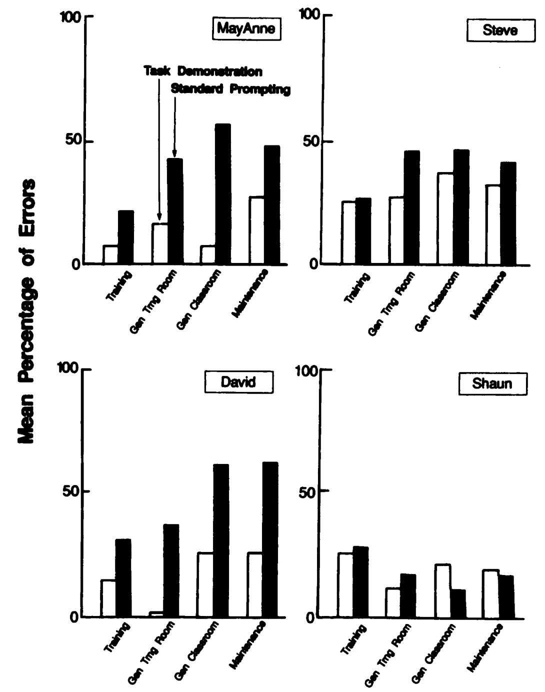

Figure 4. The percentage of errors by subjects who were praised and received a penny for each correct response during training. Phases were training, generalization in the training room, generalization in the classroom, and maintenance.

TDM and SPH, respectively. For the 10 generalization trials per task delivered in the classroom, TDM was the superior procedure in six of the eight cases and equivalent in one other. The overall means were 84% (TDM) and 62% (SPH), and the individual means were 60% and 60% for Subject 1, 75% and 35% for Subject 2, 55% and 40% for Subject 3, 80% and 70% for Subject 4, 95% and 45% for Subject 5, 65% and 55% for Subject 6, 75% and 40% for Subject 7, and 80% and 90% for Subject 8 for TDM and SPH, respectively. At the end of 6 months, 10 maintenance trials for each task were presented to the subjects individually in their classrooms. The mean percentage of unprompted correct trials across subjects was 74% for TDM and 58% for SPH. Individual means for Subject 1 were 43% and 40%; for Subject 2, 85% and 73%; for Subject 3, 78% and 55%; for Subject 4, 83% and 55%; for Subject 5, 75% and 53%; for Subject 6, 70% and 60%; for Subject 7, 75% and 40%; and for Subject 8, 83% and 85% for TDM and SPH, respectively.

A measure of efficiency, the total number of trials to criterion in each condition, also favored the TDM for most of the subjects. The average number of trials for the TDM condition was 102; for the SPH condition, 137 trials. For 5 of the subjects, the TDM resulted in fewer trials, with 2 of those subjects requiring more than twice as many trials in the SPH condition to reach criterion. Trials to criterion for individual subjects were 142 and 194 for Subject 1, 70 and 44 for Subject 2, 81 and 247 for Subject 3, 129 and 142 for Subject 4, 69 and 84 for Subject 5, 145 and 129 for Subject 6, 97 and 194 for Subject 7, and 81 and 61 for Subject 8 for TDM and SPH, respectively.

DISCUSSION

The effects of two procedures on teaching four discriminations were compared. The task demonstration model (Deitz et al., 1986) relied primarily on a fading sequence in which multiple examples of S− were made successively more like multiple examples of S+. The standard prompting hierarchy was based on a commonly used procedure for teaching persons with retardation in which successively more intrusive prompts were used following incorrect responding.

Although the usual control for studies of fading is a series of unprompted trials in which correct responses are reinforced and incorrect ones are extinguished (see Lancioni & Smeets, 1986), this procedure was not used in our study for two reasons. One is that prior research suggests that the control procedure is weaker than the experimental one, so the test might be too easy and trivial. A second reason is that we wanted to compare two teaching procedures, one that is based on stimulus fading and is untested and one that is based on response prompting and adopted by teachers as a preferred method. Results were compared in the training condition, generalization in the training room and classroom, and maintenance. Of 32 comparisons of the procedures (8 subjects × 4 comparisons of training, generalization, and maintenance), the task demonstration model proved superior in 29.

This comparison of the task demonstration model and the standard prompting hierarchy concurs with the available research on the effectiveness of stimulus fading procedures when they are compared to extrastimulus prompting procedures. However, the task demonstration model consists of a number of components (i.e., fading the S− to be more like the S+, multiple examples of S+ and S−, an error-correction procedure) not duplicated in the SPH. Which of these procedural differences made the greatest contribution to the success of the TDM is not evident from this investigation. In an earlier study, Schreibman and Charlop (1981) reported fading the S+ to be more effective than fading the S−. If the superiority of fading S+ was due to stimulus novelty and its effects on stimulus selection as those authors have suggested, then the presentation of multiple examples of S+ over trials may have produced a similar novelty effect and increased the salience of S+ in the TDM. Multiple examples of S+ and S− have proven effective in teaching persons with severe handicaps, although a detailed analysis has not been developed to indicate how the positive and negative examples should be arranged (Albin & Horner, 1988). In the TDM, the S− examples were faded to become increasingly like the S+ examples. Further research is needed to determine the combined effect of fading and multiple examples when compared to the separate fading and multiple-exemplar procedures.

In this study, the TDM was both more effective and efficient in the majority of cases. Formal investigations of the external validity of the procedure for classroom use are necessary. Although we have used the procedure across a variety of tasks, no formal tests have been made of its application across tasks, modalities, materials (two or three dimensional), or simultaneous versus successive discriminations. Although the initial implementation of the TDM may be less efficient than standard prompting procedures from the aspect of preparing materials or collecting multiple examples, we have found that this procedure can be used with stimuli from the natural environment and that S+ materials for one task can become S− materials for other tasks.

Whether individuals will learn discriminations taught with traditional procedures more effectively following exposure to the task demonstration model should be addressed. Autistic children were able to respond correctly to stimuli during an extrastimulus prompting procedure following training with a fading procedure (Schreibman et al., 1982). The TDM procedure may produce increased attention to multiple cues or to critical features distinguishing S+ from S− that may generalize to a variety of teaching situations and complex discriminations in the natural environment.

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