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TEACHING PEDESTRIAN SKILLS TO RETARDED PERSONS: GENERALIZATION FROM THE CLASSROOM TO THE NATURAL ENVIRONMENT[1]

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Little attention has been given to teaching adaptive community skills to retarded persons. In this study, five retarded male students were taught basic pedestrian skills in a classroom. Training was conducted on a model built to simulate city traffic conditions. Each subject was taught five specific skills involved in street crossing in sequence, *viz.* intersection recognition, pedestrian-light skills, traffic-light skills, and skills for two different stop-sign conditions. Before, during, and after training, subjects were tested on generalization probes on the model and under actual city traffic conditions. Results of a multiple-baseline design across both subjects and behaviors indicated that after receiving classroom training on the skills, each subject exhibited appropriate pedestrian skills under city traffic conditions. In addition, training in some skills appeared to facilitate performance in skills not yet trained.

DESCRIPTORS: classroom, community setting, generalization, multiple baseline, pedestrian skills, probes, generalization programming, transfer, retardates

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Over the past several years, a number of procedures based on operant principles have been developed for teaching basic self-help skills to retarded persons. Examples include toileting (Azrin, Bugle, and O'Brien, 1971; Azrin and Foxx, 1971, 1974), dressing (Minge and Ball, 1967), mealtime behaviors (Barton, Guess, Garcia, and Baer, 1970; O'Brien and Azrin, 1972; O'Brien, Bugle, and Azrin, 1972), and toothbrushing (Horner and Keilitz, 1975).

Due to the success of these programs, and the current movement toward de-institutionalization, there has been an increased interest in teaching more advanced skills. Although a sizeable body of literature now exists in the area of workshop and other occupationally oriented behaviors (Bateman, 1975; Gold, 1973; Greene and Hoats, 1969; Shroeder, 1972*a*, 1972*b*), only recently has research been directed at teaching retarded persons skills necessary for community adjustment or independent living: telephone usage (Leff, 1974, 1975), appropriate use of leisure time (Johnson and Bailey, *in press*), maintenance of housekeeping skills (Bauman and Iwata, *in press*), and the completion of biographical information forms (Clark, Boyd, and Macreae, 1975). These and other skills are important, in that they appear to be prerequisites for employment in the community; furthermore, the acquisition of such skills would greatly reduce potentially hazardous situations that exist in the community and have been a major obstacle to successful placement. In a survey of caretakers of community placed retarded persons, Nihira and Nihira (1975*b*) found that many were concerned about the clients' ability to move safely about the community. Further findings revealed that of 1254 reported incidents of problem behavior involving community placed retarded persons, 75% involved jeopardy to the health

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and/or safety of the retarded person (Nihira and Nihira, 1975*a*).

One potentially dangerous situation often encountered in the community is attempting to cross busy city streets. Any pedestrian exposed to traffic conditions must be able to exhibit appropriate street-crossing behaviors. Data from 1971 show that pedestrians were involved in 18% of all fatal automobile accidents (O'Brien, 1971). Of these accidents, 21% occurred at intersections, and 43% took place while pedestrians were crossing streets at some point other than an intersection. Thus, street crossing was involved in 64% of all pedestrian deaths, or 11.5% of all traffic-related fatalities.

The purpose of the present study was to develop a classroom procedure to teach pedestrian skills to retarded persons. Training in the classroom would seemingly present fewer problems than training at city intersections. Factors in the environment such as inclement weather conditions, the need for additional time and staff, and inherent dangers would not have to be considered, at least initially. Furthermore, if these skills were found to generalize to the natural environment, the procedure might have widespread applicability.

A task analysis similar to one done by Resnick, Wang, and Kaplan (1973) was applied to street-crossing behavior and yielded five specific skills. A major objective of the study was to train these skills sequentially on a classroom model, and then to test (and program, if necessary) for generalization to the natural environment after training on each skill. A secondary objective was to examine generalization to untrained skills.

METHOD

Subjects

Five male students enrolled at the Kalamazoo Valley Multihandicap Center (KVMC), a program for the physically handicapped and mentally retarded, served as subjects. All were ambulatory, with ages ranging from 16 to 25 yr (mean = 20.4 yr), and IQ scores ranging from 55 to 85 (mean = 60.6). The students spent half of each school day receiving instruction in several academic areas, and the other half in a prevocational workshop. Each student had demonstrated proficiency in basic self-help skills. Although all had previously crossed city streets in the company of parents, guardians, or teachers, none had exhibited independent street-crossing behaviors.

Setting and Apparatus

Classroom. Training sessions, review sessions, and classroom probes were conducted in a KVMC classroom located in downtown Kalamazoo. A model, simulating four square city blocks, constructed on an 81.3- by 101.6-cm posterboard was placed on a table situated against one wall of the room. Streets, cardboard houses, cars, trees, and people were either drawn on or glued to the board in appropriate places.

A 15.2-cm tall model pedestrian light with the words "WALK" and "DON'T WALK" printed on opposite sides, and two, 7.62-cm tall stop signs were constructed of heavy cardboard and colored construction paper. They could be placed at any intersection on the model or removed.

A model traffic light measuring 6.4 by 3.8 by 3.8 cm was constructed of heavy cardboard, colored construction paper, and see-through plastic. The traffic light was suspended from a 15.2-cm tall metal pole attached to the city model. On all four sides of the traffic light, one of the three colors (red, green, or amber) was colored darker than the other two and covered with see-through plastic, to indicate that it was "lighted". A 7-cm doll made of hard rubber was used as the object to be manipulated by the subjects.

City environment. Street generalization probes were conducted at three city intersections. All were within three blocks of the KVMC classroom. A pedestrian light, which alternated "WALK" and "DON'T WALK" conditions, and a tricolored traffic light were located at one intersection. A tricolored traffic light was located at a second, and a stop sign was located at the third intersection.

Procedure

Task sequence and response definitions. A component analysis of pedestrian behavior yielded five major skills. The first was intersection recognition, and consisted of crossing streets only at intersections and never in mid-block. The second was pedestrian light skills, and included behaviors appropriate at intersections equipped with pedestrian lights. The third consisted of skills used at intersections having tricolored traffic lights. The fourth applied to intersections at which a stop sign faced cars travelling across the pedestrian's path. The fifth skill was for intersections at which a stop sign faced cars travelling in the same direction as the pedestrian, or intersections at which there was no traffic control device.

Figure 1 represents an analysis of street-crossing behaviors in flow-chart form. The target behavior was for subjects to exhibit street-crossing skills based on this model. For example, a pedestrian wishing to cross the street must first locate an intersection. If the intersection has a pedestrian light, he/she waits until the light is in the "WALK" condition before crossing. While crossing, the pedestrian looks both ways, avoids any oncoming traffic, and does not stop until completely across the street. If no pedestrian light is present at the intersection, the pedestrian then looks for a traffic light, whose stimuli then control his/her behavior. Similar sequences are followed for intersections having stop signs or no traffic-control devices.

Specific components of each of the five skills are presented in Table 1 under the heading "Correct Response". These component behaviors were also operational definitions employed during training sessions, and classroom and street probes. Also presented in Table 1 are the operational definitions of incorrect responses used throughout the study.

Training. Training consisted of teaching the five street-crossing skills in order, beginning with intersection recognition. Training sessions were conducted with one experimenter and one subject seated at the table on which the model was placed. Subjects manipulated a doll, following instructions from the experimenter.

A trial was initiated when the experimenter instructed the subject to move the doll from its present location on the model to one pointed out by the experimenter. For example, when intersection recognition was taught, after placing the doll in mid-block, the experimenter instructed the subject to walk the doll to a store on the opposite side of the street. In this case, a correct response was recorded only if the subject moved the doll to a corner before crossing the street. An incorrect response would be recorded if the subject had the doll cross the street at some point other than a corner. When training on a skill with four components (*e.g.*, pedestrian light skills), a trial involved emission of all four components. For a trial to be considered correct, all four components had to be correct.

While manipulating the doll, subjects were required to verbalize what the doll was doing to get to the designated location. For example, a subject being trained on intersection skills would, after receiving an instruction, grasp the doll, walk the doll to a corner, and say, "He's going to a corner to cross".

Correct responses were followed by social reinforcement in the form of descriptive praise (*e.g.*, "Good job, you had the doll go to the corner to cross"). Incorrect responses were followed by explicit feedback as to why the response was inappropriate. A remedial trial was then initiated, during which the subject was asked to respond to the instruction a second time. Following an incorrect response on a remedial trial, the experimenter modelled the correct series of responses for the entire component, and the subject was asked to try again. Each subsequent incorrect response was followed by the experimenter modelling the correct response. Correct responses on remedial trials were reinforced, and the next training trial was then initiated.

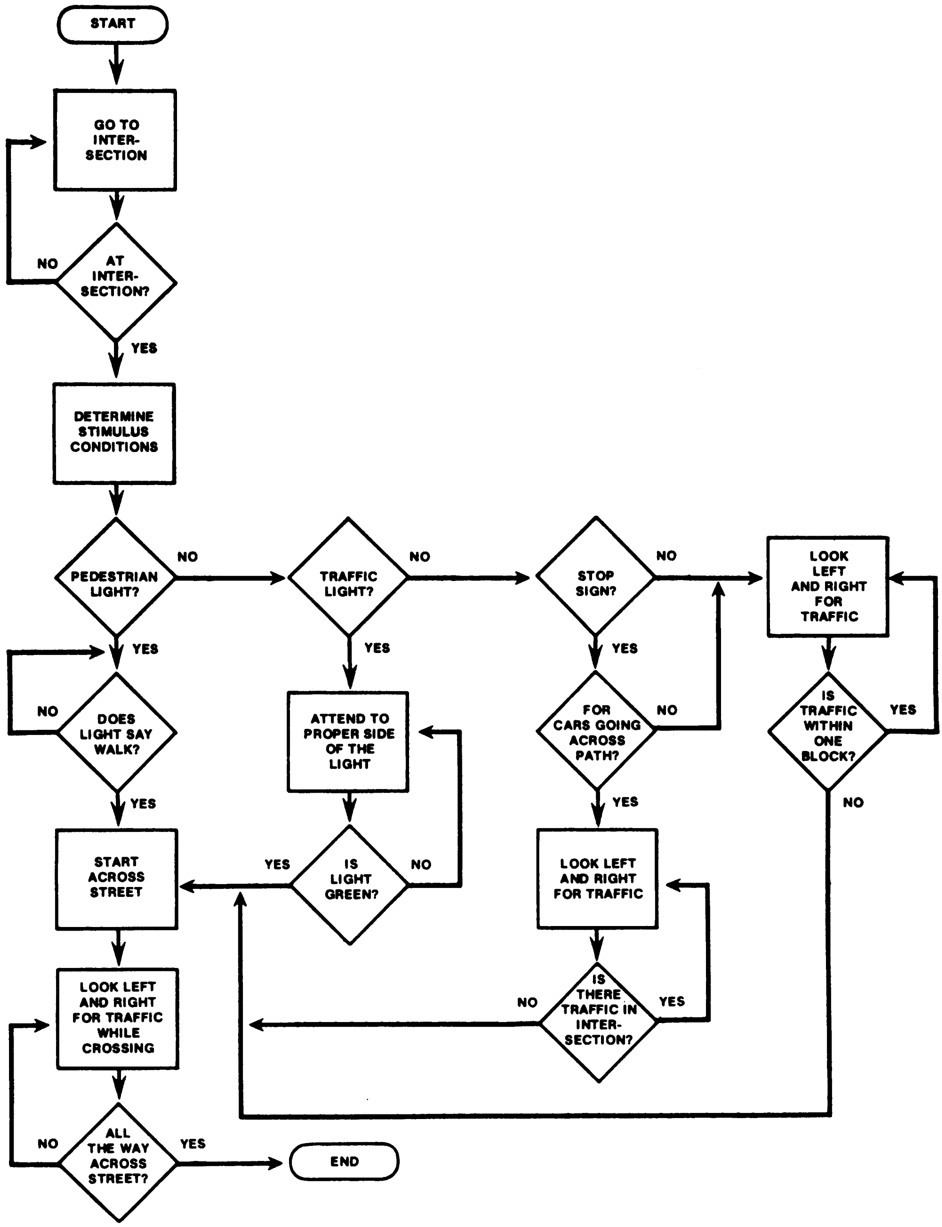

Fig. 1. Task analysis of street-crossing skills. Diamonds represent decision points in the sequence; rectangles represent specific responses to be performed.

Each training session consisted of 10 trials, not counting remedial trials. During any given session, only one of the five skills of street crossing was taught. Criteria for mastery of a skill were 90% or more correct responses over two consecutive training sessions. Whenever a subject reached criteria for a skill, a review session was held, and a classroom and street probe were conducted.

Review sessions. Review sessions were conducted before each classroom and street probe. The purpose of these was to provide practice on all previously learned skills. Sessions consisted of 10 to 12 trials, two to three for each previ-

Table 1

Correct and Incorrect Response Definitions for the Five Areas of Street Crossing

Situation	*Correct Response*	*Incorrect Response*
1. Intersection	1.1. Subject (S) goes to intersection to cross street.	S crosses street anywhere not at intersection.
2. Pedestrian light	2.1. S stops upon arrival at intersection.	S crosses street without first stopping at intersection.
	2.2. S starts across street within 5 sec of light changing to WALK condition.	1) S starts across street before light has changed to WALK condition, or 2) S does not start across street within 5 sec of light changing to WALK condition.
	2.3. S turns head at least 45° to left and right at least once while in the street.	S fails to turn head at least 45° to left and right at least once while in the street.
	2.4. S does not stop walking until completely across the street.	S stops before getting completely across the street.
3. Traffic light	3.1. Same as 2.1.	Same as 2.1.
	3.2. S starts across street within 5 sec of light changing to green condition.	1) S starts across street before light has changed to green condition, or 2) S does not cross street within 5 sec of light changing to green condition.
	3.3. Same as 2.3.	Same as 2.3.
	3.4. Same as 2.4.	Same as 2.4.
4. Stop sign (for cars going across the pedestrian's path)	4.1. S stops upon arrival at intersection and turns head at least 45° to left and right at least once.	S crosses street without first stopping at intersection.
	4.2. S starts across street within 5 sec of intersection being clear of traffic.	1) S starts across street while cars going across his path are in the intersection, or 2) S does not start across street within 5 sec of intersection being clear of traffic.
	4.3. Same as 2.3.	Same as 2.3.
	4.4. Same as 2.4.	Same as 2.4.
5. Stop sign (facing cars going in the same direction as pedestrian)	5.1. Same as 4.1.	Same as 4.1.
	5.2. S starts across street within 5 sec of street being clear of moving cars for at least one block in both directions.	1) S starts across street before street is clear of traffic for one block in both directions, or 2) S does not start across within 5 sec of street being clear of traffic for one block in both directions.
	5.3. Same as 2.3.	Same as 2.3.
	5.4. Same as 2.4.	Same as 2.4.

ously learned skill. All conditions were identical to those of training sessions, including instructions, reinforcement, feedback, and remediation. In addition to regularly scheduled review sessions, Subjects 2 and 4 received one review session each after the first classroom and street probes during the follow-up phase of the study, due to their poor performance on these probes.

Classroom probes. Probes were conducted on the training model whenever a subject reached criteria on a skill, immediately following a review session, and before conducting a street probe. The purpose of these was to assess generalization from reinforced to unreinforced trials and from trained to untrained skills. Reinforcement, corrective feedback, and remediation were not in effect. In addition, subjects were instructed to respond, not just to the stimulus conditions of previously learned skills, but to the conditions for all five skills. Thus, each classroom probe consisted of one response to each of 17 items (see Table 1). Instructions given to the subjects were identical to those used during training trials, and subjects were required to verbalize the actions of the doll.

Street probes. Probes were conducted at city intersections under actual traffic conditions to assess generalization of skills to the natural environment. As with classroom probes, subjects were asked to respond once each to all of the stimulus conditions of the five skills listed in Table 1, and the reinforcement and corrective feedback procedures were not in effect. Trials were initiated in mid-block when testing for intersection skills, and approximately 9 m from a corner when testing for the remaining skills. Trials were initiated on instruction from the experimenter to go to a specific location (*e.g.*, "I want you to go to that store with the red sign in front of it"). For pedestrian and traffic-light conditions, instructions were timed so that subjects would reach the intersection during the "DON'T WALK" or "RED" condition. After giving an instruction, the experimenter asked the subject to verbalize his actions as he crossed the street, and the experimenter followed behind the subject by several feet. After a subject crossed the street, he was accompanied by the experimenter either to the next probe site or back to the classroom.

The experimenter and subject walked to locations where street probes were conducted. Subjects wore blinder glasses when crossing streets proceeding to and from probe sites to prevent them from attending to the stimulus conditions controlling the experimenter's crossing.

As a precautionary measure, a safety monitor was always present during street probes. The safety monitor, who also served as reliability observer, was responsible for preventing injury to the subjects. The monitor was positioned at intersections that the subjects would be crossing and, if necessary, prevented subjects from walking into oncoming traffic.

Follow-up checks. When training on the fifth skill was completed, postchecks were conducted to assess the degree of maintenance of the five skills. Each follow-up check consisted of one classroom and one street probe. A minimum of three checks was obtained for each subject over a two- to six-week period. Subjects who scored 13 or fewer correct of the 17 possible responses were required to participate in one review session before the next followup check.

Reliability. Independent observations were made during training trials and classroom and street probes by either one of the experimenters or a graduate student naive to the experimental conditions. Following data collection, experimenter and observer records were compared and interobserver reliabilities calculated by dividing the number of agreements by agreements plus disagreements, and multiplying by 100. This formula was used to compute agreement percentages for: (1) occurrences of correct responses, (2) nonoccurrences of correct responses, and (3) occurrences plus nonoccurrences of correct responses.

Checks were made at least twice during each training phase. The independent observer sat across the table from the experimenter in such a way that prevented them from seeing each other's data sheets. Checks on classroom and street probes were conducted by the safety monitor. Reliability checks on training sessions yielded mean scores of 99%, 96%, and 96% for occurrences, nonoccurrences, and occurrences plus nonoccurrences, respectively. Observations taken on 32% of all classroom probes yielded mean scores of 95%, 94%, and 95%; checks made on 85% of all street probes yielded means of 92%, 91%, and 92%.

Experimental Design

This study utilized a multiple-baseline design across both subjects and behaviors (Baer, Wolf, and Risley, 1968). Baseline data in the form of classroom and street probes were taken on all subjects for the five skill areas, a minimum of four times each. Training was begun with the first subject on intersection recognition, and proceeded sequentially through the other four areas. Baseline probes continued for all skills not yet trained. When the first subject met criteria for intersection recognition and advanced to pedestrian-light skills, the second subject began training on intersection recognition. When the second subject advanced to pedestrian-light skills, the third subject began training on intersection recognition, and so on. Baseline probes continued for all subjects not yet receiving training.

RESULTS

Figure 2 shows the performance of each of the five subjects on classroom and street probes during baseline, training, and followup conditions. Each data point represents the number of correct responses of a possible 17. Subjects scored few correct responses during baseline. Mean numbers of correct responses on classroom and street probes (in parentheses) during this condition were: 4.3 (5.8), 5.0 (5.5), 4.0 (8.1), 4.2 (4.2), and 4.1 (5.0) for Subjects 1 through 5 respectively. Although Subject 3 emitted 11 correct responses on the first street probe and 15 on the second, his performance decreased to a level comparable to that of the other subjects on subsequent baseline probes.

Probe scores improved as subjects were exposed to training conditions. Mean correct responses on classroom and street probes (in parentheses) during training were: 13.0 (12.4), 9.5 (11.0), 11.7 (10.4), 10.3 (7.7), and 14.0 (13.7) for Subjects 1 through 5, respectively. Subjects 1 and 5 correctly performed each just-trained skill on all classroom and street probes. Subjects 2, 3, and 4 correctly performed each just-trained skill on all classroom probes, but these skills did not always generalize to city traffic conditions after initial training. Subjects 2 and 3 required additional training and probes before pedestrian-light skills generalized appropriately to the natural environment. Subject 4 did not generalize intersection recognition on three successive street probes. Training was then begun on pedestrian-light skills. Intersection recognition for this subject did generalize to city traffic conditions during followup probes.

Followup probes indicated that appropriate street-crossing skills were still being emitted after training had been discountinued. Mean correct responses on classroom and street probes (in parentheses) were: 16.5 (15.5), 17.0 (16.0), 16.0 (16.3), 17.0 (17.0), and 17.0 (15.5) for Subjects 1 through 5, respectively. Subject 2 scored 13 correct and Subject 4 scored 11 correct on their first followup probe. These subjects received one review session before undergoing additional probes.

Figure 3 shows the mean number of correct responses by category across subjects on final probes for baseline, each of the training phases, and followup. On the probes following training on pedestrian-light skills, increases were seen not only in this category, but also in the traffic light and both of the stop-sign categories, with the exception of the classroom probe for the traffic-light category. In addition, after training on the first stop-sign category, performance also increased in the second stop-sign category. However, these increases in untrained skills were not reflected in the training data. Mean numbers of training trials to criteria (two consecutive sessions of 90% or more correct responses) for the five categories were: 20.6, 32.4, 48.2, 73.4, and 47.0, respectively. Mean numbers of remedial trials were: 0.6, 4.4, 8.2, 17.4, and 7.0. Training data revealed that most of the incorrect responses during training on traffic-light skills and both of the stop-sign skills were due to

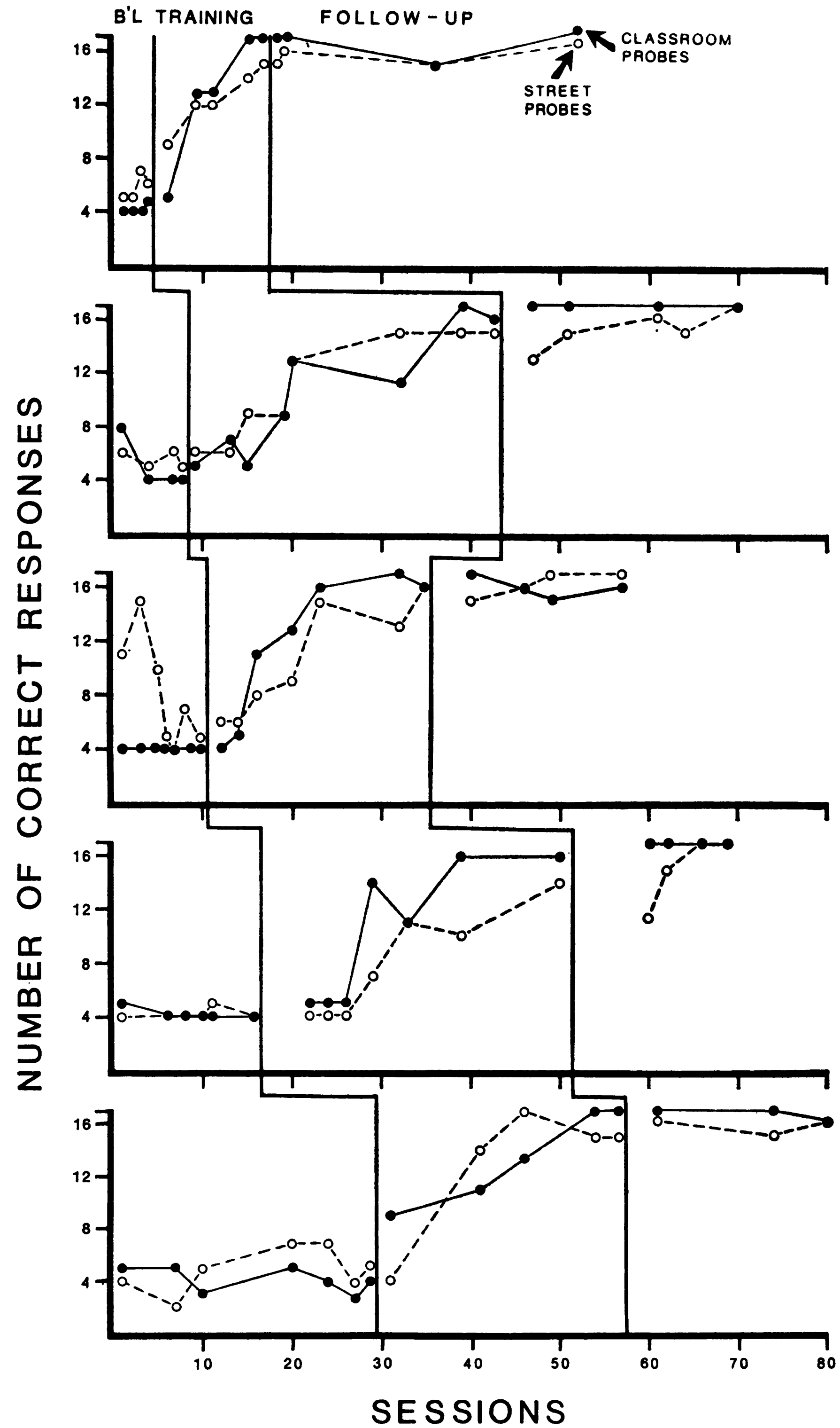

Fig. 2. Number of correct responses of 17 possible for classroom and street probes during baseline, training, and followup conditions.

mistakes on the initial parts of responses; these were areas that did not overlap across any of the skills or with the previously trained category of pedestrian-light skills.

A total of 80 street probes was conducted during the study. It was necessary for the safety monitor physically to prevent subjects from entering a street on four occasions. On five other occasions, the safety monitor stepped into the street to stop oncoming traffic. Throughout all street probes, no subject was ever in serious danger of being hit by an automobile.

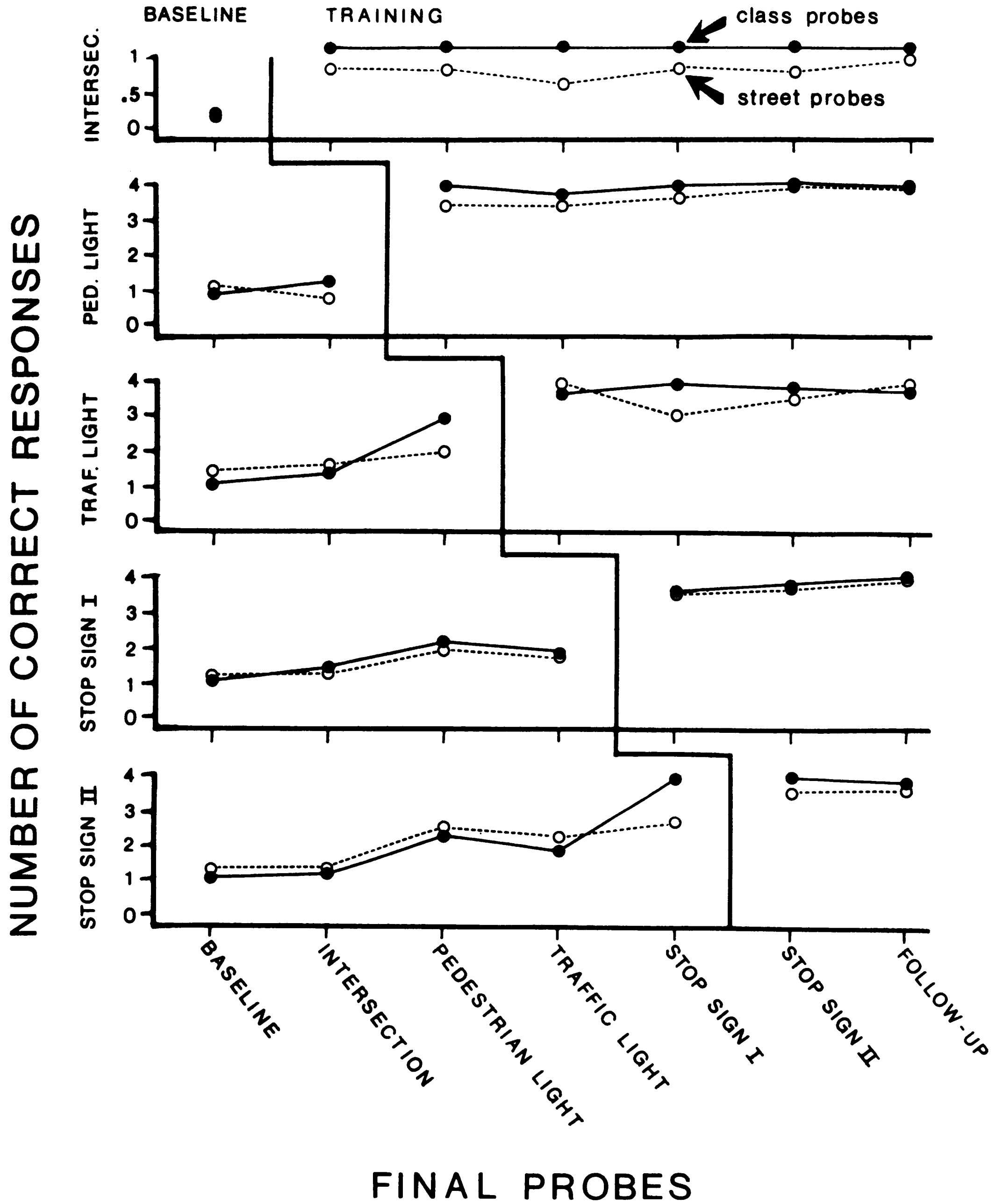

Fig. 3. Mean number of correct responses by training category on final probes for baseline, each of the training phases, and followup.

DISCUSSION

Present results indicate that pedestrian skills can be taught to retarded persons in a classroom setting, and that these skills may be generalized to the natural environment with little or no additional training. Thus, this study represents one of the few successful attempts to teach adaptive behaviors in a situation removed from the environment in which the behaviors usually take place. Leff (1974, 1975) and Clark *et al.* (1975) successfully taught adaptive behaviors and generalized them to new situations; however, these situations were still part of the classroom setting.

The effectiveness of the training procedures was demonstrated by a multiple-baseline design across subjects. Baseline data revealed that all subjects performed poorly on both classroom and street probes, although they did emit a number of correct responses. Typically, these occurred during trials in which the subjects correctly continued across the street without stopping. Since this response was a component of four of the five skills, subjects who crossed the street without stopping scored at least four correct responses on the test probes, and all the subjects consistently did this. Probe scores increased only after training conditions were initiated. In addition, these increases were maintained after training had been discontinued. Followup probes indicated that subjects continued to exhibit appropriate street-crossing behaviors two to six weeks after the training program terminated.

Since instruction for each subject was done sequentially across behaviors, training and probe data also revealed the extent to which training on one skill led to increases in untrained skills. Since the five skills were similar, it would be reasonable to assume that training on one might facilitate acquisition of another. For example, after a subject is trained on pedestrian-light skills, improved performance may be expected on traffic-light skills. The major discriminative stimuli (the lights) are different for each condition, but most of the appropriate responses are similar for both conditions. At both types of intersections, the correct response is first to stop at the corner. Once the critical stimuli are appropriate, correct responses consist of turning one's head 45° to the left and right, and not stopping until completely across the street. To some extent, both stop-sign conditions are also similar to the pedestrian-light and traffic-light conditions. Thus, after pedestrian-light skills have been taught, most of the other skills are in the subject's repertoire. Probe data did indicate that instruction on pedestrian-light skills led to increases in all yet-to-be trained skills, and that training on the first stop-sign category led to an increase in the second stop-sign category. However, such generalization across behaviors did not necessarily reduce the amount of time required to teach any of the skills. Thus, it appeared that training on one skill led to increases in redundant aspects of untrained skills, but not to the novel aspects (different initial discriminative stimuli) of those skills.

In addition to providing basic training and generalization programming, several characteristics of the present procedures are worth noting. First, the program was not complicated to administer. The components are elementary enough so that a specialist would not be needed to teach them. The program could be taught by classroom aides and community residence managers having basic knowledge of reinforcement principles and the ability to follow directions well. Second, the time required to complete the program was not excessive. The number of training sessions required for each subject ranged from 14 to 29 (mean = 21.2), and a conservative estimate of session length was 15 min; thus, total training time ranged from 3.5 to 7.25 (mean = 5.3) hr. Third, as mentioned previously, the ability to teach adaptive community behaviors in the classroom reduces a number of problems found in the natural environment. Student and staff time is not lost getting to and from different training locations. Fewer staff may be needed for training, since one instructor could teach several students at the same time and monitor their activities more closely than in the natural environment. Inclement weather conditions do not disrupt training in the classroom. Most importantly, public embarrassment and, in this case, dangers inherent in the natural environment can be reduced. Fourth, the present procedures appear to be useful for teaching a number of other community survival skills. Bus riding, purchasing, banking, and restauranting skills are some of the behaviors that could conceivably be taught in a classroom, using a model that approximates conditions in and facilitates transfer of stimulus control to the natural environment. Additional devices such as slide sequences or even life-size simulators could be used for training in areas where generalization is particularly difficult to program or where the probability of physical danger due to error is sufficiently great to warrant their use.

The rationale for teaching adaptive community behaviors emphasizes increased independence on the part of the person who learns these skills. In addition to the fact that these skills are extremely important for community placement and successful employment of the retarded, they also facilitate access to a wider range of educational opportunities (*e.g.,* libraries) and reinforcers (*e.g.,* movies). Thus, the final goal of a program such as the present one would be to demonstrate the actual use of the target behaviors by the subjects in completely unstructured settings on some type of regular basis. This goal was not achieved in the present study for several reasons. First, in order to obtain frequent and accurate measures of whether or not the subjects were, in fact, attending to the appropriate discriminative stimuli presented by the lights, it was necessary to have subjects arrive at the intersection during a "Don't Walk" or "Red" condition. Otherwise, a subject may have crossed the street during a "Walk" or "Green" condition (correct response) but may have done so without ever having attended to the condition of the light (incorrect response). Second, since the generalization of classroom-trained skills was not an assured outcome and, in fact, needed to be programmed in some instances, it was felt that the use of unstructured probes would place the subjects in unacceptably dangerous situations. Finally, street-crossing skills were selected as the target behavior for this study from a larger pool of skills on the basis of both logical sequence and simplicity. It appeared that street-crossing skills were a prerequisite to any activity involving mobility about the community, and that these skills would be easier to teach than restauranting, banking, or bus riding, which require reading and the ability to use money in addition to pedestrian skills. Thus, after acquiring only pedestrian skills, it is not clear that subjects would cross streets on any regular basis unless there were additional behaviors available to accompany the use of these skills (*e.g.,* going to a store, restaurant, *etc.*). In light of these considerations, it was determined that unstructured probes would not allow for the collection of accurate data over a short period of time, that they would be prohibitively dangerous, and that they would still be somewhat "unnatural", since the subjects would not be sent on any type of meaningful errands. Still, however, the use of such probes appears to be a desirable component for evaluating the effects of community skill-training programs and future studies should, when possible, test for the generalization of skills to unstructured settings.

A final point to be considered is that the procedures employed in this study may provide a way to teach a skill that is not always welcomed by parents or guardians of retarded persons. After being taught pedestrian skills, there may be an increased probability that persons will attempt to cross busy city streets, whereas they might not have done so before. Obviously, this increases the risk of serious injury to the person. It is possible that parents of retarded persons may wish to avoid such risks, and it is not inconceivable that some parents will be strongly opposed to a program of the present type. Thus, it is crucial that parents be fully informed of the nature of the instructional program, including the benefits, dangers, and long-term expected results of training. All parents in this study were informed of these factors, and all signed forms permitting their children to participate as subjects.

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