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TEACHING PEDESTRIAN SAFETY SKILLS TO YOUNG CHILDREN: AN ANALYSIS AND ONE-YEAR FOLLOWUP

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Twenty-four elementary school children in grades K-3 participated in a study to teach six street-crossing skills: (1) wait at curb, (2) look all ways, (3) watch vehicle distance, (4) walk, (5) continue to look, and (6) use crosswalk. The effects of an instructional package implemented on the street corner were evaluated using a multiple-baseline design across two groups of six children at each of two schools. Rapid acquisition of pedestrian skills was evident at both schools. Average skill levels improved from 44% during baseline to 97% after training at School A and from 21% to 86% at School B. Data taken at a second street at each school were used to assess setting generality of safety behaviors. A one-year followup of 14 children indicated that pedestrian safety skills either maintained at high levels or could be quickly recovered from intermediate levels after remedial training. This research represents a first step in the solution of just one of the many community problems involving safety-deficient settings.

DESCRIPTORS: pedestrian behavior, safety, instructional package, *in-vivo* training, followup, community problems, multiple baseline, elementary school children

A recent trend in applied behavior analysis has been the expanding use of training packages and instructional programs that combine several behavioral techniques to modify increasingly complex response repertoires, such as group problem solving (Briscoe, Hoffman, and Bailey, 1975), teaching skills (Clark and Macrae, 1976), public speaking (Fawcett and Miller, 1975), social skills (Frederiksen, Jenkins, Foy, and Eisler, 1976), and conversational skills (Minkin, Braukmann, Minkin, Timbers, Timbers, Fixsen, Phillips, and Wolf, 1976). The primary advantage of such a multifaceted approach is the rapidity of the behavior change (*e.g.*, Azrin and Foxx, 1971).

A related trend is toward the development of procedures that can be used to modify naturally occurring behaviors in community settings (*cf.* Behavioral Community Psychology, Briscoe *et al.*, 1975). One such important community activity is the pedestrian behavior of large numbers of young children on their way to and from school. In most cities, adult crossing guards assist children at selected street crossings. However, the role of the guard is not necessarily educational. Children appear to attend to a crossing guard much as they would a traffic light, waiting for a signal to cross, rather than observing traffic to evaluate potential safety. Furthermore, our preliminary observations suggested that young children do not use critical street-crossing skills in the presence or absence of a crossing guard.

Statistics from the pedestrian safety literature also emphasize the need for street-crossing skills in young children. Several reports indicate that young children, especially those in the 5- to 9-yr of age range, have a relatively high probability of being involved in pedestrian accidents (Yaksich, 1959, 1960; Biehl, Older, and Griep, 1969, Note 1; Smeed, 1968).

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In Florida, one of every four persons killed in a traffic accident during 1976 was a pedestrian. Again, the highest incidence of deaths and injuries occurred in the 5- to 9-yr range (Note 2). An especially dangerous time is the afternoon (American Automobile Association, 1964, Note 3), a time concurrent with dismissal from school. Part of the reason for the higher accident rate with young children may be their relative inability to perceive hazards correctly (Martin and Heimstra, 1973). Salvatore (1974) demonstrated that there were developmental aspects to the ability of children to judge speed. Young children made the greatest percentage of errors in judging velocity largely due to their misclassification of various speeds as "fast", though this error was on the side of safety. These data, and the acknowledgment by several researchers in the safety field (*e.g.*, Heimstra, Nichols, and Martin, 1969; Jennings, Burki, and Onstine, 1977) that the problem is one of unsafe pedestrian *behaviors*, argue for a modification of the street-crossing behaviors of young children.

The potential dangers of traffic for young children have not been ignored, as many states have developed curriculum materials especially designed for the teaching of pedestrian safety. A recent evaluation (Padgett and Waller, 1975, Note 4) of one such curriculum in North Carolina found statistically significant differences on paper and pencil tests of traffic safety knowledge before and after classroom instruction was implemented. However, a similar pre-post comparison using behavioral observations showed virtually no improvement in actual pedestrian skills.

The effectiveness of one pedestrian safety program was analyzed by Page, Iwata, and Neef (1976). Pedestrian safety skills were taught to six retarded persons aged 16 to 25 yr using intensive one-to-one instruction by behaviorally trained staff on a classroom model simulating actual traffic conditions. Five skills were sequentially taught, and each person required, on the average, 5.3 hr of training to reach acceptable skill levels. Though the procedure is a significant contribution to the teaching of independent living skills to older, retarded persons, a rapid, efficient method to teach simultaneously several pedestrian skills to young children on a group basis is needed.

Though attempts to evaluate pedestrian safety programs have been rare, Jackson, Mayville, and Cowart (1972; also reported by Reading, 1973) used elementary school children in an investigation of the effects of an assembly program and reinforcers delivered by observers on the street-crossing behavior of young children. The observational form used did not contain walking and looking for traffic while in the roadway, but it did include a conglomerate of appropriate behaviors in the definition of a correct crossing. Also, their method of data collection precluded an examination of effects on individual subjects and safety components.

The present study was designed to produce a field-tested model that could then be extended on a community-wide basis. The model then serves as a prototype for possible exportation to other communities sharing the same problem. Specifically, the purpose of the present study was to evaluate an instructional package used to teach pedestrian safety skills to young, elementary school children at two schools. The effects of the training program implemented on the street corner were analyzed both on a street where an adult crossing guard was present and on a nearby generalization street where there was no guard. Long-term followup measures were also taken.

METHOD

Subjects

Twelve children at each of two elementary schools participated in the study. Children were chosen who walked to school and crossed streets where training and generalization measures could be taken. Children were questioned in the morning on the training street, and their addresses were checked in the school office to ascertain if they crossed the generalization street. At School A, there were an equal number of males and females, of which seven were in the second grade and five were in the third grade. At School B, there were seven females and five males, of which four were in kindergarten and eight were in the first grade. Children ranged in age from 5 to 9 yrs. All children except one were reported to be "normal" by their teachers; S6 at School B was described as "very slow" by her teacher. (Subsequently, it was learned that one child (S7) at School A used two different routes to walk to and from school. No attempt was made to change the relative frequency of use of these two routes.)

After an initial population had been chosen, parent permission was obtained at School A. At School B, the principal suggested that children bring home a notice informing parents of their children's future participation in a pedestrian safety program and urging them to phone the school principal if they had any questions concerning the program.

Setting

Four intersections, which met two criteria, were chosen: an adult crossing guard was present on one of the streets, and a high frequency of elementary school children walked on both of the streets at a given school.

As shown by the line of dashes in Figure 1, children at both schools would walk to the training street and cross as soon as the guard held traffic. This intersection was the eventual site of training. After crossing the generalization street, children would continue home.

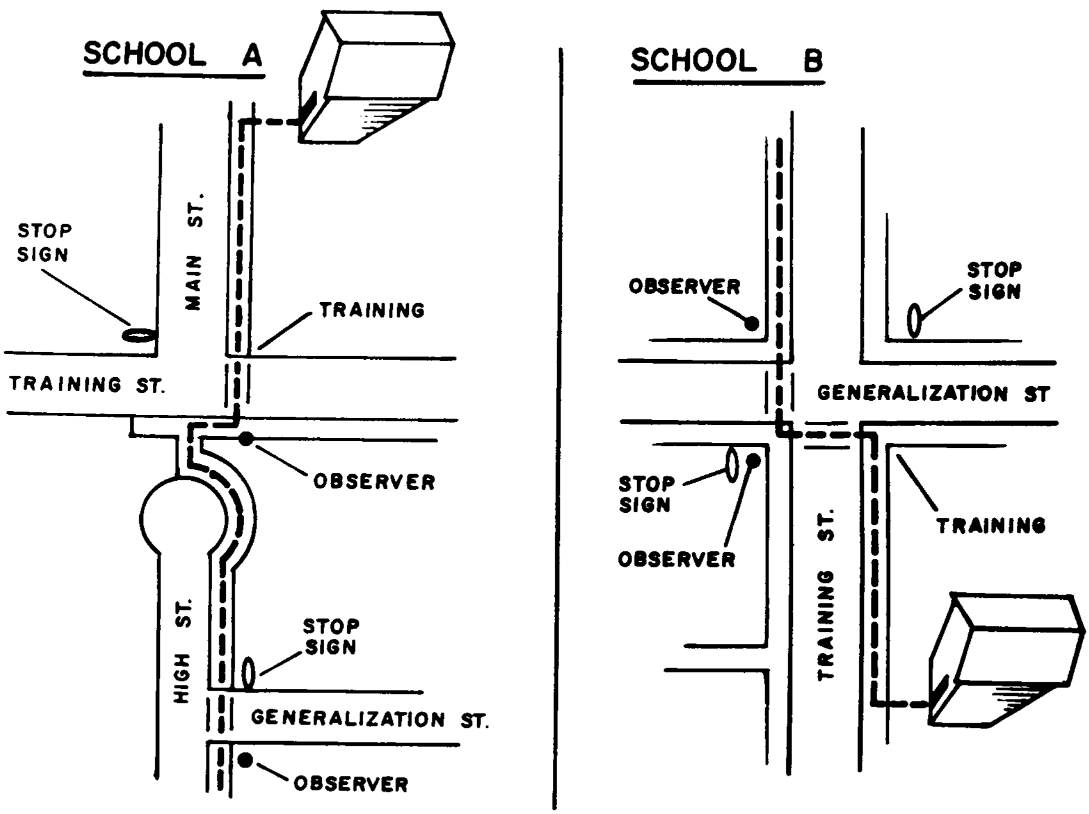


Fig. 1. The route taken in the afternoon by the experimental children at both schools is shown by the dashed line. At School A, the training street and Main Street appeared to have moderate amounts of traffic; the generalization street and High Street apparently had light traffic flow. At School B, both streets, but especially the training street, appeared to be heavily trafficked.

Observation and Reliability

Afternoon observations were made at the training and generalization streets of each school. Morning data were taken at both schools on the training street, but these data are not included due to the extremely low frequency of child crossing. (Many children were brought to school by their parents.)

Observers were positioned on the side of the road facing the children and within 1.6 to 7.6 m from the crosswalk where children passed. The specific positions were chosen to maximize visibility of traffic and children, to minimize obtrusiveness of observation, and to ensure child safety in case of emergency. Observers were instructed to avoid conversation with subjects but to respond in a brief but friendly manner if necessary (*e.g.*, "I'm sorry, I can't talk right now. I'm very busy.").

Seven observers were used throughout the research. All were undergraduates at the Florida State University. During the study, a reliability observer was present on 20% of the 91 occasions when children were observed at the four locations. Each observer would record the presence or absence of correct street-crossing behaviors for each child, unless two or more children crossed simultaneously. In this case, the behaviors of two children were observed, and a portion of the reliability was sacrificed in order to maximize the amount of individual data available. Reliability checks were taken at least once during each of the baseline, training, and prompt conditions at each school and location except during baseline at the training street at School B, when it became necessary on two different occasions for the reliability checker to substitute for an absent observer. Different observers were present on different days at each of the four sites except at the generalization street at School A. A reliability check was made at least once on each of the seven observers by three different reliability observers.

Reliability was assessed by the percentage of observer agreement. This percentage was calculated by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100. An agreement was scored when both observers marked yes (no) to indicate when a child had performed a street-crossing component correctly (incorrectly). When a particular street-crossing component was *not* observed by a primary or reliability observer, an "X" was marked in this child's box on the data sheet, and this information was not used to calculate reliability. However, when an "X" was scored by only one observer for the same child and component, the information recorded by either observer was used in calculating individual and group data. A disagreement was scored when one observer marked a component yes (no) for a given child, and the other observer marked the same component no (yes). The range of the daily reliability was 83 to 100%, with all but three of the reliabilities over 90%. The mean reliabilities by component were: 94% for Wait at Curb, 88% for Look All Ways, 89% for Watch Vehicle Distance, 96% for Walk, 92% for Continue to Look, and 99% for Use Crosswalk. The overall mean reliability was 93%.

Response Definitions

Six independent components were used to define correct street crossing. Each component appears in at least one of the American Automobile Association safety publications for parents and children (*e.g.*, *Safe Walking Tips*, *Note 5*). The definitions were:

Wait at Curb. The child comes to a complete stop on the curb (or off the edge of the roadway) within 1 sec of initiating a crossing.

Look All Ways. Before leaving the curb, the child will look in all possible ways that traffic may pass just before entering the street. This is accomplished by looking left and right, with each look at least 45° from the "straight ahead" line.

Watch Vehicle Distance. A child is considered to have watched vehicle distance when no vehicle coming toward the child passes within

7.6 m of the area of roadway adjacent to or on the path of the child during the duration of a crossing. (These points were marked with tape to ensure high interobserver reliability.) If the driver of a vehicle that has stopped signals a child who is waiting on the curb to cross, consider the child to have attended to vehicle distance. (Note: The Watch Vehicle Distance component was not recorded on the training street, since the guard determined when a crossing should occur.) This definition was purposely stringent given the lack of an accepted guideline concerning the appropriate time to initiate a cross.

Walk. The child must walk to the opposite curb and not come to a complete stop while crossing the street. Nonwalking includes running, hopping, and skipping at any point in the road.

Continue to Look. The child must look at least once in each possible direction that a car may pass after leaving the curb and before arriving on the opposite curb. This is accomplished by looking left and right with each look at an angle at least 45° from the "straight ahead" line. The look to the left and to the right may occur at any point during the duration of the crossing.

Use Crosswalk. The child will keep both feet on or within the lines of the crosswalk for the duration of the crossing.

Pedestrian Safety Instructional Package

During a single training session, four phases were used to teach pedestrian safety skills. Within each phase, the following eight steps were emphasized[2]: walk on sidewalk, cross on corner, and safety components 1 to 6 included in the *Response Definitions* section. Children were also instructed to "Use these steps each time you cross the street" in Phase I and asked an appropriate question during Phase III.

The four phases and the eight steps were written on a 50.8 by 63.5 cm poster covered with transparent plastic. The poster was used during each training session to help direct the children's attention to the task at hand. The poster also helped to ensure that instructions were given on a consistent basis from day to day.

Phase I: "Tell Them". The trainer described the correct behaviors involved in each of the eight steps. For example: "You should always walk on the sidewalk if there is one, except when you have to cross the street. See, there is no car coming in any direction so it is okay to cross. Now, there is a car and it's *too close* for you to get all the way across before it gets here so you should wait. Here comes another car that is far away so you could cross right now. Now it's getting closer, but it's still okay to cross. (These points of minimum distance to initiate a crossing were confirmed during consultation with the crossing guard.) Now it's too close, and you will wait on the curb. Now you look on one side and the other and make sure all the cars are far away before you start to cross."

Phase II: "Show Them". The trainer demonstrated the complete street-crossing sequence so the children could watch. The trainer verbalized the steps while completing the response chain: stop at the curb, look left, look right, walk, look left, look right. The trainer did not step into the road when there was a vehicle in close proximity and took only a few steps into the road to model the response chain.

Phase III: "Ask Them". The trainer translated each of the eight steps into an appropriate question and asked the group to answer. For example: "Where should you wait when you are getting ready to cross the street?" "Should you cross when a car is close?" "When should you cross?" Occasionally, a specific individual was asked a question to ensure that everyone was paying attention. The questions were not asked in the order in which the steps appeared on the poster. Correct answers were conse-

[2]A cassette recording of an actual training session is available from the first author, Department of Psychology, Florida State University, Tallahassee, Florida 32306.

quated with descriptive praise. If someone did not answer a question or gave an incorrect response, they were told the correct answer and asked the same question again. When the correct answer was obtained, the next question was asked. Approval was given by saying such things as: "Wonderful, that's another correct answer. You remembered that you should stay between the lines."

Phase IV: "Let Them". The children were allowed to practise the pedestrian safety steps with the guard present to intervene in case of a potential emergency. The guard was also instructed to supply immediate descriptive feedback for correct and incorrect responses during a crossing. For example, they might say: "Right! That's excellent! You remembered to walk."

As every child prepared to cross, the trainer asked each one to verbalize what they would do during their cross. Praise was given for correct responding. Mistakes were corrected, and the child was asked to repeat the correct answer. As the first child was about to initiate a cross, the second child was asked to observe the first child's crossing and verbalize any errors. Praise was given for correct indication of errors, while mistakes of observation were corrected. The second child then verbalized the pedestrian safety steps before they crossed, and the third child was instructed to observe and point out errors. These self-instructional procedures, which incorporate techniques similar to those used successfully by Meichenbaum and his colleagues (Meichenbaum and Goodman, 1971; Meichenbaum and Cameron, 1973), were continued until all the children had crossed.

Experimental Conditions

A multiple-baseline design across two groups of six children was used to analyze the effects of the instructional package on pedestrian behavior at both schools. Children were assigned to groups so as to equate baseline level of responding and to preserve natural pairings of brothers and sisters and those children who typically walked together. The order of training the two groups at each school was random. The experimental conditions were as follows:

Group Baseline. On the first three days at School A, children were observed as they normally crossed the street. This condition was terminated when it became obvious that a single observer could not easily monitor the component behaviors of experimental children as they crossed the street with large groups of non-experimental children. Also, many experimental children crossed simultaneously, which made observation difficult.

Baseline. Children were released from school approximately 15 min early each day. The training-street observer met the children at the school office and accompanied them to the street corner. Here they lined up in single file approximately 3 m from the curb and were told to cross the street when the crossing guard signalled. The guard went to the center of the street to hold traffic and gave a signal to cross to each child. Children were told to wait at a point some distance from the training street if they had been instructed by their parents to walk with a brother, sister, or friend in their experimental group.

Training. On the first day of training at each school, Group 2 crossed the street as they had during baseline. Then, Group 1 received the pedestrian safety skills instructional package on the corner of the training street. After Group 1 had received training, this order was reversed; Group 1 crossed first, followed by Group 2, the current training group. Training was given by the first author on nine of the 11 training days.

Children received the following greeting: "Hi! Today I'm going to help you learn the right steps in crossing the street safely." Children were instructed to cross new streets only with parent permission and to continue to ask their parents when they wanted to leave the confines of their parents' property. After the instructional package was given, the children were allowed to practise the pedestrian safety steps. From the center of the street, the guard signalled each child to cross. The guard returned to the training corner to allow observers time to record data and to minimize the disruption to the natural flow of traffic. This procedure was especially important at School B where the generalization street was in such close proximity to the training street. However, the procedure did seem to increase the probability that the subject would have to wait at the curb, since vehicles stopped by the guard were now passing by.

Although the same general procedure was used on each day of training, less time was taken on successive days to explain the eight steps during the "Tell Them" phase. Also, the crossing guard at School A served as trainer on Day 3 of training with Group 1 and on Day 2 of training with Group 2.

Immediate Followup. While Group 2 received instruction on the training street, the experimental procedures on the generalization street were exactly as in baseline and training. This condition represented a brief followup period of those children in Group 1 who had already received training.

Prompt. After formal instruction on the training street, the crossing guard reminded the children each day with the following message: "I want each of you to remember to use all the safety steps every time you cross the street." An observer gave each child a similar message before he/she crossed the generalization street: "I want you to remember to use all the safety steps every time you cross the street." At School B, the training-street observer delivered this message immediately after each subject finished training-street crossing. At School A, the generalization-street observer delivered this message after the children had walked about 0.2 km at a point approximately 3 m before the generalization street. Before this time, all conditions on the generalization street had referred to experimental procedures in effect on the training street.

At School A, children were allowed to initiate an independent crossing without the assistance of a guard. However, the crossing guard stood approximately 1.5 m behind and 1.5 m to the left of each child before they crossed. From this position it would have been possible to terminate verbally and/or physically an unsafe crossing; fortunately, this was never necessary. Due to the high volume of traffic at School B, children would have been forced to wait an inordinate period of time to initiate a crossing. Therefore, this feature was not implemented at School B, despite its potential benefits.

ONE-YEAR FOLLOWUP AND REMEDIATION

Subjects and Setting

Ten children at School A and four children at School B were available to participate in a 1-yr followup of the program. The intersections crossed and route taken by the children were identical to those of the original study.

Observations and Reliability

Afternoon observations at the training and generalization streets at each school were taken from the same positions as in the original study by six newly trained observers and one observer who had taken data during the previous year. A reliability observer was present on 68% of the 22 occasions when children were observed at the four locations. The procedures for calculating reliability were identical to those used in the original study. The range of daily reliability was 63 to 100%, and the overall mean reliability was 90%. Reliability checks were taken at least once on the training and generalization streets during all conditions of the 1-yr followup. The mean reliabilities by component were: 89% for Wait At Curb, 76% for Look All Ways, 87% for Watch Vehicle Distance, 94% for Walk, 94% for Continue to Look, and 97% for Use Crosswalk.

Followup Conditions

One-year followup (School A, three days; School B, two days). Children were released from school approximately 15 min early each day and were accompanied to the street corner. They received the single instruction: "Now I want to see how you cross the street when the crossing guard holds traffic." Otherwise, the procedures were identical to the baseline conditions of the original study.

Remediation training (School B, one day). Remediation training was identical to the procedures used in the original training condition, except that more time was spent on those street-crossing skills that had not been performed during the initial two days of the 1-yr followup. No prompt was given on the generalization street.

Remediation prompt (School B, two days). The crossing guard prompted the children at School B with the message: "I want each of you to remember to use all the safety steps every time you cross the street." Again, no prompt was given on the generalization street.

Remediation followup (School B, three days). After one week, the children at School B received the single instruction: "Now I want to see how you cross the street when the guard holds traffic." Once again, no prompt was given on the generalization street.

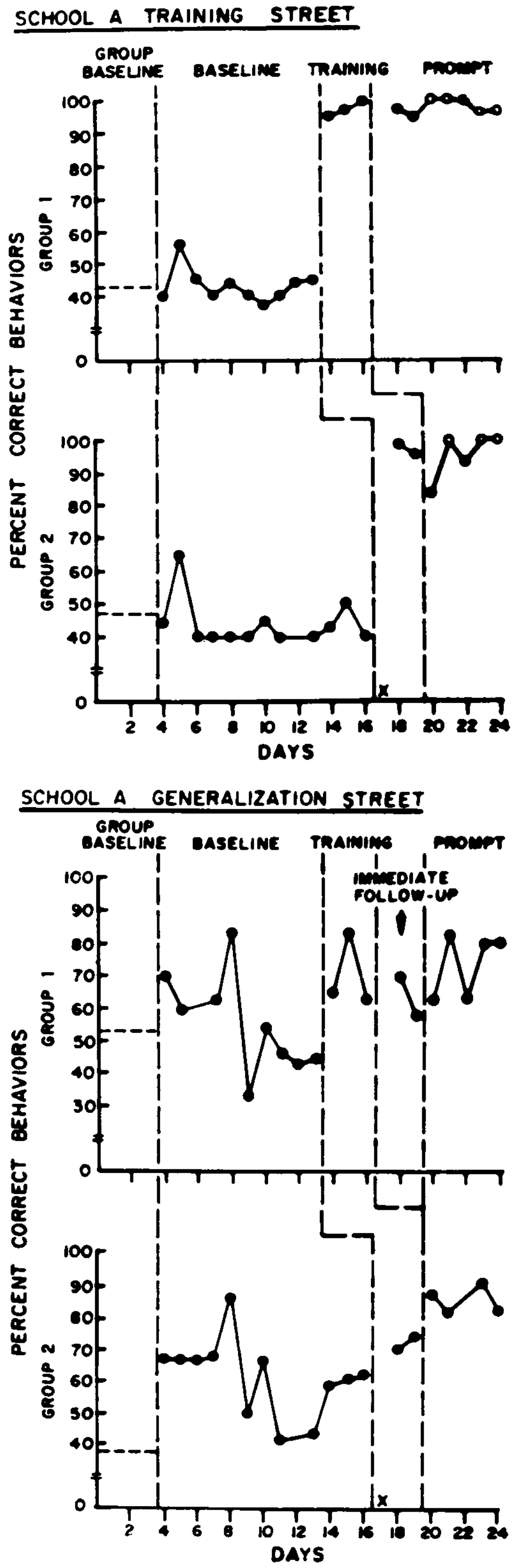
In summary, the complete sequence of experimental conditions was: group and individual baselines, pedestrian safety training, immediate followup with Group 1, and a prompt procedure. Subsequently, a 1-yr followup was conducted at both schools. At School B, remediation training and remediation prompt conditions were instated, as well as a one-week remediation followup.

RESULTS

The percentage of correct pedestrian behaviors of the two groups of children at School A on the training street is shown at the top of Figure 2. During the baseline conditions, correct pedestrian responses typically ranged between 40% and 50%. When the pedestrian skills instructional package was implemented with Group 1, the percentage of correct behaviors rose immediately to 95%, and reached 100% by the third day of training. Meanwhile, Group 2's percentage of correct responding remained within the 40 to 50% range. When this group received training, the group average went to 100% on the first day and stayed above 95% during training. A brief prompt was sufficient to maintain high levels of correct responding. Allowing children to cross independently was not associated with a decrease in appropriate responding. In fact, of the eight days when either of the two groups crossed perfectly, five occurred when they crossed independently.

On the generalization street at School A, also shown in Figure 2, baselines of both groups were relatively unstable. The average during group baseline was comparable to the baseline level for Group 1 but lower for Group 2. During baseline, Group 1's average (54%) was somewhat lower than the average in Group 2 (61%), though both groups stabilized before training. When instruction was given on the training street, the average percentage of correct behaviors rose to 73% in Group 2 and 72% in Group 1, but dropped to 65% during the followup condition for Group 1. When both groups received prompts, the average increased to 75% in Group 1 and 86% in Group 2.

At School B, shown at the top of Figure 3, baseline level of responding for both groups stabilized between 10% and 20% after the first three days. When training was implemented with Group 1, percentage of correct responding rose to 77% on the first day of training and reached 88% on the third day. Group 2's percentage of correct responding rose immediately to 77%, and showed a general upward trend over the three days of training. When training ceased, both groups dropped initially, rose eventually to reach 100%, and de-



creased slightly over the final few days of the study.

Figure 3 also shows the generalization-street data for both groups at School B. Both groups showed a general pattern of decrease during baseline, though Group 2's percentage increased during the three days just before training. When instruction was given on the training street, the average percentage increased to 66% for Group 1 and 65% for Group 2. Both increases were more than 20% over the baseline level of responding. During the followup condition with Group 1, the percentage of correct responding decreased slightly. When prompts were delivered, Group 1's average rose slightly to 69%. Group 2's increase was nearly 10%.

Figure 4 shows the training-street data at School A. Increases due to the instructional package were unambiguous across all 12 experimental children. However, at the generalization street, effects were less clear due to the variability within conditions. There would appear to be clear increases in the percentage of correct behaviors in Subjects 5, 6, 9, 10, 11, and 12. Subjects 1, 2, 4, and 8 are associated with smaller increases in pedestrian skills. The small number of data points in the graphs of Subjects 3 and

Fig. 2. The per cent of correct street-crossing behaviors by two groups of six children at School A on the training street (top) and generalization street (bottom). Results are shown across group baseline, baseline, training, immediate followup (on the generalization street only), and prompt conditions. Due to the difficulty in obtaining data on all children during the group baseline condition, the average per cent correct behaviors over the first three days of observation is represented by the dashed line. The "X" marks a single day when heavy rain prevented observations of children. The open circles indicate days when some children crossed the training street without assistance from the crossing guard. Each point on the training-street graph represents at least 15 observed behaviors or one half the maximum possible total for a given day. Each point on the generalization-street graph represents at least 18 observed behaviors or one half the maximum possible total for a given day.

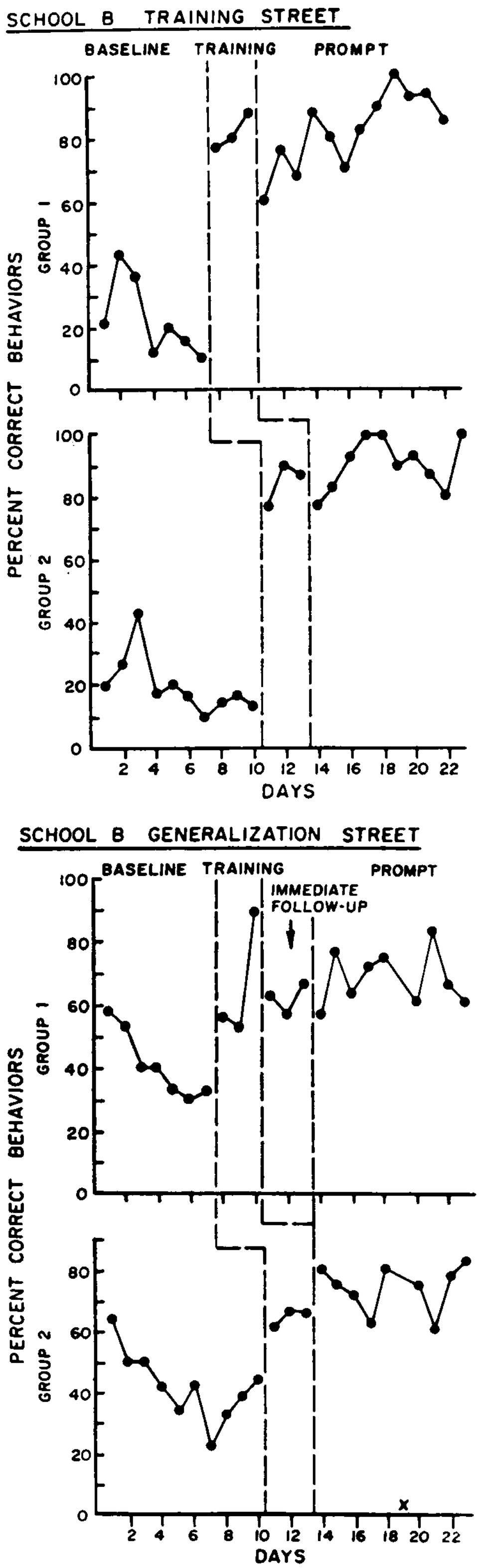


Fig. 3. The per cent of correct street-crossing behaviors by the two groups of six children at School B on the training street (top) and generalization street (bottom). Results are shown across baseline, training, immediate followup (on the generalization street only), and prompt conditions. The "X" marks a single day when generalization-street data were not available due to the absence of an observer. Each point on the training-street graph represents at least 15 observed behaviors or one half the maximum possible total for a given day. Each point on the generalization-street graph represents at least 18 observed behaviors or one half the maximum possible total for a given day.

7 prevent any conclusive statements about the effects of the instructional program.

In Figure 5 at School B, the individual data on the training street likewise show clear and consistent increases for all 12 children. Again, the generalization data are quite variable within experimental conditions. However, increases are apparent in Subjects 1, 2, 3, 4, 8, 9, and 12. Smaller increases occur with Subjects 5, 7, and 11. Subjects 6 and 10 show minimal increase.

Figure 6 shows the average percentage of correct street-crossing behaviors on the training and generalization streets for the subjects at both schools during selected conditions of the study for those children available during the 1-yr followup. On the training street at School A, the average percentage of street-crossing behaviors for the 10 children decreased from 97% during posttraining to 79% in the 1-yr followup. Of the 28 mistakes made during this condition, 17 were on the Wait-At-Curb category. At the same time, on the generalization street at School A, the percentage of correct behaviors increased from 78% to 87%.

On the training street at School B, the average percentage of appropriate street-crossing behaviors for the four children in the 1-yr followup decreased from 89% during posttraining to 49% during the 1-yr followup but remained above the 21% level during baseline. On the generalization street, the average percentage of correct behaviors (52%) was again almost midway between the posttraining level (72%) and

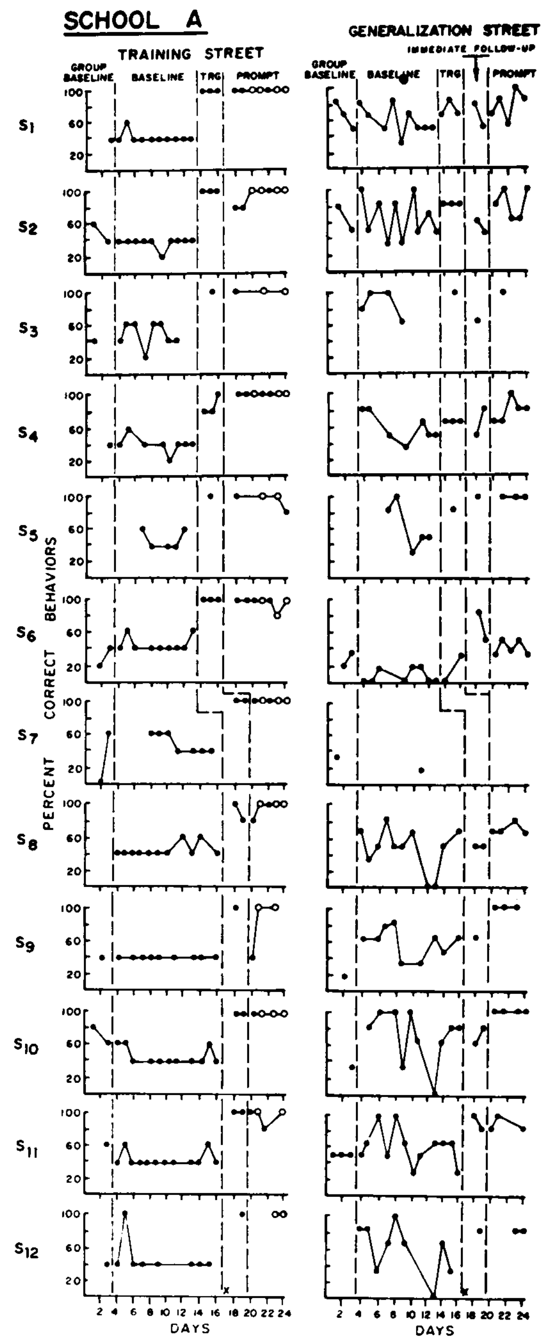


Fig. 4. The per cent of correct behaviors made by the 12 children at School A on both the training and generalization streets for each experimental condition. Open circles show days when a subject crossed the training street without assistance from the crossing guard. The "X" marks a single day when heavy rains prevented observations of children.

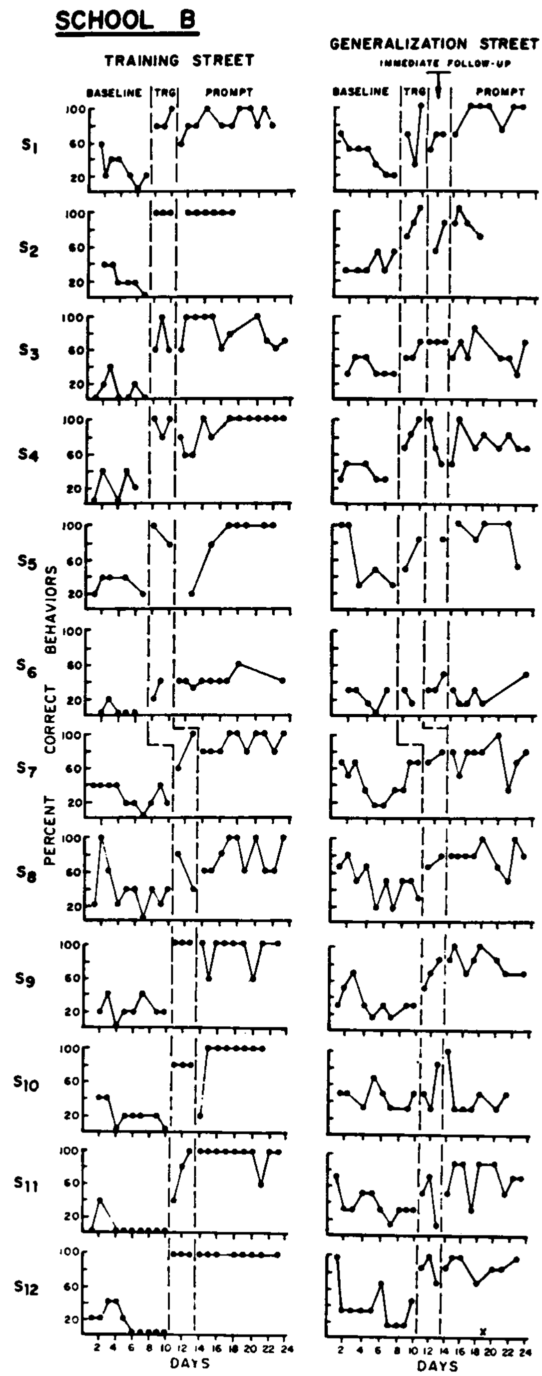


Fig. 5. The per cent of correct behaviors made by the 12 children at School B on both the training and generalization streets for each experimental condition. The "X" marks a single day when generalization street data were not available due to the absence of an observer.

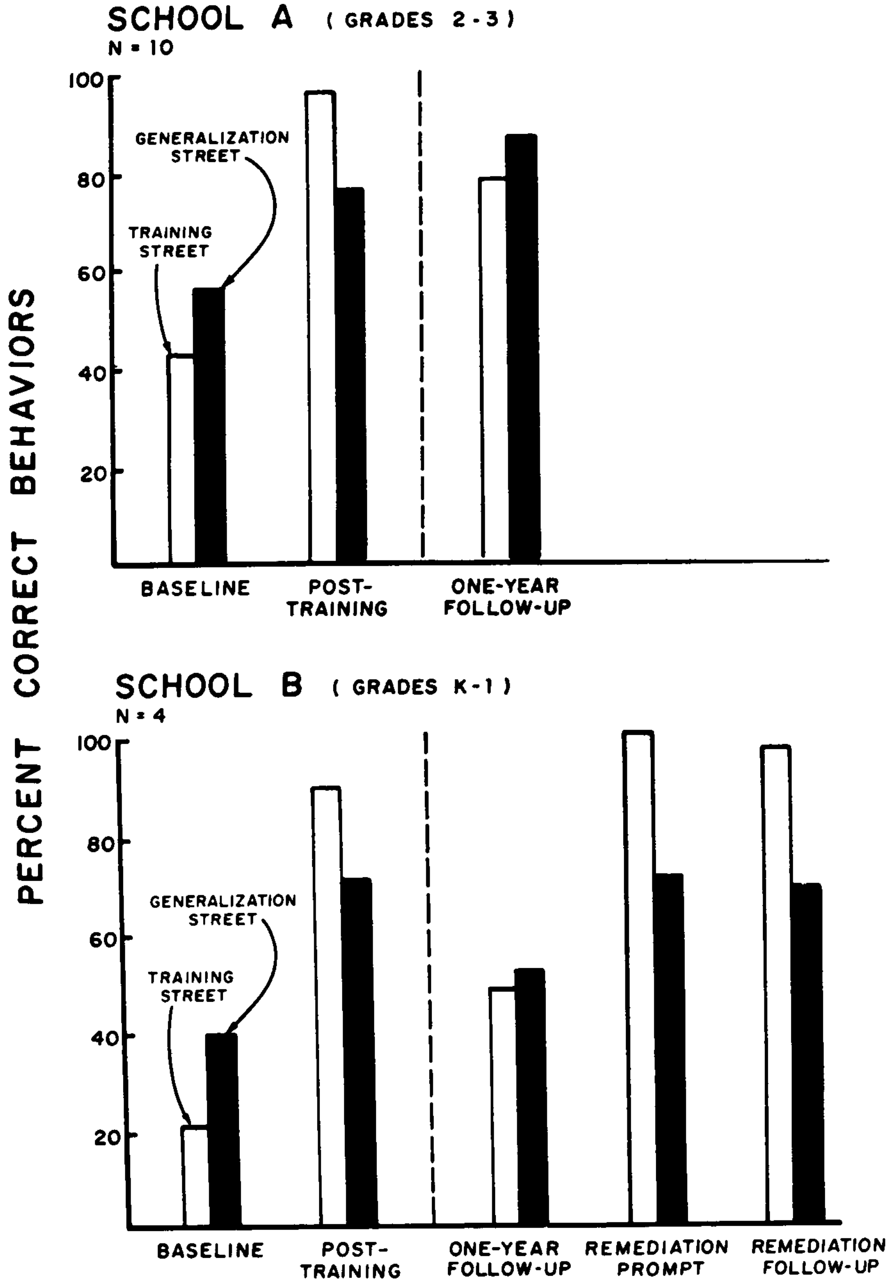


Fig. 6. The per cent of correct street-crossing behaviors by 10 children at School A and four children at School B for selected conditions of the study. Data are shown at both schools during baseline, posttraining, and 1-yr followup conditions on both training and generalization streets. School B's graph also shows subsequent remediation prompt and remediation followup conditions.

the baseline level (40%). The one-day remediation training (not shown in Figure 6) raised the level of correct behaviors to 90% on the training street and 79% on the generalization street. During the remediation prompt condition, the percentage of correct behavior was 100% on the training street and 73% on the generalization street. The percentage of correct behaviors was 97% on the training street and 69% during remediation followup. Twelve of the 22 mistakes made on the generalization street were in the Watch-Vehicle-Distance category.

Training Time

An average of 16 min per training session (range 10 to 25 min) was required for each of the 11 days the instructional package was administered.

DISCUSSION

An instructional package implemented on the street corner proved to be an effective procedure to teach pedestrian safety skills to elementary school children. Immediate and significant increases in safe street-crossing behaviors were evident with each of two groups of children, and the increases were replicated at a second school. The beneficial effects of instruction were evident in all 24 children who received training. Seven of these children who crossed the training street after receiving training or a brief prompt did so with no errors at any time. Each component of street crossing increased in frequency as a result of instruction. These findings extend the one-to-one procedures of Page *et al.*, (1976) with retarded subjects, but suggest that the problem of generalization is more difficult than they indicated. Safety skills recently acquired as a result of training were also used on a nearby street, though beneficial effects were less pronounced and varied in degree across different experimental subjects and safety components. Individual remediation of mistakes might have produced larger increases in correct behaviors.

The results of the 1-yr followup indicate that pedestrian safety skills either maintained at high levels or could be quickly recovered from intermediate levels with only a minimum of remedial training. Since prompts were never given on the generalization street during any of the conditions of long-term followup or remediation, the findings provide a stern test of the durability of training. On the training street at School A, skill levels maintained near 80% after 1 yr. The majority of mistakes were in the Wait-At-Curb category, a deficiency that is understandable, given that the crossing guard was holding traffic. On the generalization street, the percentage of correct behaviors actually increased to approximately 90%. At School B, the 1-yr followup data on both streets are approximately midway between the original baseline and posttraining levels. However, after one session of remediation training, two days of remediation prompting on the training street increased the percentage of correct street-crossing behaviors to a level slightly higher (100 *versus* 89% on the training street and 73 *versus* 72% on the generalization street) than during posttraining. A one-week remediation followup left the percentage of appropriate street crossing at a level comparable to the original posttraining results. Furthermore, the percentage of correct street crossing on the generalization street might have been substantially higher, except for the stringency of the Watch-Vehicle-Distance definition where subjects made the majority of their mistakes. It appeared that the volume of traffic produced few occasions when the subjects could have been credited with satisfying the Watch-Vehicle-Distance definition.

One ironic result of careful assessment of the maintenance of skill levels across lengthy followup periods is the tentativeness of the conclusions that can then be drawn with regard to initial training. It is possible that as children age they learn new pedestrian safety skills or use them more frequently. Strong statements about the skill utilization of individual children as a function of the experiences associated with aging await long-term observations of untrained, normative control children. Differences other than age (*e.g.*, configuration of streets, proximity of training and generalization streets, use of the independent crossing procedure at School A) also distinguished the children at the two schools used in this study, and prohibit definitive statements regarding the association of age levels with maintenance of skills. For whatever reason incomplete maintenance of training effects occurred with some children, this research suggests that though remedial training may be necessary, remediation will reinstate high skill levels with accompanying savings of training time.

Several features of the findings require careful scrutiny. For instance, the variability in the group data, especially on the generalization street, was partially due to the presence or absence of children with very high or very low levels of correct pedestrian behaviors. This variability may also be partially attributed to the defining characteristics of the Watch-Vehicle-Distance category, which was recorded only on the generalization street. A child who was not watching traffic would receive credit for Watch Vehicle Distance automatically if no vehicles were present. The exact same behavior on another day when traffic was present would receive no credit. In other words, the presence or absence of traffic, an uncontrolled variable varying across days and conditions of the experiment could have increased variability in the data. It is also important to note that the instructional package was differentially effective with particular safety components.[3] For example, the Watch-Vehicle-Distance response did not increase until the prompt condition. This may be due to the unrealistically conservative response definition chosen, since increased waiting and looking should bring the subject under the control of traffic-related stimuli (*e.g.*, speed of vehicle, sound of vehicle, *etc.*). Apparently, each definition for the correct time to initiate a crossing should be intersection-specific by taking into account the unique factors of the situation (*e.g.*, kind of intersection, volume of traffic, width of street, age of subjects, *etc.*).

The instructional package given on the street corner offers several advantages over a traditional, classroom-based program. The procedure would require no use of teacher time beyond the logistics of releasing small groups of students each day. Training in the situation where responding is required would seem to maximize the likelihood of transfer of training effects. Frequent and immediate feedback can be given in the setting where the behavior is performed. Also, *in-vivo* group training not only produces large and immediate effects but also does so with minimal expenditure of time per subject. Since an average of 16 min was required for each of the 11 training sessions, less than 8 min of time was spent for each of the 24 subjects in the study. A final advantage is that an adult skilled in traffic safety was always present to offer protection in case of a potential emergency.

Besides offering the above advantages, the program appears to be a feasible one to implement. The crossing guard at School A was able to deliver the training package skillfully after attending an instructional session of approximately 1 hr and being given the opportunity to observe the first author deliver training. Since the average length of training was approximately 15 min, there was little extra time burden on the guard, since they typically arrived for work before the end of school. The prompt delivered could easily be given by a safety patrol student. Together, these features suggest that the procedure could realistically be implemented without additional manpower by simply changing the role of existing student and adult safety personnel. Of course, the effectiveness of the program when implemented by existing personnel is itself an empirical question worthy of careful study.

Future research should address the problem of testing procedures specifically designed to maximize the generalization of pedestrian safety skills across streets. Addressing the possibility that a strong prompt such as: "Show me how safely you can cross the street," might be associated with higher baseline levels of pedestrian safety skills is also an important question for future research. Another concern is the nature of the most appropriate condition to initiate

[3]Graphs of the per cent of correct behaviors for each of the safety components on both streets at both schools during all experimental conditions before the 1-yr followup are available from the first author.

and terminate a pedestrian safety study. Assuming that the presence of peers may affect how a subject crosses the street, it becomes necessary to observe subjects during group crossing both pre- and posttraining. However, additional observers or videotape observations seem to be necessary to accomplish this. A final issue will be the development and evaluation of procedures to teach crossing guards and other adults how to administer the safety package.

Apparent from this research are the potential benefits of a behavioral approach to the field of safety education. The demonstration of an effective, durable, and practical technology to teach pedestrian safety that can then be systematically extended community-wide is a critical first step in the solution of this socially significant problem. By expanding the competencies of an adult, such as the crossing guard, to include teaching as well as protecting young children, safe passage can be given all the way home. Clearly, the transfer of stimulus control from the guard to traffic is an important step in guaranteeing this safe passage.

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