A COMMUNITY-WIDE INTERVENTION TO IMPROVE PEDESTRIAN SAFETY
Guidelines for Institutionalizing Large-Scale Behavior Change

THOMAS E. BOYCE *is an assistant professor of psychology and director of the Center for Behavioral Research Safety at the University of Nevada, Reno. He is also a faculty associate with the Department of Environmental Health and Safety. Dr. Boyce is an active member of the Association for Behavior Analysis and has reviewed manuscripts for the Journal of Applied Behavior Analysis and the Journal of Organizational Behavior Management.*

E. SCOTT GELLER *is a professor of psychology and director of the Center for Applied Behavior Systems at Virginia Polytechnic Institute and State University, where he has been a faculty member since 1969. He is a fellow of the American Psychological Association, the American Psychological Society, and the World Academy of Productivity and Quality. He is past editor of Journal of Applied Behavior Analysis (1989-1992) and current Associate Editor (since 1983) of Environment and Behavior.*

ABSTRACT: An A-B-A reversal design with a long-term follow-up evaluated a community-wide commitment and incentive program to improve pedestrian safety. The campaign encouraged residents of a college community to sign promise cards to use crosswalks when crossing campus roads and to yield to pedestrians in crosswalks when driving. Crosswalk use increased during a 6-week intervention period to 68%

AUTHORS' NOTE: *Preparation of this article was supported in part by a contract to the second author from the Virginia Department of Motor Vehicles through the National Highway Traffic Safety Administration, Washington, DC. The authors acknowledge the contributions of their colleagues in the Center for Applied Behavior Systems, whose persistence made this research possible. A special thanks is extended to Candy Cecil, who was instrumental in the design of the promise card. Correspondence concerning this article should be addressed to Thomas E. Boyce, Department of Psychology/296, University of Nevada-Reno, Reno, NV 89557, or E. Scott Geller, Center for Applied Behavior Systems, 5100 Derring Hall, Department of Psychology, Virginia Tech, Blacksburg, VA 24061-0436. Electronic mail may be sent to teboyce@unr.edu.*

ENVIRONMENT AND BEHAVIOR, Vol. 32 No. 4, July 2000 502-520

(n = 1,718) from a baseline mean of 58% (n = 2,038). Driver-yielding behavior significantly increased throughout the study, from a baseline mean of 23% (n = 979) to a mean of 44% (n = 272) for 2 weeks after the removal of intervention materials and termination of publicity. Observations of crosswalk use and yielding behavior 1 year after the intervention revealed that crosswalk use returned to near baseline levels (61%, n = 1,954), but driver-yielding behavior (53%, n = 602) remained high, substantially above the baseline. Recommendations for institutionalizing pedestrian safety campaigns are offered.

Approximately one half of all fatalities involving a motor vehicle also involve a pedestrian. In addition, pedestrian injuries occur most commonly as a result of midblock crossings (Harborview Injury Prevention Research Center, 1997). Given that in the United States 115 people die each day in a motor vehicle crash (National Highway Traffic Safety Administration, 1998), it can be estimated that at least 50 of these deaths involve pedestrians. At the setting for this research, 14 pedestrians and 11 bicyclists were hit by vehicles in less than 1 year. One of these incidents resulted in a pedestrian fatality. Thus, according to accepted criteria (e.g., Baer, Wolf, & Risley, 1968, 1987; Kazdin, 1977; Wolf, 1978), pedestrian safety is a socially significant problem worthy of systematic behavioral research.

Previous attempts to increase pedestrian safety have relied heavily on engineering strategies or a redesign of the traffic environment. This has been accomplished by increasing the visibility of pedestrians (Harrell, 1993); decreasing traffic flow (Harrell, 1992); and increasing the number of signs, flashing lights, and other warning signals (Garder, 1989; Harrell, 1994; Jonah & Engel, 1983; Van Houten & Malenfant, 1992). In addition, these strategies have been paired with enforcement procedures that provide disincentives or announcements of punitive consequences for not obeying the law. Laws, if consistently enforced, can be effective. However, in the domain of pedestrian safety, applications of negative consequences for inappropriate behavior are inconsistent and rare.

To illustrate, an intervention package to increase pedestrian safety was evaluated by Malenfant and Van Houten (1989), who used advance stop lines for vehicles at pedestrian crossings as well as "pedestrian crossing" warning signs. The intervention also involved (a) the local police, who ticketed drivers not yielding to pedestrians; (b) community feedback signs to track safety progress; and (c) community education on crosswalk behavior delivered through fliers, signs, and other forms of media attention. The total program resulted in a 50% reduction in pedestrian injuries. Because there was a simultaneous implementation of several intervention strategies, the impact of any one intervention component could not be determined. However, Harrell

(1994) reported that crosswalk warning signs placed at various distances from a crosswalk had no effect on motorists' yielding.

Thus, consistent with the recommendations of Azrin (1977), it could be speculated that a combination of strategies is necessary to improve pedestrian safety. Because engineering strategies or "traffic calming" techniques such as warning signs (Van Houten, 1998) are not always feasible or practical, it may be most effective to combine interventions that target behaviors directly in a straightforward manner (Geller, 1996).

Pedestrian safety may be improved, for example, by providing specific information on relevant safe versus at-risk behavior and asking for a personal commitment to choose the safe alternative. As operationalized by Geller and Lehman (1991), a *commitment* is a personal pledge or promise to abide by a certain rule; a *rule* is a verbal description of a contingency (Malott, 1992). Although no explicit consequence is specified with a promise strategy, participants might add self-imposed consequences, such as social disapproval for not following a promise (Stokes & Baer, 1977). In essence, a promise strategy operates by the same principle as a traffic law but is met with less countercontrol (Skinner, 1953, 1974) or reactance (Brehm & Brehm, 1981). Countercontrol results from inconsistent and infrequent occurrence of punishing contingencies (Skinner, 1974), as is often the case with traffic laws.

Because commitments imply self-imposed consequences, they also influence self-directed behavior (Watson & Tharp, 1997). As a result, generalization across settings and maintenance of desired behavior change are more likely because provision of the consequence does not require the presence of a law enforcement agent (cf. Boyce & Geller, 2000). Such a phenomenon was referred to as *mediated generalization* by Stokes and Baer (1977). Promise card commitment strategies have been effective at increasing safety belt use among industry workers (Kello, Geller, Rice, & Bryant, 1988); pizza deliverers (Ludwig & Geller, 1991); and faculty, staff, and students throughout a university campus (Geller, Kalsher, Rudd, & Lehman, 1989).

This research offered a chance for the faculty, staff, and students of a large university in southwest Virginia to enter raffle drawings for prizes donated by local merchants. Raffle entry was contingent on signing a pedestrian safety promise card (adapted from Geller & Lehman, 1991). Residents of the community in which the university is located were also eligible. The promises committed participants to use crosswalks when walking across campus roads and, when driving, to yield to pedestrians in crosswalks. We hypothesized that an intervention package that provided a visible stimulus (i.e., a program theme) and a simple easy-to-follow rule (i.e., the safety commitment) would increase the number of pedestrians using crosswalks and the frequency of drivers yielding to pedestrians in those crosswalks.

METHOD

PARTICIPANTS AND SETTING

Participants were faculty, staff, and students of a large state university in southwest Virginia (N = 29,000; 3,800 faculty/staff and 25,200 students). Residents of Blacksburg, Virginia (N = 36,000), the community in which the university is located, were also potential targets of the intervention.

The university has a self-contained resident and commuter campus with a variety of single-lane and two-lane divided roads. Hashed crosswalks are located at all high-traffic areas of campus. Pedestrians in these crosswalks have the legal right of way; however, campus police rarely enforce this law.

Observations were made at five crosswalks, including one near the university's library and four near the university's "academic quad," the area of campus that houses academic buildings and the majority of classrooms. All the crosswalks extended through two-way traffic from sidewalks that are primary campus walkways. The speed limit at each observation site was 25 mph. None of the crosswalks were near a traffic-controlled intersection. These environmental characteristics are consistent with the environmental context surrounding most of the campus crosswalks.

MATERIALS

The Safety STAR logo and acronym. A logo was created to give the program a uniform and prominent theme. It was visible on all materials that promoted the pedestrian safety campaign. This logo is depicted in Figure 1; it was included on the top front portion of the promise card. The STAR acronym represented the four steps of the intervention process, as they were described in promotional flyers and media reports:

S = See—Observe others and pay attention to their behaviors related to pedestrian safety.
T = Think—Think before you act so you will give feedback in a way that won't hurt people's feelings or make them angry.
A = Act—Give rewarding or correcting feedback about pedestrian safety. Praise others for safe behavior or suggest a safe alternative for at-risk behavior.
R = Reward—Deliver or receive a prize coupon for behavior promoting pedestrian safety.

Promise cards. Figure 1 depicts the promise card used for a written commitment and raffle entry. The cards were printed on attractive glossy card

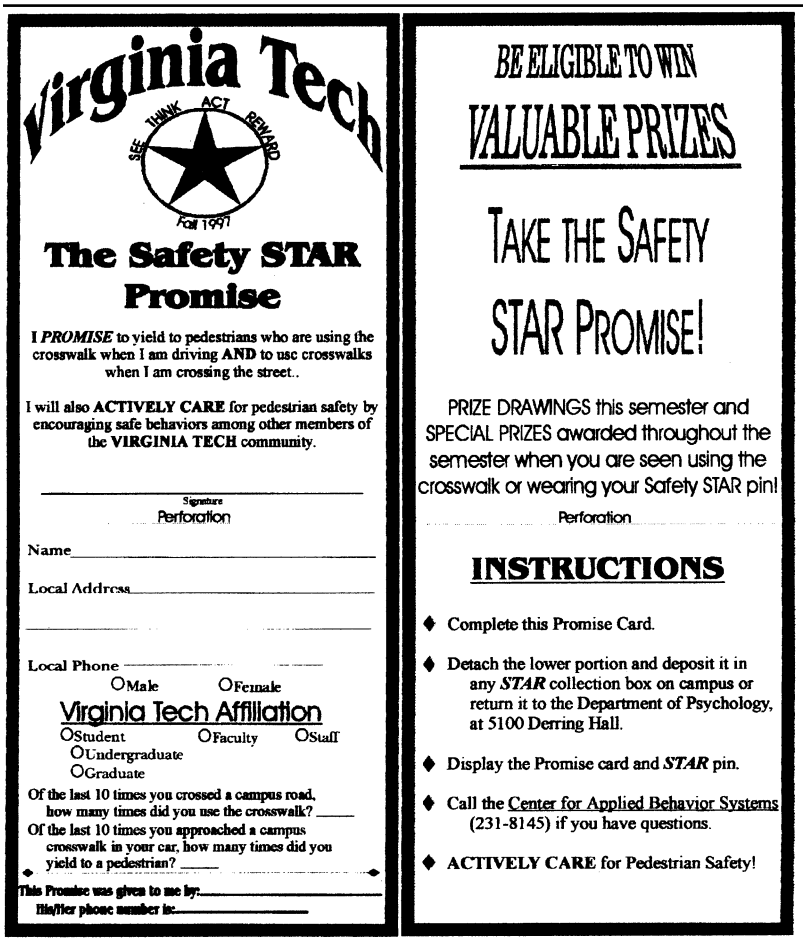

Figure 1: Pedestrian Safety STAR Promise Card
NOTE: The front and back of these cards are displayed. Cards were distributed to all participants, who were to fill out and return the bottom portion for raffle entry.

stock in maroon and orange, the school colors. They measured 4″ × 12″ and had a perforation across the middle to separate the promise portion (top) from the raffle entry (bottom). As shown in Figure 1, the top of the promise cards contained the Safety STAR logo and the promise statement. The front of the promise card (top portion) included a space for the participant's signature,

located directly beneath the written promise. On the back of the top portion was a description of the raffle incentive.

The bottom portion of the promise card (front side) contained an area for the participant's name, address, phone number, gender, and university affiliation. A place for the name and phone number of the person who gave out the card was located on the bottom (front side). The back of the promise card contained instructions about how to return the card and a phone number for participants to call if they had questions.

Trifold brochures. These also contained the Safety STAR logo on the front. The text explained the STAR logo and gave educational information on crosswalk use. A brochure accompanied the delivery of each promise card.

Buttons and T-shirts. The Safety STAR logo was printed on 3,000 buttons. These buttons simply had the STAR logo shown in Figure 1 with the university "VT" symbol in the center. Displaying the university colors, the buttons were worn by the 12 undergraduate research assistants on the project, except when conducting field observations. The buttons were also given to anyone who took additional promise cards for distribution to their friends.

White T-shirts with the STAR logo and acronym on the back in full color were worn by research assistants during formal pedestrian safety activities, including raffle drawings and promise-card distribution. The T-shirts were not worn by research assistants when they conducted field observations. The front upper left-hand corner of the shirts included the words "Center for Applied Behavior Systems" and "Pedestrian Safety Team" printed in black and positioned around the university's logo.

Posters. Posters were made for display in campus buildings and in community stores and businesses. They described the STAR acronym, provided information on upcoming raffle drawings, and encouraged the signing of promise cards. These were hung throughout the campus and in the windows of 30 businesses that contributed prizes for the raffle.

The posters were printed on 17″ × 22″ glossy poster paper. The posters displayed on campus contained the heading "BE A STAR AND WIN," whereas the posters in local businesses read "THIS STORE IS STAR QUALITY." Beneath the heading were the words "Actively Care for Pedestrian Safety" and a black-and-white drawing of a pedestrian displaying her Safety STAR button, using a crosswalk, and waving "thanks" to a yielding driver. The bottom of the poster displayed relevant incentive/reward information, including who was eligible, the duration of the pledge period, where promise cards could be obtained, what signing a promise meant, and how to receive a STAR

button. Superimposed behind this text was the STAR logo, as described previously.

Prizes. Local merchants donated prizes for raffle drawings. All were solicited in advance of the intervention phase. In return for their donations, community merchants were promoted as supporters of the pedestrian safety campaign and acknowledged in the print ads that ran in the campus newspaper. Most merchants also displayed the STAR promotional materials in their businesses and assisted in collecting signed promise cards.

The prizes ranged in value from $5 to more than $500 and included discount coupons, movie passes, and free dinners. Four grand prizes were drawn, one for each week of the intervention period. The grand prizes included a pearl necklace, a diamond ring, a used car, and two airline tickets to anywhere in the continental United States or to Bermuda or the Bahamas.

PROCEDURE

Baseline observation procedures. For 4 consecutive weeks, trained and experienced observers collected data unobtrusively at five predesignated sites across campus, Monday through Friday. To obtain a representative sample of behavior, data collection times and dates were scheduled so as to sample the target behaviors at various times per site. Three observation sessions were scheduled each weekday to coincide with class changes at 10:00 a.m., 1:00 p.m., and 4:00 p.m. Classes change 10 minutes before the hour, and researchers collected data immediately after the class change rush, making the observation process more manageable and reliable. Sites and times were rotated each day, and the number of sites observed at each time varied. At a minimum, one site was monitored during each designated time.

Observations were taken in an area that included the crosswalk and 10 feet on either side. Any pedestrian who entered this area could be targeted for observation, regardless of whether they used the crosswalk. It was not possible to record observations on all pedestrians who entered the observation area. Instead, after observers recorded their previous observation, they looked up and collected data on the first pedestrian who passed a stationary landmark (e.g., street lamp, road sign) and entered the observation zone. Vehicles were selected by their potential to interact with the pedestrian who had been targeted. Therefore, at times, only pedestrian data were collected, and this was indicated on the observation checklist. This is the same basic protocol used to collect data in prior field studies on vehicle safety belt use in a stream of traffic (e.g., Geller et al., 1989).

Data were collected on pedestrian gender and crosswalk use and driver-yielding behavior. Safe crosswalk use was defined as entering the road in the crosswalk and remaining between the boundaries of the crosswalk while crossing the road. Safe yielding was recorded when a vehicle approaching the crosswalk being entered by a pedestrian (previously targeted for observation) ceased all forward motion outside the boundaries of the crosswalk while the pedestrian crossed in front of it. Driver stopping imposed when a pedestrian stepped in front of a vehicle was scored as at-risk.

Interobserver reliability was assessed on approximately 30% of the scheduled data-collection sessions by having two research assistants make independent observations on the same pedestrians and drivers. On these occasions, the researchers did not communicate with one another except to identify the target of their next observation. Pedestrians were identified by the color of their shirts, and drivers by the make and model of their vehicles.

Intervention. The promise-card campaign began with a kickoff celebration that included free food, news coverage, and a special appearance of the famous Crash Test Dummies, Vince and Larry. During the next 4 weeks, promise cards were distributed at several public locations around campus, in classes, and in the stores that donated prizes. They also were disseminated by members of the pedestrian safety team at their discretion. Participants who signed a promise card also were asked to take extra cards and distribute them throughout the campus.

After filling out a card, a participant could deposit it in any one of nine raffle collection drop boxes located in the psychology department and at participating stores near campus. Cards also could be returned to members of the pedestrian safety team or to the classroom instructor of the class in which they had been distributed. Each participant was allowed to sign only one promise and thus have a maximum of one entry into each of the four weekly raffles. However, participants could increase their chances of winning by passing out more promise cards and writing their names and phone numbers on the bottom of each card distributed. Additional raffle entries were contingent on the return of signed promise cards to the psychology department. Participants were allowed to complete and return promises throughout the 4 weeks of intervention.

Data collection continued as described previously throughout the planned 4-week intervention period. Throughout the intervention period, the time and place of each Friday raffle drawing were announced prominently on flyers posted on campus and in weekly ads placed in the campus newspaper. The grand prize for the week and the names of the previous week's winners also were advertised. The four raffles were held at the university student union by

members of the pedestrian safety team, who drew raffle entries out of a large box. Five prizes were drawn each week. All winners' names and phone numbers were logged for data records so winners not present at the raffle could be contacted. After documenting the names of the winners, the cards were returned to the raffle box for entry into the remaining raffles.

Because of extraordinary media coverage prompted by the pedestrian safety program, 2 additional weeks of data collection were included as part of the intervention period. During that time, unsolicited newspaper articles and editorials kept the program prominent despite the removal of all intervention materials, the grand prize raffle drawing, and announcement of the final grand prize winner at a university football game that occurred on the Saturday following the formal 4-week intervention period.

Withdrawal and follow-up. Withdrawal lasted 2 weeks. This phase occurred after a 1-week university holiday (i.e., Thanksgiving Break) and was conducted precisely like the preintervention baseline. One year later, follow-up observations were taken. These occurred for 6 weeks beginning the same week the intervention had begun a year earlier.

RESULTS

INTEROBSERVER AGREEMENT

A second observer simultaneously but independently collected data on 31% of all observation days across the four phases of the study (30% to 33% per phase). Interobserver agreement for pedestrian gender, crosswalk use, and yielding behavior was calculated on a session-by-session basis by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Mean agreement was 99% for pedestrian gender (range = 89% to 100%), 96% for crosswalk use (range = 80% to 100%), and 93% for yielding behavior (range = 50% to 100%).

PROMISE-CARD SIGNING

Of the 20,000 promise cards printed, 11,556 (57.8%) were successfully distributed to the population of 15,042 (60%) men and 10,171 (40%) women students and 3,800 faculty and staff. Of those distributed, 2,322 (20%) were

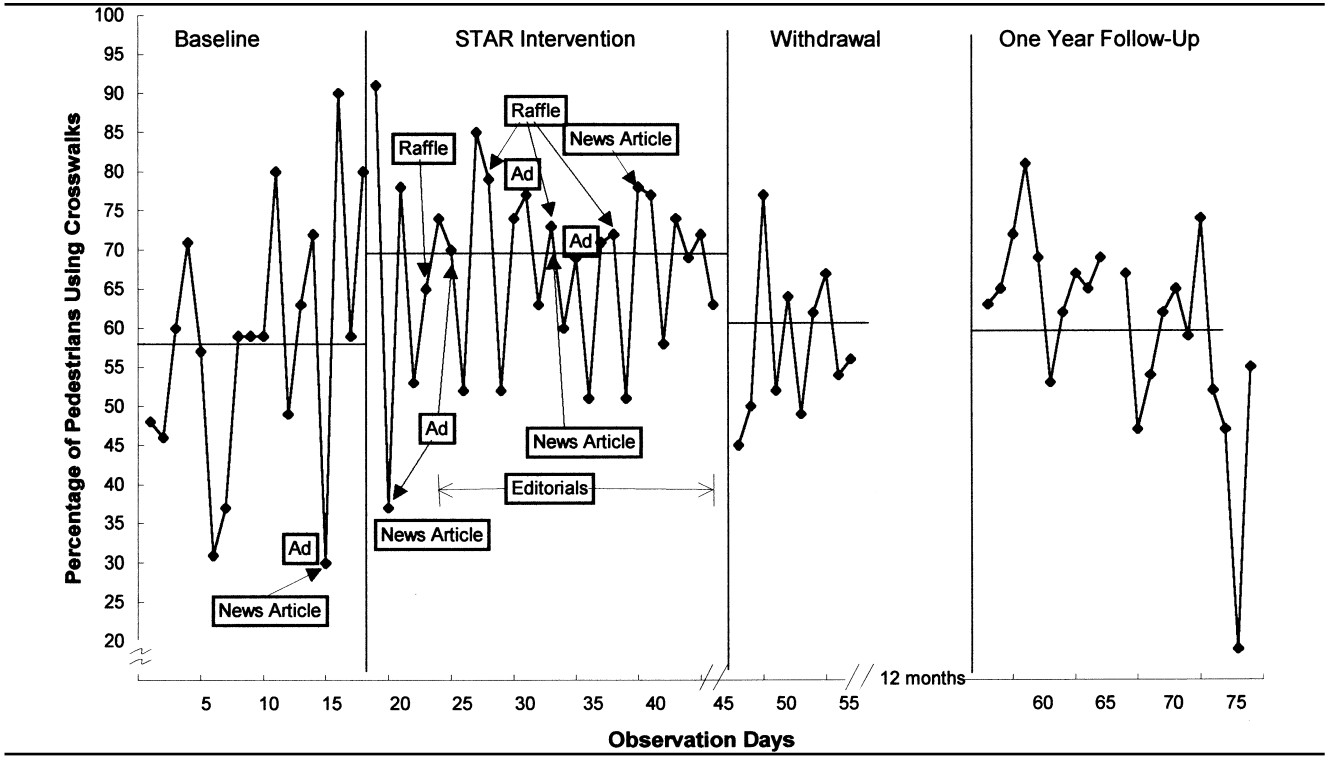

Figure 2: Crosswalk Use as a Function of Experimental Phase (baseline, intervention, withdrawal, and follow-up)

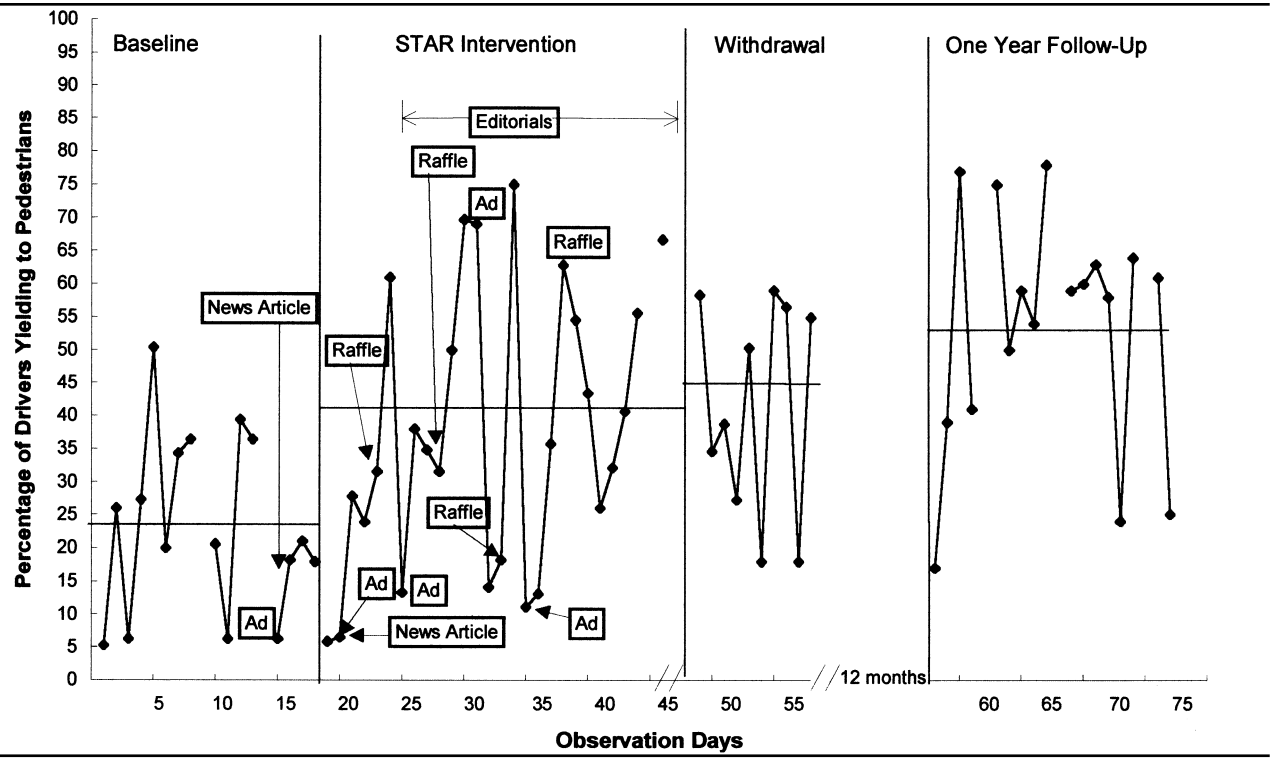

Figure 3: Yielding Behavior as a Function of Experimental Phase (baseline, intervention, withdrawal, and follow-up)

returned and entered into the raffle drawing; 880 cards (38%) were returned by men and 1,440 cards (62%) by women. Two participants did not indicate their gender.

A Chi-Square analysis indicated that promise signing was dependent on gender, $\chi^2(1) = 3{,}596$, $p < .01$. The cells depicting nonsigners were calculated by taking the total number of men and women attending Virginia Tech and subtracting the number of returned student entries. This calculation presumes the promotion reached men and women with equal success.

CROSSWALK USE

Figure 2 shows the percentage of pedestrians using crosswalks as a function of experimental phase. Because no specific hypotheses were made regarding gender, data are collapsed across men and women. Vertical lines indicate the introduction of the STAR campaign, withdrawal, and follow-up phases. Horizontal lines represent the phase means calculated as the average of each daily percentage. Data points coinciding with newspaper advertisements, articles, and editorials, as well as each weekly raffle during intervention, are also shown. Percentages with less than 15 observations were deleted from the analysis ($n = 2$). Individual data points consist of an average of 86 observations (range = 15-567).

As depicted in Figure 2, overall crosswalk use increased from a baseline mean of 58% ($n = 2{,}038$) to an intervention mean of 68% ($n = 1{,}718$) and decreased to a mean of 62% ($n = 1{,}441$) during withdrawal. Inspection of data from observations during follow-up indicates a return to preintervention baseline levels of crosswalk use 1 year after the STAR campaign ($M = 61\%$, $n = 1{,}954$). Visual inspection of Figure 2 also reveals less variation in daily percentages of crosswalk use during the intervention phase.

Because crosswalk use appeared to be trending upward during baseline, a *C* statistic was calculated on baseline data to detect significant trends (Tyron, 1982). *Trends* are defined as systematic departures from random variation and are calculated by the *C* statistic, which compares the sum of the squared deviations from the mean (of the series) with the sum of the squared successive differences among series data points. The ratio of the *C* statistic to its standard error results in a standardized score equivalent to a *z* score.

The *C* statistic is warranted when the series does not contain enough data points for auto-regressive integrated moving average (ARIMA) procedures (Tyron, 1982). It is recommended that each phase of time-series data contain between 50 and 100 data points before ARIMA can be used (Hartmann et al., 1980). Our data did not satisfy this criterion, thus the *C* statistic was selected. Absence of a significant baseline trend allows one to append a portion of the

treatment series to the baseline data and reapply the procedure to this aggregate portion of the data. Presence of a significant trend in this case (i.e., across phases) allows for conclusion of a significant treatment effect and is intended to buttress a visual inspection of the time-series data depicted in Figure 2.

The *C* statistic was first calculated on the mean daily percentages of crosswalk use during baseline and was not significant ($z = 0.23$, $p > .50$), indicating no presence of a trend. Then, the procedure was applied to a series containing the last 5 days of baseline and the first 5 days of the intervention period. This resulted in the detection of a significant upward trend ($z = 1.9$, $p < .05$). Finally, the *C* statistic was applied to the last 5 days of the intervention period and first 5 days of the withdrawal phase. This analysis revealed a downward trend that approached significance ($z = 1.53$, $p = .09$). The critical value of z for the .05 level of significance for all sample sizes is 1.64.

YIELDING BEHAVIOR

Figure 3 shows the percentage of drivers yielding to pedestrians in crosswalks as a function of the experimental phase. Vertical lines indicate the introduction of the intervention, withdrawal, and follow-up phases. Horizontal lines depict the mean percentage of yielding per phase, calculated as the average of the daily percentage points. Data points coinciding with newspaper advertisements, articles, and editorials are also labeled, as well as each weekly raffle during intervention. Any percentage with fewer than 10 observations was deleted from the analysis ($n = 7$). Individual data points consist of an average of 41 observations (range = 10-345).

A visual inspection of the daily percentages indicates that driver yielding increased steadily throughout the course of the study. Specifically, Figure 3 reveals that substantial increases in driver yielding occurred from a baseline mean of 23% ($n = 979$) to an intervention mean of 41% ($n = 956$) and a withdrawal mean of 44% ($n = 272$). One year later, the mean percentage of yielding reached 53% ($n = 602$).

The *C* statistic was applied to the daily percentages of yielding behavior for baseline, and no significant trend was detected. Aggregating the last 5 days of baseline with the first 5 days of the intervention period also revealed no significant trend. However, when applied to the data points gathered during the first half of the intervention period (12 observation days), a significant upward trend was detected ($z = 1.64$, $p = .05$). No further applications of the *C* statistic seemed warranted because of the obvious increases in yielding behavior indicated in Figure 3.

DISCUSSION

The purpose of this research was to facilitate pedestrian safety among residents of a college community without the countercontrol generally associated with punishment contingencies, such as increasing enforcement. Although we acknowledge the benefit of enforcement and engineering to increase safety, the assessment of this community environment with regard to pedestrian safety issues indicated that such strategies were not feasible. As such, the results indicate that a community-wide information and promise card/incentive intervention successfully increased the number of people using crosswalks and the number of drivers yielding to pedestrians in crosswalks on a large college campus. Furthermore, in contrast to countercontrol responses, the publicity generated by the STAR process increased formal (e.g., numerous newspaper editorials) and informal (e.g., phone calls and e-mails to the research center) communication among members of the community. In addition, the local public transportation system got involved by distributing promise cards on buses, which in turn led to bus drivers advocating pedestrian safety.

A 17% increase in crosswalk use (or 10 percentage points above baseline) is substantial considering the conservative definition of *safe use of crosswalks* used in the current research. Specifically, pedestrians were not considered to be in the crosswalk unless they entered and remained between the boundaries of the crosswalk the entire time they were in the road. As such, many pedestrians who veered out of the crosswalk on the far side of the road, although essentially using it through traffic, were coded as not using the crosswalk.

If the aim of a community-wide pedestrian safety program is to increase safety, then encouraging crosswalk use just to the extent that walkers are within the boundaries of the crosswalk through the flow of traffic may be sufficient to ameliorate a traffic hazard. Thus, future efforts to improve pedestrian safety might be benefited by a more liberal definition of safe crosswalk use. A challenge in all community applications is to operationalize desired behavior in such a manner that allows for experimental rigor and replication as well as practical impact (Baer et al., 1968, 1987).

It is noteworthy that twice as many promise cards (68%) were returned by women as were returned by men (32%). This is a notable result because men increased their use of crosswalks during the intervention to a greater extent over their baseline than did women. Specifically, during the intervention period, men increased their use of crosswalks from 55% (n = 1,132) to 62% (n = 643), whereas women increased from a baseline of 61% (n = 906) to 66% (n = 545). However, there were not substantial differences in crosswalk

use by gender during follow-up. As such, one could argue that the observed gender differences during the intervention provide evidence that the promise card may not have been the variable controlling behavior; instead, an intervention package that more broadly affected the campus environment was necessary to increase crosswalk use.

Our definition of *proper yielding* was also conservative. It required the driver to make a complete stop entirely outside the boundaries of a crosswalk in which a pedestrian had entered until the pedestrian crossed the vehicle completely. Drivers who slowed or stopped within the crosswalk but still allowed the pedestrian the right of way were coded as not yielding. Thus, an overall increase in driver-yielding behavior of twice the initial baseline is remarkable.

It could be argued that as more pedestrians started using crosswalks as a result of the promise card campaign, more drivers perceived an obligation to yield. Put differently, as traffic increased in crosswalks, drivers by necessity had to stop more often because they simply could not get through. This result is verified by visual inspection of Figures 2 and 3, which show the positive relation between increases in crosswalk use and yielding behavior through the removal of the programmed intervention contingencies. However, during withdrawal and follow-up, yielding continued to increase despite decreases in crosswalk use. Thus, the long-term impact on yielding may have resulted from a history of receiving desirable interpersonal consequences (i.e., a "thank you" wave) for stopping at crosswalks that started during the safety campaign.

The unplanned positive side effect of community interest expressed in the media appeared to serve as a reminder and helped to sustain the desired behaviors. As such, the intervention was not really completely withdrawn until after the campus was vacant for the week-long Thanksgiving holiday. Similar effects have been reported previously by Rudd and Geller (1985), who reintroduced intervention contingencies in their incentive/reward program to increase the use of safety belts on the same college campus. In their research, each subsequent return to baseline produced higher levels of safety belt use than the baseline that preceded it. These types of desirable side effects rarely accompany strict enforcement policies.

LESSONS LEARNED

The issues and recommendations discussed subsequently are consistent with Stolz's (1981) discussion of the key variables necessary for the adoption of behavior-change technology. In short, this research met the following of Stolz's criteria: (a) funds were available for dissemination; (b) the

intervention was tailored to local conditions; (c) key persons, trained and enthusiastic, persisted through obstacles; (d) the intervention was timely (one pedestrian death had occurred during the prior year and therefore the media were attentive to a pedestrian safety program); and (e) the data showed the intervention improved the two targeted behaviors.

Although it could be argued that these findings may not generalize beyond the context of a college campus environment, college campuses are among the worst environments for pedestrians and motorists to interact. Thus, even if our intervention program is perceived as relevant only for a college or university campus, the findings are important. Our recommendations could be used in multiple college safety efforts, pedestrian and otherwise. To this extent, the generalizability of the results seems robust and the involvement of community entities noteworthy. Enlisting the help of law enforcement would add to the broad-based and long-term impact of future efforts (e.g., Malenfant & Van Houten, 1989).

The monetary cost of the pedestrian safety program was low but not insignificant. All intervention materials were developed and produced for approximately $10,000. The majority of these costs were related to developing and printing the promise cards, posters, buttons, and T-shirts. A repeat of the same program would be much less expensive, however, given that print templates are already available. In addition, the enrollment of police officers or other community agents to help implement the program would reduce personnel costs and promote a positive community image of law enforcement.

In terms of personnel, the program was initiated by a core group of 12 research team members, including the first author, who was the only paid member of the team. The intervention was implemented by this core group and was ultimately sustained, with help from the research team, by volunteers from indigenous university service groups, fraternities, sororities, the town transit system, local establishments, and municipal agencies. Although there was minimal cost for scheduled print ads, the majority of the publicity came from media interest in the innovative pedestrian safety efforts. All of these entities become a dynamic part of the safety effort and the environmental context in which safety is discussed. As a result, the following lessons should be considered when attempting to institutionalize large-scale behavioral community interventions.

It is necessary to solicit support from local community and business interests. In this research, approximately 30 community merchants donated more than 600 prizes. Prizes were donated in exchange for acknowledgment in campus newspaper ads promoting the safety program. Prizes must be solicited well in advance of the intervention efforts, and the benefits of contributing must be explained to the merchants. For example, in this study, major prizes

were used as raffle items and provided the benefit of publicity for the contributing merchants during the public raffle. More modest prizes were randomly distributed by research personnel to pedestrians using crosswalks.

It was important to involve members of the community in the development of the intervention materials. In our case, teams of undergraduate research assistants (campus pedestrians and motorists themselves) met regularly to design logos, posters, pledge cards, and distribution procedures. People are more likely to use strategies they have designed themselves, if only to maintain a consistency between saying and doing (Rogers-Warren & Baer, 1976). It was also useful that the problem addressed was visible and obvious to the target community. If an intervention target is not seen as a real problem, then time and effort could be wasted. These latter points revolve around the core issues of social validity (Wolf, 1978).

Regarding the social validity of a behavior-change intervention, it is important to consider the benefits and social acceptability to the relevant consumers (Kazdin, 1977; Wolf, 1978). Specifically, how important is the proposed behavior change to individuals giving and receiving the intervention? Is the inconvenience or intrusiveness of the intervention process worth the potential benefits? Wolf (1978) detailed these evaluations of social validity with regard to the importance of effects, significance of goals, and appropriateness of procedures. Because of the injuries and death sustained in the year prior to the STAR process, it is intuitive that the answer to all these questions would support the need for a "user-friendly" intervention, not necessarily more enforcement. The positive media attention generated by the program upheld this conclusion.

The short-term nature of the formal intervention of this research is a significant liability. At best, this was a demonstration project, constrained by the university semester. Follow-up data indicated that, for crosswalk use, a much longer program is needed for institutionalization and long-term improvement. Unfortunately, competing contingencies and time constraints imposed by the university's academic calendar prevented that here (cf. Goldiamond, 1978; Holland, 1978). Our core group of field observers and intervention agents come and go as the university schedule dictates.

Regardless, our demonstration revealed strong community support for the STAR process and suggested that a long-term pedestrian safety program could be implemented with additional support. In fact, a special advantage of community behavioral interventions is that these technologies can be used effectively by members of the community with minimal effort and training. If community members are taught the principles of behavioral science and how to recognize and target a socially significant problem within a dynamic environment, each new application of an intervention program should require less

and less involvement of the research team. A self-sustaining community program that addresses and improves an important problem is socially valid.

REFERENCES

Azrin, N. (1977). A strategy for applied research: Learning based but outcome oriented. *American Psychologist*, *32*, 140-149.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis*, *1*, 91-97.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1987). Some still-current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis*, *20*, 313-327.

Boyce, T. E., & Geller, E. S. (2000). *Applied behavior analysis and occupational safety: The challenge of response maintenance*. Manuscript submitted for publication.

Brehm, S., & Brehm, J. W. (1981). *Psychological reactance: A theory of freedom and control*. San Diego, CA: Academic Press.

Garder, P. (1989). Pedestrian safety at traffic signals: A study carried out with the help of a traffic conflicts technique. *Accident Analysis and Prevention*, *21*, 435-444.

Geller, E. S. (1996). *The psychology of safety: How to improve behaviors and attitudes on the job*. Boca Raton, FL: CRC Press.

Geller, E. S., Kalsher, M. J., Rudd, J. R., & Lehman, G. R. (1989). Promoting safety-belt use on a university campus: An integration of commitment and incentive strategies. *Journal of Applied Social Psychology*, *19*, 3-19.

Geller, E. S., & Lehman, G. R. (1991). The buckle-up promise card: A versatile intervention for large-scale behavior change. *Journal of Applied Behavior Analysis*, *24*, 91-94.

Goldiamond, I. (1978). The professional as a double-agent. *Journal of Applied Behavior Analysis*, *11*, 178-184.

Harborview Injury Prevention Research Center. (1997). *Pedestrian injury facts* [Online]. Retrieved November 1998. Available: http://weber.u.washington.edu/-hiprc/childinjury/topic/pedestrians/

Harrell, W. A. (1992). Delays in traffic and motorists' yielding to pedestrians. *Perceptual and Motor Skills*, *75*, 451-455.

Harrell, W. A. (1993). The impact of pedestrian visibility and assertiveness on motorist yielding. *Journal of Social Psychology*, *133*, 353-360.

Harrell, W. A. (1994). Effects of pedestrians' visibility and signs on motorists' yielding. *Perceptual and Motor Skills*, *78*, 355-362.

Hartmann, D. P., Gottman, J. M., Jones, R. R., Gardner, W., Kazdin, A. E., & Vaught, R. S. (1980). Interrupted time-series analysis and its application to behavioral data. *Journal of Applied Behavior Analysis*, *13*, 543-559.

Holland, J. (1978). Behaviorism: Part of the problem or part of the solution. *Journal of Applied Behavior Analysis*, *11*, 163-174.

Jonah, B. A., & Engel, G. R. (1983). Measuring the relative risk of pedestrian accidents. *Accident Analysis and Prevention*, *15*, 193-206.

Kazdin, A. E. (1977). Assessing the clinical or applied importance of behavior change through social validation. *Behavior Modification*, *1*, 427-452.

Kello, J. E., Geller, E. S., Rice, J. C., & Bryant, S. L. (1988). Motivating auto safety-belt wearing in industrial settings: From awareness to behavior change. *Journal of Organizational Behavior Management*, *9*(2), 7-21.

Ludwig, T. D., & Geller, E. S. (1991). Improving the driving practices of pizza deliverers: Response generalization and moderating effects of driving history. *Journal of Applied Behavior Analysis*, *24*, 31-44.

Malenfant, L., & Van Houten, R. (1989). Increasing the percentage of drivers yielding to pedestrians in three Canadian cities with a multifaceted safety program. *Health Education Research*, *5*, 275-279.

Malott, R. W. (1992). A theory of rule-governed behavior and organizational behavior management. *Journal of Organizational Behavior Management*, *12*, 45-63.

National Highway Traffic Safety Administration. (1998). NHTSA homepage. Retrieved January 1999. Available: www.nhtsa.gov

Rogers-Warren, A., & Baer, D. M. (1976). Correspondence between saying and doing: Teaching children to share and praise. *Journal of Applied Behavior Analysis*, *9*, 335-354.

Rudd, J. R., & Geller, E. S. (1985). A university-based incentive program to increase safety-belt use: Toward cost-effective institutionalization. *Journal of Applied Behavior Analysis*, *18*, 215-226.

Skinner, B. F. (1953). *Science and human behavior.* New York: Macmillan.

Skinner, B. F. (1974). *About behaviorism*. New York: Vintage.

Stokes, T. F., & Baer, D. M. (1977). An implicit technology of generalization. *Journal of Applied Behavior Analysis*, *10*, 349-367.

Stolz, S. B. (1981). Adoption of innovations from applied behavioral research: "Does anybody care?" *Journal of Applied Behavior Analysis*, *14*, 491-505.

Tyron, W. W. (1982). A simplified time-series analysis for evaluating treatment interventions. *Journal of Applied Behavior Analysis*, *15*, 423-429.

Van Houten, R. (1998, May). *New opportunities: Can behavior analysis help with traffic safety?* Panel discussion presented at the 24th annual convention of the Association for Behavior Analysis, Orlando, FL.

Van Houten, R., & Malenfant, L. (1992). The influence of signs prompting motorists to yield before marked crosswalks on motor vehicle-pedestrian conflicts at crosswalks with flashing amber. *Accident Analysis and Prevention*, *24*, 217-225.

Watson, D. L., & Tharp, R. G. (1997). *Self-directed behavior: Self-modification for personal adjustment* (7th ed.). Pacific Grove, CA: Brooks/Cole.

Wolf, M. M. (1978). Social validity: The case for subjective measurement or how applied behavior analysis is finding its heart. *Journal of Applied Behavior Analysis*, *11*, 203-214.