Injury Epidemiology: Fourth Edition

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CHAPTER 11. EVALUATION OF PROGRAMS TO CHANGE HUMAN FACTORS VOLUNTARILY

This and the next two chapters focus on research estimating the effects of injury control efforts. Research on effectiveness of attempts to change voluntary behavior is addressed in this chapter followed by chapters on evaluation of the effectiveness of laws directed at individual behavior and changes in energy carriers and environments that potentially reduce injuries or severity without changing behavior of those at risk. The latter usually involve laws and regulations aimed at corporate and government behavior but some corporations and other organizations have reduced injury incidence or severity without laws or rules imposed by government. Changing the energy agents of injury and how they are conveyed to human hosts has historically been called the "passive" approach meaning that the individual whose risk of severe injury is reduced does not have to take any action to reduce the risk. The responsibility for such changes falls to the leadership of product manufacturers and governments through voluntary or legal standards for products and environmental infrastructure.

Some injury researchers refer to approaches to injury control as the "3 Es" (education, enforcement and engineering) but as we shall see, that is an oversimplification of the approaches. For example, it usually takes more than education to change behavior. As noted in previous chapters, behavior of the person injured or others at the scene is a factor in most injuries. It does not logically follow that behavior change is always necessary to reduce the injuries if there is an alternative passive approach, particularly one that effectively manages the necessary condition for injury – energy or its conveyances.

The research focus is the degree of effectiveness of the behavior change and the availability and effectiveness of passive alternatives and whether either one can be implemented on a large scale. Programs aimed at changing human factors without resort to law are of three types: 1. attempts to change abilities such as driving skills and strength and gait of the elderly, 2. attempts to change behaviors that are presumed or known to contribute to risk such as treatment of

bipolar disorder, storage of guns and household materials hazardous to children, violent responses to peer challenges, speeding and alcohol use while driving, and 3. attempts to increase use of protection such as child restraints, seat belts, motorcycle and bicycle helmets, and certain sports equipment. Various techniques are used -- information and motivation by education in schools and media campaigns, outreach programs for children and the elderly, behavior modification using incentives or punishments, and enhancement of perception of risk.

Among the issues to be considered in attempting to modify behavior relative to children's injuries are the seriousness of the injuries, whether to focus on the parents' or guardians' behavior, the children's behavior, or the behavior of others, and the variety of injuries on which to focus in any one attempt to modify behavior. If a program can be demonstrated to reduce injuries, another major consideration is the means of implementation. If there is no societal organization or institution to implement the program among those who would benefit, demonstration of effectiveness is irrelevant.

SKILLS AND KNOWLEDGE TRAINING. Evaluation of behavior change programs can be researched in a controlled experiment, the most definitive of study designs. Indeed, given the huge variety of circumstances and products that contribute to injuries, as well as the potential for unintended consequences of training regarding potentially injurious activity, it is unethical to launch programs on a large scale without demonstrated efficacy. Despite that problem, many educational and other behavioral change programs are not subjected to careful study before being adopted. Seldom considered is the possibility that a program could be ineffective at best or potentially harmful. For example, driver education was introduced in the public schools without good research on its effects, based on the premise that driving skills were a primary factor in the probability of a crash, and that those skills could be improved by formal training in school.

Decades later, the first controlled experiment indicated that high school driver education did not reduce risk of individual drivers' crashes per mile driven, but increased the number of drivers licensed at an earlier age such that the risk per population was increased (Shaoul, 1975). The adverse effect was found to be widespread in an ecological study of teenaged licensure and involvement in fatal crashes in 27 U.S. states during a period when driver education was increased by federal government funding supplements (Robertson and Zador, 1978). A subsequent comparative study of driver licensure and crash records of teenagers in schools that dropped the courses, compared to those in schools that retained the courses, found large reductions in months licensed before age 18, and parallel reductions in crashes among those in schools that dropped the courses (Robertson, 1980). Yet another experimental-control study was supported by the National Highway Traffic Safety Administration. Its advanced driver education

course produced no significant effect on subsequent crash rates per licensed driver (Stock, et al., 1983). The U.S. government stopped subsidizing the courses. Nevertheless, decades later, in many communities, teenagers continue to receive driver education in high schools.

Several principles are illustrated by this experience. The value of a program intended to reduce injuries is not necessarily a function of the good intentions of the program's proponents. Skill or behavior change programs can have unintended harmful effects and those effects are often found only by well-designed research. This is particularly true of programs that have the potential to increase exposure to hazards. Once a program becomes institutionalized, it is difficult to remove it no matter how ineffective or harmful its consequences.

A major barrier to the scientific evaluation of programs is the reluctance of those who develop, advocate or profit from programs to have them evaluated objectively. In some cases, their investment in the programs is only psychological, but in others it is economic. Authors of textbooks used in driver education courses and an insurance company that sold driving simulators to schools were among the most adamant critics of the high school driver education studies. They pointed to old studies of differences in driving records of students who had the course and those who did not as indicative of efficacy. However, those studies did not account for selection of the courses by students, or their parents, who were different in other ways that accounted for the differences in driving records (McGuire and Kersh, 1969).

In the September 2012 issue of the Journal of Safety Research, employees at the Center for Injury Prevention and Control (CIPC) at CDC and a few other researchers discussed some of the activities of the Center during its first 20 years (e.g., Kress, et al. 2012). One of these programs is the "Heads Up" campaign to reduce concussions and their consequences in sports. Beginning in 2005, the Center, in collaboration with the National Football League and 84 other organizations distributed written materials, websites and used social media to promote awareness and recommended practices to reduce concussions among participants in sports. Beginning in 2009, most US states enacted laws requiring that concussions be seen by a medical professional before the player resumed activity (CDC, undated).

The evidence to support the efficacy of "Heads Up" by Kress, et al. (2012) referred to articles reporting mail surveys of coaches to which only about a third of those surveyed responded (Sarmiento, et al., 2010; Covassin, et al., 2012). That is no way to assess the effectiveness of any program. No mention was made of any attempt to test the effectiveness of the materials in a controlled trial before they were disseminated. One survey of physicians randomly selected to receive "Heads Up" materials, indicated no change in knowledge of concussions but they were substantially more reluctant to recommend a player return to action the day after concussion than a comparison group of physicians that were not sent the material (Chrisman, et al., 2011).

During the same time that "Heads-Up" was launched, the CIPC was supporting data collection on injuries in high school sports (Comstock, et al., 2006). A sample of 100 high schools that had certified trainers willing to report injuries in organized sports were used to estimate annual occurrence of injuries that were seen by a trainer or physician and resulted in lost time of a day or more during the academic year. The surveillance continued from 2005 through 2012.

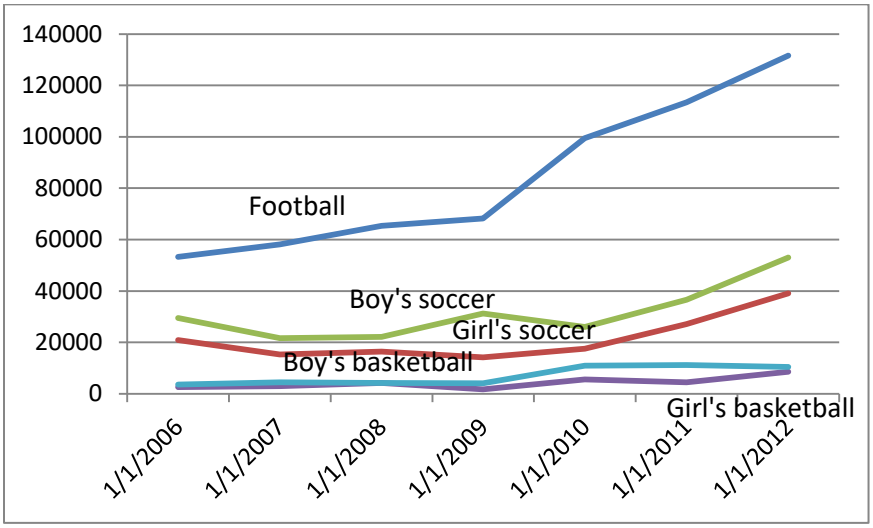

Figure 11-1. Annual estimated concussions in popular high school sports
Source: http://www.nationwidechildrens.org/cirp-rio-study-reports

Figure 11-1 shows trends in reported concussions from the surveillance for five of the more popular sports. Reported concussions in football practice or games increased in the first four years after the "heads-up" program began distributing materials and accelerated from 2009 as the reporting laws were enacted. Smaller increases are seen in the other sports during that period. Prior to the laws, did increased awareness of concussion and its possible consequences result in players having activities curtailed more often resulting in increased reporting of injuries that would not have been reported previously? Or did the coaches who received or watched "heads-up" materials change their coaching in ways that increased the probability of concussion? Without information on when each of the coaches received information, and an analysis of concussions in relation to that timing, we cannot answer the questions. CDC researchers could have obtained data regarding if and when coaches in the sampled schools were exposed to "heads-up" materials but, if they did, it has not been reported.

Finally, after the "head-up" program had been promoted for years without adequate supportive evidence of effectiveness, a study of high school football players found a favorable effect. Teams with at least one coach who had heads up training were compared to those without. School trainers reported 32 percent fewer concussions per player on teams that had coaches with "heads-up" training (Tokish, et al., 2017).

Another form of health education is counseling. One project that had an exemplary research design is questionable regarding its focus. In a prepaid medical plan serving an upper-middle-class clientele, parents who brought children in for medical visits (excluding those with very acute illnesses or chronic conditions) were randomly assigned to experimental and control groups. Parents in the experimental group were counseled regarding a variety of hazards to children in the home and were given a booklet emphasizing ten such hazards and a packet of electrical outlet covers. In a follow-up telephone call, the parents in the experimental group were asked whether they had changed given hazards, and those who said no were encouraged to do so. In an unannounced home visit, the numbers of hazards observed were recorded in both experimental and control groups (Dershewitz and Williamson, 1977).

Two aspects of the research design are excellent: 1.The random assignment of experimental and control groups should equalize the potential effects of factors other than the counseling between the two groups. 2. Actual observation of certain targeted hazards in the home rules out the potential biases of self-reporting. Such biases were indeed found by comparing the results of the telephone interview and the observed hazards. While parents claimed reductions in hazards in the experimental group more than in the control group in the telephone interviews, there were no differences between the two groups in hazards actually observed in the homes.

A possible problem with the approach is the lack of focus on one or a few hazards likely to result in severe injury. The types of hazards included were cleaning agents, prescription drugs, waxes and polishes, non-prescription drugs, coins, jewelry, watches, keys, appliances on counter tops, matches, pins, needles, kitchen knives and hazards on the floor. These differ substantially in associated injuries and severity. The lack of focus on one or a few of the most important may have defeated the purpose of the counseling.

Projects with a similar research design, but focused exclusively on a single problem, have found favorable effects of counseling parents. A forty percent reduction in injuries from falls among infants was found relative to a control group after counseling in the experimental group (Kravitz, 1973). Counseling and demonstration of use of child restraints in two studies, and counseling regarding smoke detectors in another, found increased use in the counseled group when actually observed (Berger, 1984; Reisinger, et al., 1981; Miller, et al., 1982). A review of randomized trials of the effects of home visiting programs on injuries indicates some effectiveness (Roberts, et al., 1996). Nevertheless, the extent of use of this approach is apparently unusual. For example, only 4.1 percent of pediatricians report counseling regarding drowning hazards and only 17 percent of those with training in such hazards did so (O'Flaherty and Pirie, 1997).

In a randomized trial among primary care practices in England, a variety of checklists and information was given to the parents in the experimental group.

They also received free equipment such as stair guards and smoke alarms. There was no significant difference in subsequent injury-related clinic visits among children in the experimental and control groups. Also, only 55 of 162 practices agreed to be in the study at the outset (Kendrick, et al., 1999). A study of families counseled by pediatric residents trained in injury counseling compared to a control group found more counseling in recorded sessions with patients but no statistically significant changes in several prevention practices during visits to patients' homes (Gielen, et al., 2001). Studies of counseling regarding use of trigger locks on guns and safe storage are limited and better research is needed (http://www.gao.gov/assets/690/687239.pdf).

These results raise research questions. How many behaviors can be influenced at any one time by counseling? How can the behavior of physicians be changed? A review of controlled trials found that didactic continuing education sessions have little or no effect on physician practice (Davis et al 1999).

Attempts at influencing children's behavior directly have also had some success. For example, based on research that indicated "dart-out" as the most important type of child pedestrian injuries up to age nine, a program directed at that specific behavior in that age group was developed. A cartoon character called "Willy Whistle", as well as older children portrayed as role models, was shown in films, television spots, and posters in mid-block and intersection situations. The characters in these media demonstrated to children that they should always stop at the edge of curbs and the edge of parked cars.

The materials were used by television stations and in the schools in three communities. Data were collected on children's knowledge, and observers at selected sites recorded child behaviors, before and after the campaign. Also, police reports of pedestrian injuries were compared for the two periods. Knowledge increases were substantial, and correct behaviors observed among children on the streets increased somewhat. Mid-block dart and dash injuries declined among three to seven year olds, but those at other locations did not change appreciably (Blomberg, et al., 1983).

There are two problems with this approach, one methodological and one regarding implementation. Without a comparison to control cities, it is not possible to estimate precisely how much of the observed injury reduction can be attributed to the campaign. Without continued implementation in these and other cities, the campaign is only useful to demonstrate a principle. I attempted to find out where the campaign was used some six years subsequent to the study and found only one city in which it had been systematically implemented afterward.

A number of controlled trials of pedestrian education have been implemented with mixed results regarding road-crossing behavior. The studies did not follow up to see if pedestrian injuries were reduced in those instances where crossing behavior changed (Duperrex, et al., 2002). Several controlled trials have shown

reductions in sports injuries related to behavior and the use of protective equipment (Parkkari, et al., 2001; Aaltonen et al. 2007*).*

In a controlled trial aimed at the reduction of violence, violent offenders in the experimental group met the parents of victims of violent trauma and were shown the clinical consequences to trauma patients. They were also given mental health referrals. The authors found an 85 percent reduction in repeat offenses among the experimental group compared to the control group. The researchers were lucky that the observed effect was large because the numbers of offenders in the two groups (38 each) were too small to detect a smaller but important difference (Scott, et al., 2002). Subsequent review of studies of recidivism after violent offenders meet with victims found a much smaller but significant effect (Strang et al. 2013). The disadvantage of a program based on repeat offenses is that the original offense is not prevented.

A double-blind trial of the effect of diet on violent behavior found that certain vitamins, minerals and essential fatty acids for 2 weeks produced a 35 percent reduction in offenses among prisoners compared to a control group given placebos. Although the subjects were incarcerated, there is no reason to believe that the results cannot be generalized, albeit at a less frequent baseline rate (Gesch, et al. 2002). Students in schools randomly assigned to receive instruction in "Safe Dates" reported fewer instances of violence on dates than those in control schools (Foshee, et al. 2004).

Although experimental-control studies of ensconced programs may be difficult to initiate, clever researchers can sometimes find ways to design studies that reveal biases in other types of evaluations. For example, the "defensive driving" course that is sold widely by the National Safety Council has apparently never been subjected to an experimental-control study. The effect of self-selection in the course was controlled in one evaluation, however, in a situation where everyone who selected the course could not be enrolled. Comparison of the driving records of those who took the course at one point and those who took it later, found no difference in crashes in the interim period (Mulhern, 1977). Therefore, when self-selection was constant, the course had no apparent effect. At its website regarding a virtual version of the Defensive driving course, the NSC said in 2006, "Over 40 years and 50 million drivers later, no other driver improvement course has a higher rate of success in reducing the number and severity of collisions for its participants." Of course that is technically true if the defensive driving program has no effect and no other program does either. A review of studies of the defensive driving course found no effects in studies that used good methodology (Lund and Williams, 1986). A meta-analysis of 21 controlled experiments of post-license driver training found no evidence of effectiveness (Ker, et al. 2004). Yet in 2017 the National Safety Council still says, "A defensive driver safety program can reduce risk and keep people safer on the road." (http://www.nsc.org/learn/Safety-Training/Pages/defensive-driving-driver-safety-training.aspx?gclid=CPX9ut7YjsQCFY6UfgodoisAzw).

The variety of programs attempting to reduce driving under the influence of alcohol (DUI) among young drivers is large. One survey in the 1980s identified 248. These are most commonly single sessions or short segments in the curricula of senior high schools. The programs vary in focus and some are multi-focused. About 83 percent of surveyed programs emphasize personal knowledge and skills regarding decisions to drink and drive, and 48 percent include emphasis on resistance to peer pressure. Virtually none of these programs had been evaluated as to effectiveness in actually reducing injuries by strict scientific standards, although some data is available on pre- and post-program knowledge, attitudes, and self-reported behavior (Vegega and Klitzner, 1988). Such data is known to be misleading (Chapter 7). A more recent review of studies of education of DUI recidivists found the literature so poor that the authors could not generalize about their effects (Miller et al., 2015). A meta-analysis of effects of short-term efforts to reduce alcohol consumption find positive results on average (Tanner-Smith and Lipsey, 2015), but most such studies are based on self-reports of alcohol use which are of dubious reliability.

Virtually all of the attempts to reduce alcohol-related injuries are directed at driving while intoxicated. There seems to have been little notice that drunk walking, drunk arguing, or even drunk sleeping (given fire/smoke hazards) are also dangerous. If the anti-alcohol-driving programs were successful in reducing driving while intoxicated without reducing intoxication, it is no certainty that the overall severe injury rate would be reduced, given the possibility that the intoxicated would engage in other activities in which risk is increased by intoxication. Not only does the lack of program evaluation suggest the need for research, the research should examine the effects on the total severe injury rate, not just that in motor vehicles.

Much of injury control in industry is oriented to worker education, but research on the effects of corporate programs is seldom published. A notable exception is a controlled trial of an educational program to prevent repetition of musculoskeletal injuries of workers (Santos, et al. 2011). Unfortunately, the program had no discernable effect. Some successes of educational programs in industry have been reported. For example, participation in an 18-24 hour intensive course on emergency preparedness is associated with fewer drowning and hypothermia deaths among commercial fishermen in Alaska (Perkins, 1995). Miners were successfully trained in proficient use of gas masks but performance deteriorates rapidly after three months without repeated practice (Vaught, et al., 1993).

Claims have been made that so-called "back schools" have reduced incidence, lost days and workers' compensation costs from back pain and strain, but details on how the research was conducted was not indicated (Isernhagen, 1988). Since diagnosis of pain and strain is largely subjective, and willingness to work with back strain or pain has been shown to decrease substantially as a function of amount of workers compensation increases, adjusted for inflation (Robertson

and Keeve, 1983), attention to measurement issues and what is actually affecting the changes observed is needed.

In the case of low back pain, the emphasis prevalent in this book on the physics of energy exchanges may not be as applicable. Low back pain is only slightly correlated to heavy lifting. While 47 percent of workers doing heavy lifting in a division of one company during a ten-year period reported such pain, 35 percent of those doing light or sedentary work also reported low back pain (Rowe, 1983). Indeed there is little evidence of any ameliorative benefit of a wide variety of remedies for prevention or treatment of lower back pain (U.S. Preventive Services Task Force, 2004).

Therefore, carefully controlled experiments should be conducted to find to what extent any changes in claimed pain or strain related to "back schools" or other programs is a result of workers' gratitude for increased attention to their problems by management versus actual changes in lifting behavior related to the educational content of a given program (Snook and White, 1984; Demoulin et al., 2012). In this case, two control groups would be advisable -- one in which management without specific ameliorative instruction shows increased concern, and one in which there is neither a program nor management attention to workers' back injuries.

Since the vast majority of the population views television, it is a potential media for behavior change. Two types of use of television to change behavior have been attempted, public service advertising (e.g., "buckle up for safety") and integration of messages in dramatic programs (e.g., showing the consequences of drunk driving in dramatic series). Documentaries on television “magazine” shows (Dateline NBC, 60 Minutes, 20/20) and self-administered knowledge tests (e.g., "The National Driving Test") may also change behavior, but are not primarily intended for that purpose.

While the ad-type messages are short and can be inserted relatively frequently in breaks in programming if the time is donated or a sponsor is found, the integrated messages in dramatic programs and documentaries are likely to be seen infrequently. The effects of ads and other programs could be studied experimentally in communities with split-cable television systems that advertisers use to study product advertising. The effects of the program can be measured unobtrusively when the outcome behavior is frequent and easily observable, such as seat belt use. One study of such a campaign found no effect on observed belt use compared to the control group in the absence of belt use laws (Robertson, et al., 1974, Appendix 11-1). The effects on behaviors such as alcohol use would require stopping a sample of drivers and obtaining breath tests, which could be done with police department cooperation, but the author is unaware of any such study related to television ad campaigns.

There is a substantial literature indicating that if the behavior to reduce risk is needed frequently, it is more difficult to persuade people to do it than in cases where the behavior is required only once (Robertson, 1975a). Therefore, one

would expect that persuading people to use seat belts consistently would be more difficult than persuading them to purchase a relatively safer vehicle. Yet much research and program effort has been directed at belt use and virtually none at vehicle purchase behavior.

A great dissertation project could be undertaken to distribute the results of the Insurance Institute for Highway Safety's vehicle safety ratings to an experimental group and compare their subsequent vehicle purchases to a control group to see to what degree, if any, the experimental group was more likely to purchase the more crashworthy vehicles. (See http://www.iihs.org/ratings/default.aspx). Instead all we have is dubious self-reports that safety is an important part of purchase behavior (e.g., Koppel, et al., 2008).

The effect of various therapies and exercise on agility and tissue vulnerability of the elderly is under active investigation. The emphasis in studies of falls among the elderly is often on perceptual and motor abilities, changes in blood pressure, and so-called "drop attack" in which the person collapses for no apparent reason. Multiple drug use and poor vision are primary risk factors (Delbaere, 2006).

Several experimental trials of various approaches such as exercise and balance programs and modifications of poly drug prescriptions, indicate fewer falls among those in the programs (Ory, et al., 1993; Tinetti, et al., 1993; Buchner, et al., 1993; Robitaille, et al., 2005). Staff education in nursing facilities was unsuccessful as was staff assessment of patients followed by prevention efforts (Ray, et al., 2005; Kerse, et al., 2004). Other approaches, such as use of energy absorbing protective garments in sub- acute hospital care and nursing home facilities, have some ameliorative effects (Haines, et al., 2004; Meyer, 2005).

INCENTIVES. Operant conditioning theory based on animal studies of rewards and punishments has been applied to influence injury-related behavior in some settings. In animals punishment is less effective than rewards. Oddly, rewards are more effective if administered randomly after elicited behaviors rather than systematically applied.

In contrast to the failure to increase belt use appreciably by advertising, various lottery-like incentive systems and direct warnings, e.g., a sticker on the dash saying, "Belt use required in this vehicle", have been found to increase belt use, in some cases substantially (Geller, 1988). Despite the demonstrated success of the latter approaches, they have not been adopted for widespread use. The adoption of this approach to reduce health care and absentee costs in corporations should be attractive to their executives, but the number of industries with belt use or other incentive systems for injury-related behaviors is unknown. At the community level, governments have not undertaken such programs and apparently private organizations have not used such programs on a large scale (Geller, 2006).

When an insurance company offered a $10,000 bonus to the family of someone killed using his or her seat belt, there was no effect on belt use by drivers insured by that company compared to drivers insured by other companies. After observing belt use in traffic, the company insuring the vehicle was identified in the department of motor vehicles using the license plate number on the vehicle (Robertson, 1984). When the reward is remote in time and not available to the target of the behavior change, there is no apparent effect.

To reduce distracted driving by teenaged drivers, a randomized trial included two conditions, a camera activated by an accelerometer that parents reviewed with the teen after trips and the camera plus a block on cell phone use. Both decreased incidents that activated the camera by 50-90 percent compared to a baseline period (Ebel, et al, 2015). Apparently the incentive for the teenagers was to reduce parental displeasure. The number of participants (28) was too small to create confidence in the results. A study using a much larger sample should be undertaken.

SCREENING ON HUMAN FACTORS. To the extent that measurable human factors are predictive of injury, these factors could be used to refuse employment or select people for some sort of injury reduction program. For example, among the 10 percent of applicants for positions in the postal service who had urine tests positive for marijuana (7.8 percent) or cocaine (2.2 percent), injury rates on the job were 85 percent higher than those negative for the drugs, controlling for several other factors (Zwerling, et al., 1990). If persons who tested positive for the drugs had not been hired, the postal service would likely have experienced fewer injuries. However, the net benefit for society is more questionable. If those persons refused employment became employed in a more hazardous environment or were engaged in more hazardous activities if they remained unemployed, the net effect could be worse. Research on the subsequent injuries of persons refused employment on the basis of drug screens or other factors would be interesting and perhaps useful.

If, on the basis of screening, those at higher risk were placed in behavior change programs that reduce injuries, the screening could have a net benefit. If the screening is not sensitive or if the program is ineffective, the usefulness of such programs can be very limited or even harmful. Children with burn scars in Ghana were found to have repeated burns at a rate less, not more, than expected from the prevalent rate (Furjuoh, 1996). Therefore, prior burns were not sensitive in identifying new cases.

I examined the FARS data in counties in which more than 90 percent of fatally injured drivers were tested for alcohol and noted that about 80 percent of fatally injured drivers with illegal blood alcohol had no prior convictions for driving while intoxicated. Therefore, screening those with such convictions for treatment programs will have a maximum 20 percent effect even if the programs were perfectly effective. The same applies to legal requirements that person convicted

of driving under the influence have systems installed that prevent the vehicle from starting unless the driver passes and alcohol test.

Persons assigned to an education-rehabilitation program rather than the usual court procedure in one county had a higher subsequent crash record, probably because license suspension is more effective than education-rehabilitation (Preusser, et al., 1976). Evaluation of attempts to improve screening for commercial drivers' licenses found no effect (Hagge and Romanowicz, 1996).

Authors of a study of suicide rates subsequent to emergency room visits for a variety of conditions cleverly included text searches of clinical narratives to detect mention of suicide attempts, suicide ideation, self-harm or overdose. On the basis of the relatively higher subsequent suicide rates among those so detected, they recommended psychiatric referral and treatment, if appropriate, for persons identified as potentially suicidal using these criteria (Crandell, et al., 2006). Such a recommendation raises two issues. Since 98 percent of people who met the criteria did not commit suicide (false positives), the process would be expensive. Second, the efficacy of the treatment would have to be high given that most of those referred are not really at risk.

MULTIPLE COMMUNITY CHANGES. Some experimenters have adopted a more community-wide approach directed either toward one goal, such as reduction of injuries from violence, fireworks or increased bicycle helmet use, or multiple goals, such as reductions in several injury rates simultaneously.

In an experiment in schools with higher violence rates, students were randomly assigned to get part-time summer jobs and a control group. Arrests for violent behavior during the subsequent eight months were 43 percent lower among those who were given the jobs compared to those in the control group (Heller, 2014).

Study of fireworks injuries associated with New Year celebrations in Naples, Italy indicated sixty percent of injuries occurred from illegal fireworks and children's injuries often occurred while attempting to relight unexploded fireworks or from powder assembled from partially exploded fireworks. A community program to reduce the injuries in the holiday season at the end of 1993 included police seizure of 12.5 million illegal fireworks, street sweeping to remove partially and unexploded fireworks, and an increased public information program relative to previous years. During that holiday season, there were 48 percent fewer injuries from fireworks treated in 18 surveyed emergency rooms compared to the holiday season in the previous year (D'Argenio, et al., 1996).

In Harstad, Norway, distribution to the local population of information on pedestrian injury, including locations where they occurred and stories of individual cases, was accompanied by a substantial reduction in hospitalization for child pedestrian and bicycle injury (Ytterstad, 1995). Unfortunately, neither the Naples not Harstad studies looked at other communities without programs to assess the possibility that other factors were reducing the injuries studied.

Several studies that employed such comparisons found little or no effect of community-wide efforts to control a variety of injuries (Spinks, et al., 2004).

The reduction in violent and other crimes in the U.S. in recent decades is correlated with the rise in nonprofit neighborhood improvement and crime prevention organizations (Sharkey, et al., 2017). For each ten such organizations among 264 cities studied, the subsequent murder rate declined 9 percent and the total violent crime rate declined 6 percent.

A case-control study of head injuries to helmeted and non-helmeted bicyclists showed 85 percent effectiveness of helmets in reducing such injuries (Thompson, et al., 1987). This led to a study of a campaign to promote helmet use. A control community was included to measure the trend in bicycle helmet use where there was no campaign. The campaign was directed at both parents and children, and had several features in addition to television spots and a program in elementary schools. Tags urging helmet purchase were hanged on bicycles for sale. Coupons for free french fries at fast-food outlets and free tickets for baseball games were distributed to helmet users, and coupons for discounts of $25 toward helmet purchases were distributed at various organizations and events. Helmet use by bicyclists, observed at a sample of sites in the community, increased from 5.5 percent to 15.7 percent compared to an increase of only 2.6 percentage points in the control community that had no special effort to promote bicycle helmet use (DiGuiseppi, C.G., et al., 1989). A study of such a program in Quebec found a similar effect overall but a much greater effect in middle class and wealthy communities than in those less wealthy (Farley, et al., 1996).

That is not to say that underprivileged communities cannot benefit from injury control programs if the programs are tailored to the needs of the children and their families. Based on surveillance of injuries in Central Harlem, a neighborhood including some 28,000 children in 1990, a program aimed at the most severe injuries to children 5-16 years old was initiated (Davidson, et al., 1994). The targeted injuries included those from motor vehicles, falls, assaults, and firearms (intentional or not). Such injuries to same-aged children in a comparison neighborhood, Washington Heights, that had no program, were examined to rule out trends not related to the program. The program included renovation of playgrounds, increased child supervision including involvement in skill training (dance, art, sports, horticulture, and carpentry), education in prevention of injury and violence, and lowered costs of bicycle helmets. An appealing aspect of the program is that many of the activities have intrinsic value even if they have no discernible impact on injuries.

Although the results were not entirely unambiguous, there was apparently a reduction in some of the targeted injuries. Since injuries also declined in the comparison community, other factors may have accounted for some of the observed reductions. The major evidence for efficacy of the program was that targeted injuries except falls declined in Harlem, but non-targeted injuries did not, while all injuries declined in Washington Heights. It also makes sense that

children diverted from street activities would have decreases in motor vehicle and assault injuries without changes in fall injuries that occur in sports.

Particularly encouraging was the decline in assault and gun injuries, which decreased in Harlem while increasing in the comparison neighborhood during the intervention period (Durkin, et al., 1996). This is likely due to diversion of children from the street culture rather than training in conflict resolution. In another study, students in seventh-grade classes who had such training were compared to those from other classes without training. Contrary to the intended effect, the students with training reported an increase in aggression and delinquency relative to the comparison group (Colyer, et al., 1996). Because of the questionable validity of self-reports, more definitive data on injuries related to training in conflict resolution is needed.

Various communities have developed coalitions, ad campaigns, school programs, and clinical interventions aimed at reducing violence but there is precious little effort to evaluate their effects. One volume published in 1996, in which such efforts are described (Hampton, et al., 1996), contains no reference to a study of ten communities where peer mediation in potentially violent situations was studied and found ineffective (Spiro and DeJong, 1991). There was also no reference to the aforementioned success of alternative activities in Harlem.

GROUP BEHAVIOR. People behave in groups differently than they would as individuals. One interesting group phenomenon is "pluralistic ignorance" (Thibault and Kelley, 1965). In groups (corporations, governments, injury control coalitions), people will agree to action or inaction to which they would not personally commit in the absence of the group because they falsely believe the others in the group (or its constituency) support the action. One fascinating area for research is the extent to which revelation of pluralistic ignorance changes action.

An example occurred in White River, Arizona where horses wandering into roads were frequently struck by motor vehicles. The White Mountain Apache Tribal Council had years earlier adopted a law prohibiting horses outside fences but there were no provisions for enforcement. When a health educator became concerned about the issue, he found that the injury surveillance system had identified the problem as a priority (Rothfus and Akin, 1988).

He talked with members of the Council, but they were not convinced that other Council members or the population would favor having to pay fines for their stray animals. He then conducted a community survey to see if there was support for removing horses from the road. The survey revealed overwhelming community desire for action. When the Council was shown the survey, a wrangler was appointed to search for and round up stray animals daily and the owners were fined. The incidence of vehicle collisions with domestic livestock was greatly reduced (Anderson, 1995).

Interventions to curtail violence can be a community effort. Based on a cease fire program to reduce gun violence in Chicago, an effort now called Cure Violence and other names (Butts, et al. (2015). In Baltimore, neighborhoods were offered grants to implement a program of initiation of negotiations among individuals and groups such as gangs that frequently involved in violence. The programs failed to get underway in some neighborhoods, but in those where it took hold, gun violence was substantially reduced relative to other high violence neighborhoods without the program (Webster, et al., 2012). The problem with such efforts is sustainability in the longer run. Funding for the original program in Chicago has been a roller coaster affair (http://cureviolence.org/wp-content/uploads/2016/09/2016.09.22-CV-Chicago-Memo.pdf).

Some group processes magnify the effects of individual human error or reduce it. In many cultures, pointing out individual foibles is considered impolite or offensive. Social status may inhibit communications regarding errors, such as a nurse telling a physician about the physician's mistake. In a study of hospital drug administration, detection of errors was strongly related to nurse manager coaching and nurse manager direction setting as determined by observers who had no knowledge of actual error rates or corrections (Edmondson, 1996).

ENVIRONMENT AND BEHAVIOR. The extent to which physical and social environments can be modified to reduce violence is an important area for research. Apparently night lighting of high crime areas reduces fear far more than incidence (Murray, 1996). Numerous approaches have been proposed, and some employed, such as various types of barriers (bullet-proof material in cash windows of service stations and other establishments), bus stop placement, and street closures (Clarke, 1992). Two or more clerks in convenience stores reduce robberies, as do signs indicating limited cash, access control and location of stores in areas of high traffic (Hunter and Jeffrey, 1992).

Although some researchers claim that the vast majority of motor vehicle crashes are the result of "driver error" (e.g., Treat, 1977), they do not specify the extent to which the "error" is enhanced by vehicle characteristics or environmental conditions. Perception of speed by vehicle occupants is more related to sound than vision (Evans, 1971). Yet some vehicle manufacturers attempt to minimize sound and maximize speed capability. What, if any, is the difference in crash rates between vehicles that filter out varying degrees of noise, controlling for radio use and other factors? The crashes of drivers turning left across the paths of motorcycles are ten times more frequent than crashes of motorcyclists turning left in front of cars (Griffin, 1974), perhaps because of misperception of speeds of smaller vehicles.

When I first read that study, I thought perhaps that the car and truck drivers that turned in front of motorcycles had their vision of narrower vehicles obstructed by poles or other objects in the median, or by sunlight in drivers' eyes. Armed with some fatal motorcycle crash reports from Maryland where the

driver of the other vehicle was turning, a camera and a stopwatch, I photographed the scenes from the viewpoint of an approaching driver and timed the seconds required to make the left turn. After visiting several sites, it was obvious that sight obstruction was not a factor and the turns took little time. The dead motorcyclists had to be near the other vehicles when the turns were initiated. The drivers were not facing direct sunlight. I abandoned the notion of a full-fledged study of vision obstruction and never got around to a study of the effect of vehicle size on speed perception. One study of estimated speeds by participants viewing videotapes of approaching vehicles of different sizes, including motorcycles, found no effect of vehicle size on estimated speed (Herstein and Walker, 1993).

Several studies indicate that vehicle and environmental changes to enhance perception can be effective. Experiments in which vehicles in corporate and government fleets were equipped with a variety of rear brake-light configurations found that a high-mounted, center light substantially reduced rear-end crashes while braking (e.g., Reilly, et al., 1980). Research on the effect of flashing lights on slow moving farm and construction vehicles is needed. Only 4 percent of all vehicle fatalities involve vehicles struck in the rear but 36 percent of fatal farm vehicle crashes on public roads found in the Fatality Analysis Reporting System occurred when the farm vehicle was rear-ended (Gerberich, et al., 1996). An experiment is needed to test rear lighting of slow moving vehicles. For example, farm vehicles with and without flashing lights turned on at random could reveal a relatively inexpensive way to reduce severe rear crashes of slow moving vehicles. To measure the deceleration of approaching vehicles when the lights were on or off, one could use a radar gun to measure the closing speed per second of vehicles approaching from the rear.

Crash rates of vehicles at intersections are related to the length of the amber phase of traffic control lights (Zador, et al., 1984a). Controlled experiments specify the extent to which incidence and severity of injury is affected by changes in light timing. In one such study, pedestrian/bicyclist collisions were reduced 37 percent at intersections where signals were changed to conform to Institute of Transportation Engineers proposed standards (Retting, et al., 2002). Separate tracks for walking and bicycling, cycle lanes through intersections and grade-separated crossing points reduce injury to pedestrians and bicyclists. Various other changes in roads that moderate speeds or alter traffic patterns (rumble strips, speed bumps, bypasses, roundabouts, interchanges, limited access roads, road alignment, sight distance, one-way traffic, limited parking) have been shown to reduce injuries to vehicle occupants as well (Elvik and Vaa, 2004).

Evidence that road lighting greatly reduces crashes where they cluster at night was noted in Chapter 7. Lines painted across the road at exponentially decreased intervals reduces speed of drivers crossing them and, when studied at sites in England, resulted in substantially reduced crashes at certain sites (Denton, 1980). Various road markings at curves have a differential effect on speed, depending

on type of vehicle (cars versus trucks) and are deserving of further study as to effect on crash incidence and severity (Shinar, et al., 1980). Crashes of aircraft on runways also raise the issue of the extent to which runway versus taxiway markings are clear.

This chapter has noted several instances in which programs such as increasing supervision and alternative activities for children and adolescents, behavior-change counseling, incentive systems and environmental enhancement of perception resulted in reduced injuries, or behavior that would reduce risk. Some behavioral scientists have been defensive about the emphasis on the agents, vehicles and physical environmental factors that cause or contribute to injury, pointing to the noted studies as evidence that behavioral factors can also be changed. No one denies the latter, but as noted for some of the known effective behavior-change approaches, effective ones are not being used and harmful ones remain in use. Perhaps behavioral scientists that emphasize the efficacy of a behavioral approach should spend more effort on research that demonstrates removal of barriers to the use of effective programs, whether oriented to behavior, agents, vehicles or environments.

Appendix 11-1. Experimental Evaluation of the Effectiveness of a Seat Belt Advertising Campaign

When I joined the Insurance Institute for Highway Safety in 1970, one of the highest priorities was to increase the use of seat belts in motor vehicles. Self-reports of high use rates had been discredited by Waller and Barry (1969) who observed belt use by drivers in cars and subsequently called them to receive self-reports of belt use. Drivers' claimed belt use "always" in the phone interviews was much higher than actually observed use.

The Institute had arranged to produce and test some television ads promoting belt use using a television cable system that allowed the ads to be shown only to part of the audience, preserving the rest as controls. Before producing the ads, I suggested that we needed better data on factors leading to belt use.

Brian O'Neill, Chuck Wixom and I did a case-control study of belt use. We observed drivers using and not using belts. The latter were so few that we compared users with a random sample of nonusers. We used motor vehicle license records to identify households where the observed vehicles were registered and did a phone interview with belt users and non-users. We learned that the primary factors related to use were formal education, rating of belts on comfort-convenience scales and whether or not the respondent had a friend or relative who was injured, but not killed, in a crash. Apparently, if the friend or relative lived to tell about it, the story influenced some respondents to use belts (Robertson et al. 1972).

Given these results, we contracted with an advertising agency to create advertising that addressed comfort-convenience of belts and simulated friends

injured when not wearing belts. Working with the agency writers, we approved scripts for 6 ads. We were cautious of the comfort-convenience issue. Giving people an excuse not to wear belts was off limits. The ad people did a clever script for children's shows that featured the Wicked Car Witch and the Good Car Fairy. The Wicked Car Witch tangled belts and stuffed them down between seats. The children watching were urged to help the Good Car Fairy by persuading their parents to untangle or find the belts and wear them. Most of the ads involved surrogates for the friend or family member injured, e.g., a young girl and, separately, a wife preparing to go out with her husband, each with a scarred face that they didn't want seen in public, expressed regret that they had not used seat belts. A paralyzed son was shown being loaded in a car by his dad and began talking about the football game they were to attend while the father's conscience voiced over with guilt for not teaching the son to use seat belts.

We tested the effectiveness of the ads on a cable television system in a city of about 100,000 people that was split so that half the customers were on one cable and half on the other. The split cables ran along streets perpendicular to each other. The advertising industry used the system to test the effectiveness of ads by doing household surveys of product use and measuring increases or decreases in use of products when new ads were introduced on one of the cables. While the distribution of households between the cables was not strictly random, there was not likely to be bias given the crosshatched distribution that cut across all sorts of neighborhoods.

Figure 11-1 The Wicked Car Witch and the Good Car Fairy

We decided to run the ads on one of the cables for 9 months. And they were placed on shows with relevant themes, in contrast to many public service ads shown at daybreak or just before sign off or during some unpopular show. The father-son ad was shown during NFL games on Sunday afternoon. The scarred women were shown on soap operas. The children's ad popped up frequently on popular children's shows. An ad featuring a nurse and a doctor talking about an injured patient that was not belted was shown on prime time medical drama shows popular at the time. When one of our ads was on the designated cable, an ad for a product being tested was shown on the other cable. We estimated on the basis of ratings of the audience of the programs on which the messages were shown that the average television viewer saw one or another of the messages two to three times per week. Of course, high frequency viewers saw the messages more often and low frequency viewers saw them less often than the average. In total, the campaign was equivalent to the type of major advertising effort which companies use to promote a new product. If this campaign had been sponsored on a national basis, it would have cost approximately $7,000,000 in 1974 dollars.

For 11 months, including one month before and one month after the ads were shown, belt use of drivers was observed at selected sites around the city. To identify which cars belonged to households on each cable, we obtained addresses from the Department of Motor Vehicles that matched the license tags and then matched the addresses to the cable company's billing records

Dates	Experimental Cable A		Control Cable B		No Cable, Same County		No Cable, Out of County	
	% use	No. observed	% use	No. observed	% use	No. observed	% use	No. observed
Preexperimental	15	461	16	552	14	4343	14	1672
5/28–6/16	14	372	14	469	13	3840	12	1521
6/17–7/6	13	338	15	511	14	3706	9	1551
7/7–7/26	8	370	11	456	11	3825	9	1764
7/27–8/13	11	332	11	465	11	3785	8	1641
8/16–9/2	12	356	10	442	9	3458	8	1455
9/3–9/22	7	312	9	439	8	3367	7	1861
9/23–10/12	7	343	6	372	7	3322	5	1776
10/13–10/29	13	199	8	287	12	2005	7	1151
11/1–11/16	9	304	10	428	8	3207	8	1725
11/17–11/30*	9	124	10	164	10	1301	9	723
12/13–12/30	5	274	7	278	5	3271	5	1704
12/31–1/18	5	382	4	447	5	4154	4	2091
1/19–2/7	6	355	5	457	4	4497	6	2544
2/8–2/25	5	408	5	564	4	5139	4	2903
2/28–3/16	4	308	4	478	5	4270	4	2889
3/17–3/31	5	297	6	371	5	3474	4	2400

Table 11-1. Percent Observed Male Driver Use of Seat belts by Household Location

We found no evidence whatsoever that the ads had any influence on belt use. Actually, belt use declined slightly, but it happened in cars from households on both TV cables and other locations as well (Tables 11-1 and 11-2). Since the period of the experiment ran from summer to winter, we speculated that when people donned heavier winter clothing, they had difficulty adjusting the belts being installed at the time, and some gave up.

Dates	Experimental Cable A		Control Cable B		No Cable, Same County		No Cable, Out of County	
	% use	No. observed	% use	No. observed	% use	No. observed	% use	No. observed
Preexperimental	15	273	13	374	17	2760	15	772
5/28–6/16	13	238	16	301	14	2310	6	639
6/17–7/6	12	240	13	276	13	2139	11	685
7/7–7/26	13	197	11	273	13	2193	11	769
7/27–8/13	13	226	12	277	11	2105	13	753
8/16–9/2	12	187	10	273	11	1933	11	641
9/3–9/22	12	150	13	288	8	1948	10	696
9/23–10/12	10	206	8	259	7	1935	5	724
10/13–10/29	13	118	10	173	12	1136	12	455
11/1–11/16	16	192	14	324	11	2029	10	717
11/17–11/30*	14	74	15	103	14	743	12	227
12/13–12/30	8	196	8	232	7	1933	6	720
12/31–1/18	7	248	8	342	10	2494	9	1088
1/19–2/7	12	259	8	368	8	2731	8	1130
2/8–2/25	7	272	5	354	7	2727	6	1318
2/28–3/16	8	232	7	336	7	2565	7	1333
3/17–3/31	10	170	7	222	7	2006	7	1114

Table 11-2. Percent Observed Female Driver Use of Seat belts by Household Location

Later, the U.S. government allowed vehicle manufacturers to install buzzers that sounded until belts were latched and interlocks that prevented vehicles from starting until belts were latched in the mid-1970s. There were temporary increases in belt use (Robertson, 1975b), but negative public reaction almost resulted in the demise of the National Highway Traffic Administration. Seat belt increased only when laws were enacted requiring use (Chapter 12).

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