UMTRI

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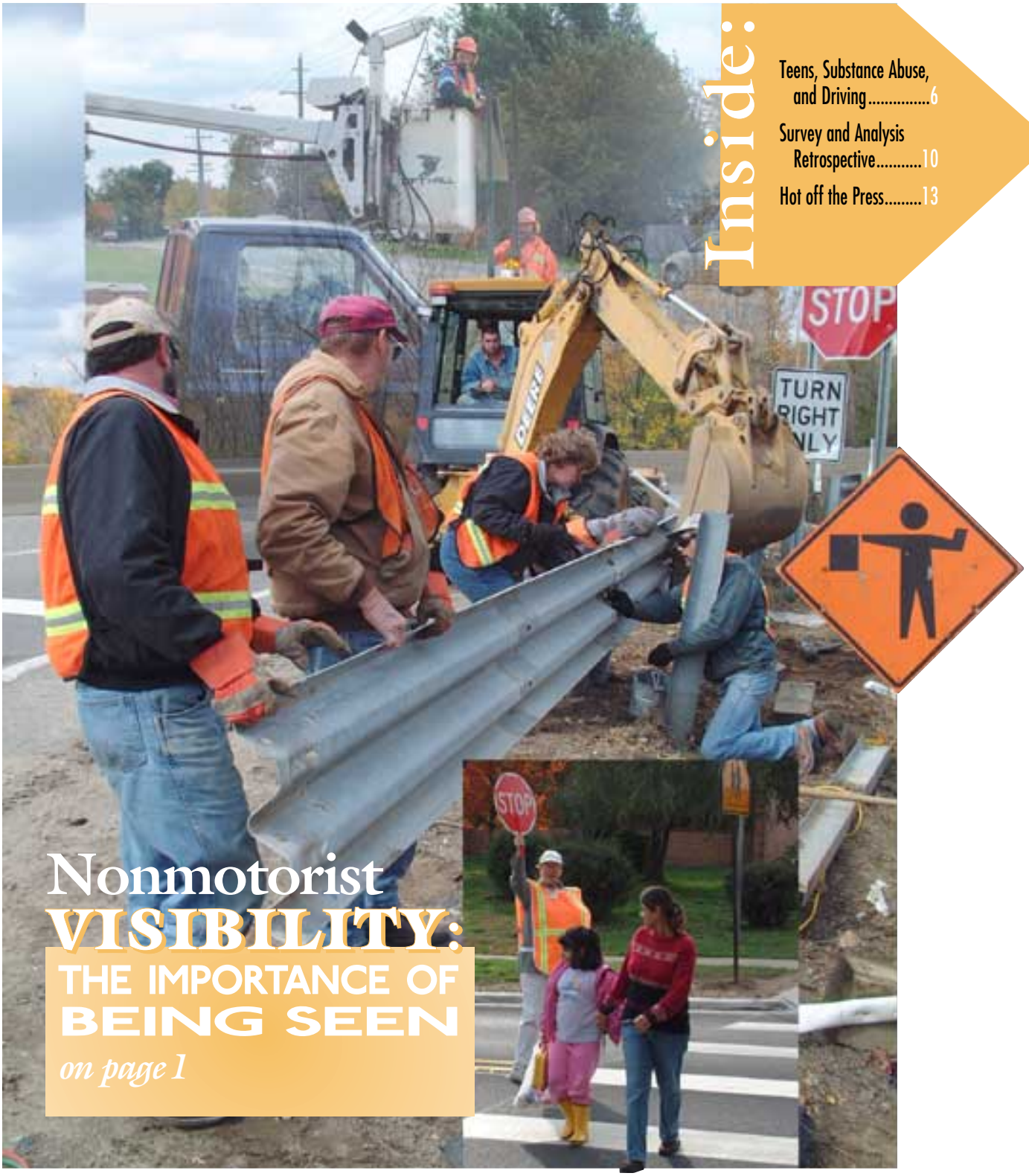

Inside:

Nonmotorist VISIBILITY: THE IMPORTANCE OF BEING SEEN

on page 1

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CONFERENCES & EVENTS

Fundamentals of Seat Ride Dynamics
October 17–18, Troy, Michigan
http://www.sae.org/calendar/sempart.htm#ride

Transportation 2001: A Time & Space Odyssey
October 22–24, Williamsburg, Virginia
http://www.utexas.edu/depts/ctr/trf/conference/index.html

Injuries, Anatomy, Biomechanics, and Federal Regulation
October 29–30, Troy, Michigan
http://www.sae.org/calendar/semsafe.htm#injuries

SAE 2001 India Mobility Conference
November 1–3, Chennai, India
http://www.saeindia.org/Events/conference2001.html

First Human-Centered Transportation Simulation Conference
November 4–7, Iowa City, Iowa
http://www.nads-sc.uiowa.edu/hctsc/

Motor Vehicle Accident Reconstruction
November 5–7, Troy, Michigan
http://www.sae.org/calendar/semsafe.htm#motor

International Truck and Bus Meeting and Exhibition
November 12–14, Chicago, Illinois
http://www.sae.org/calendar/itb/

Current Issues in Using Crash Injury Data
November 13, Troy, Michigan
http://www.sae.org/calendar/semsafe.htm#current

45th STAPP Car Crash Conference
November 15–17,
San Antonio, Texas
http://www.stapp.org/

2001: Road Safety Research, Policing, and Education Conference
November 18–20,
Melbourne, Australia
http://www.monash.edu.au/oce/roadsafety

Second International Conference on Smart Urban Transport
November 19–21,
Brisbane, Australia
http://www.transportroundtable.com.au

RR

PHOTOS THROUGHOUT FEATURE ARTICLE: UMTRI / SHEKINAH ERRINGTON

THE IMPORTANCE OF BEING SEEN

RETROREFLECTIVE GARMENTS SAVE NONMOTORISTS' LIVES

Each year in the United States, pedestrians, pedalcyclists, and workers in road construction zones are killed by motor vehicles because drivers couldn't detect the nonmotorist in time.

In 1999, 4,906 pedestrians were killed and 85,000 were injured in traffic crashes. In the same year, 750 pedalcyclists were killed, and 51,000 injured. Jim Sayer, assistant research scientist in UMTRI's Human Factors Division, says, "At nighttime pedestrians and pedalcyclists dramatically overestimate their ability to be seen, and drivers dramatically overestimate their ability to see." In any given year, between 120 and 130 roadway workers die in road construction activities. About 23 percent of these pedestrian roadworkers are struck by traffic passing through a work zone and 19 percent are struck by construction vehicles in the work zone. Overall, nonmotorist fatalities account for 14 percent of all traffic fatalities. When involved in a traffic accident, pedestrians are as much as six times more vulnerable to fatality when compared with injuries incurred by motorists involved in traffic accidents. Children and the elderly, in particular, are disproportionately represented in pedestrian fatalities because the former are more likely to rely on walking as a primary mode of transit and the latter may be frail.

Motorists and nonmotorists alike overestimate their ability to see and be seen at night, and the comparative risk of pedestrian crashes in darkness is as much as 4.14 times higher than in daylight. According to a recent UMTRI study, the elevated risk to pedestrians in darkness is likely the result of inadequate visibility distance, as provided by low-beam headlamps, for motor vehicle speeds normally observed in darkened conditions. In other words, motorists tend to "out drive" the ability of low-beam headlamps and therefore fail to detect and avoid pedestrians in the dark.

VISIBILITY IN DARKNESS AND LIGHT

Color contrast between an object and its surrounding area contributes

continued...

significantly to daytime visibility. However, at night, the dominant factor is most often luminance contrast. Luminance contrast can be achieved by illuminating the object itself (either internally or externally) or by relying on motor vehicle headlights to illuminate the object. Although we rely on headlamps to illuminate objects in the roadway environment at night, retroreflective materials are special because we also rely on special optical properties of the objects themselves to redirect light back to the driver. The amount of light returned to the source will depend on the lighting geometry and retroreflective properties of the illuminated material. Road signs, lane markings, and road edge delineators are just a few examples of retroreflective materials used to aid nighttime driving. Sayer explains, "Research has shown that, at night, retroreflective material worn by pedestrians is most noticeable to motorists if it is placed on major joints or the extremities, such as the wrists and ankles." When pedestrians wear retroreflective materials on their extremities, the motions associated with walking make it easier for motorists to identify the object with retroreflectors as a pedestrian. This effect has been referred to as biomotion. However, placing retroreflective material on the torso is also beneficial because the torso provides room for large amounts of retroreflective material.

"At night, pedestrians and pedalcyclists dramatically overestimate their ability to be seen, and drivers dramatically overestimate their ability to see."

PEDESTRIANS VERSUS ROADWORKERS

Roadworkers often contend with different roadway environments than those that pedestrians or pedalcyclists face. State laws typically govern the wearing of reflective clothing by roadworkers, particularly if work is being performed in a posted road construction zone. Under these circumstances, motorists often expect to see roadworkers when they enter a construction zone, and temporary signs reinforce this expectation while forcing traffic to slow down. However, as previously stated, roadworkers are also in danger of being struck by construction vehicles within the work zone. There are also some regulations for pedalcyclist markings, including state-by-state regulations and industry standards for bicycle reflectors, but the accident statistics might suggest that these standards are not enough. And there are no regulations at all to require the use of retroreflectors by pedestrians. In nighttime situations when visibility distances are relatively short, motorists are less likely to see a pedestrian or pedalcyclist who is not wearing retroreflective materials. As a result,

two-thirds of all pedestrian and cyclist accidents occur at night. The most common pedestrian accidents are at intersections or when a pedestrian is crossing a street, while pedalcyclist accidents more frequently occur when the pedalcyclist is traveling parallel to the motor vehicle traffic.

Sayer says, "The ideal is for high visibility both during the day and night, and it would be even better if you could provide drivers with visual cues as to whether the person is a pedestrian, pedalcyclist, or roadworker. One approach to distinguishing between classes of nonmotorists might be to place retroreflectors on persons in such a manner that a motorist could

ILLUSTRATION: UMTRI / KATHLEEN CROCKETT RICHARDS

FIGURE 1. A diagram of the experimental setup for some recent UMTRI studies.

distinguish between nonmotorists classes by recognizing movements that are characteristic of what a class of nonmotorists is doing."

Still, there are many similarities among classes of nonmotorists. Sayer continues, "When talking about fatalities, you can't separate the nonworker from the roadworker. The same qualities of retroreflective material hold for both. Pedestrian deaths in recent years have decreased, but the rate is still high when you consider the percentage of people walking. The fundamental qualities of materials intended to improve roadworker visibility are just as applicable to pedestrian visibility and vice versa."

A roadworker commented that the vests "make us look like bright orange pumpkins."

COUNTERMEASURES TO NONMOTORIST FATALITIES AT NIGHT

Various countermeasures have been proposed to reduce nonmotorist fatalities. One such countermeasure is the introduction of educational campaigns aimed at school-aged children. Educational campaigns have been credited for significantly reducing the number of child-pedestrian deaths and injuries. However, most of the proposed countermeasures rely heavily on changes to the roadway infrastructure; some are easily implemented at a reasonable cost, but others require substantial restructuring of the roadway environment to separate vehicles and pedestrians. Unfortunately, many of these infrastructure-based countermeasures are either cost prohibitive or impractical, particularly for rural settings with lower levels of pedestrian traffic and limited infrastructures currently in place.

The least expensive countermeasure may be educating and encouraging nonmotorists of all ages to wear high-visibility garments, such as light-colored garments and especially those that include retroreflective markings, when exposed to traffic. Currently, federal regulations in the United States govern the safety apparel worn by flaggers and roadworkers. Flaggers must wear reflectorized garments at night, and roadworkers must wear garments that are reflectorized or made of high-visibility materials. Since 1975, the Consumer Product Safety Commission has required bicycle manufacturers to equip new bicycles with a series of retroreflectors to help motorists detect pedalcyclists at night. However, Sayer says, "It is very unlikely that any state or federal authority will mandate that pedestrians wear high-visibility or reflectorized garments-despite their known safety benefit."

Various studies show that wearing retroreflective materials, or lighted markings, significantly increases the distance at which drivers can detect nonmotorists. Sayer says, "Research has shown that at night motorists tend to out drive their headlamps by traveling at speeds that limit their ability to respond in time to obstacles once they

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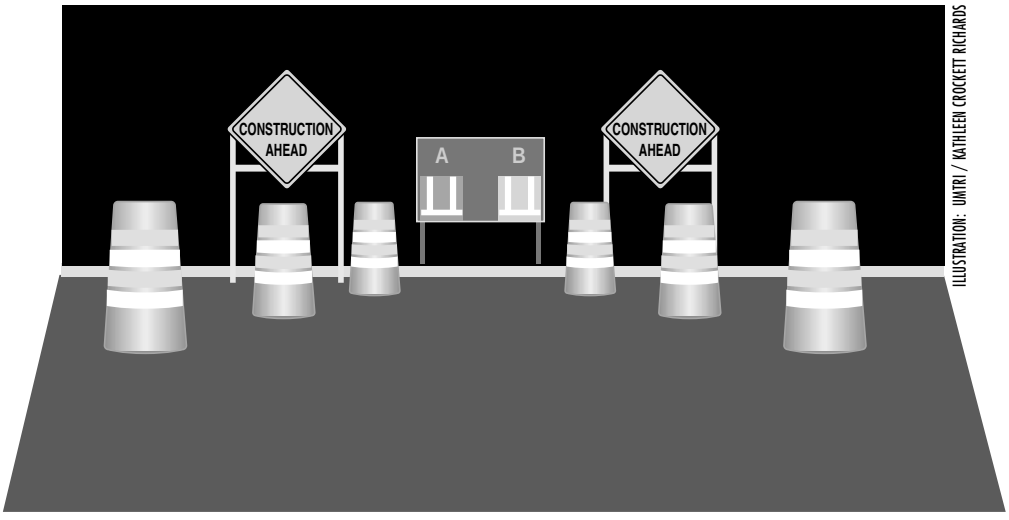


FIGURE 2. A diagram of the cluttered condition for evaluating the selection of retroreflective materials used in roadworker safety vests.

are illuminated by the headlamps." At night, the visibility distance of a dark-clad pedestrian who is illuminated by low-beam headlamps is approximately one-half the distance required to stop a vehicle that is traveling 55 mph. However, the nighttime visibility distance for nonmotorists can be increased if the nonmotorist is wearing retroreflective markings.

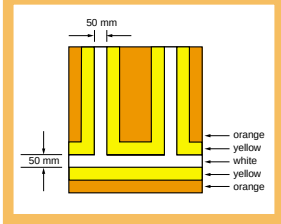
UMTRI STUDIES SHED LIGHT ON RETROREFLECTORS

In a recent nighttime field study conducted by Sayer and Mary Lynn Mefford, research associate at UMTRI, the effects of retroreflective material area, distribution, and color on judgments of conspicuity were assessed. Results indicate that color (white, fluorescent yellow-green, and fluorescent red-orange) significantly affected judgments of noticeability. Yet for all three colors, neither the distribution of the material nor the age or gender of the observer affected how noticeable the retroreflective stimuli appeared. However, the amount of material (area) had a significant effect on visibility—with more material resulting in higher judgments of noticeability. Sayer says, "It appears to be important for materials to contrast with the surrounding environment so the nonmotorist stands out from the background. Yet, familiarity is also likely to influence the noticeability of a nonmotorist. For example, people expect orange and white clad roadworkers in work zones, but a variety of other orange and white objects also exist in the work zone, such as barrels. By adding fluorescent yellow to roadworker vests, for example, you are likely to increase the color contrast between the worker and the surrounding materials, while still maintaining roadworker familiarity."

Not all retroreflective materials reflect color, but for those that do, color may be effective in increasing the visibility of nonmotorists. As the result of a psychological phenomenon known as the Helmholtz-Kohlrausch effect, people perceive colored stimuli (such as red and green) to be brighter than neutral stimuli (such as white and gray) when the stimuli are matched photometrically (i.e., a light meter would say that they are giving off equal amounts of light). "At night, the use of color can be effective because you may be able to use less of a colored retroreflective material than of a white that is photometrically equal, because colored material is perceived to be brighter." Sayer says. "Our research has shown, for example, that for large amounts of material, equivalent to that used in a roadworker vest, you'd have to use much more white retroreflective material than red material if the materials are photometrically matched. However, most retroreflective materials of various colors are not photometrically matched, and in fact vary in their retroreflective power (the efficiency of reflecting light back to the source of illumination). Therefore, in many instances a retroreflective material that is white or silver, as opposed to colored, will make the nonmotorist more noticeable at night simply because of its efficiency in reflecting light. Whether it is white light or colored light that is reflected

UMTRI research has shown the following facts about the visibility of retroreflective materials:

- The greater the area of retroreflective material, the greater the visibility.
- Color contrast within the garment, as well as relative to the surroundings, affects judgments of noticeability during the daytime.
- A suggested color combination that might provide the most noticeable roadworker safety apparel for daytime conditions is fluorescent yellow and fluorescent orange.



- The color of a retroreflective marking (red, yellow, or green) affects the distance at which a pedestrian can be detected at night; colored retroreflective markings were detected at longer distances than a photometrically matched white marking.
- Whether white or colored light is reflected back to a motorist, more light is always better as it increases the distance at which a motorist can detect a nonmotorist.

ILLUSTRATION: UMTRI / KATHLEEN CROCKETT RICHARDS

back to a motorist, more light is always better as it increases the distance at which a motorist can detect you."

In another recent study, Sayer and Mefford examined how color contrast (in daytime and nighttime) affects noticeability of roadworker vests. They matched fluorescent orange and yellow fabrics with orange, yellow, or silver retroreflective trim arranged to look like a roadworker safety vest. Comparisons were made between stimuli to develop a scale of how noticeable various color combinations appeared under cluttered and uncluttered viewing conditions. (See figure 2.) The results showed that color contrast within the safety vest, as well as relative to environmental surroundings, affects judgments of noticeability during the day. At night, color contrast was not identifiable in this study because all of the retroreflective materials used appeared white when illuminated. As a result, the retroreflective power of the trim material accounted for almost all of the relative judgments of noticeability. The results suggest that a design for roadworker safety apparel that includes a combination of fluorescent

yellow and fluorescent orange materials (providing color contrast) is likely to improve the daytime conspicuity of roadworkers.

Sayer et al. also conducted a nighttime field study to assess the effects of color on the detection of retroreflective pedestrian markings. Observers were seated in a stationary vehicle with its headlights on and were asked to indicate at what distance a moving pedestrian, wearing small retroreflective markings on her legs, was first detectable. (See figure 1.) Independent variables in the study included color of the marking (matched for retroreflective power), retroreflective power, and observer age. The study showed that the color of a retroreflective marking (red, yellow, or green) affects the distance at which a pedestrian can be detected; colored retroreflective markings were detected at longer distances than a photometrically matched white marking.

LET THERE BE LIGHT

The results of UMTRI research on nonmotorist visibility show that the retroreflective power, color, and placement of retroreflective materials can make the nonmotorist more easily detected. The studies, most of which were funded by the Human Factor's Industry Affiliate Program, produced results that may help to improve safety for roadworkers and pedestrians in general.

Sayer says, "For optimum visibility, one must combine approaches and issues, consider the amount and placement of the retroreflective materials, and make decisions about tradeoffs in color and retroreflective power."

One roadworker commented that the vests "make us look like bright orange pumpkins." Not much of a fashion statement, but a good attention grabber for both passing motorists and fellow crew members who are operating heavy machinery. RR

COLLABORATIONS

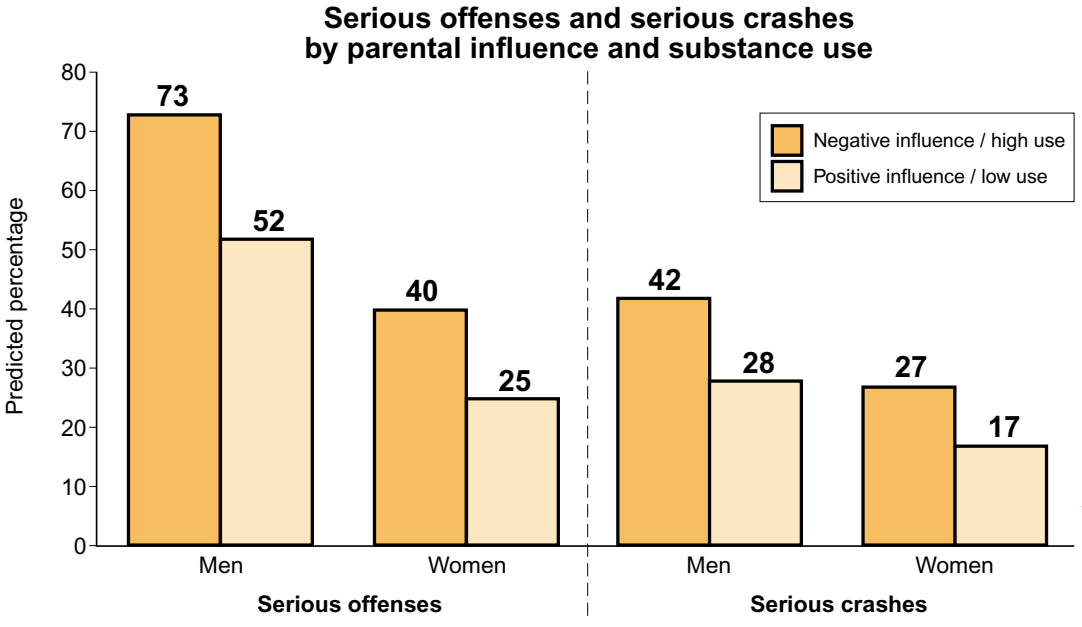
Teens, Substance Abuse, and Driving

Jean Shope, head of UMTRI's Social and Behavioral Analysis (SBA) Division, is working with experts from several University of Michigan departments on research projects regarding teens, substance abuse, and injury in motor vehicle crashes.

Teens and Motor Vehicle Crashes

Motor vehicle crashes are the major cause of death and serious disability in teenagers and young adults. The SBA Division is working with both the UM School of Public Health and the Medical School on a long-term collaborative project regarding young people and alcohol use, related to motor vehicle crashes. The project, sponsored by the National Institute on Alcohol Abuse and Alcoholism, aims to understand the predictors that explain adolescent and young-adult high-risk driving behavior—particularly alcohol-related driving behavior—and to enhance the design of interventions aimed at modifying high-risk driving behavior.

The study debuted in 1991 with principal investigators Shope and Patricia F. Waller, then the director of UMTRI and now retired. Over the years, the study expanded and involved more researchers, including Roderick Little, department chair of the UM Biostatistics Department and professor at the School of Public Health; Trivellore E. Raghunathan, associate professor in the UM School of Public Health; C. Raymond Bingham, assistant research scientist in psychiatry at the UM Medical School; Michael R. Elliot, a former graduate student research assistant and now an assistant professor at the University of Pennsylvania School of Medicine; and Sujata Patil, a graduate student research assistant, recently appointed to a



Alcohol-related driving behavior is highest in young adults. A recent follow-up survey of respondents at ages twenty-three and twenty-four found how parental influence and substance use in their teen years affected the respondents' later driving behavior.

postdoctoral fellowship with the UM Substance Abuse Research Center.

Shope says, "Many experts, from various UM departments, have made essential contributions to this study over the years. The knowledge, resources, and perspectives of different disciplines combine to make the study a success."

The project was piggy-backed onto earlier research, based in the UM Medical School in which Shope was involved, with initial data collection starting in 1984 from fifth and sixth graders in six southeastern Michigan public school districts. Data were collected from self-administered questionnaires that included psychosocial and substance-use measures. The respondents completed more questionnaires when they reached tenth and twelfth grades. Starting in 1992, students' names and birth dates were submitted annually to the Michigan Secretary of State's office, and driver history data were obtained for over 13,000 subjects. The data have been updated each year as drivers age. Most of the students completed the survey before they started driving, so their predriving experiences can be used as predictors of subsequent driving behavior.

Recently, the study was extended from the teen years through the young adult years, when alcohol-related driving behavior is the highest of any age group. A follow-up phone survey was conducted when the respondents were five to six years out of high school (at ages twenty-three to twenty-four). The survey gathered self-reported driving information and updated demographic, substance use, and psychosocial data.

Specifically, the follow-up examined how substance use (of alcohol, cigarettes, and marijuana) and other influences act as predictors of offenses and crashes. One set of analyses examined parental influences in terms of monitoring, nurturing, permissiveness, family connectedness, and family structure. The results show that predictor trends are similar for men and women, and that, in general, more positive parental influences reported before licensure—particularly monitoring, nurturing, and family connectedness—were significantly associated with lower subsequent rates of serious offenses and serious crashes. Also, for both sexes, higher self-reported use of cigarettes, marijuana, and alcohol before licensure was significantly associated with higher subsequent rates of serious offenses and serious crashes.

As illustrated in the figure, the likelihood of having at least one serious offense for those with negative parental influences and high substance abuse is 73 percent for men and 40 percent for women, whereas with positive parental influences and low substance abuse, the rates are 52 percent for men and 25 percent for women. The likelihood of having at least one serious crash is 42 percent for men and 27 percent for women with negative parental

The longitudinal study:

- **Examines the relationship of alcohol use/misuse and previous school-based alcohol prevention programs to high-risk adolescent and young adult driving**
- **Looks at problem-behavior theory risk factors, as well as protective factors, to determine their relationship with high-risk driving behavior among adolescents and young adults**
- **Develops recommendations for prevention efforts in the policy, education, and enforcement areas targeted toward high-risk driving behavior, particularly alcohol-related, of adolescents and young adults**

influences and high substance abuse, and 28 percent for men and 17 percent for women with positive parental influences and low substance abuse.

However, even the best-scenario numbers are high due to significant risky driving during the early years of licensure. The prevention implications that came out of the study include supporting parents' roles, providing substance abuse prevention programs, and encouraging parents' involvement in young people's driving. Shope says, "Substance abuse prevention among young people has been an important effort, and is worthy of being sustained and enhanced in the broadest sense to reduce the consequences of substance use both from motor vehicle crashes as well as from other high-risk behaviors."

For more information on this study, see "Adolescent antecedents of high-risk driving behavior into young adulthood: substance use and parental influences," in *Accident Analysis & Prevention*, volume 33, issue 5, September 2001, pp. 649–658.

Adolescent Injury Prevention

Shope is also involved in a project to prevent alcohol-related adolescent injury, which is sponsored by the National Center for Injury Prevention and Control, Centers for Disease Control and Prevention. Other investigators on the project include Dr. Ronald F. Maio, principal investigator of this project, associate professor and associate chair of research in emergency medicine, and assistant research scientist with UMTRI; and Dr. Frederic C. Blow, associate professor of psychiatry and psychology, and senior associate research scientist at UMTRI.

The study was developed around the fact that injury is a major cause of adolescent morbidity and mortality, and alcohol is frequently associated with injury. The goal of this three-year project is to prevent alcohol use and misuse among adolescents, thereby decreasing their risk of alcohol-related injuries. The project will ideally reinforce other alcohol prevention efforts in homes, churches, schools, and communities.

To meet this goal, the team developed an interactive computer program that takes adolescents through various drinking scenarios and makes them think about their alcohol use. The program hopes to:

- Increase knowledge about the effects of alcohol
- Promote more positive attitudes about not using or abusing alcohol
- Encourage more positive behavioral intentions.

The study has been conducted in two sites: an academic medical center and a community teaching hospital. Teens aged fourteen to eighteen, who came into the emergency room for injuries other than major trauma, suicide attempts, sexual assault, or poisoning, were asked to participate in the study. The interactive computer software runs on a laptop with animated graphics and consists of a survey, an interactive house party, and a post-party survey.

The initial survey consists of thirty-three questions that assess demographics, knowledge, attitudes, and alcohol behavior. The house party section lets teens randomly assigned to the intervention group choose a "party pal" and visit different rooms in the house, while they learn about alcohol use and misuse. After leaving the virtual party, they are asked twenty

PHOTOS: UMTRI / SHEKINAH ERRINGTON

Teens use the interactive computer program developed in the study. It takes them through various drinking scenarios and makes them think about alcohol use.

additional questions, including how they can say no to alcohol in various situations.

At three and twelve months after completing the program, the teens participate in a follow-up phone call that measures how the program has affected their subsequent behavior.

Most teens said they liked the software and it made them think about their alcohol use. One participant commented, "I really enjoyed the program and thought it was interesting. I didn't know all of the facts included in the program." RR

Ken Campbell Retires from UMTRI

A Career of Contribution to Survey and Analysis

Ken Campbell, head of the Survey and Analysis Division, recently retired from UMTRI after twenty-six years of service. He has accepted a position as program manager of transportation safety at the Oak Ridge National Laboratory, which builds on his experience at UMTRI.

Campbell holds a Ph.D. in mechanical engineering from the University of Wisconsin and started working at UMTRI in 1974 as an assistant research scientist. He had previously worked as a research engineer for General Motors. He was promoted to associate research scientist in 1977, to research scientist in 1991, and to senior research scientist in 1997. Campbell had led the group since the earlier Systems Analysis Division dissolved in the mid-1980s.

While in school, Campbell focused on traffic safety, including a dissertation on occupant safety using accident data. His first job was with General Motors in biomechanics, working on the neck of the hybrid II test dummy. He also worked at the GM Proving Grounds doing barrier crash testing and field data collection. In 1974, he came to UMTRI to pursue his interest in passenger occupant protection. UMTRI was part of a landmark development in that area and had field accident investigation teams. Campbell explains, "UMTRI, in collaboration with the UM Institute for Social Research, first proposed the notion that NHTSA needed nationally representative accident data, and UMTRI developed the original design of the National Accident Sampling System (NASS, now known as the National Analysis Sampling System)."

Starting in 1975, Campbell led a multiyear program to assess the national safety impact of a new truck air brake standard, FMVSS 121. The project culminated with Campbell being called to present the study finding of no significant safety benefit to a Senate committee. The standard was subsequently dropped until improved braking systems were developed.

In the early 1980s, the statistical modeling taking place at UMTRI was the best in its day. An example was the analysis of the National Collision Severity Study (NCSS, the precursor to NASS) data. Phyllis Gimotty and Ted Chira-Chavala developed multivariate probit models relating the probability of injury to the type of collision, restraint use, and occupant age. The NCSS study was the pilot test for an accident reconstruction algorithm to calculate collision severity. The algorithm was developed at Calspan (now Veridian) and used energy estimation techniques developed by Campbell, which are still used today both in North America and in Europe.

Survey and Analysis Grows under Campbell

The Survey and Analysis Division consists of three main groups: the Center for National Truck Statistics, the Transportation Data Center, and Statistical Analysis. There is also a new initiative under the Transportation Data Center, the Center for International Transportation Data.

Center for National Truck Statistics

Campbell served as the director for the Center for National Truck Statistics from its inception in 1988 until 2001 (Dan Blower, assistant research scientist in the Survey and Analysis Division, has now taken over). The Trucks Involved in Fatal Accidents (TIFA) Survey was started in 1980. From 1985 through 1987, a major national survey of truck travel, the National Truck Trip Information Survey (NTTIS), was conducted. In 1988, this program was formalized as the Center for National Truck Statistics to collect and analyze truck accident and travel data.

Campbell's work also includes a 1991 project on large truck crashworthiness. The study assessed the potential safety benefit of restraint use, improvements in cab interior surfaces, and cab structural improvements. The project used information from in-depth investigations carried out by the National Transportation Safety Board and integrated it with national data on heavy truck occupant fatalities from TIFA.

More recently, Campbell and his team were involved in hours-of-service research to develop baseline estimates of the prevalence and risk of truck driver fatigue in fatal accidents. Estimates of the vehicle miles of travel and accidents involving fatigue are tabulated for various segments of the trucking industry. The incidence of fatigue accidents is combined with the travel data to estimate the overall risk of fatigue in fatal accidents, The study uses data from UMTRI's TIFA files and the 1992 Truck Inventory and Use Survey, conducted by the Bureau of the Census.

Currently, the center is addressing a methodology to study the causes of heavy truck accidents. The method,

developed by Blower, has been adopted for a major national study, the Large Truck Crash Causation Study, to be conducted by the National Highway Transportation Safety Administration for the Federal Motor Carrier Safety Administration. Campbell currently sits on a Transportation Research Board advisory committee for this study.

Transportation Data Center

The Transportation Data Center started in 1968, before Campbell arrived at UMTRI, to study transportation safety using real-world data. Campbell says, "In late 1968, analyzing accident data presented a computing challenge. The TDC group was formed to provide the software to meet this challenge. Motor vehicle manufacturers were the primary sponsors and the data center provided data for researchers and manufacturers."

The primary purpose was data access and computing ability. Campbell explains, "In those days, data was stored on magnetic tape and all the formatting information for each file had to be passed to an analysis program. By the early 1970s, TDC had developed an easy interface that simply prompted for an eight-character name to access the data, making the complexity of data storage transparent to the user."

Today the TDC continues to help reduce injury and suffering, and the associated costs of crashes, by providing transportation safety researchers worldwide with expert consulting and a readily accessible source of motor vehicle crash data. It is currently involved in several ongoing projects with members of the traffic safety community.

Statistical Analysis

The Statistical Analysis group applies statistical methods in the analysis of traffic safety, including collision-avoidance and crashworthiness issues. Projects generally involve the analysis of accident and travel data to study the risk of accident involvement or the risk of injury in a collision.

In the 1990s, Dawn Massie produced a series of interesting studies of the relationship of accident risk to driver age and gender for the Insurance Institute for Highway Safety. Massie combined travel data from the Nationwide Personal Transportation Survey with data on fatal and nonfatal accidents from NHTSA. Initial results were controversial because they showed women to have higher rates for nonfatal accidents. Subsequent multivariate models revealed that this result was a consequence of an intervening variable, annual travel.

The Survey and Analysis Division has three groups that analyze transportation safety issues based on the actual highway experience:

- ***Center for National Truck Statistics***
- ***Statistical Analysis***
- ***Transportation Data Center***

This is an important complement to the laboratory-based research carried out in the other divisions. As an interdisciplinary team, the division addresses the driver, vehicle, and roadway dimensions of the transportation system. The foundation of the division's approach is a commitment to data quality developed from experience with field data collection, survey methods, and state and federal data files. The Transportation Data Center maintains a library of transportation-related datasets.

The interdisciplinary approach includes consideration of the interaction between the driver, vehicle, and roadway. Factors associated with the risk of a collision, and the risk of injury in a collision, are identified by applying multivariate statistical methods. Overall, the goal is to produce objective information on the performance of the transportation system.

Campbell and Massie initiated work on the development of collision typologies that classify accidents in ways that facilitate identification of collision situations with the greatest potential for advanced collision avoidance technology. More recently, Campbell was a member of the independent evaluation team for the IVI Generation 0 field operation tests, which address a methodology for estimating safety benefits of collision avoidance technology.

Campbell and Blower examined injury-producing contact rates. Using data from the NHTSA National Accident Sampling System (NASS) Crashworthiness Data System (CDS), they developed injury-producing contact rates for passenger vehicle drivers in tow-away frontal collisions. The injury rate was calculated as the number of injury-producing contacts per 100 drivers involved in a collision. The contact rates were specific to injury severity, body region injured, and contact point of the injury. These injury-producing contact points were used to compare four restraint configurations: unrestrained, three-point belted, driver airbag alone, and driver airbag plus three-point belt.

More recently, Hans Joksch, a research scientist at UMTRI, has developed some innovative analytic approaches for the study of airbag effectiveness and vehicle compatibility in collisions for NHTSA. Joksch has developed estimates of the probability of fatality for drivers at the make-model level by combining FARS and GES data. His work on airbag effectiveness has focused on situations where the effectiveness is unusually

continued...

high or low. Such situations can provide insights to improve airbag performance. To address vehicle compatibility issues, Joksch has added information from the New Car Assessment Program (NCAP) on structural stiffness and vehicle geometry, the two main sources of vehicle incompatibility in collisions. Again, multivariate models are developed to relate these factors to the increased risk of fatality that arises from a lack of structural compatibility when vehicles of differing design collide.

The members of the Statistical Analysis group often work with other divisions in providing experimental designs or in developing statistical models, for example to identify factors associated with misadjusted truck air brakes or to study heavy truck mirrors.

Center for International Transportation Data

Campbell initiated the Center for International Transportation Data (CITD) in 2000 as an expansion of the efforts of the UMTRI Transportation Data Center to encompass global issues. Campbell says, "By sharing information globally, we hope to improve road safety and the quality and consistency of data worldwide." Cooperative projects include determining the effects of drinking age on Ontario drivers in the United States with the University of Western Ontario in Canada, and defining U.S. crash characteristics in rollovers, frontal crashes, and collision types to make better protection systems with Autoliv Research & Development in Germany.

CITD was formed based on a Harvard report, the Global Burden of Disease and Injury. This project was a worldwide collaboration of over 100 researchers (sponsored by the World Health Organization and the World Bank, based at the Harvard School of Public Health) that investigated trends of all major causes of death worldwide. Among medical causes, transportation-related injuries and deaths were forecast to move from the ninth to the third leading causes of injuries and deaths in the next twenty years, with the growth taking place in developing countries. "The global picture of transportation safety is becoming more and more important," Campbell says. "Historically, UMTRI has focused on analyzing only U.S. data, but it would be beneficial to compare techniques and methods with those of other countries," Campbell says. "The initial goal of the CITD is to identify and catalog all international data sources and to act as a referral service. The program is promising but requires funding."

PHOTOS THIS ARTICLE: UMTRI / SHEKINAH ERRINGTON

Ken Campbell enjoys a moment with his wife Paula and daughter Masha at his retirement party at UMTRI.

An Eye on the Future

Campbell has enjoyed his work at UMTRI, and watching his division grow over the years. He says, "I stayed at UMTRI for a long time because it's a great place to work. The staff is excellent and I enjoyed the people I worked with. They are engaged in work that tries to save lives. Our group has benefited greatly from the opportunity to collaborate with outstanding people in other UMTRI units that are leading their fields, such as Biosciences, Engineering Research, and Human Factors.

Still, when the position at Oak Ridge presented itself, Campbell saw it as a good opportunity. He says, "My family thought the time was right for a change. I'm looking forward to exchanging cold weather and flat land for a warmer clime and mountains. I've definitely had second thoughts about leaving UMTRI, but the chance to be in an organization building new capabilities and training new people addresses a critical need in transportation."

Oak Ridge is associated with the recently completed National Transportation Research Center, a collaboration with the University of Tennessee Transportation Center.

As to the future of the Survey and Analysis Division, Campbell says, "Dan Blower is already adding buses to the truck program, and there are prospects of a hazardous material supplement, as well as an expansion to nonfatal accidents." A search is underway to hire a new head of UMTRI's Survey Analysis Division. RR

Hot Off The Press

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Hot Off The Press

continued from page 13...

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