STATUS REPORT

INSURANCE INSTITUTE FOR HIGHWAY SAFETY

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If you start into a curve too fast or for some other reason start to lose control

ELECTRONIC STABILITY CONTROL

can help avoid disaster; lowers risk of fatal single-vehicle crash by 56%

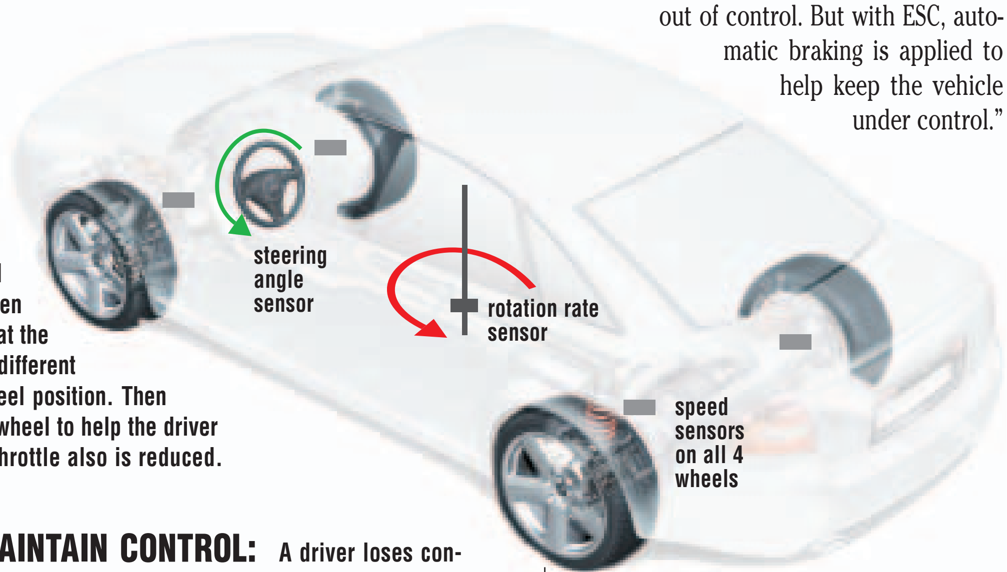
About half of the 28,000 passenger vehicle crashes with occupant deaths that occur each year on U.S. roads involve a single vehicle. Equipping cars and SUVs with electronic stability control (ESC) can reduce the risk of involvement in these crashes by more than 50 percent. The effect on all single-vehicle crashes (fatal and nonfatal) is somewhat less, about 40 percent, and the effect on multiple-vehicle crashes is much less. These are the main findings of a new Institute study comparing crash rates for cars and SUVs with and without ESC.

How it works: ESC is an extension of antilock brake technology, which has speed sensors and independent braking for each wheel. For ESC, additional sensors continuously monitor how well a vehicle is responding to a driver's steering input. These sensors detect when the vehicle is about to stray from the driver's intended line of travel. Such loss of control usually occurs in high-speed maneuvers or on slippery roads. Then ESC brakes individual wheels automatically to keep the vehicle under control.

"For most drivers ESC isn't likely to activate frequently. For example, it won't prevent most of the fender-bender crashes that occur so often in stop-and-go traffic," says Susan Ferguson, Institute senior vice president for research. "ESC is designed to help a driver in the relatively rare event of loss of control at high speed or on a slippery road. When a driver enters a curve too fast, for example, the vehicle may spin out of control. But with ESC, automatic braking is applied to help keep the vehicle under control."

WHAT IS ESC?

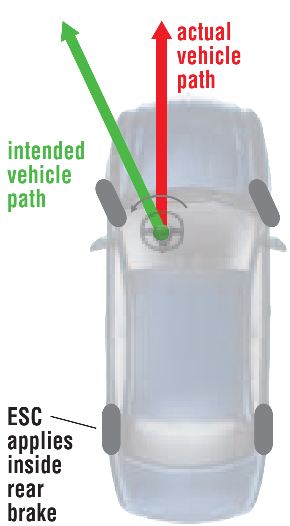
Electronic stability control, or ESC, uses the speed sensors on each wheel and the ability to brake individual wheels that are the basis of antilock brakes. ESC adds a steering angle sensor, a vehicle rotation rate sensor that measures rotation around the vehicle's vertical axis, and a control unit. The control unit monitors when the steering and rotation sensors detect that the vehicle is about to travel in a direction different from the one indicated by the steering wheel position. Then ESC automatically brakes the appropriate wheel to help the driver maintain control. In many cases engine throttle also is reduced.



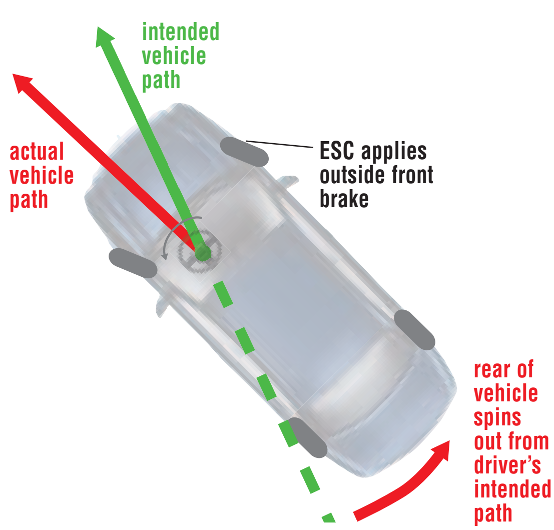
HOW ESC HELPS DRIVERS MAINTAIN CONTROL:

A driver loses control when the vehicle goes in a direction different from the one indicated by the position of the steering wheel. This typically occurs when a driver tries to turn very hard (swerve) or to turn on a slippery road. Then the vehicle may understeer or oversteer. When it OVERSTEERS it turns more than the driver intended because the rear end is spinning or sliding out. When a vehicle UNDERSTEERS it turns less than the driver intended and continues in a forward direction because the front wheels have insufficient traction. ESC can prevent understeering and oversteering by briefly braking the appropriate wheel. In many cases engine throttle also is reduced.

UNDERSTEER



OVERSTEER



Findings of the Institute study: The new study indicates that ESC reduces crash risk and is most effective in reducing fatal single-vehicle crashes. This isn't surprising because such crashes typically are characterized by drivers losing control of their vehicles, often on curves. Specific findings of the Institute study include these:

ESC reduced fatal single-vehicle crash risk by about 56 percent. The fatality risk reduction for crashes involving two or more vehicles was smaller (17 percent) and not statistically significant.

ESC reduced the risk of all single-vehicle crashes, fatal and nonfatal, by 41 percent.

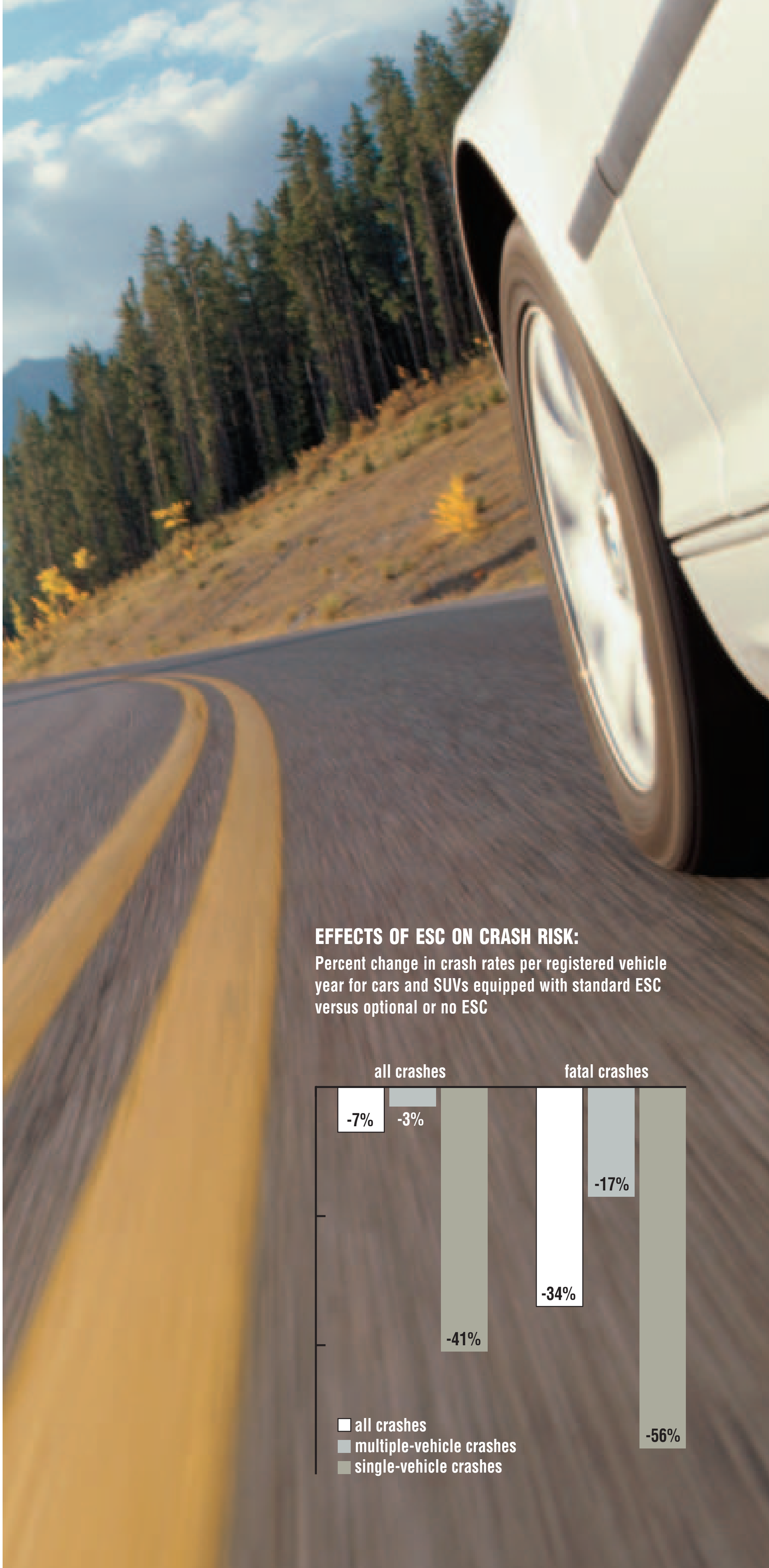
To establish these results, Institute researchers analyzed police-reported crashes in 7 states over 2 years as well as data from the federal Fatality Analysis Reporting System. The researchers analyzed the crash rates (all crashes, injury crashes, and fatal crashes per registered vehicle year) of cars and SUVs with ESC as standard equipment versus prior versions of these vehicles when they weren't equipped with ESC or ESC was available only as an option (very few vehicles were equipped with this option). The study vehicles were restricted to models with no design changes except for the addition of ESC.

Automakers are equipping their vehicles with various versions of ESC and marketing the systems under various names. The Institute's study included Audi, Mercedes, and Volkswagen vehicles with Electronic Stability Program; BMW and Jaguar vehicles with Dynamic Stability Control; Lexus and Toyota vehicles with Vehicle Stability Control; Cadillacs with StabiliTrak; Chevrolets with Active Handling; Volvos with Dynamic Stability and Traction Control; and Acuras equipped with Vehicle Stability Assist (see p. 4 for a list of 2005 model cars and SUVs equipped with some version of ESC).

Not all ESC systems are identical. The hardware is similar, but there are variations in the way the systems are programmed to respond once loss of control is detected. Some ESC systems activate sooner than others or slow a vehicle more quickly when a driver begins to lose control. However, data were insufficient for Institute researchers to compare the effectiveness of different versions of ESC. Nor were data sufficient to compare ESC effectiveness for cars versus SUVs.

"SUVs typically have high single-vehicle rollover rates, and these crashes usually involve drivers losing control of their vehicles," Ferguson notes, "so it wouldn't be surprising if SUVs benefited more from ESC. This will be a subject of future study when more vehicles are equipped with ESC and data are more plentiful."

Other studies also indicate effectiveness: Previous studies of ESC in Europe and Japan as well as a study recently conducted by the U.S. National Highway Traffic Safety Administration (NHTSA) reported results in line with the Institute's findings. Some of these studies assumed that certain types of crashes (in particular, multiple-vehicle

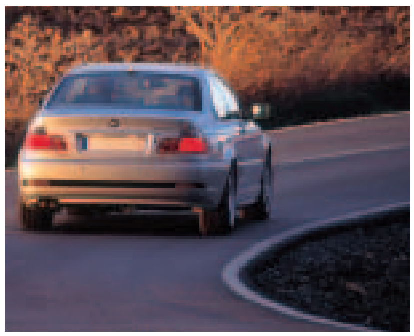


EFFECTS OF ESC ON CRASH RISK:
Percent change in crash rates per registered vehicle year for cars and SUVs equipped with standard ESC versus optional or no ESC

crashes) wouldn't be affected by ESC, and none of the studies except the Institute's controlled for differences between study and comparison vehicles other than the addition of ESC. NHTSA reported a 35 percent reduction in single-vehicle crash risk for cars and a 67 percent reduction for SUVs. Fatal single-vehicle crashes were reduced about 30 percent (cars) and 63 percent (SUVs).

Potential to save lives: Together these studies, including the Institute's new one, indicate that widespread application of ESC in the vehicle fleet can be expected to afford a significant safety benefit. If all vehicles on U.S. roads had ESC, we might avoid as many as 800,000 of the 2 million or so single-vehicle crashes that occur each year. About 14,000 fatal single-vehicle crashes occurred in 2003, which means there's a potential to save more than 7,000 lives each year.

"Effect of electronic stability control on automobile crash risk" by C.M. Farmer is published in *Traffic Injury Prevention* 5:317. Or obtain a copy by writing: Publications, Insurance Institute for Highway Safety, 1005 North Glebe Road, Arlington, VA 22201 (email publications@iihs.org).

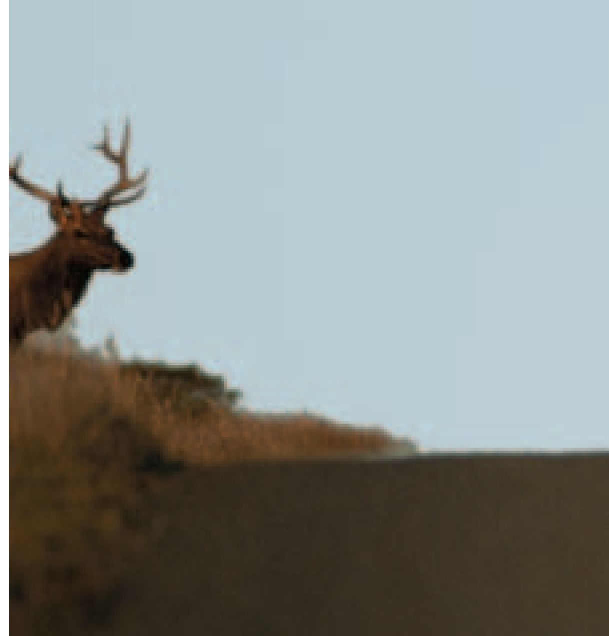


2005 MODEL CARS AND SUVS WITH ELECTRONIC STABILITY CONTROL

ACURA TL, RL, MDX, TSX	standard
AUDI, all models	standard
BMW, all models	standard
BUICK	
LaCrosse, LeSabre, Park Avenue, Terraza	optional
CADILLAC, all models except CTS, DeVille	standard
CTS, DeVille	optional
CHEVROLET Corvette	standard
Suburban, Tahoe, Uplander	optional
CHRYSLER Crossfire	standard
300	optional
DODGE Magnum	optional
FORD Explorer	standard
Expedition, Freestar	optional
GMC Yukon, Yukon XL	optional
HONDA CR-V, Odyssey	standard
Pilot	optional
HYUNDAI Tucson	standard
INFINITI, all models	standard
JAGUAR, all models	standard
JEEP Grand Cherokee	optional
KIA Amanti, Sportage	optional
LAND ROVER LR3, Range Rover	standard
LEXUS, all models except ES 330, IS 300	standard
ES 330, IS 300	optional
LINCOLN Aviator, Navigator	standard
LS	optional
MAZDA RX-8	optional
MERCEDES, all models	standard
MERCURY Mountaineer	standard
Monterey	optional
MINI Cooper	optional
MITSUBISHI Montero	standard
Endeavor	optional
NISSAN Pathfinder, Armada	standard
350Z, Maxima, Murano, Quest, Xterra	optional
PONTIAC	
Bonneville, Grand Prix, Montana SV6, Vibe	optional
PORSCHE, all models	standard
SAAB 9-3, 9-5, 9-7X	standard
SATURN RELAY	optional
SCION xB	standard
SUBARU Outback	optional
TOYOTA	
4Runner, Highlander, Land Cruiser	standard
RAV4, Sequoia	standard
Avalon, Camry, Camry Solara, Corolla	optional
Matrix, Prius, Sienna	optional
VOLKSWAGEN, all models	optional
VOLVO XC90	standard
all models except XC90	optional

MORE VEHICLES TO BE OUTFITTED WITH ESC

Since publication of studies about the effectiveness of electronic stability control (ESC), major automakers have announced plans to expand the number of vehicles with this technology. Chrysler says ESC will be on all of its SUVs within two years. General Motors and Ford are promising this technology during the next year on most midsize and large SUVs. In addition, Hyundai will make ESC standard on 2007 Santa Fe models.



Human deaths in crashes with animals can be reduced, even without reducing the collisions

Most deaths in collisions with deer and other animals occur in subsequent events when a vehicle runs off the road or a motorcyclist falls off the bike. Many of these deaths wouldn't occur with appropriate protection. In a new study of the characteristics of fatal vehicle-animal crashes, the Institute found that 60 percent of people killed riding in vehicles weren't using safety belts, and 65 percent of motorcyclists killed weren't wearing helmets.

"A majority weren't killed by contact with the animal," says Allan Williams, the Institute's chief scientist. "As in other kinds of crashes, safety belts and motorcycle helmets could have prevented many of the deaths."

Fatal crashes involving animals have increased, federal government data show. During 1998-2002, the annual average was 155 crashes in which vehicle occupants died. This compares with an average of 119 during 1993-97. In 2003 there were 201 fatal crashes, a 27 percent increase compared with 2002.

The Institute examined 147 police reports on vehicle-animal collisions in which there were human fatalities. The deaths occurred in nine states in different regions of the country: Colorado, Georgia, Minnesota, Missouri, North Carolina, Ohio, Pennsylvania, South Carolina, and Wisconsin. The reports account for 32 percent of fatal vehicle-animal crashes in the United States during 2000-02.

Passenger vehicles were involved in more than half of the crashes. Motorcycles were

the striking vehicles in more than one-third even though registered cars, SUVs, and pickups outnumber motorcycles by about 40 to 1.

Usually a single vehicle: Eighty percent of the collisions with animals involved one passenger vehicle, motorcycle, truck, all-terrain vehicle, or moped. In 38 percent of the crashes a motorcycle struck an animal, and the rider fell off. Thirty-six percent of the crashes involved a passenger vehicle or truck striking an animal and then running off the road and hitting an object or overturning. In 5 percent of the crashes, the animal went through the striking vehicle's windshield.

Twenty percent of the crashes involved multiple vehicles. In half of these, the struck animal became airborne and went through the windshield of an oncoming vehicle. The other crashes resulted in deaths when the vehicles that struck animals then hit other vehicles or a second vehicle struck the animal and then ran off the road.

"Belts and helmets could have made a difference," Williams says. "The absence in most states of helmet laws covering all riders is a factor. In states with universal helmet laws, 80 percent of cyclists were helmeted, compared with 14 percent in states without such laws."

Deer are biggest problems: Deer were struck in 3 out of 4 of the crashes. These crashes were most likely to occur in late fall, coinciding with deer breeding and migration. The impacts occurred most often in rural areas, on roads with 55 mph or higher speed limits, and in darkness or at dusk or dawn.

An estimated 1.5 million deer-vehicle crashes occur each year on U.S. roads, resulting in at least $1.1 billion in vehicle damage. A recent Institute report identified countermeasures that could reduce collisions (see *Status Report*, Jan. 3, 2004; on the web at iihs.org). One method that's proven not to work is the use of whistles mounted on vehicles.

"The best defense to avoid injury is for the people in vehicles to use their safety belts and for motorcyclists to wear helmets," Williams says.

For a copy of "Characteristics of vehicle-animal crashes in which vehicle occupants are killed" by A. Williams and J.K. Wells, write: Publications, Insurance Institute for Highway Safety, 1005 North Glebe Road, Arlington, VA 22201, or email publications@iihs.org.

Types of vehicles that struck animals, killing vehicle occupants

	Number	Percent
Passenger vehicles	**80**	**54**
Motorcycles	**55**	**37**
Medium or heavy trucks	**9**	**6**
All-terrain vehicles, mopeds	**3**	**2**

Note: If more than 1 vehicle struck an animal, the first striking vehicle is indicated.

Animals in the collisions in which vehicle occupants were killed

	Number	Percent
Deer	**113**	**77**
Cattle	**13**	**9**
Horses	**9**	**6**
Dogs	**9**	**6**
Bear	**1**	**1**
Cat	**1**	**1**
Opossum	**1**	**1**

Types of vehicle-animal crashes in which vehicle occupants were killed

	Number	Percent
Single-vehicle crashes		
Motorcyclist or operator of all-terrain vehicle or moped struck animal, fell off vehicle	**56**	**38**
Passenger vehicle or truck struck animal, went off road, struck fixed object and/or overturned	**53**	**36**
Animal went through window of passenger vehicle	**8**	**5**
Multiple-vehicle crashes		
Vehicle struck animal, which then went through windshield of oncoming vehicle	**14**	**10**
Vehicle struck animal and then collided with another vehicle	**12**	**8**
Vehicle struck animal; then another vehicle struck same animal, went off road, struck fixed object and/or overturned	**3**	**2**
Other crash types	**1**	**1**

Junk science

Don't use results of this flawed report to decide anything about red light cameras

Policy decisions about highway safety — which programs to implement? which ones in operation are worth continuing? — should be guided by scientific evaluations of program effectiveness. Few would argue with this. Still, there's the issue of how competent the evaluations are. As in many applied fields, this one isn't lacking for junk science, which sometimes gets into the public domain.

A recent example is an investigation of the effects of red light cameras in Greensboro, North Carolina. Mark Burkey and Kofi Obeng of the North Carolina Agricultural and Technical State University concluded that installing cameras led to a 42 percent increase in crashes where cameras were located.

"This conclusion flies in the face of every competent study that has been conducted on red light cameras. Study after study has found reductions in both signal violations and crashes," says Richard Retting, the Institute's senior transportation engineer. "It isn't that Burkey and Obeng found a better way to evaluate a measure that already has been assessed by researchers. The reason their findings are so different from previous studies is that the methods of their investigation are fundamentally flawed."

Two main flaws: Burkey and Obeng's purpose was to estimate crash effects at intersections with cameras. One flaw is that they used signalized intersections without cameras in the same community as controls.

"This ignores the well-known spillover effect," Retting points out. That is, the effects of cameras spill over to intersections without cameras. Publicity and media coverage make drivers aware of the general presence of cameras in a community. The result is a generalized change in driver behavior at intersections with and without cameras. This is why assigning signalized intersections in the same community as controls compromises the findings.

A worse problem is that Burkey and Obeng treated data from intersections with and without cameras as if the cameras had been randomly assigned to their locations. In fact, Greensboro officials installed cameras at intersections with higher crash rates — more than twice as many crashes as at other intersections in the city before the cameras were installed.

Burkey and Obeng ignored this difference and concluded that, because crashes at intersections with cameras outnumbered those at the comparison sites, the cameras must be the culprits. But this simply reflects the far higher number of crashes at the camera sites to begin with. A somewhat better approach would have been to look at how crash rates changed at intersections with cameras versus other intersections.

"That approach still would have ignored spillover, but it would have avoided the silly conclusion that cameras increased crashes," Retting points out. He adds that "it wasn't camera placement that caused the higher number of crashes at intersections with cameras. More likely it was the other way around. The higher number of crashes is what caused the cameras to be placed where they were."

Conclusions weren't reviewed by peers: Burkey and Obeng's investigation isn't published in the scientific literature. This means it hasn't been subjected to peer review, which involves critique by impartial experts to determine the validity of the methods and findings.

"Studies, especially ones with findings that contradict a body of existing research, should be subjected to peer review," Retting says. "Doing so provides a study with a sort of seal of competence that says, 'These findings are worth paying attention to.' If Burkey and Obeng's report had been subjected to peer review, the reviewers would have pointed out the obvious flaws. Policymakers should ignore the faulty conclusions of this report."

The report by M. Burkey and K. Obeng, "A detailed investigation of crash risk reduction resulting from red light cameras in small urban areas," is available at www.ncat.edu/transit/Burkey_Obeng_Updated_report_2004.pdf. A review of this investigation by Institute researchers S.Y. Kyrychenko and R.A. Retting is at iihs.org/safety_facts/rlc.htm.

Statistical rigor or scientific error?

Confusion of the two can lead to policies that harm, not help, public safety

It's important to evaluate highway safety programs scientifically to find out whether or not they're reducing losses, and if so by how much. But sometimes sound data and analyses are incorrectly interpreted to arrive at unsound conclusions.

This is the caution offered by the University of Toronto's Ezra Hauer, who supplies examples of the pitfalls of misinterpreting scientific findings. One example involves allowing drivers to turn right on red lights after stopping, which was almost universally adopted in response to the oil crisis of the mid-1970s. Several studies of this practice, conducted in 1976-77, found associated crash increases, but the results of individual studies weren't statistically significant. So even though every study pointed to crash increases, policymakers could conclude that safety wasn't being compromised.

But effects that are statistically nonsignificant aren't the same as no effects at all. The initial datasets were small, which means very large effects would have been needed to achieve statistical significance. Later on, after right turn on red had been allowed for years and sample sizes were larger, research did show a statistically significant 20 percent increase in right-turn crashes. The effect on pedestrian crashes was worse (see *Status Report*, Dec. 9, 1980).

By then, right turn on red had been firmly entrenched. The practice still is in effect, despite the documented adverse safety consequences.

Hauer cites two other examples, one involving whether wider paved shoulders alongside roads would reduce crashes more effectively than narrower shoulders, and another case involving whether raising speed limits produced an increase in motor vehicle deaths. In both cases, initial studies didn't find statistically significant effects. Subsequent analyses based on more data did find definitive effects.

In each case, the confusion involved a statistical exercise known as null hypothesis testing, which long has been regarded as a safeguard against spurious findings. The process involves trying to determine the size of an effect (for example, the increase in crashes after right turn on red), but the estimated size always is subject to variability. So statistical tests are used to determine whether the estimated effect is large enough to imply that the true effect is greater than zero.

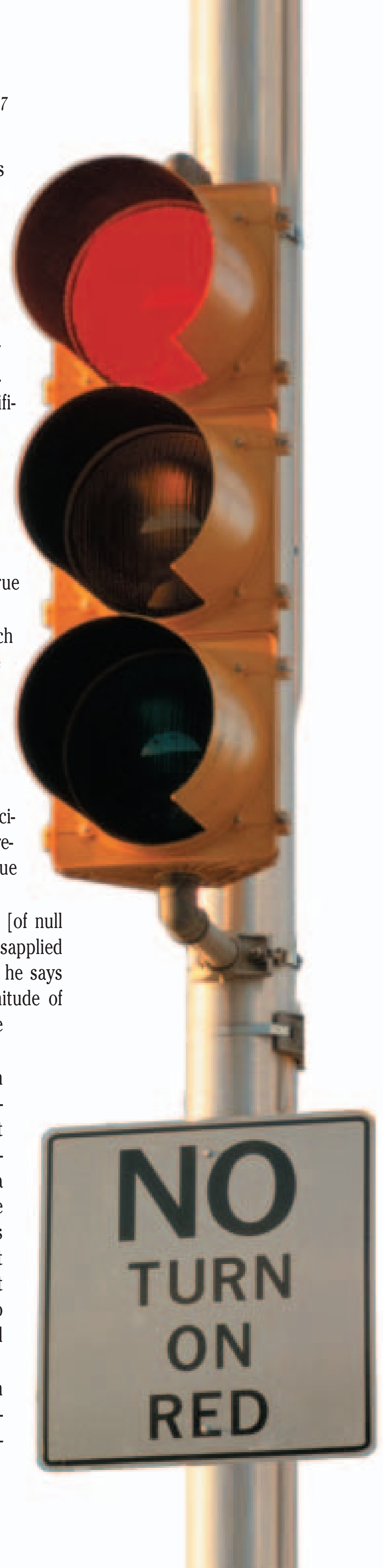
When estimated effects are nonsignificant, it means the researchers couldn't be confident that the true effects were different from zero. But when separate studies find positive effects that, individually, aren't statistically different from zero, they collectively add weight to the conjecture that the true effect is greater than zero.

A problem arises when descriptors such as "insignificant" or "unimportant" are substituted for a statistical finding of "nonsignificant." Then common understanding of the findings changes from "effects could be zero" to "effects are zero." When such misrepresentations are used to guide highway safety policy decisions, promising programs are ended prematurely and unsafe practices continue indefinitely, costing lives and money.

What to do? Hauer says "the ritual [of null hypothesis testing] is so pervasively misapplied as to be simply unfit for use." Instead he says researchers should estimate the magnitude of each effect and supply measures of the precision of the estimates.

Institute chief operating officer Adrian Lund agrees, saying "promising countermeasures shouldn't be discarded just because the data are insufficient. Researchers should continue to gather data and evaluate results until the findings are definitive. In the meantime, policymakers shouldn't cite inconclusive data to tout their own pet programs or to discredit programs they oppose. This amounts to willy-nilly policymaking, not policy based on science."

The report by E. Hauer, "The harm done by tests of significance," is published in *Accident Analysis and Prevention* 36:495-500.



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On the inside

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