

# Status Report

Insurance Institute for Highway Safety | Highway Loss Data Institute

## Imperfect protection

Some protected bike lanes leave cyclists vulnerable to injury

### ALSO IN THIS ISSUE

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Safety at two-lane roundabouts improves with time

Knee airbags show little benefit

HLDI's list of most stolen vehicles

**B**ike lanes separated from the roadway by physical barriers make cyclists feel safer and encourage more people to ride. But a new IIHS study shows that protected bike lanes vary in terms of injury risk. Factors such as the number of driveways or alleys intersecting the lanes and whether the lanes are one- or two-direction affect the likelihood of a crash or fall.

Sometimes called cycle tracks or separated bike lanes, protected bike lanes are separated from vehicle traffic by a physical barrier such as parked cars, a curb, landscaping or posts. Little research has been done on the safety effects of protected bike lanes, which are relatively new in the U.S. but are gaining popularity. Studies of conventional bike lanes — those separated from traffic by painted lane markings but without physical barriers — have had inconsistent results.

Cycling has become more popular among adults in recent years, with many cities actively encouraging it as an alternative to driving. At the same time, safety is a growing concern. Although bicyclists represent only about 2 percent of road fatalities, bicyclist deaths have increased 25 percent since reaching their lowest point in 2010. A total of 777 bicyclists were killed in crashes with motor vehicles in 2017.

For the new study, IIHS collaborated with George Washington University, Oregon Health and Science University and New York University. The researchers used what is known as a case-crossover design to look at the risks associated with different types of cycling infrastructure, including protected bike lanes.

First, they interviewed bicyclists who visited emergency rooms in the District of Columbia, New York City and Portland, Oregon, after crashing or falling. After gathering information about the characteristics of the location where the crash or fall occurred, the researchers then compared the site to another, randomly selected point on the cyclist's route. A total of 604 adults were included in the study.

A crash or fall didn't have to involve a vehicle to be included in the study, and only about half did. Most of the injuries in the study were



#### IIHS RESEARCH

“Not all protected bike lanes are the same: infrastructure and risk of cyclist collisions and falls leading to emergency department visits in three U.S. cities” by J.B. Cicchino et al.

To request this paper, email [researchpapers@iihs.org](mailto:researchpapers@iihs.org).

Street-level protected bike lanes like this one in D.C. have a high risk of injury to cyclists, the new IIHS study found.



minor, and there were no fatalities.

Compared with a major road with no bike infrastructure, the risk of a crash or fall was much lower on two-way protected bike lanes on bridges or raised from the roadway — for example, within greenways. In contrast, the risk of a crash or fall on a two-way protected bike lane at street level was much higher than that of a major road.

One-way protected bike lanes differed little from major roads in terms of injury risk.

“A cyclist on a protected lane at street level is likely to encounter vehicles at intersections,

bicyclist crashes involving motor vehicles occur midblock, while cyclists in protected bike lanes in the study collided with vehicles most often at intersections or junctions with driveways and alleys. In such cases, vehicles are usually turning and traveling slowly.

A recent study by researchers at the University of Colorado Denver and the University of New Mexico found that cities with more feet of protected bike lanes per square mile had fewer fatalities and serious injuries to all road users than other cities.

“There is evidence that protected bike



The study found that conventional bike lanes (left) were less risky than street-level protected bike lanes, but that may be because they were located on safer roads. Protected bike lanes raised from the roadway (right) or within bridges were safest.



Bike routes with streetcar tracks (left) and temporary obstacles such as illegally parked vehicles (right) have higher injury risk, the researchers found.

driveways and alleys more often than on a protected lane enclosed within a bridge or greenway,” says Jessica Cicchino, IIHS vice president for research and the lead author of the new paper. “Pedestrians also sometimes enter street-level bike lanes, which can cause cyclists to swerve and fall.”

### More injuries, but fewer fatalities

That said, the types of bicyclist crashes seen in street-level protected lanes weren't the type that are typically most severe. Most fatal

lanes help prevent the worst crashes,” Cicchino says. “What our study shows is that certain locations are better than others for this type of infrastructure.”

A section of two-way protected bike lane along 15th Street NW in D.C. illustrates the problems that can occur with street-level lanes. The section, which is about two-thirds of a mile, had the highest injury risk of any protected bike lane in the study. The lane runs next to two-way vehicle traffic and is separated from the road by posts »



A two-lane roundabout in Vancouver, Washington, that was part of the study

# Safety at two-lane roundabouts improves over time, new study shows

**R**oundabouts improve safety over traditional intersections, but the benefits of two-lane roundabouts have been less clear than those of single-lane roundabouts. Now IIHS researchers have found that

## IIHS RESEARCH

“Long-term crash trends at single- and double-lane roundabouts in Washington state”  
by W. Hu and J.B. Cicchino

To request this paper, email [researchpapers@iihs.org](mailto:researchpapers@iihs.org).

crashes at two-lane roundabouts fall over time as drivers gain familiarity with them.

Roundabouts force drivers to slow down and all but eliminate the most severe types of intersection crashes — right-angle, left-turn and head-on collisions. Single-lane roundabouts see fewer total crashes of any type.

Adding another lane makes roundabouts more complex, creating more potential conflicts. Some studies have found smaller benefits when intersections with stop signs or traffic signals are converted to two-lane

roundabouts than when they are converted to single-lane roundabouts. One 2012 study found that crashes actually increase after such conversions.

IIHS researchers decided to look at how crash trends at both single- and two-lane roundabouts change over time, as drivers gain familiarity with them. They focused on Washington state, which has more than 300 roundabouts.

The study involved 98 single-lane and 29 two-lane roundabouts built between 2009

(« from p. 3) and parked cars and is crossed five times by other streets and four times by alleys or driveways.

The combination of busy intersections and junctions and a two-way bike lane likely contributed to the high risk at this location. Intersections and junctions at a two-way bike lane can be particularly challenging for turning drivers. They need to look for oncoming traffic as they turn and must look in both directions for bicyclists.

**The authors recommend installing protected bike lanes where there are few intersections, driveways and alleys or to consider raised cycle crossings at such junctions.**

The paper’s authors advise cities to locate protected bike lanes where there are fewer junctions if possible or to consider raised cycle crossings, which have been found to improve safety on protected bike lanes in Europe. They also suggest cities take measures to prevent pedestrians from entering bike lanes.

## Other bike routes

Among all types of cycling routes looked at in the paper, local roads had the lowest risk of a crash or fall.

Conventional bike lanes also had a lower risk in the study than major roads. The risk was higher, however, at intersections.

It’s not clear why protected bike lanes would be more dangerous than conventional bike lanes, but it may have to do with the locations cities choose for protected lanes.

“Typically, protected lanes are installed on busy roads that pose more of a risk to cyclists in the first place,” Cicchino says. “Our finding that conventional bike lanes were less risky doesn’t mean that cyclists on roads with protected lanes would be better off without that separation.”

The study found that certain road features were associated with elevated risk. They included streetcar or train tracks, downhill grades, and temporary obstacles caused by construction or parked cars. ■

and 2015. For each roundabout, researchers looked at crashes beginning with the first full calendar year after completion and ending with 2016. Thus, older roundabouts had more years of data. To account for the effects of the economy and traffic volumes on crashes, the analysis included the unemployment rate and annual vehicle miles traveled in the area where each roundabout was located.

The number of crashes at two-lane roundabouts decreased on average 9 percent per year. At the same time, the odds that a crash at a two-lane roundabout involved an evident or incapacitating injury decreased by nearly one-third annually.

The number of crashes increased on average 7 percent at single-lane roundabouts, and the odds of an injury fell 19 percent annually, but those changes weren't statistically significant. It's not clear how long the crash reductions would be expected to continue. The longest period analyzed for any of the roundabouts was seven years.

"Two-lane roundabouts are inherently more complex than the single-lane type," says IIHS Senior Research Transportation Engineer Wen Hu, the study's lead author. "Even in a place like Washington, many drivers still aren't familiar with them, so it makes sense that there would be more crashes when a roundabout is first built than after it has been in place for a while."

A common problem at roundabouts is failing to yield the right-of-way. The odds that a crash at a two-lane roundabout involved that type of error fell 11 percent annually.

Meanwhile, the results suggest drivers learned to go slower at single-lane roundabouts. The researchers found a 19 percent decrease in the odds that a single-lane roundabout crash was speed-related.

As the authors point out, however, traffic engineers shouldn't rely on drivers to learn how to navigate roundabouts on their own. Better design could help people drive through a roundabout safely the first time they encounter it.

More prominent signs and pavement markings, for example, could help drivers understand appropriate speeds and yielding patterns. Appropriate curvature, adequately sized splitter islands and even landscaping that limits drivers' ability to see across the roundabout also promote slower speeds. ■

## IIHS researchers find little benefit from knee airbags

**A**irbags are essential, lifesaving devices that have prevented tens of thousands of deaths. More airbags, one might assume, would provide even greater protection.

That isn't always the case, a recent IIHS study shows. One increasingly common type of airbag — the knee airbag — has a negligible effect on injury risk and, in fact, may even increase it in some cases, researchers found.

Knee airbags usually deploy from the lower dashboard and are intended to distribute impact forces to reduce leg injuries. They may also help reduce forces on an occupant's chest and abdomen by controlling lower body movement.

To find out if knee airbags improve safety, IIHS researchers examined both crash test data and information from real-world crash reports.

For the first part, they looked at injury measures from more than 400 frontal crash tests conducted as part of the IIHS vehicle ratings program to see if injuries were less likely when vehicles were equipped with knee airbags.

To look at real-world outcomes, they compiled crash reports from 14 states and compared injury risk in vehicles with knee airbags with risk in vehicles without knee airbags.

Knee airbags had only a small effect on injury measures recorded by dummies in IIHS driver-side small overlap front and moderate overlap front crash tests. In the small overlap test, knee airbags were associated with increased injury risk for lower leg injuries and right femur injuries, though head injury risk was slightly reduced. The airbags had no effect on injury measures in the moderate overlap test.

In the analysis of real-world crashes, knee airbags reduced overall injury risk by

half a percentage point, from 7.9 percent to 7.4 percent, but this result wasn't statistically significant.

"There are many different design strategies for protecting against the kind of leg and foot injuries that knee airbags are meant to address," says Becky Mueller, an

**Researchers looked at IIHS crash test data and police reports from real-world crashes. In both sets of data, the effect on injury risk was small.**



IIHS senior research engineer and co-author of the paper. "Other options may be just as, if not more, effective."

One reason some manufacturers have been installing knee airbags is to help vehicles pass federally mandated tests with unbelted dummies. It's possible that knee airbags would help unbelted occupants in real-world crashes. The IIHS study didn't look specifically at crashes in which people weren't using seat belts, and dummies are always belted in IIHS vehicle ratings tests. ■

### ■ IIHS RESEARCH

"Effectiveness of knee airbags across two crash paradigms" by S.S. Monfort and B.C. Mueller

To request this paper, email [researchpapers@iihs.org](mailto:researchpapers@iihs.org).



# Auto thieves target big engines, luxury cars and pickups, HLDI shows in new report

**T**wo large cars known for their powerful engines — the Dodge Charger HEMI and the Dodge Challenger SRT Hellcat — top the Highway Loss Data Institute’s list of vehicles most likely to be stolen.

Both vehicles have claim rates for whole-vehicle theft that are more than 5 times the average for 2016-18 models, as does the Infiniti Q50, a midsize luxury sedan. Nearly all 20 models with the highest theft rates are either vehicles with big engines, luxury vehicles or pickups.

Somewhat puzzlingly, the car that tops the list of least stolen vehicles is also a midsize luxury sedan, the two-wheel-drive BMW 3 series. It had just one claim for whole-vehicle theft in 104,901 insured vehicle years. An insured vehicle year is one

vehicle insured for one year.

Two of the vehicles on the least-stolen list are the Tesla Model S and Model X. Their low theft rate may be related to the fact that, as electric vehicles, they are usually parked in garages or close to a house to be near a power supply. In a separate report last year, HLDI showed that electric vehicles from a variety of manufacturers have lower theft claim rates than comparable vehicles.

Absent from the most-stolen list is any version of the Cadillac Escalade, which previously dominated HLDI’s rankings of vehicles popular with thieves. Part of the reason is that the large luxury SUV now has more competition in that category, including from the Infiniti QX80 and the Land Rover Range Rover, vehicles that are now among the most stolen.

Escalade owners are also likely benefiting from enhanced security features that go beyond the ignition immobilizers that most of today’s vehicles have in order to prevent them from being started without a

proper key. Standard immobilizers weren’t enough to prevent the Escalade from being frequently stolen, so Cadillac added more antitheft features beginning with the 2015 model year. They include glass breakage sensors, motion detectors and an inclination sensor that triggers an alarm if someone tries to take the wheels off, tow the vehicle or lift it onto a flatbed truck.

“The models most likely to be stolen tend to be powerful, pricey or pickups, but vehicle theft is also a crime of opportunity,” says HLDI Senior Vice President Matt Moore. “Better security features on all vehicles would be the best way to address the problem.”

By looking at claims per insured vehicle year, HLDI’s theft reports allow people to compare the relative risk of each vehicle. In contrast, other most-stolen-vehicle lists report raw numbers of thefts and are therefore dominated by the most common vehicles on the road.

HLDI’s whole-vehicle theft report differs

## ■ HLDI RESEARCH

“Whole vehicle theft losses: 2016-18 passenger cars, pickups, SUVs, and vans”

To request this report, email [researchpapers@ihs.org](mailto:researchpapers@ihs.org).

## Vehicles with the highest claim frequencies for whole-vehicle theft, 2016-18 model years

	Vehicle size/type	Relative claim frequency (100 = average)
Dodge Charger HEMI	large 4-door car	544
Dodge Challenger SRT Hellcat	large 2-door car	529
Infiniti Q50 4-door	midsize luxury car	525
Infiniti QX80	large luxury SUV	422
GMC Sierra 1500 crew cab	large 4-door pickup	393
Dodge Challenger	large 2-door car	358
Nissan Maxima	midsize 4-door car	351
Chevrolet Silverado 1500 crew cab	large 4-door pickup	320
Chrysler 300 4WD	large 4-door car	293
Mercedes-Benz S-Class 4-door long-wheelbase 4WD	very large luxury car	291
Dodge Charger 4WD	large 4-door car	274
Dodge Durango 4WD	large SUV	271
Land Rover Range Rover	large luxury SUV	271
Chevrolet Silverado 1500 crew cab 4WD	large 4-door pickup	269
Dodge Charger	large 4-door car	266
Nissan Titan crew cab short bed	large 4-door pickup	250
Chevrolet Silverado 1500	large 4-door pickup	248
GMC Sierra 1500 crew cab 4WD	large 4-door pickup	241
Audi A7 4WD	large luxury car	239
Infiniti QX80 4WD	large luxury SUV	236



## Vehicles with the lowest claim frequencies for whole-vehicle theft, 2016-18 model years

	Vehicle size/type	Relative claim frequency (100 = average)
BMW 3-series 4-door	midsize luxury car	4
Tesla Model S 4WD	large luxury car	11
Tesla Model X 4WD	large luxury SUV	12
Chevrolet Equinox 4WD	small SUV	15
Buick Encore 4WD	small luxury SUV	15
Subaru Legacy with EyeSight	midsize 4-door car	17
GMC Acadia	midsize SUV	19
Subaru Forester with EyeSight	small SUV	20
GMC Acadia 4WD	midsize SUV	20
Volkswagen New Beetle	small 2-door car	21
BMW 3 series 4-door 4WD	midsize luxury car	21
Subaru Outback with EyeSight	midsize station wagon	22
BMW X5	midsize luxury SUV	22
Subaru Crosstrek	small station wagon	25
Chevrolet Traverse	midsize SUV	26
Subaru Crosstrek with EyeSight	small station wagon	26
Lexus RX 450h 4WD	midsize luxury SUV	28
Honda Odyssey	minivan	28
Mazda MX-5 Miata	mini sports car	30
Cadillac XT5	midsize luxury SUV	30

The Dodge Charger HEMI, Dodge Challenger SRT Hellcat and Infiniti Q50 have whole-vehicle theft rates more than 5 times the average.

**The Cadillac Escalade no longer dominates HLDI's rankings of vehicles popular with thieves. Added anti-theft features on the large luxury SUV appear to be helping.**

from its standard theft report, which looks at all theft claims, including those for stolen vehicle parts or for items taken from a vehicle.

To isolate whole-vehicle claims, HLDI looked at the amounts paid for total losses under collision coverage, which is generally the residual value of the vehicle. If the payment associated with a theft claim is around the same as would be expected for a total loss under collision coverage for the same vehicle of the same age, it is considered to be a whole-vehicle theft claim.

As with all HLDI analyses, the results in the whole-vehicle theft report are adjusted to account for the effect of demographic and geographic factors. ■

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**IIHS** is an independent, nonprofit scientific and educational organization dedicated to reducing the losses — deaths, injuries and property damage — from motor vehicle crashes.

**HLDI** shares and supports this mission through scientific studies of insurance data representing the human and economic losses resulting from the ownership and operation of different types of vehicles and by publishing insurance loss results by vehicle make and model.

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