



Status Report

Insurance Institute for Highway Safety | Highway Loss Data Institute

Stay within the lines

Lane departure warning, blind spot detection help drivers avoid trouble

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Lane departure warning, a technology designed to address an often-fatal type of crash, is preventing crashes on U.S. roads, new research from IIHS shows. A separate study shows that blind spot detection also is yielding benefits when it comes to preventing lane-change crashes.

The studies are the latest in a series by Jessica Cicchino, IIHS vice president for research, that evaluates different crash avoidance features by looking at data from police-reported crashes (see *Status Report*, Jan. 28, 2016, and Nov. 17, 2016, at iihs.org). Police reports include information on the circumstances of a crash, making it possible to look specifically at the types of crashes that particular technologies are designed to address, rather than just looking at crash rates generally. Cicchino's previous studies found that front crash prevention with autobrake cuts the rate of front-to-rear crashes in half and that rearview cameras can prevent about 1 in 6 backing crashes.

Results of the new study indicate that lane departure warning lowers rates of single-vehicle, sideswipe and head-on crashes of all severities by 11 percent and lowers the rates of injury crashes of the same types by 21 percent. That means that if all passenger vehicles had been equipped with lane departure warning, nearly 85,000 police-reported crashes and more than 55,000 injuries would have been prevented in 2015.

The analysis controlled for driver age, gender, insurance risk level and other factors that could affect the rates of crashes per insured vehicle year.

A simpler analysis that didn't account for driver demographics found that lane departure warning cut the fatal crash rate 86 percent. There weren't enough fatal crashes to include them in a statistical model that controlled for demographics. In the simpler analysis, the rate of all crashes was 18 percent lower for vehicles equipped with the feature, and the rate of injury crashes was 24 percent lower.



“This is the first evidence that lane departure warning is working to prevent crashes of passenger vehicles on U.S. roads,” Cicchino says. “Given the large number of fatal crashes that involve unintentional lane departures, technology aimed at preventing them has the potential to save a lot of lives.”

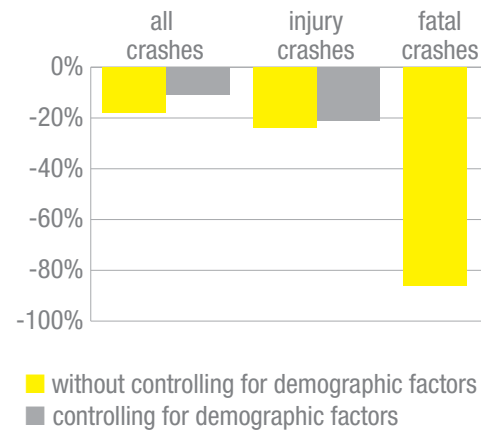
Analyses by HLDI haven’t uncovered direct benefits in the form of lower claim rates from lane departure warning. On many vehicles, lane departure warning is bundled with front crash prevention, making it impossible to separate the effects, as the insurance data don’t include the type of crash. And on the few vehicles studied that don’t bundle the feature, no benefits for lane departure warning have been found (see *Status Report*, Jan. 28, 2016, and July 3, 2012).

However, a 2015 study of lane departure warning on trucks in U.S. fleets found the technology cut the rate of relevant crashes nearly in half, and a study of Volvo cars in Sweden found a reduction of relevant injury crashes of 53 percent.

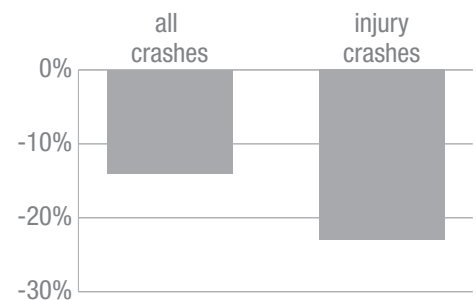
Compared with those results, the new findings of an 11 percent reduction in all relevant crashes and a 21 percent reduction in injury crashes are modest. One reason may be that U.S. drivers of passenger vehicles frequently turn off lane departure warning (see *Status Report*, June 22, 2017). Researchers don’t know what percent of the time lane departure warning was turned on in the earlier studies, but if drivers in the new study had kept the feature on all the time, the results would be in line with the benefits found in the earlier studies, Cicchino estimates.

Another factor affecting the size of the benefit is that lane departure warning requires an appropriate response from drivers. IIHS researchers recently looked at 631 lane-drift crashes and found that 34 percent of the drivers were physically incapacitated (see *Status Report*, Sept. 1, 2016).

Effects of lane departure warning on police-reported crashes relevant to system



Effects of blind spot detection on police-reported lane-change crashes



Many fatal crashes happen when drivers unintentionally stray from their lanes and run off the road or collide with another vehicle. New research from IIHS indicates that lane departure warning is preventing single-vehicle, sideswipe and head-on crashes.

The new study included vehicles with optional lane departure warning from six manufacturers: General Motors, Honda, Mazda, Mercedes-Benz, Subaru and Volvo. The automakers provided information about the presence of optional features on specific vehicles by vehicle identification number (VIN). Researchers used 2009-15 crash data from states that provided VINs of the crash-involved vehicles, making it possible to identify the vehicles and determine if they had lane departure warning.

Cicchino used the same method to examine blind spot detection systems, which provide a visual alert when an adjacent vehicle is in the driver's blind spot. In this case, she focused on crashes in which the vehicles were changing lanes or merging. Fiat Chrysler, General Motors, Honda, Mazda, Mercedes-Benz and Volvo vehicles were included.



Controlling for other factors that can affect crash risk, blind spot detection lowers the rate of all lane-change crashes by 14 percent and the rate of lane-change crashes with injuries by 23 percent. Although only the reduction in crashes of all severities was statistically significant, the effect for injury crashes was consistently in the expected direction for 5 of the 6 manufacturers studied.

“Blind spot detection systems work by providing additional information to the driver. It’s still up to the driver to pay attention to that information and use it to make decisions,” Cicchino says. “That said, if every passenger vehicle on the road were equipped with blind spot detection as effective as the systems we studied, about 50,000 police-reported crashes a year could be prevented.”

For a copy of “Effects of lane departure warning on police-reported crash rates” and “Effects of blind spot monitoring systems on police-reported lane-change crashes” by J.B. Cicchino, email publications@ihs.org. ■

Automated parking system pulls drivers’ attention away from road

When cars do some of the work for their drivers, the focus of drivers’ attention shifts, new research from IIHS and MIT’s AgeLab shows.

The researchers looked at how a system that helps identify a parking spot and uses automated steering to maneuver into it influenced where drivers directed their gaze while parallel parking. The 31 volunteers parked a 2010 Lincoln MKS equipped with the Active Park Assist system between two

important to understand how these features affect driver behavior,” says David Kidd, an IIHS senior research scientist and lead author of the new study. “In the case of automated parking, some of the changes in glance direction were unexpected.”

Active Park Assist helps select a parking space for the driver and then directs the driver to remove his or her hands from the steering wheel. The system steers automatically during the parking process, while the



Ford Motor Company/Sam Varnhagen

inflatable dummy cars. The drivers parked both with and without Active Park Assist in use. When drivers weren’t using the system, parking sensors and a rearview camera were still operational.

When using the automation, drivers spent more time looking at the dashboard and less time looking at the parking spot or at the road in front of or behind them. This was even true when the system was searching for a parking spot but steering wasn’t automated.

“As manufacturers add more assistance technology and automation to vehicles, it’s

driver moves the car forward and in reverse, as instructed by the system.

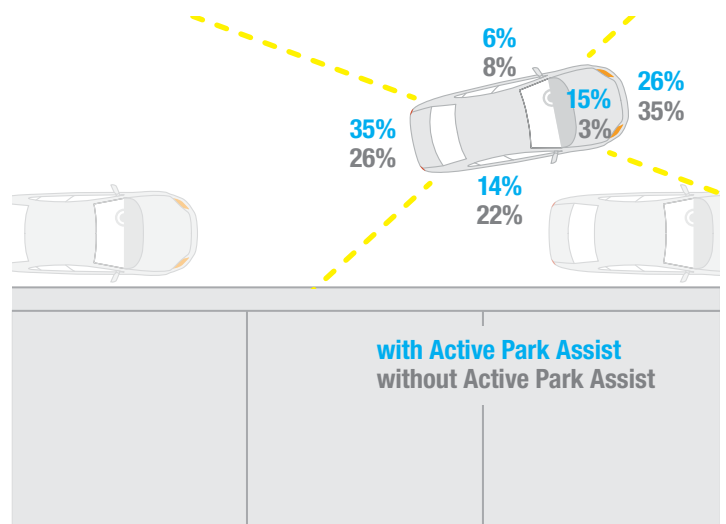
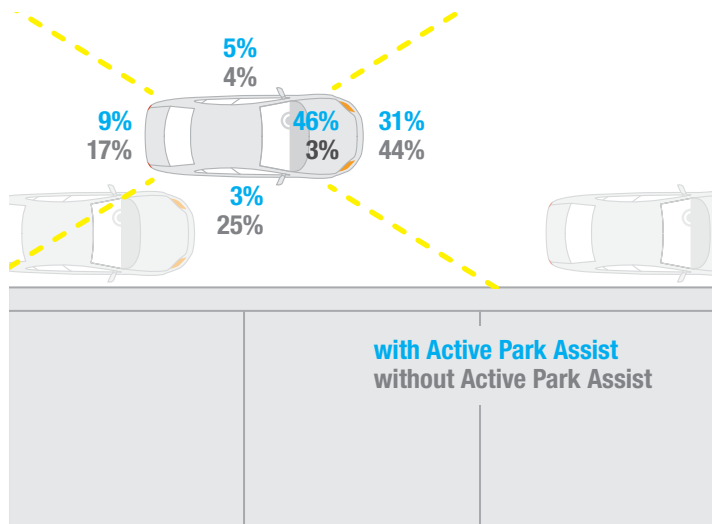
Overall, drivers in the study glanced at the parking space less frequently and spent less time looking at it when steering was automated than when it wasn’t. At the same time, the proportion of glances and time spent looking at the dashboard display, which contained information from the automation, increased.

The researchers expected that drivers would look at the instrument cluster more and at the vehicle’s surroundings

Time driver spends looking at areas in and around vehicle...

While approaching and selecting a parking spot

While maneuvering into a parking spot



Drivers parallel parked a Lincoln MKS equipped with Active Park Assist, which alerts the driver to a parking spot and calculates whether the space is big enough. The system steers automatically as the driver moves the car forward and in reverse to maneuver into the spot.

Ford Motor Company/Sam Varnhagen

less during the actual parking maneuvers, when steering was automated. However, it was surprising that this pattern was even more pronounced when the vehicle was approaching a parking space, even though drivers were in complete control of the vehicle during that phase.

The drivers spent 46 percent of their time looking at the dashboard as they approached an open parking space when using Active Park Assist, compared with just 3 percent when not using it. They also spent less time looking forward and rearward (31 percent

and 9 percent, compared with 44 percent and 17 percent without the automation).

During the approach, the system calculates whether the parking space is big enough and alerts the driver with a message in the instrument cluster and an audible chime. Drivers didn't need to constantly monitor the display, but they diverted their attention from the road anyway.

The drivers in the study received detailed instructions on using the system and practiced parking with and without it. Still, as novice users, they may have behaved

differently than they would have after long-term use.

"Although we don't yet know how this change in glance behavior affects crash risk, manufacturers should consider how the design of new technologies can affect driver behavior in ways they might not intend," Kidd says.

For a copy of "Changes in driver glance behavior when using a system that automates steering to perform a low-speed parallel parking maneuver" by D. G. Kidd et al., email publications@ihs.org. ■

GM's rear autobrake reduces crashes

The benefits of autobrake are well-established when it comes to preventing front-into-rear crashes. Now, a new HLDI analysis indicates that a rear automatic braking system on General Motors models is reducing crashes reported to insurers.

HLDI compared losses for rear autobrake on the 2015 Cadillac ATS, CTS, SRX, XTS and Escalade (some 2013 and 2014 models were included, too) with losses for the same

or seat vibrations, the system will automatically brake to avoid or mitigate the crash. GM's system operates at speeds faster than 0.5 mile per hour.

HLDI found a 26 percent reduction in the frequency of claims filed under property damage liability (PDL) coverage and a 13 percent reduction in the frequency of claims under collision coverage for Cadillacs equipped with rear autobrake compared

to alleviate some of these headaches for Cadillac owners. And it's another reminder that consumers don't have to wait for self-driving cars to reap the benefits of automated technologies."

HLDI examined the claims experience of other crash avoidance systems on Cadillacs, plus the 2014-15 Buick Lacrosse and Regal and Chevrolet Impala and the 2015 Suburban, Tahoe and Yukon.

Vehicles with both parking alerts and rearview cameras showed large reductions in the frequency of claims across physical damage coverages — a 17 percent reduction in PDL claims and a 7 percent reduction in collision claims. The frequency of bodily injury liability claims was 14 percent lower and the frequency of MedPay claims was 13 percent lower for models equipped with the combined system compared with models without the system. It's not clear how systems designed to prevent low-speed parking crashes are preventing injuries in the insured vehicles. HLDI and IIHS researchers continue to study these crashes to understand this effect.

Bodily injury liability coverage insures against medical and other expenses for injuries that at-fault drivers inflict on occupants of other vehicles or others on the road. MedPay covers injuries to insured drivers and passengers in their vehicles but not injuries to people in other vehicles involved in the crash. In no-fault insurance states, personal injury protection (PIP) pays for injuries to occupants of involved-insured vehicles, regardless of the driver at fault in the crash.

GM's forward alerts/automatic braking package combining camera- and radar-based forward collision warning with automatic braking, adaptive cruise control and lane departure warning or lane-keeping support is trimming the frequency of physical damage and injury claims under all coverages. Reductions range from 5 percent under collision coverage to 23 percent under PIP. GM's high intensity discharge headlights are reducing the frequency of claims under PDL by 6 percent and PIP by 8 percent.

For a copy of the HLDI Bulletin "General Motors collision avoidance features," email publications@iihs.org. ■



Rear autobrake on Cadillacs is preventing crashes, cutting the frequency of physical damage claims submitted to insurers.

Cadillac models without the feature. Cadillacs with rear autobrake also have front autobrake, forward collision warning, a rearview camera, front and rear parking alerts, blind spot detection with rear cross-traffic alert and lane departure warning or lane-keeping support. The analysis controlled for the presence or absence of these features.

Rear autobrake uses ultrasonic sensors and short-range radar when the vehicle is in reverse to help the driver avoid hitting detected objects directly behind the vehicle. If the driver doesn't respond to warning beeps

with Cadillacs without the feature. Property damage liability covers damage to other vehicles and property. Collision coverage insures against physical damage to people's vehicles in crashes with other vehicles or objects if the drivers are at fault.

"Backing crashes usually don't occur at high speeds, but damage from the everyday collisions that happen when backing out of driveways and parking spots can be costly and time-consuming to repair," says Matt Moore, senior vice president of HLDI. "GM's reverse autobrake system is helping

Alerts boost teen drivers' turn-signal use

Crash avoidance warning features help teenage drivers improve their turn-signal use and stay in their travel lanes but appear to increase the time they spend following vehicles at close distances, new IIHS research indicates.

Crash avoidance systems monitor driver input and the environment around the vehicle and warn the driver of a potential collision. The systems could be especially beneficial to young beginning drivers. Real-time feedback on their driving could help teens develop safer habits (see *Status Report*, May 7, 2009, at iihs.org).

To explore this possibility, IIHS undertook a naturalistic driving study with the University of Michigan Transportation Research Institute and Honda. The study is the first to evaluate how novice drivers respond to warnings from crash avoidance systems.

Forty 16-17-year-old teenagers who had been licensed for about six to nine months were recruited from Michigan high schools to drive instrumented Honda Accords with crash avoidance technologies. These included forward collision warning, lane departure warning, blind spot monitoring and curve speed warning. Sensors captured information about vehicle movement and driver inputs, and cameras recorded views both inside and outside the car.

Researchers examined whether the warning systems altered teens' driving in terms of headway maintenance, lane keeping and turn-signal use, and whether any changes were sustained after warnings were disabled. They also looked at distraction.

The 20 teens in the experimental group drove for a three-week baseline period with all crash warnings disabled, an eight-week treatment period in which they received crash warnings and a three-week post-treatment period with warnings disabled again. The 20 teens in the control group drove a fully instrumented car for 14 weeks but never received any crash warnings. Data were collected during a 14-month period from late July 2011 to October 2012. When warnings were disabled, the cars continued to collect data on all events that would have prompted alerts.

Teens drove more than 90,000 miles and logged about 10,000 events that triggered

warnings. Seventy-three percent of the warnings were for lane drifts, often because the driver failed to signal an intentional lane change. Forward collision alerts accounted for 8 percent of all warnings logged.

After the baseline period, forward conflicts increased for teens in both the experimental and control groups, possibly reflecting their growing comfort with the study cars or acclimation to driving

on the warning system to let them know when they should brake.”

Lane departure warning and blind spot monitoring changed behavior in more positive ways. When drivers received warnings, unsignaled lane departures fell by more than a third. This could indicate higher turn-signal use. Once the warnings were disabled, the proportion of unsignaled lane changes rose but remained about 75 percent lower



Teenagers in the study drove instrumented vehicles equipped with several crash avoidance warning technologies. The alerts helped teens increase turn-signal use but didn't curb tailgating.

in general. The similar behavior by both groups may be because the experimental driver group may have ignored warnings after getting a large number of false alerts. The Hondas were outfitted with a prototype forward collision warning system that wasn't necessarily representative of market technology. The system had the highest rate of false warnings of the three technologies.

“We didn't find evidence of safety benefits from forward collision warning,” says Jessica Jermakian, a senior research engineer for IIHS and the study's lead author. “During the treatment period, the teens actually spent more time following vehicles closely. Once the forward collision warning system was disabled, they backed off. This might indicate that the drivers were relying

than during the baseline period, suggesting lingering benefits. The increase in turn-signal use is consistent with prior surveys (see *Status Report*, March 13, 2014).

The researchers didn't find any evidence that the teens engaged more in secondary tasks, such as talking to a passenger or using phones, when warnings were active. A separate study by IIHS and UMTRI specifically examined distraction among these teens and a group of adults. Having the warning system activated didn't make the drivers more or less likely to engage in secondary behaviors (see *Status Report*, Nov. 17, 2016).

For a copy of “Effects of an integrated collision warning system on teenage driver behavior” by J.S. Jermakian et al., email publications@iihs.org. ■

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