COLLISION AVOIDANCE FEATURES: INITIAL RESULTS

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ABSTRACT

Objective Analysis examined how individual collision avoidance features affected losses under a variety of insurance coverages for vehicle damage and injuries.

Methods Five automakers supplied identification numbers of vehicles that had each feature, allowing a comparison of the insurance records for those vehicles that included the optional feature with the same models without the feature. Coverage and loss data were supplied by insurers representing over 80 percent of the U.S. private passenger vehicle insurance market. Regression analysis was used to quantify the effect of each vehicle feature while controlling for the other features and covariates, including driver age and gender, garaging state, and collision deductible. Claim frequency was modeled using a Poisson distribution. Claim severity was modeled using a Gamma distribution. Estimates for overall losses were derived from the frequency and severity models.

Results Forward collision avoidance systems, particularly those that can brake autonomously, along with adaptive headlights, showed the biggest claim reductions. Other systems, such as blind spot detection and park assist, did not show consistent effects on crash patterns across different manufacturers. Lane departure warning systems were associated with increased claim rates; however, the 95% confidence intervals were large, indicating the results are uncertain. Forward collision avoidance systems with autonomous braking showed 10-14 percent reductions in the frequency of claims to repair damage that the studied vehicles caused to other vehicles; adaptive headlights showed reductions of as much as 10 percent in the same types of claims. Consistent with this finding, injury liability claims also were reduced. Both systems were associated with more modest reductions in the frequency of claims to repair studied vehicles. Forward collision avoidance systems without autonomous braking also reduced claims for damage and injuries but to a lesser extent.

Conclusion Insurance data show some collision avoidance technologies are preventing crashes and injuries. In the case of forward collision avoidance systems, the largest crash reductions involve damage to other vehicles. That is consistent with a reduction in rear-end crashes, the particular hazard these systems are meant to address. Adaptive headlights also appear to prevent collisions with other vehicles, but it is unclear why they aren't more effective at preventing single-vehicle collisions. Insurance data provide a first look at the overall effectiveness of these systems, but detailed crash information is limited. Most systems can be deactivated by the driver, and the status of a feature at the time of the crash is not known. Deactivation could partially account for the lack of demonstrated benefit for certain features. These analyses estimate real-world effectiveness of several crash avoidance technologies. While some results indicate the need for further investigation, it is clear that certain systems, such as those that help drivers avoid collisions with the vehicle in front or better illuminate the road ahead, can play a role in making roads safer.

Keywords Collision avoidance; forward collision avoidance; adaptive headlights; lane departure warning; autonomous emergency braking; blind spot; rear collision avoidance

INTRODUCTION

Collision avoidance technologies are becoming popular in U.S. motor vehicles. According to information collected by the Highway Loss Data Institute (HLDI), 211 model 2013 vehicles are available with forward collision warning (FCW), and 107 include some form of autonomous emergency braking (AEB). In addition, 146 current models have lane departure warning (LDW), 244 have blind spot information systems, and 250 have adaptive headlights. Both FCW and LDW are technologies recommended by the U.S. Government's New Car Assessment Program (NCAP). These features are optional on the 2013 model Honda Accord, one of the best-selling cars in the U.S. Not surprisingly, automakers tout the potential safety benefits of these systems as reason to buy their products.

This enthusiasm is not without reason. Several studies estimate large potential benefits. A study by the Insurance Institute for Highway Safety (IIHS) suggests that a combination of four technologies – side view assist, forward collision warning/mitigation, lane departure warning/prevention, and adaptive headlights – on all vehicles might prevent or mitigate up to 1,866,000 crashes each year, including 149,000 serious and moderate injury crashes and 10,238 fatal crashes (Jermakian, 2011). Other studies trying to predict the benefits of systems with specific characteristics also have found impressive possible benefits. For example, the National Highway Traffic Safety Administration predicts that AEB meeting certain requirements could prevent 13,000-28,000 minor injuries and 500-700 serious injuries and save 38-65 lives (NHTSA, 2012). However, few studies have measured the actual benefits of these systems.

One of the first studies to document the real-world benefits of new crash avoidance technology found that Volvo's City Safety, a low-speed AEB system, reduced crashes involving damage to other vehicles by 26 percent (see *Status Report*, July 19, 2011, HLDI, 2011). Studies by Volvo found similar benefits, and a study by the German Insurance Association (Gesamtverband der Deutschen Versicherungswirtschaft, or GDV) found similar crash reductions for Ford Focus models equipped with a similar system (Isaksson-Hellman and Lindman, 2012; Hummel et al., 2011). Otherwise, there have been few analyses of the real benefits of new crash avoidance technologies.

It's not surprising that the studies that have documented the benefits of crash avoidance technologies involved insurance data. Unlike databases of police-reported collisions, insurance databases are compiled in real-time to facilitate the settling of claims for crash losses. In contrast, the Fatal Accident Reporting System (FARS), which is a census of fatal crashes in the U.S., is typically not publicly available until a year after crashes occur. Complete databases of police-reported crashes in individual states have even longer lag times. The HLDI database, which covers 80 percent of the private passenger vehicle insurance market in the U.S., is unique in that it is updated three times yearly. Furthermore, more crashes are reported to insurers than to the police, and police-reported property damage only crashes outnumber fatal crashes by more than 100 to 1. Consequently, HLDI's database offers the possibility to measure the effects of crash avoidance technologies well before data on fatal crashes or police-reported crashes are available to the public.

This study uses the insurance data in the HLDI database to examine the early insurance claims experience for Acura, Buick, Mazda, Mercedes-Benz, and Volvo models equipped with various collision avoidance features.

METHODS

Insurance data

Automobile insurance covers damages to vehicles and property, as well as injuries to people involved in crashes. Different insurance coverages pay for vehicle damage versus injuries, and different coverages may apply depending on who is at fault. The current study is based on property damage liability, collision, bodily injury liability, personal injury protection, and medical payment coverages.

Because different crash avoidance features may affect different types of insurance coverage, it is important to understand how coverages vary among the states and how this affects inclusion in the analysis. Collision coverage insures against vehicle damage to an at-fault driver's vehicle sustained in a crash with an object or other vehicle. This coverage is common to all 50 states. Property damage liability (PDL) coverage insures against damage that at-fault drivers cause to other people's vehicles and property in crashes. This coverage exists in all states except Michigan, where vehicle damage is covered on a no-fault basis (each insured vehicle pays for its own damage in a crash, regardless of who is at fault). Coverage of injuries is more complex. Bodily injury (BI) liability coverage insures against medical, hospital, and other expenses for injuries that at-fault drivers inflict on occupants of other vehicles or others on the road. Although motorists in most states may have BI coverage, this information is analyzed only in states where the at-fault driver has first obligation to pay for injuries (33 states with traditional tort insurance systems). Medical payment coverage (MedPay), also sold in the 33 states with traditional tort insurance systems, covers injuries to insured drivers and the passengers in their vehicles, but not injuries to people in other vehicles involved in the crash. Seventeen other states employ no-fault injury systems (personal injury protection coverage, or PIP) that pay up to a specified amount for injuries to occupants of involved-insured vehicles, regardless of who is at fault in a collision. The District of Columbia has a hybrid insurance system for injuries and is excluded from the injury analysis.

Insurance measures

Claim frequency is defined as the number of claims for a group of vehicles divided by the exposure for that group, expressed as claims per 100 or 1,000 insured vehicle years. Exposure is the length of time a vehicle is insured under a given coverage type and is measured in insured vehicle years. An insured vehicle year is one vehicle insured for one year, two for six months, etc. Claim severity is the total of all loss payments made for the claims for a group of vehicles divided by the number of claims paid. Claim severity is measured in dollars paid to settle a claim. It is not a measure of the change in velocity in a crash or injury severity. Overall losses for a group of vehicles is the product of claim frequency and claim severity, expressed as dollars per insured vehicle year. This is an insurance measure and represents the average annual payout for a vehicle or feature. For the injury coverages, only claim frequencies were analyzed because injury claims can take years to develop full costs. Table 1 lists the exposure, measured in insured vehicle years and claims by manufacturer for collision coverage.

Table 1.
Collision exposure and claims by manufacturer

Manufacturer	Exposure (Insured vehicle years)	Claims
Acura	218,201	15,591
Buick	171,777	11,828
Mazda	621,594	45,929
Mercedes-Benz	7,066,981	509,093
Volvo	631,664	41,012

Vehicles

Collision avoidance features are offered as optional equipment on various Acura, Buick, Mazda, Mercedes-Benz, and Volvo models. The presence or absence of these features is not discernible from the information encoded in the vehicle identification numbers (VINs), but rather, this must be determined from build information maintained by the manufacturer. Manufacturers supplied HLDI with the VINs for any vehicles equipped with at least one collision avoidance feature. Table 2 shows available features by automaker. The values given in Table 2 correspond to the exposure (insured vehicle years) for the vehicles equipped with the technology. Vehicles of the same model year and series not identified by the manufacturers were assumed not to have these features, and thus served as the control vehicles in the analysis.

Table 2.
Collision exposure (insured vehicle years) by manufacturer and feature

	Acura	Buick	Mazda	Mercedes-Benz	Volvo
FCW				72,345	6,353
FCW with autobrake	13,570			32,978	5,324
LDW		28,414		6,884	5,324
Blindspot	5,766	28,414	116,222	14,660	96,470
Adaptive headlights	168,056		20,997	652,616	66,172
Other lighting technologies				1,545,163	
Rear cameras			120,436	502,389	
Other parking features		105,588		872,200	

Statistical methods

Regression analysis was used to quantify the effect of each vehicle feature while controlling for the other features and several covariates. The covariates included calendar year, model year, garaging state, vehicle density (number of registered vehicles per square mile), rated driver age group, rated driver gender, rated driver marital status, deductible range (collision coverage only), and risk.

For insurance purposes the rated driver is the one who typically is considered to represent the greatest loss potential for the insured vehicle. In a household with multiple vehicles and/or drivers, assignment of drivers to vehicles varies by insurance company and by state, but usually it reflects the driver most likely to operate the vehicle. Information on the actual driver at the time of a collision is not available in the HLDI database.

For insurance purposes the garaging state and zip code are the location of the rated driver's primary residence. The HLDI database does not include information about the location of crashes. The vehicle density assignment is based on the garaging ZIP code.

For each safety feature supplied by the manufacturer a binary variable was included. Based on the model year and series a single variable called SERIESMY was created for inclusion in the regression model. Statistically, including such a variable in the regression model is equivalent to including the interaction of series and model year. Effectively, this variable restricted the estimation of the effect of each feature within vehicle series and model year, preventing the confounding of the collision avoidance feature effects with other vehicle design

changes that could occur from model year to model year.

Claim frequency was modeled using a Poisson distribution, whereas claim severity (average loss payment per claim) was modeled using a Gamma distribution. Both models used a logarithmic link function. Estimates for overall losses were derived from the claim frequency and claim severity models. Estimates for frequency, severity, and overall losses are presented for collision and property damage liability. For PIP, BI and MedPay only frequency estimates are presented.

A separate regression was performed for each feature, coverage type, and insurance loss measure for a total of 15 regressions per manufacturer. More than 350 regression models were constructed. For space reasons, only the estimates for the individual crash avoidance features are shown on the following pages. Details of the regression models are not included in this report. To further simplify the presentation, the exponent of the parameter estimate was calculated, 1 was subtracted from the exponent, and that value was multiplied by 100. The resulting number corresponds to the effect of the feature on the loss measure.

RESULTS

Forward collision avoidance

Forward collision warning systems alert the driver if the vehicle is gaining on the traffic ahead so quickly that it is likely to crash. Some of these systems also are equipped with autonomous braking, meaning the vehicle will brake on its own if the driver doesn't respond in time.

Five different systems offered by Acura, Mercedes-Benz, and Volvo were evaluated. Mercedes-Benz and Volvo both had systems with and without auto brake functionality. The results indicate that forward collision avoidance systems are reducing insurance claim frequencies. The Acura system and both of the Mercedes systems showed reductions in claim frequency for all coverage types. The Volvo systems showed claim frequency reductions under collision, PDL, and BI liability. The results also indicate that the systems with auto brake functionality provide more benefit than those without. The Volvo and Mercedes-Benz systems with auto brake had larger reductions in PDL and BI claim frequencies than those without.

The results indicate that the systems are associated with increases in claim severity. With the exception of the Volvo system with auto brake, the forward collision avoidance systems were associated with increases in collision and PDL claim severity. Overall losses for collision and PDL were generally down. The systems with increases in overall losses were all due to increases in claim severity as opposed to increases in claim frequency. Table 3 summarizes these results.

Table 3.
Change in insurance losses for forward collision avoidance

Coverage type	Acura with auto brake	Mercedes-Benz with auto brake	Mercedes-Benz without auto brake	Volvo with auto brake	Volvo without auto brake
Claim frequency					
Collision	-3.1%	-7.1%*	-3.1%	-2.9%	-6.6%
PDL	-14.2%*	-14.3%*	-7.1%*	-10.0%	-7.1%
BI	-15.0%	-16.0%	-4.0%	-31.9%	-9.2%
MedPay	-3.0%	-21.1%	-23.1%*	13.3%	-27.5%
PIP	-16.5%	-15.1%	-1.7%	21.3%	14.0%
Claim severity					
Collision	0.6%	2.6%	14.8%*	-4.2%	10.4%
PDL	2.5%	4.3%	2.0%	-3.1%	9.9%
Overall losses					
Collision	-2.5%	-4.6%	11.2%*	-7.0%	3.1%
PDL	-12.1%	-10.5%	-5.2%	-12.8%	2.2%

Significant results are indicated by *

Adaptive headlights

Adaptive headlights respond to steering input to help a driver see around a curve in the dark. The headlights' horizontal aim is adjusted based on the speed of the vehicle, direction of the steering wheel, and other factors so that the lights are directed where the vehicle is heading. Systems from Acura, Mazda, Mercedes-Benz, and Volvo were evaluated.

The results indicate that adaptive headlights are associated with reductions in insurance claim frequencies. Of the 20 measures of claim frequency in the study, 19 showed reductions and many were statistically significant. However, these systems are all associated with increases in collision claim severity ranging from 0.3 to 3.5 percent.

Overall losses for collision results were mixed, with half showing increases and half showing decreases, while all of the PDL estimates show decreases. The largest decrease was for Mazda at a statistically significant 23 percent. Table 4 summarizes these results.

Table 4.
Change in insurance losses for adaptive headlights

Claim frequency				
Coverage type	Acura	Mazda	Mercedes-Benz	Volvo
Collision	-2.0%	-6.4%*	-0.8%	-0.7%
PDL	-6.3%	-10.1%*	-4.7%*	-9.0%*
BI	8.7%	-12.5%	-9.9%*	-16.8%*
MedPay	-28.2%	-28.9%*	-14.0%*	-6.3%
PIP	-7.9%	-28.8%*	-1.9%	-6.6%
Claim severity				
Collision	0.3%	3.3%	3.2%*	3.5%
PDL	-0.3%	-14.3%*	1.4%	-1.1%
Overall losses				
Collision	-1.7%	-3.3%	2.3%	2.8%
PDL	-6.6%	-23.0%*	-3.4%	-10.0%*

Significant results are indicated by *

Lane departure warning

Lane departure warning identifies lane markings and indicates if the vehicle path deviates from the lane and the turn signal is not on. Evaluated systems included those from Buick, Mercedes- Benz, and Volvo.

Buick and Mercedes systems were associated with higher claim frequencies under collision and PDL coverages. The Volvo system showed a reduction in claim rates under these coverages, as well as BI liability, however Volvo's system is bundled with forward collision warning with autonomous braking. Claim frequencies for injuries under PIP and MedPay showed increases for all three manufacturers, although the results were not statistically significant. Table 5 summarizes these results.

Table 5.
Change in insurance losses for lane departure warning

Claim frequency			
Coverage type	Buick	Mercedes- Benz	Volvo
Collision	4.2%	5.6%	-2.9%
PDL	7.2%	10.9%	-10.0%
BI	-1.5%	-2.8%	-31.9%
MedPay	12.5%	106.5%	13.3%
PIP	11.6%	10.6%	21.3%
Claim severity			
Collision	-1.1%	18.2%*	-4.2%
PDL	2.0%	5.2%	-3.1%
Overall losses			
Collision	3.0%	24.9%*	-7.0%
PDL	9.3%	16.6%	-12.8%

Significant results are indicated by *

Blind spot information

Blind spot information alerts drivers to vehicles that are adjacent to them. The purpose of this technology is to reduce or prevent crashes that occur during lane-change maneuvers. Acura, Buick, Mazda, Mercedes-Benz, and Volvo systems were evaluated.

Only the Acura system showed a clear reduction in collision claim frequency. Three of the five systems were associated with reductions in PDL claim frequency. The Mazda system was associated with a statistically significant reduction of 7.5 percent. Three of the five systems were associated with reductions under MedPay coverage. Under BI liability all but the Acura system showed reductions, while under PIP coverage Acura, Buick, and Volvo showed an increase.

Under collision claim severity, Buick, Mercedes-Benz, and Volvo systems showed decreases, while the Acura system showed an increase, and the Mazda system showed a near zero effect. Under PDL coverage three of the five estimates indicate a decrease although none are significant.

For collision coverage the Acura and Buick systems were associated with an increase in overall losses, while the other three systems were associated with decreases. All systems with the exception of Buick showed a decrease in overall losses for PDL coverage. Table 6 summarizes these results.

Table 6.
Change in insurance losses for blind spot information

Claim frequency					
Coverage type	Acura	Buick	Mazda	Mercedes-Benz	Volvo
Collision	-5.4%	4.2%	0.0%	-0.1%	1.3%
PDL	-16.2%	7.2%	-7.5%*	0.4%	-2.4%
BI	24.1%	-1.5%	-20.9%*	-3.6%	-6.2%
MedPay	-5.0%	12.5%	-23.9%*	-26.5%	-11.4%
PIP	43.1%	11.6%	-14.5%*	-7.2%	3.9%
Claim severity					
Collision	6.5%	-1.1%	-0.5%	-7.8%	-3.7%*
PDL	-6.7%	2.0%	2.3%	-5.5%	-1.0%
Overall losses					
Collision	0.7%	3.0%	-0.4%	-8.0%	-2.5%
PDL	-21.8%	9.3%	-5.3%	-5.1%	-3.4%

Significant results are indicated by *

Rear park assist

Rear park assist is designed to detect objects behind the rear bumper and warn the driver of its presence. These systems are intended to aid in low-speed maneuvers. Buick and Mercedes-Benz systems were evaluated.

The Buick system was associated with statistically significant reductions in collision and PDL frequencies. The PDL reduction for the Buick system was more than 16 percent. The Mercedes-Benz system was associated with a small increase in collision claim frequency and a small reduction in PDL frequency, although neither of these estimates reached statistical significance. The Mercedes-Benz systems were associated with statistically significant reductions in claim frequency of about 7 percent under MedPay and PIP. Both systems showed increases in claim severity for collision and PDL.

Overall losses for collision and PDL for the Buick system showed reductions, while the Mercedes-Benz system was associated with increases. Table 7 summarizes these results.

Table 7.
Change in insurance losses for rear park assist

Claim frequency		
Coverage type	Buick	Mercedes- Benz
Collision	-5.0%*	0.8%
PDL	-16.6%*	-1.8%
BI	-0.8%	0.5%
MedPay	-12.3%	-6.7%*
PIP	4.7%	-7.3%*
Claim severity		
Collision	1.6%	5.0%*
PDL	1.8%	4.2%*
Overall losses		
Collision	-3.4%	5.8%*
PDL	-15.1%*	2.3%

Significant results are indicated by *

Rear cameras

Rear cameras are also designed to aid in low- speed maneuvers. Systems were evaluated from Mazda and Mercedes-Benz.

Claim frequencies for both systems increased under collision coverage. The increase for the Mazda system was a statistically significant 3.1 percent. However, both systems showed reductions under PDL coverage. Claim frequency results were mixed for the injury-related coverages.

Collision claim severity increased a statistically significant 3.2 percent for the Mazda system. There was little change for Mercedes-Benz. Both systems were associated with increases in claim severity under PDL coverage.

Both systems were associated with increases in overall losses for collision coverage. The Mazda system showed a decrease under PDL while Mercedes-Benz showed an increase. Table 8 summarizes these results.

Table 8.
Change in insurance losses for rear cameras

Claim frequency		
Coverage type	Mazda	Mercedes- Benz
Collision	3.1%*	0.5%
PDL	-2.3%	-0.5%
BI	-3.1%	10.8%
MedPay	0.6%	1.3%
PIP	-2.1%	-4.0%
Claim severity		
Collision	3.2%*	-0.1%
PDL	1.3%	3.2%
Overall losses		
Collision	6.4%*	0.4%
PDL	-1.1%	2.7%

Significant results are indicated by *

Mercedes-Benz had the widest range of collision avoidance features of any manufacturer. Some of the other features showing significant reductions in PDL claim frequency include high intensity discharge lights (-5.5 percent) and night view assist (-8.1 percent). Adaptive high beams also showed a reduction in PDL claims, but the result was not significant (-5.9 percent). Active cornering lights (1.7 percent) and park guidance (5.0 percent) resulted in nonsignificant increases.

DISCUSSION

The results for forward collision warning with and without braking are encouraging. Claim frequencies show reductions across all coverage types and manufacturers. The pattern of findings for vehicle damage coverages is consistent with the expected benefits; that is, the reduction in claims is greater for PDL coverage than for collision coverage. Forward collision warning systems are intended to reduce the occurrence and/or severity of front-to-rear collisions, and those types of crashes are more common among PDL claims than among collision claims, which include many single-vehicle crashes.

Forward collision systems that include autonomous braking prevent up to twice as many claims as those without autonomous braking, despite the fact that the autonomous braking systems studied here are described by their manufacturers as being primarily designed to mitigate crash severity. This is possible because not all crashes result in insurance claims since the involved vehicles may not suffer damage if the speed is sufficiently reduced. Thus, systems with autonomous braking prevent more claims than those without because the autonomous intervention backs-up drivers who fail to respond to the warnings or respond too slowly. There are also other differences between systems with and without autonomous braking that may help explain the larger benefit of those with braking. For example, Volvo's system without auto brake is functional only at speeds over 20 mph, while the version with auto brake starts working at 3 mph.

All four adaptive (steerable) headlight systems show benefits for most coverages, and many of these estimated reductions are statistically significant. The analysis indicates a benefit in claims reduction, but the pattern is not consistent with expectations. For example, the prevalence of single-vehicle crashes at night suggests that adaptive lighting would have a greater effect on collision coverage than PDL. However, to the extent that this feature is effective, it appears to reduce PDL claims more than collision claims. Making the pattern even more perplexing is the fact that just 7 percent of police-reported crashes occur between 9 p.m. and 6 a.m. and involve more than one vehicle, and even fewer occur on curves where adaptive lights would seem to have the greatest benefit over those that are not steerable. Given the reductions in PDL claim frequency (5 to 10 percent), this would mean that nearly all nighttime PDL claims were prevented. This raises questions about the exact source of the estimated benefits: Does steerable lighting work because the lamps are steerable or is there something else about cars with active lighting, such as brightness or range, which has not been adequately accounted for in the current analysis?

This analysis show higher claims for Buick and Mercedes models equipped with lane departure warning. Only Volvo's system showed a nonsignificant benefit, which may not be due to the LDW system. Volvo's LDW is always bundled with FCW among the studied population. Noting the benefits of FCW among other manufacturers' products, it seems plausible that FCW and not LDW explains claim reductions.

The lack of a benefit for LDW is disappointing because earlier estimates of the potential benefits suggested that LDW could possibly prevent more than 7,000 fatalities annually if it could significantly prevent single-vehicle run-off-road crashes, many of which end in death (Jermakian, 2011). It's possible that LDW systems are preventing such crashes without being detected in these analyses because fatal crashes make up a very small proportion of insurance claims. Nevertheless, the increase in damage and first-party injury claims raises questions about whether the predicted benefits of LDW will be realized.

The results for blind spot information, park assist and rear cameras did not show clear effects. The results for Mazda's blind spot information system were encouraging, with significant reductions in claim frequency for 4 of 5 insurance coverage types. However, the lack of an effect on collision claims is puzzling. The lack of confirmatory findings for other manufacturer's blind spot systems raises questions about the robustness of this finding. Similarly, the park assist system in Buicks significantly reduced the frequency of claims under both collision and PDL, but the lack of similar effects for the Mercedes-Benz system or rear camera systems from either of the two automakers studied undermines confidence in this result. It's possible that more data will bring the results from the different manufacturers more in line with each other.

LIMITATIONS

There are limitations to the data used in this analysis. At the time of a crash, the status of a feature is not known. The features in this study can be deactivated by the driver, and there is no way to know how many of the drivers in these vehicles turned off a system prior to the crash. If a significant number of drivers do turn these features off, any reported reductions may actually be underestimates of the true effectiveness of these systems. However, surveys of owners of vehicles equipped with crash avoidance features show that significant majorities claim to leave the systems switched on (60-90 percent) even when they report that the systems annoy them with unwanted warnings (Braitman et al., 2010, Eichelberger et al., 2012).

Data supplied to HLDI do not include detailed crash information. Information on point of impact or information on vehicle operation at the time of the event is not available. The technologies in this report target certain crash types. For example, the blind spot information system is designed to prevent sideswipe-

type collisions. However, all collisions, regardless of the ability of a feature to mitigate or prevent the crash, are included in the analysis. All of these features are optional and are associated with increased costs. The type of person who selects these options may be different from the person who declines them. While the analysis controls for several driver characteristics, there may be other uncontrolled attributes associated with people who select these features.

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