Safety First

Car Crashes, Innovation, and Why Federal Policy Should Prioritize Adoption of Existing Technologies to Save Lives

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Executive Summary

To provide a guide for policymakers and the auto industry on how best to substantially and expeditiously reduce road crashes, deaths, and injuries, this study analyzed the safety benefits of currently available crash avoidance systems and other existing motor vehicle safety technologies, including a review of the safety research that has been conducted on the topic. The focus of this analysis was the publicly available fatality reduction benefits of safety technologies extrapolated to the entire U.S. light vehicle fleet -- with systems evaluated that exist today, as opposed to creating estimates of effectiveness based on simulated or idealized technology. The analysis found that currently available automatic emergency braking (AEB), lane departure warning (LDW), blind spot warning (BSW), and pedestrian detection technologies would be expected to combine for fatality reductions of 11,800 lives per year once fully adopted fleetwide. Two safety applications of V2V communications technology -- intersection movement assist (IMA) and left turn assist (LTA) -- would be estimated to save more than 1,300 lives per year with full fleet adoption. One existing drunk driving prevention technology, the Driver Alcohol Detection System for Safety (DADSS), would be estimated to save 3,700-7,400 lives under the scenarios assessed. Summed together, **existing motor vehicle safety technology would save 16,800-20,500 lives per year** if equipped across the full U.S. light vehicle fleet. This totals approximately **one-half of the 36,560 lives lost** on U.S. roads in 2018. Therefore, to cut roadway fatalities in half, policymakers should prioritize requiring and setting strong performance standards for existing vehicle safety technologies, and automakers should equip effective systems standard across all trim lines of their models as soon as possible.

Introduction

The United States faces a road safety crisis. In recent years, motor vehicle crashes in the U.S. have accounted for at least 36,000 deaths and 2.5 million injuries per year.[1] These crashes are the leading cause of death in the first three decades of Americans' lives, and they cost the nation an estimated $800 billion in direct and indirect expenses per year.[2]

Substantial reductions in motor vehicle deaths, injuries, and crashes will be required for the U.S. to achieve a transportation system in which people can readily get around without fear that they or their loved ones will not make it to their destination. As part of the pursuit of safer roads, a suite of technologies has developed through auto industry innovation that, over time, will revolutionize the experience -- and the safety -- of driving a car. Various existing crash avoidance systems are capable of automatically applying the brakes to avoid a crash, warning drivers of a vehicle in their blind spot, or detecting a pedestrian crossing the street. These technologies are all on cars *today*, providing major proven safety benefits to consumers.

To provide a guide for policymakers and the auto industry on how best to substantially and expeditiously reduce road crashes, deaths, and injuries, this study analyzed the fatality reduction benefits of currently available crash avoidance systems and other existing motor vehicle safety technologies, including a review of the safety research that has been conducted on the topic. The estimated lives saved on U.S. roads depends greatly on the choices made by policymakers; specifically, whether they choose to prioritize mandating existing crash avoidance systems or expediting the future deployment of automated vehicles (AVs) as envisioned under previous legislation.

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[1] Centers for Disease Control and Prevention, Web-based Injury Statistics Query and Reporting System (accessed May 13, 2020). Available at: www.cdc.gov/injury/wisqars/index.html.

[2] Blincoe, L. J., Miller, T. R., Zaloshnja, E., & Lawrence, B. A. (May 2015). The economic and societal impact of motor vehicle crashes, 2010. (Revised) (Report No. DOT HS 812 013). Washington, DC: NHTSA. Available at: crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812013.

Background

For vehicle safety technologies to deliver in full on their lifesaving potential, they must -- by definition -- be standard equipment on all vehicles on our roads. It is also critical for there to be strong performance requirements for these technologies, so that safety innovation leads to systems that consumers can trust to function when they need them.

Today, the U.S. still is far from these goals with respect to crash avoidance technologies. Automatic emergency braking (AEB), a version of which major automakers voluntarily committed to equip standard on virtually all passenger vehicles by 2022, now comes standard on just 67% of 2020 vehicle models more than four years after the commitment was made. Pedestrian detection, an enhancement of AEB, comes standard on 61% of 2020 models, while lane departure warning (LDW) and blind spot warning (BSW) lag behind at only 49% and 29%, respectively. Furthermore, there are no current laws or regulations in the U.S. requiring automakers to equip their vehicles with lifesaving crash avoidance systems, nor are there any requirements specifying how well the systems must perform.

Several members of Congress have sought to use federal policy to accelerate auto industry safety innovation and ensure consumers continuously gain greater access to the benefits of crash avoidance systems. For example, a bill recently introduced in the U.S. House of Representatives, the 21st Century Smart Cars Act, would require systems including AEB with pedestrian detection, LDW, and BSW to come standard on all new cars and to meet mandatory performance standards.[3] Another new bill, the Five Stars for Safe Cars Act, would require upgrades to the government's New Car Assessment Program (NCAP) so that it accounts for these and other auto safety systems, including through the development of new National Highway Traffic Safety Administration (NHTSA) test procedures, devices, fixtures, and performance metrics.[4]

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[3] H.R. 6284, the "21st Century Smart Cars Act," U.S. House of Representatives, 116th Congress. Available at: www.congress.gov/bill/116th-congress/house-bill/6284/text. *See also* Sec. 32003 of H.R. 2, U.S. House of Representatives, 116th Congress. Available at: rules.house.gov/sites/democrats.rules.house.gov/files/BILLS-116HR2-RCP116-54.pdf#page=1426.

[4] Implementation of this legislation would bring the U.S. NCAP close to the level of the European version of the program, which has been testing and publishing ratings on crash avoidance systems since 2013. H.R. 6256, the "Five Stars for Safe Cars Act," U.S. House of Representatives, 116th

There also has been significant manufacturer, investor, media, and government attention in recent years devoted to the role of vehicles with enhanced driving automation systems, the most advanced of which are known colloquially as AVs or self-driving cars. AVs offer enormous potential to improve safety and mobility by substantially reducing the road crashes attributable to driver error. Similar to what is needed for existing crash avoidance technologies, rigorous performance requirements are essential for driving automation systems to reach their full potential.

Currently, the real safety benefits AVs will deliver for consumers are largely unknown. These systems generally are not yet commercially available, and public trust in AVs is low, with Americans somewhat optimistic about the future of the vehicles while wary of the technology today.[5] In addition, there have been fatal crashes involving driving automation systems, with the National Transportation Safety Board publishing detailed crash investigation reports that found insufficient safety protocols in place.[6]

In 2017 and 2018, federal legislation was considered in each chamber of Congress that would have expedited the deployment of AVs on U.S. roads for commercial use -- without requiring completion of any mandatory standards or performance requirements regulating the safety of these vehicles.[7] The legislation's approach to

Congress. Available at: www.congress.gov/bill/116th-congress/house-bill/6256/text. *See also* Sec. 32004 of H.R. 2, U.S. House of Representatives, 116th Congress. Available at: rules.house.gov/sites/democrats.rules.house.gov/files/BILLS-116HR2-RCP116-54.pdf#page=1433.

[5] *See, e.g.*, AAA, "American Trust in Autonomous Vehicles Slips," press release (May 22, 2018). Available at: newsroom.aaa.com/2018/05/aaa-american-trust-autonomous-vehicles-slips; *see also, e.g.*, Partners for Automated Vehicle Education, *PAVE Poll: Fact Sheet* (May 18, 2020). Available at: pavecampaign.org/wp-content/uploads/2020/05/PAVE-Poll_Fact-Sheet.pdf.

[6] *See, e.g.*, "What Uber's Fatal Self-Driving Crash Can Teach Industry and Regulators," Consumer Reports (Nov. 20, 2019). Available at: www.consumerreports.org/car-safety/what-ubers-fatal-self-driving-crash-can-teach-industry-and-regulators; *see also, e.g.*, "NTSB Findings Put Pressure on Tesla to Change Autopilot," Consumer Reports (Feb. 25, 2020). Available at: www.consumerreports.org/car-safety/ntsb-findings-put-pressure-on-tesla-to-change-autopilot.

[7] H.R. 3388, the "SELF DRIVE Act," U.S. House of Representatives, 115th Congress. Available at: www.congress.gov/bill/115th-congress/house-bill/3388/text; S. 1885, the "AV START Act," U.S. Senate, 115th Congress. Available at: www.congress.gov/bill/115th-congress/senate-bill/1885/text.

vehicle safety was the target of significant criticism, including by CR,[8] and the bills were not approved before the end of the 115th Congress.

Instead of establishing meaningful requirements for AVs to provide greater occupant protection and crash avoidance capabilities, the 2017-2018 legislation would have required only that AVs provide a level of safety the same as the average car on the road. For example, the House's SELF DRIVE Act would have permitted AVs in commerce that could be exempt from one or more federal motor vehicle safety standards if they had "an overall safety level at least equal to the overall safety level of nonexempt vehicles." Nonexempt vehicles -- in other words, vehicles on the road today -- currently have the safety performance of more than 36,000 deaths, 2.5 million injuries, and 6 million crashes per year.

Methodology

Fatality reduction benefits were examined for four existing crash avoidance technologies: automatic emergency braking (AEB), lane departure warning (LDW), blind spot warning (BSW), and pedestrian detection. Additionally, the fatality reduction benefits of two safety applications for vehicle-to-vehicle (V2V) communications technologies, as well as one drunk driving prevention technology, were investigated. The focus of this analysis was limited to the publicly available fatality reduction benefits of safety technologies extrapolated to the entire U.S. light-duty motor vehicle fleet of about 250 million vehicles[9] -- with systems evaluated that exist today, as opposed to creating estimates of effectiveness based on simulated or idealized technology.

Recently, the National Highway Traffic Safety Administration (NHTSA) conducted a comprehensive meta-analysis on three of these technologies: AEB, LDW, and BSW.[10] NHTSA's analysis expanded on the work done by Leslie et al. (2019), which

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[8] *See, e.g.*, Letter of Consumer Reports to the U.S. House of Representatives regarding H.R. 3388, the SELF DRIVE Act (Sept. 6, 2017). Available at: advocacy.consumerreports.org/wp-content/uploads/2017/09/CU-letter-on-SELF-DRIVE-Act-for-House-floor-9-6-2017.pdf; *see also, e.g.*, Joint statement on failure of S. 1885 in the 115th Congress (Dec. 21, 2018). Available at: advocacy.consumerreports.org/wp-content/uploads/2018/12/AV-START-Act-Joint-Statement-12-21-18.pdf.

[9] Davis, S. C., & Boundy, R. G. (2020). Transportation Energy Data Book: Edition 38.1. Table 4.3. Oak Ridge: Oak Ridge National Laboratory. Retrieved from TEDB.ORNL.GOV.

[10] NHTSA, "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Year 2021 – 2026 Passenger Cars and Light Trucks." Available at: www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/final_safe_fria_web_version_200330.pdf.

estimated the effectiveness of crash avoidance systems currently equipped on General Motors vehicles.[11] In order to translate these effectiveness rates into fatality reductions, the agency expanded on the work done by Wang et al. (2019), adding consideration for already expected fatality reduction from existing technologies such as electronic stability control (ESC).[12]

Absent from the agency's meta-analysis are the estimated safety benefits of pedestrian detection. However, in 2017 NHTSA published a report detailing the expected fatality reduction from full fleet adoption of this technology.[13] This research was performed with then-available pedestrian detection technology, and the effectiveness estimate was derived from test-track evaluations of the systems combined with contemporary observed crash scenarios and injury risk curves. Further, this report focused only on two prominent vehicle-pedestrian crash scenarios, which accounted for 60% of all fatal pedestrian crashes. Since the publication of this report, pedestrian detection technologies have improved; however, in order to stay consistent with the selected analysis inclusion criteria and more conservative estimates, researchers chose to use the figures from 2017.

In addition to the four crash avoidance technologies AEB, LDW, BSW, and pedestrian detection, researchers examined the expected fatality reduction benefits of two safety applications of vehicle-to-vehicle (V2V) communications technology, as well as one drunk driving prevention technology, if fully adopted throughout the U.S. light vehicle fleet. While these two technologies are not currently widespread on roads, they are the subject of years of extensive testing and they offer a clear path to saving lives.

To stay consistent with the selected approach to estimate only the more conservative potential of these safety technologies, just two V2V safety applications were used. These two applications -- intersection movement assist (IMA) and left turn assist (LTA) -- are those that NHTSA used in its expected benefit analysis for its

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[11] Leslie, A, Kiefer, R., Meitzner, M, and Flannagan, C. (2019). Analysis of the Field Effectiveness of General Motors Production Active Safety and Advanced headlighting Systems. University of Michigan Transportation Research Institute, UMTRI-2019-6, September, 2019.

[12] Wang, J. S. (2019). Target Crash Population for Crash Avoidance Technologies in Passenger Vehicles (No. DOT HS 812 653).

[13] Yanagisawa, M., Swanson, E., Azeredo, P., & Najm, W. G. (April 2017). Estimation of potential safety benefits for pedestrian crash avoidance/mitigation systems. (Report No. DOT HS 812 400). Washington, DC: NHTSA. Available at: rosap.ntl.bts.gov/view/dot/12475/dot_12475_DS1.pdf.

notice of proposed rulemaking to require V2V-capable systems on all new cars, which was finalized in late 2016 and formally published in early 2017.[14] While additional V2V safety applications have since been analyzed, this report only includes the aforementioned two applications in the benefits analysis for V2V because these two applications address hazards that would not be addressed by other existing crash avoidance technologies.[15]

Additionally, researchers examined potential reduction in road deaths through the use of drunk driving prevention technology. An analysis of NHTSA's Fatality Analysis Reporting System (FARS) was used to estimate the lives that could be saved if one technology, the Driver Alcohol Detection System for Safety (DADSS), prevented drivers from operating the vehicle if they had a Blood Alcohol Concentration (BAC) of 0.08 or higher.[16] Two estimates were produced: an upper estimate based on the FARS analysis, and a lower estimate that was established by reducing that value by half.

Researchers evaluated the fatality reduction benefits of DADSS because the technology has been the subject of the most extensive testing and published research among drunk driving prevention technologies. Alternative approaches, such as those based on the use of systems that monitor a driver's performance, may also prove effective at detecting impairment and preventing or limiting vehicle operation by drunk drivers.[17]

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[14] NHTSA, "FMVSS No. 150 Vehicle-To-Vehicle Communication Technology For Light Vehicles - Preliminary Regulatory Impact Analysis" (Dec. 12, 2016). Available at: www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/v2v_pria_12-12-16_clean.pdf.

[15] Additional safety applications of vehicle-to-vehicle communications technology offer significant lifesaving benefits. Red light violation warning, pedestrian in signalized crosswalk warning, curve speed warning, and traffic-management applications have been estimated to combine to prevent more than 7,000 fatal crashes per year. However, these additional benefits overlap with benefits offered by the AEB, LDW, BSW, and pedestrian detection crash avoidance technologies analyzed -- and thus they were not included in this analysis. NHTSA, "Estimated Benefits of Connected Vehicle Applications: Dynamic Mobility Applications, AERIS, V2I Safety, and Road Weather Management" (Aug. 1, 2015). Available at: rosap.ntl.bts.gov/view/dot/3569.

[16] Zaouk, A. (2015) Driver Alcohol Detection System for Safety (DADSS) – A Status Update, Enhanced Safety of Vehicles Conference. Available at: www-esv.nhtsa.dot.gov/Proceedings/24/files/24ESV-000276.PDF.

[17] U.S. House legislation would require NHTSA to promulgate and finalize a motor vehicle safety standard that would require all new passenger motor vehicles to be equipped standard with advanced drunk driving prevention technology, defined as: a passive system that monitors a driver's performance to identify impairment of a driver; a system which passively detects a blood alcohol level exceeding .08 BAC; or a similar system that detects impairment and prevents or limits vehicle

The target crash populations that would be addressed by DADSS are separate from the target crash populations that would benefit from AEB, LDW, BSW, pedestrian detection, or V2V (e.g., in the fatality reduction benefits analyses for these five technologies, all impaired driving crashes were excluded). Therefore, the two technology effectiveness estimates for DADSS (i.e., the upper estimate and lower estimate) were added to the estimates of the other technologies in order to determine an overall number of expected lives saved if the technologies were fully adopted throughout the U.S. light vehicle fleet. These estimates can be summed because their crash populations are exclusive, with no fatal crashes potentially double-counted by the individual technology effectiveness analyses.

A review of the papers on AVs found no on-road research establishing that vehicles driving themselves freely on fully public roads provide a safety benefit compared to vehicles operated traditionally by a human driver under the same circumstances. While some AV developers report that they have driven their vehicles many miles without crashes, their detailed safety data is rarely, if ever, made public. The specific conditions under which these vehicles are tested are also not public, and potentially are unrepresentative of the conditions these vehicles would encounter if deployed nationally.

Results

The analysis found that currently available AEB, LDW, and BSW technologies would be expected to combine for fatality reductions of approximately 11,000 lives per year once fully adopted throughout the U.S. light-duty motor vehicle fleet. Currently available pedestrian detection technologies would be expected to prevent at least an additional 800 fatalities per year once equipped on every light vehicle, as well. Additional research outside of this analysis has found that with reasonable system improvements, more than 3,500 lives could be saved annually by pedestrian detection; however, this number was not used in the analysis as the authors of this additional research assumed idealized systems.[18] Two safety applications of V2V communications technology -- intersection movement assist (IMA) and left turn

operation. Sec. 32005 of H.R. 2, U.S. House of Representatives, 116th Congress. Available at: rules.house.gov/sites/democrats.rules.house.gov/files/BILLS-116HR2-RCP116-54.pdf#page=1446.

[18] In order to present a conservative estimate and focus on currently available technologies, this much larger potential benefit of pedestrian detection was not included in the analysis. However, the safety promise of these systems is massive, and this research reflects that.

assist (LTA) -- would be estimated to save more than 1,300 lives per year with full fleet adoption. One existing drunk driving prevention technology, the Driver Alcohol Detection System for Safety (DADSS), would be estimated to save 3,700-7,400 lives under the scenarios assessed.

Summed together, these figures led researchers to conclude that **existing motor vehicle safety technology would save 16,800-20,500 lives per year** if equipped across the full U.S. light-duty motor vehicle fleet. This totals approximately **one-half of the 36,560 lives lost** on U.S. roads in 2018.

Conclusion

This analysis makes clear that the path to substantially and expeditiously reducing the enormous toll of U.S. road crashes runs squarely through the full, fleetwide adoption of currently available crash avoidance technologies and other existing motor vehicle safety technologies. An alternative approach -- prioritizing the expedited deployment of AVs that meet the minimum level of safety envisioned by Congress -- cannot be analytically supported given the lack of available evidence establishing on-road safety benefits to vehicles that drive themselves compared to traditionally-driven vehicles.

Policymakers in Congress and at NHTSA should prioritize requiring and setting strong performance standards for these existing, lifesaving vehicle safety technologies to accelerate auto industry safety innovation and ensure consumers continuously gain greater access to the benefits of the technologies. Automakers should prioritize equipping effective versions of these features standard across all trim lines of their models as soon as possible and continuing to improve these technologies' safety benefits over time. Delay by either the government or manufacturers would unduly leave people at risk and effectively let essential auto industry innovations go to waste.

Appendix A: Recent analysis of the potential safety benefits of self-driving vehicles

In contrast to the technologies analyzed in this study, self-driving vehicles are the subject of little, if any, publicly available on-road research establishing their safety benefits on public roads compared to traditional human-driven vehicles. The Insurance Institute for Highway Safety (IIHS) recently investigated the potentially addressable crash population of self-driving vehicles as they are currently designed -- in other words, with these vehicles programmed to drive like people and to prioritize speed and convenience over safety -- and found that if these vehicles prevented all crashes involving a sensing, perceiving, or incapacitation error on the part of a human driver, 34% of all crashes would be avoided.[19] The IIHS study, however, does not claim to evaluate whether or not existing driving automation technology could prevent these crashes. Further, the IIHS analysis does not take into account the percentage of those crashes which already would be prevented with full deployment of existing crash avoidance technologies such as AEB, LDW, BSW, and pedestrian detection.

[19] Insurance Institute for Highway Safety, "What humanlike errors do autonomous vehicles need to avoid to maximize safety?" (May 2020) Available at: www.iihs.org/api/datastoredocument/bibliography/2205.