Litigating Partial Autonomy

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Who is responsible when a semi-autonomous vehicle crashes? Automobile manufacturers claim that because Advanced Driver Assistance Systems (ADAS) require constant human oversight even when autonomous features are active, the driver is always fully responsible when supervised autonomy fails. This Article argues that the automakers' position is likely wrong both descriptively and normatively. On the descriptive side, current products liability law offers a pathway toward shared legal responsibility. Automakers, after all, have engaged in numerous marketing efforts to gain public trust in automation features. When drivers' trust turns out to be misplaced, drivers are not always able to react in a timely fashion to re-take control of the car. In such cases, the automaker is likely to face primary liability, perhaps with a reduction for the driver's comparative fault. On the normative side, this Article argues that the nature of modern semi-autonomous systems requires the human and machine to engage in a collaborative driving endeavor. The human driver should not bear full liability for the harm arising from this shared responsibility.

As lawsuits involving partial autonomy increase, the legal system will face growing challenges in incentivizing safe product development, allocating liability in line with fair principles, and leaving room for a nascent technology to improve in ways that, over time, will add substantial safety protections. The Article develops a framework for considering how those policy goals can play a role in litigation involving autonomous features. It offers three key recommendations, including (1) that courts consider collaborative driving as a system when allocating liability; (2) that the legal system recognize and encourage regular software updates for vehicles, and (3) that customers pursue fraud and warranty claims when manufacturers overstate their autonomous capabilities. Claims for economic damages can encourage manufacturers to internalize the cost of product defects before, rather than after, their customers suffer serious physical injury.

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INTRODUCTION

"The person in the driver's seat is only there for legal reasons."—Elon Musk, 2016.[1]

In December 2022, German police attempted to pull over a Tesla on the Autobahn, "signaling for a traffic stop with repeated horns and sirens."[2] For fifteen minutes, there was no response; the Tesla maintained a constant speed of about 110 kilometers per hour.[3] The police officer could see that the driver's seat was reclined, and the driver's eyes appeared to be closed. Eventually, the driver awoke, pulled to the side of the road, and was ticketed for "endangering road traffic."[4] The vision of a sleeping driver leading the police on a high-speed chase became a punchline around the world, though it wasn't the first (or even second) time such a thing had happened.[5] And luckily, these sleeping drivers were awoken before they caused physical injury.

Other drivers haven't always been as lucky, however. On Thanksgiving Day in 2022, a Tesla Model S driving on San Francisco's Bay Bridge made a sudden lane change into the far left lane and then

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[1] Hyunjoo Jin, *Tesla Video Promoting Self-Driving Was Staged, Engineer Testifies*, REUTERS, Jan. 18, 2023, at https://www.reuters.com/technology/tesla-video-promoting-self-driving-was-staged-engineer-testifies-2023-01-17/.

[2] Zachary Rogers, *Tesla Autopilot Leads Police Chase After Driver Falls Asleep*, ABC NEWS 4, Dec. 30, 2022, *at* https://abcnews4.com/news/nation-world/tesla-autopilot-leads-police-chase-after-driver-falls-asleep-bamberg-germany-steering-wheel-weight-autobahn

[3] *Id.*

[4] *Id.*

[5] Trevor Mogg, *Cops Chased A Tesla For 7 Miles While Its Driver Appeared To Be Sleeping*, DIGITAL TRENDS, Dec. 2, 2018 *at* https://www.digitaltrends.com/cars/cops-chased-a-tesla-for-7-miles-while-the-driver-apparently-slept/ (recounting an earlier police stop in Palo Alto, California); Timothy B. Lee, *Cop Arrests Apparently Sleeping Tesla Driver Going 93mph*, ARS TECHNICA, Sept. 18, 2020, *at* https://arstechnica.com/cars/2020/09/cop-arrests-apparently-sleeping-tesla-driver-going-93mph/ (recounting a driver arrest in Alberta, Canada).

came to an abrupt stop.[6] The cars behind the Tesla weren't able to stop in time, leading to an eight-car pile-up that injured nine people—one of them a two-year-old child.[7] The crash attracted global attention when it was reported that Tesla's "Full Self Drive" (FSD) feature was enabled at the time of the crash.[8] The Tesla driver alleged that the software had malfunctioned, leading to an uncontrollable "phantom braking" incident.[9] That explanation seemed plausible—over a nine-month period in 2021-22, Tesla owners had lodged 354 complains of "unexpected braking" with the National Highway Transportation Safety Administration, and NHTSA estimated that up to 416,000 vehicles may have been affected.[10] Tesla ultimately recalled an FSD software update "to fix false-positive triggers of the emergency braking system."[11]

Some crashes involving semi-autonomous systems have resulted in property damage.[12] Others have even resulted in death, either of the

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[6] Matt McFarland, *Tesla 'Full Self-Driving' Triggered An Eight-Car Crash, A Driver Tells Police*, CNN, Dec. 21, 2022, *at* https://www.cnn.com/2022/12/21/business/tesla-fsd-8-car-crash

[7] Aaron Gold, *This Is Your Tesla FSD and Autopilot Crash Mega Thread*, MOTORTREND, Jan. 16, 2023, *at* https://www.motortrend.com/news/tesla-fsd-autopilot-crashes-investigations/;

[8] *Id.*

[9] *Id.*

[10] Matt McFarland, *US Government Investigates Tesla Cars After Reports Of Unexpected Braking*, CNN, Feb. 17. 2022, https://www.cnn.com/2022/02/17/cars/tesla-phantom-braking-nhtsa/index.html

[11] Gold, *supra* note 7.

[12] *See, e.g.*, Bard D. Borkon, *Pay Attention to the Road, Current Regulatory, Legislative, and Litigation Trends Affecting Advanced Driver Assistance System and Highly Automated Vehicle Technologies*, 62 No. 1 DRI For Def. 24, 31 (2020) (describing a case alleging that "the co-defendant was told by the salesperson to allow the automatic braking system to stop the car as part of the sales demonstration; however, the automatic braking system did not stop the car and the collision followed) (citing Miel v. First Texas Honda, Case No. D-1-GN-19-003365 (Travis Cty. Dist. Ct., Tex., June 2019); *id.* (describing a case alleging "that Mercedes-Benz's forward collision avoidance system is defective, as it failed to stop a collision with another vehicle, causing injuries to the plaintiff") (citing Wong v. Daimler AG, et al., Case No. HG19009805 (Alameda Cty. Super. Ct., CA, March 2019); *id.* (describing a case alleging that "[o]n a test drive, the defendant car dealership's employee crashed into a tree while demonstrating a vehicle's 'Eye Sight' technology, which is designed to apply automatic braking when

driver or of other roadway users; Joshua Brown, Walter Huang, Gilberto Lopez and Maria Guadalupe all died in crashes involving semi-autonomous technology.[13]

These events raise significant questions about how the law should allocate liability when both the human driver and a partially autonomous system share driving responsibility.[14] Tesla, like many other car companies, maintains that full responsibility rests with the person in the driver's seat.[15] Under this view, whenever there is a human in the loop (that is, "a human in the driver seat who can take control if a failure in

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drivers are about to collide with an object or other car") (citing Lieberman v Schumacher Auto Group, Case No. 2018ca004355 (Palm Beach Cty. Cir. Ct., FL, April 2018)).

[13] *See, e.g.*, Colin Barnden, *Unanswered Questions in the Aftermath of Fatal BMW Crash*, OJO-YOSHIDA REP., Aug. 23, 2022 at https://ojoyoshidareport.com/unanswered-questions-in-the-aftermath-of-fatal-bmw-crash/; Faiz Siddiqui, *Tesla Sued by Family of Apple Engineer Killed In Autopilot Crash*, WASH. POST, May 1, 2019, *at* https://www.washingtonpost.com/technology/2019/05/01/tesla-sued-by-family-man-killed-autopilot-crash/ (discussing the death of Walter Huang); Alexander B. Lemann, *Autonomous Vehicles, Technological Progress, and the Scope Problem in Products Liability*, 12 J. TORT L. 157, 166 (2019) (discussing the death of Joshua Brown, who was using Tesla's Autopilot system when his vehicle crashed into a stationary tractor-trailer); Dani Anguiano, *Landmark Trial Involving Tesla Autopilot Weighs If 'Man Or Machine' At Fault*, GUARDIAN, Nov. 14, 2022 at https://www.theguardian.com/technology/2022/nov/14/tesla-autopilot-landmark-case-man-v-machine (discussing the criminal prosecution of Kevin George Riad, who allegedly had the Autopilot function engaged on his Tesla when he ran a red light and crashed into a Honda Civic, killing its occupants; Gilberto Lopez and Maria Guadalupe Nieves-Lopez, were a couple on their first date).

[14] *See* Complaint, Huang v. Tesla, Inc., Case No. 19CV346663, Superior Court of California, County of Santa Clara, April 26, 2019 (asserting claims for negligence, wrongful death, and strict liability).

[15] Junko Yoshida, *Tesla Deposition Exposes Disregard for Human Drivers*, OJO-YOSHIDA REP., Jan. 20, 2023, *at* https://ojoyoshidareport.com/tesla-deposition-exposes-disregard-for-human-drivers/ ("[P]ractically every carmaker is cramming active automated features into their models while using the Level 2 [partial automation] as a shield to dodge liability for accidents. If the machine malfunctions or the software falters, carmakers typically claim, 'driver error.'").

automation were to occur"[16]), then legal responsibility rests exclusively on the driver.

This view of exclusive driver liability, however, is likely wrong as a descriptive matter under current law. Products liability law and comparative fault statutes offer a pathway to shared responsibility.[17] Exclusive driver liability is also wrong as a normative matter. To the extent that liability for harm should (1) follow the least-cost avoider[18] and (2) offer incentives for safe behavior,[19] then automakers should bear a share of the responsibility when advanced driver assistance (ADAS) systems cause harm.

Modern semi-autonomous systems require collaboration between human and machine. Autonomous systems can out-perform humans on many driving tasks: they never get bored, distracted or drunk.[20] Humans, on the other hand, have an advantage when it comes to exercising judgment in new and unexpected conditions—something that autonomous systems find notoriously difficult.[21] In theory, putting the two together seems like it would offer the best of both worlds—routine machine safety, supervised by a human who excels in emergencies. In

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[16] Kevin Funkhouser, Note, *Paving the Road Ahead: Autonomous Vehicles, Products Liability, and the Need for A New Approach*, 2013 UTAH L. REV. 437, 442 (2013).

[17] *See infra* Part III.

[18] Garry A. Gabison & Miriam C. Buiten, *Platform Liability in Copyright Enforcement*, 21 COLUM. SCI. & TECH. L. REV. 237, 240 (2020) ("From an efficiency perspective, legal liability should generally rest on the party best able to prevent, limit or eliminate harm (the 'least cost avoider').").

[19] *See* Oren Bracha & Patrick R. Goold, *Copyright Accidents*, 96 B.U. L. REV. 1025, 1048 (2016) (discussing how various allocations of liability incentivize harm avoidance).

[20] Jeffrey K. Gurney, *Crashing into the Unknown: An Examination of Crash-Optimization Algorithms Through the Two Lanes of Ethics and Law*, 79 ALB. L. REV. 183, 191–92 (2016) ("The autonomous vehicle also does not drink alcohol; it does not get drowsy; and it does not make phone calls, text, eat, or engage in any other activity that distracts the human driver.").

[21] Neal E. Boudette, *5 Things That Give Self-Driving Cars Headaches*, N.Y. TIMES, June 4, 2016, *at* https://www.nytimes.com/interactive/2016/06/06/automobiles/autonomous-cars-problems.html ("[T]here is something self-driving cars do not yet deal with very well – the unexpected. The human brain is still better than any computer at making decisions in the face of sudden, unforeseen events on the road – a child running into the street, a swerving cyclist or a fallen tree limb.").

practice, however, it doesn't quite work that way. Partial autonomy can induce the human driver to over-rely on system features, hindering reaction time and making effective oversight difficult.[22] How should legal processes, which are adversarial by their nature, distribute liability for the failure of a collaborative system?

This Article analyzes the legal challenges arising from the rapid growth of semi-autonomous vehicles and attempts to frame an answer to that question. Part I describes the current state of vehicle automation, explores the industry's attempt to categorize partial autonomy, and identifies the legal issues arising from the growth of semi-autonomous vehicles.

Part II explains how modern systems can appear deceptively autonomous. It explores the "ironies of automation,"[23] whereby the addition of autonomous features can induce a human response that paradoxically decreases system safety. In addition, it explores the effect of "autonowashing"[24]—that is, vehicle manufacturers' attempts to inflate the capabilities of autonomous systems, inducing customers to let down their guard when supervising those systems.

Part III examines how current legal doctrine is likely to allocate liability when semi-autonomous systems cause injury. It explores the likelihood that vehicle manufacturers will face liability and considers how that liability is likely to be shared with the human driver. Although it concludes that liability will often be shared between human driver and manufacturer, it also identifies some liability gaps where the injured party is likely to be made to bear the cost of that injury.

Part IV offers three suggestions for how the legal system can incentivize product safety without stifling innovation. First, it recommends that courts should consider collaborative driving as a system when allocating liability. Second, it argues that the legal system should recognize the effect of regular software updates and the ongoing relationship between the manufacturer and driver. Finally, the Article recommends that customers pursue fraud and warranty claims when manufacturers overstate their autonomous capabilities. Economic-damage claims may appear insignificant next to lawsuits for life-

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[22] *See infra* Part II.A.

[23] Lisanne Bainbridge, *Ironies of Automation*, 19 AUTOMATICA 775, 777 (1983).

[24] Liza Dixon, *Autonowashing: The Greenwashing of Vehicle Automation*, 5 TRANSP. RSCH. INTERDISC. PERSPS. 7 (2020) *available at* https://www.sciencedirect.com/science/article/pii/S2590198220300245

changing personal injury, but they can encourage manufacturers to consider the cost of potential harm at an earlier stage in production.

I. THE DRIVE TOWARD AUTOMATION

The original promise of vehicle automation was one of safety. Every year, more than 30,000 people in the United States (and over a million around the world) die in automobile crashes.[25] Most of those crashes are caused in part by human error—cellphone distraction, speeding, and drinking and driving all contribute heavily to the annual death toll.[26] Pursing vehicle autonomy was viewed as a way to eliminate this risk of human error and to make driving safer.[27]

As autonomous capabilities have grown, two things have become clear. First, the safety benefits of full autonomy—although significant—are likely to be somewhat lower than initially hypothesized.[28] Second, the track toward full autonomy is much longer than initially realized—while

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[25] ROAD TRAFFIC INJURIES AND DEATHS—A GLOBAL PROBLEM, CENTERS FOR DISEASE CONTROL AND PREVENTION, Jan. 10, 2023, *at* https://www.cdc.gov/injury/features/global-road-safety/

[26] NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., DOT HS 812 115, CRITICAL REASONS FOR CRASHES INVESTIGATED IN THE NATIONAL MOTOR VEHICLE CRASH CAUSATION SURVEY (2015).

[27] Michael Chatzipanagiotis & George Leloudas, *Automated Vehicles and Third-Party Liability: A European Perspective*, 2020 U. Ill. J.L. Tech. & Pol'y, 109, 111–12 (2020) (stating that autonomous vehicles are expected to dramatically decrease accidents and make roads safer, given that 94% of grave accidents are due to human error, while at the same time reduce significantly traffic congestion, driving costs and CO2 emissions"). Of course, this pursuit largely ignored other major factors in roadway safety, including legal speed limits, vehicle size and weight, and providing adequate space for vulnerable road users, including bicyclists, pedestrians, and wheelchair users. *See* Gregory H. Shill, *Should Law Subsidize Driving?*, 95 N.Y.U. L. REV. 498, 563 (2020) (criticizing the U.S. regulatory emphasis on crashworthiness); Sara C. Bronin & Gregory H. Shill, *Rewriting Our Nation's Deadly Traffic Manual*, 135 HARV. L. REV. F. 1, 19 (2021) (criticizing the Manual on Uniform Traffic Control Devices for Streets and Highways and concluding that "[t]he biases enshrined in the Manual undermine safety, equity, and economic development").

[28] Phil Koopman, *A Reality Check on the 94 Percent Human Error Statistic for Automated Cars*, SAFE AUTONOMY, June 5, 2018, *at* http://safeautonomy.blogspot.com/2018/06/a-reality-check-on-94-percent-human.html (analyzing the safety improvements likely to be available in practice).

getting the vehicles to 90% capability went relatively quickly, the final 10% is proving much more difficult.[29]

In response to these difficulties, carmakers and technology companies have pivoted to prioritize the development of Advanced Driver Assistance (ADAS) systems that provide for human oversight of semi-autonomous features.[30] Ford, for example, recently shut down Argo AI, the autonomous-vehicle development company it had previously backed.[31] Ford announced that it would instead "shift toward the development of [semi-autonomous] driver assist systems."[32] Chipmaker Nvidia has similarly "pivot[ed] to support ADAS technologies."[33] Likewise, Mobileye has also shifted its primary development focus away from pursuing full autonomy and toward developing ADAS systems, "reflect[ing] what may be a broader shift toward a less futuristic vision of vehicle automation with benefits closer at hand."[34] After Mobileye

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[29] *See* Matt McFarland, *Self-Driving Cars Were Supposed To Take Over The Road. What Happened?*, CNN, Nov. 1, 2022, *at* https://www.cnn.com/2022/11/01/business/self-driving-industry-ctrp/index.html ("[T]here's a funny saying from the software world, known as the 90-90 Rule. Once 90% of the work is done, you only have 90% to go. The ability of self-driving car software to steer the vehicle within a highway lane is great, but being able to do so, even for thousands of miles at a stretch, isn't enough.").

[30] *See* Lawrence Ulrich, *As Driverless Cars Falter, Are 'Driver Assistance' Systems in Closer Reach?*, N.Y. TIMES, Sept. 16, 2022, *at* https://www.nytimes.com/2022/09/16/business/driverless-cars-assistance-systems.html (suggesting that "a pared-down approach . . . variously called 'partial autonomy' or 'driver assistance' systems" could be "the more realistic future of hands-free driving").

[31] Alexandra Purcell, *Ford Will Pivot From Argo AI To L2 And L3 Adas Development*, FORD AUTHORITY, Oct. 27, 2022, *at* https://fordauthority.com/2022/10/ford-will-pivot-from-argo-ai-to-l2-and-l3-adas-development/

[32] *Id.*

[33] *Nvidia's Danny Shapiro On Pivoting To ADAS Technology*, SHIFT: A PODCAST ABOUT MOBILITY, Episode 44, May 25, 2020, *available at* https://www.stitcher.com/show/futurismo-an-automotive-news-podcast/episode/nvidias-danny-shapiro-on-pivoting-to-adas-technology-episode-44-69896690.

[34] Stephen Lawson, *Mobileye CEO: Automation Can Save Lives Without Self-Driving Cars*, TU AUTOMOTIVE, Jan 9, 2019. *at* https://www.tu-auto.com/mobileye-ceo-automation-can-save-lives-without-self-driving-cars/.

announced that it was delaying development of fully autonomous vehicles until at least 2050 in order to focus on ADAS systems, its stock value more than doubled.[35]

The stock market's reaction to Mobileye's pivot makes sense in light of economic realities. The market for ADAS systems is rapidly growing bigger; it was a $27 billion market in 2020,[36] and a $31 billion market in 2022.[37] This growth is expected to accelerate worldwide, with the ADAS market anticipated to reach $65.1 billion by 2030.[38] Given the growth of this industry, it is nearly certain that lawsuits involving semi-autonomous technology will increase as the technology becomes more widely available.

A. Categorizing Autonomy

Both scholars and industry professionals have struggles with how to categorize semi-autonomous ADAS systems. The most well-known categorization of autonomous vehicles is the Society of Automotive Engineers' "SAE J3016 Recommended Practice: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles," first developed in 2014 and often referred to as "levels of automation."[39] The SAE updated the level descriptions in 2021, though the basic level definitions remained the same.[40] Under the SAE taxonomy, vehicles can be categorized from Level 0 (no automation) to Level 5 (a fully autonomous car that "can drive anywhere in all conditions").[41]

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[35] Sophie Shulman, *Mobileye Riding High After Shelving Fully Autonomous Vehicle Dream*, CTECH, Feb. 2, 2023 *at* https://www.calcalistech.com/ctechnews/article/8a9d1csy2

[36] Christopher Elliott, *Are Vehicle Safety Features Actually Reducing Car Accidents?*, FORBES, Sep. 2. 2020 at https://www.forbes.com/advisor/car-insurance/vehicle-safety-features-accidents/

[37] *ADAS Market Worth $65.1 Billion By 2030*, YAHOO NEWS, Feb. 20, 2023, *at* https://news.yahoo.com/adas-market-worth-65-1-093000549.html.

[38] *Id.*

[39] *SAE Levels of Driving Automation™ Refined for Clarity and International Audience*, Soc'y of Auto. Eng'rs, May 3, 2021, *at* https://www.sae.org/blog/sae-j3016-update [hereinafter SAE Levels].

[40] *Id.*

[41] *Id.*

Under the revised taxonomy, the SAE has further clarified that in Levels 0 to 2, the human in the driver's seat must provide constant supervision of the system, stating: "You *are* driving whenever these driver support features are engaged—even if your feet are off the pedals and you are not steering."[42] Further breaking down the levels, Level 0 includes only passive driver support—for example, blind spot warnings or automatic emergency braking.[43] Level 1 offers active driver support, including either lane centering or adaptive cruise control.[44] Level 2 offers lane centering and adaptive cruise control at the same time. With these products, a human "must constantly supervise these support features" and must "steer, brake, or accelerate as needed to maintain safety.[45]" Because of the need for human oversight, Tesla claims that both of its autonomy products (Autopilot and Full Self-Drive) qualify as Level 2 products.[46]

The SAE distinguishes Levels 3-5 by stating that at these levels, "you *are not* driving when these automated features are engaged—even if you are seated in 'the driver's seat.'"[47] Level 5 autonomous vehicles that can drive everywhere in all conditions do not yet exist.[48] Levels 3 and 4, offering limited autonomy, do exist in small numbers. The difference between these two levels is that Level 3 will be self-driving only in certain circumstances, so "[w]hen the feature requests, you must drive."[49]

At the current time, Level 4 vehicles are in public use only as robotaxis, not as privately-owned vehicles. Within the United States, both Cruise and Waymo offer paid transit in these vehicles in limited geographic areas (as of this writing, in San Francisco, Austin, and the

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[42] *Id.*

[43] *Id.*

[44] *Id.*

[45] *Id.*

[46] Roberto Baldwin, *Tesla Tells California DMV that FSD Is Not Capable of Autonomous Driving*, CAR & DRIVER, March 9, 2021, at https://www.caranddriver.com/news/a35785277/tesla-fsd-california-self-driving/

[47] SAE Levels, *supra* note 39.

[48] *See* Rachel Theodorou, Note, *"With Cars Like These, Who Needs Policies?" The Inevitable Battle Between Autonomous Vehicles, the Insurance Industry, Manufacturers and Consumers*, 35 SYRACUSE J. SCI. & TECH. L. 72, 79 (2019) ("[E]xperts believe introduction of Level 5 vehicles licensed for use on all public roads will not occur until at least the late 2030s.").

[49] SAE Levels, *supra* note 39.

Phoenix metropolitan areas only); Motional is also expected to offer driver-out service in Las Vegas later in 2023.[50] Other companies have introduced robotaxis in other cities around the world.[51] In these cities with driver-out robotaxi service, it has become common to see vehicles traveling through the streets with an empty front seat.

In early 2023, Mercedes widely publicized that it would sell the first Level 3 system ("Drive Pilot") for sale to the American public.[52] When Level 3 is engaged, the vehicle itself will control speed and distance and keep the vehicle in its lane.[53] However, the conditions in which the Level 3 system will work are quite limited at the current time: the system is authorized only in Nevada (though the company hopes to have approval to operate in California soon), only on freeways, and only up to 40 miles per hour.[54] In addition, the autonomous features cannot be engaged in unfavorable weather or light conditions; a development manager acknowledges that "[i]f it's too dark, too wet, too cold, or there's too much snow, the system will not operate."[55] Thus, the operating

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[50] Kara Carlson, *You Now Can Ride In A Driverless Car In Austin, As GM-Owned Cruise Expands Rideshare Services*, AUSTIN AM.-STATESMAN, Dec. 21, 2022 *at* https://www.statesman.com/story/business/technology/2022/12/21/ cruise-car-company-launches-austin-driverless-rideshare-service/69743913007/ ; Rebecca Bellan, *Motional Opens Las Vegas Robotaxi Service To Nighttime Hours*, TECHCRUNCH, Feb. 23, 2023, *at* https://techcrunch.com/2023/02/23/motional-las-vegas-robotaxi-uber-lyft-night-rides/

[51] Sebastien Bell, *Hyundai Launches Robotaxi Service In Seoul With Level-4 Ioniq 5*, CARSCOOPS, June 9, 2022, *at* https://www.carscoops.com/2022/06/hyundai-launches-robotaxi-service-in-seoul-with-level-4-ioniq-5/; Dashveenjit Kaur, *China's First Level 4 Robotaxis Production Line By Alibaba-Backed Autox Is Ready*, TECHWIRE ASIA, Dec. 22, 2021, *at* https://techwireasia.com/2021/12/chinas-first-level-4-robotaxis-production-line-by-autox-is-ready/ ("Currently, AutoX operates China's largest service area for fully driverless RoboTaxis across 65 square miles of Shenzhen.").

[52] *Mercedes-Benz World's First Automotive Company To Certify SAE Level 3 System For U.S. Market*, MERCEDES-BENZ MEDIA NEWSROOM USA, Jan. 26, 2023, *at* https://media.mbusa.com/releases/release-1972539e60b30e8816b4 ea4b6302f67e-mercedes-benz-worlds-first-automotive-company-to-certify-sae-level-3-system-for-us-market

[53] *Id.*

[54] *Id.*

[55] Angus MacKenzie, *Mercedes-Benz Drive Pilot First Drive: It Actually Drives Itself* (*In specific conditions and under certain parameters. But we're one big*

domain is really quite limited, essentially requiring a daytime good-weather stop-and-go traffic situation on a Nevada highway. Nonetheless, these technological capabilities are expected to expand quickly, and sale of a Level 3 vehicle is still a major milestone.

B. *Re-Categorizing Partial Autonomy*

When the SAE first published its taxonomy in 2014, vehicle autonomy was still largely speculative. Many observers expected that autonomy would progress from one level to another in sequence and that full Level 5 autonomy was not far off.[56] As time has passed, it has become increasingly clear that neither the sequence nor the timeline would pan out as imagined.[57] Indeed, Level 4 robotaxis offered driver-out transportation in two U.S. cities before any automaker offered even a limited Level 3 vehicle to the American public.[58]

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step closer to the truly autonomous car), MOTORTREND, Jan. 21, 2022, *at* https://www.motortrend.com/reviews/mercedes-benz-drive-pilot-autonomous-first-drive-review/

[56] Jason Torchinsky, *Lots Of People Seem To Completely Misunderstand The Autonomy Levels, So Let's Clear This Up*, JALOPNIK, Aug. 23, 2021 *at* https://jalopnik.com/lots-of-people-seem-to-completely-misunderstand-the-aut-1847541014 (pushing back against the idea "that the SAE levels are a sort of scale of capability, with Level 2 being less capable than Level 3, and Level 4 being able to drive better than the ones behind it, and Level 5 being able to drive the best of all" and explaining that instead "the levels describe the parameters of how the system interacts with the humans in the car, and the environment around the car"); David C. Vladeck, *Machines Without Principals: Liability Rules and Artificial Intelligence*, 89 WASH. L. REV. 117, 150 (2014) ("The introduction of highly sophisticated autonomous machines may be literally around the corner. Truly autonomous machines may be driving cars through our neighborhoods or piloting drones that fly above our heads sooner than we think.").

[57] Tom Maxwell, *Lyft Gives Up On Autonomous Vehicles, Sells Division To Toyota*, INPUT, April 26, 2021, *at* https://www.inverse.com/input/tech/lyft-gives-up-on-autonomous-vehicles-sells-division-to-toyota (explaining that vehicle autonomy had entered the "trough of despair" in the development cycle, as "[e]arly excitement in the space gave way to realism and far more conservative predictions of when autonomous cars will actually be ready for primetime, as companies came to understand the tolerance for error must be extremely low, and the legal quagmire around culpability remains difficult to navigate.").

[58] *See supra* Part I.A. (noting that Cruise and Waymo both offered driver-out transportation before Mercedes offered the first Level 3 vehicle for sale); *see*

As autonomy has progressed, Advanced Driver Assistance Systems (ADAS) have grown both more common and more complex.[59] Some industry participants began using the term "Level 2+" to describe more advanced autonomous features that still rely on human oversight.[60] Experts note that features like "lane centering assistance," (LCA) although perhaps confusingly similar to name to "lane keeping assistance," (LKA) actually go much further—LCA "uses a front-mounted camera and automatic steering to make constant adjustments based on road markings.[61] The more advanced ADAS systems, such as GM's Super Cruise and Ford's BlueCruise, can "accelerate, brake and steer to provide supervised automation continuously."[62]

Both scholars and industry professionals have grown increasingly concerned that the SAE levels of automation are confusing to consumers and that Level 2, especially, is far too broad a category given the varying levels of technology that fit within it. On the industry side, the company Mobileye, which specializes in producing ADAS systems, has proposed a new customer-focused taxonomy.[63] Mobileye uses four designations

also Jake Goldenfein, Deirdre K. Mulligan, Helen Nissenbaum & Wendy Ju *Through the Handoff Lens: Competing Visions of Autonomous Futures*, 35 BERKELEY TECH. L.J. 835, 842 (2020) (explaining that although "[t]hese models or archetypes—driver-assist, fully-driverless, and connected-cars—may appear to follow a historical trajectory" the reality is that "the players are more tangled and integrated, the role and the location of human drivers or operators are not yet determined, and the path forward is still unclear").

[59] Harry Surden & Mary-Anne Williams, *Technological Opacity, Predictability, and Self-Driving Cars*, 38 CARDOZO L. REV. 121, 134 (2016) ("ADAS refers to a series of emerging technologies that automatically take control of particular driving functions. ADAS systems have been available since about 2012 as optional features and are becoming common in ordinary consumer vehicles.").

[60] Lindsay Brooke, *'Level 2+': Making Automated Driving Profitable, Mainstream*, SAE INT'L, Dec. 24, 2021, *at* https://www.sae.org/news/2020/12/rise-of-sae-level-2 ("The terms 'enhanced L2' and 'Level 2-point-something' coined by engineers gave way to a more market-friendly 'Level 2+.'")

[61] Junko Yoshida, *Mind the Gap: ADAS Pitfalls in 2023*, OJO YOSHIDA REP., Jan 2, 2023 *at* https://ojoyoshidareport.com/mind-the-gap-adas-pitfalls-in-2023/.

[62] *Id.*

[63] Amnon Shashua &. Shai Shalev-Shwartz, *Defining a New Taxonomy for Consumer Autonomous Vehicles*, Feb. 6, 2023, *at* https://www.mobileye.com/opinion/defining-a-new-taxonomy-for-consumer-autonomous-vehicles/

that categorize autonomous products not just by *whether* customers must provide oversight during their use, but *how* they provide that oversight:

(1) Eyes-on/Hands-on;
(2) Eyes-on/Hands-off;
(3) Eyes-off/Hands-off;
(4) No Driver[64]

In the first "eyes-on/hands-on" category, the autonomy features are acting as a backstop for the driver, "intervening (rarely) to avoid an accident (like applying the brakes to avoid collision)."[65] In the second "eye-on/hands-off" category (intended to replace the "Level 2+ designation) the human is acting as a backstop for the autonomous system, staying alert and intervening when necessary.[66] In the third category, "eyes-off/hands-off," category, "the system controls the driving function within a specified ODD (say, highways with on/off ramp transitions) without the human driver needing to supervise the driving."[67] Unlike the "eyes on" categories, the driver does not need to be prepared to take control on a moment to moment basis and could safely read or text when the vehicle's autonomy features are activated. When the vehicle leaves the operational design domain—for example, by leaving the highway—the driver must be prepared to take control.[68] Finally, of course, a driver-out vehicle will not have a human driver present at all and the passenger will have no responsibility to supervise the system. Support, if needed, will likely be provided by a teleoperator on call.[69]

While Mobileye's proposed taxonomy focuses on consumer understanding, scholars Willian Widen and Philip Koopman have proposed a revised categorization that focuses on what parts of the driving the autonomy features are actually performing, rather than on what supervisory role the driver is expected to perform.[70] Widen and Koopman point out that the categorization based on supervision is really

[64] *Id.*

[65] *Id.*

[66] *Id.*

[67] *Id.*

[68] *Id.*

[69] *Id.*

[70] William H. Widen & Philip Koopman, *Autonomous Vehicle Regulation & Trust: The Impact of Failures to Comply with Standards*, 27 UCLA J.L. & Tech. 169, 251-52 (2022).

more a legal issue than a technical one.[71] They suggest that the terminology may be an attempt to avoid both government regulation and potential legal liability for crashes:

> We infer that motivation to introduce the term "Level 2 plus" into the AV discourse comes from an industry desire to identify advanced automation technology for discussion purposes without leading to regulatory oversight that would follow from a feature being classified above Level 2 in the SAE taxonomy. The ability to potentially sell advanced automation technology while still holding the driver responsible for any crashes likely plays a part as well.[72]

Widen & Koopman recommend instead that any vehicle "in which a computer exerts steering control that is intended to execute turns at intersections" should be designated as a "highly automated vehicle" and subject to stronger regulatory oversight.[73]

Partial Autonomy's Legal Challenge

Much of the scholarship on liability challenges for autonomous cars focuses on fully autonomous vehicles.[74] This future-thinking approach is an important one; these are legal questions that should precede the deployment of autonomous vehicles.[75] In the last few years, however, it has become clear that partial autonomy isn't just a brief waypoint on the road to full autonomy.[76] Instead, partial autonomy is an

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[71] *Id.* at 232.

[72] Widen & Koopman, *supra* note 70, at 232–33.

[73] *Id.* at 252.

[74] *See* Kenneth S. Abraham & Robert L. Rabin, *Automated Vehicles and Manufacturer Responsibility for Accidents: A New Legal Regime for A New Era*, 105 VA. L. REV. 127, 132 (2019) (proposing a new system of liability allocation and "setting aside the current liability and insurance regime . . . when twenty-five percent of all registered vehicles are HAVs operating at SAE Level 4 or 5.").

[75] *Id.*; *see also* Carrie Schroll, Note, *Splitting the Bill: Creating A National Car Insurance Fund to Pay for Accidents in Autonomous Vehicles*, 109 NW. U. L. REV. 803, 833 (2015) (arguing that early legislative action "to decide how best to distribute liability and costs for accidents involving Avs" would help "manufacturers to feel secure in releasing these cars and for drivers to feel secure in using them").

[76] Brooke, *supra* note 60 (quoting an industry representative saying that "[w]e believe the market is going to be focused on particularly Level 2-Plus for a long time").

"intermediate technology" that is likely to be around for years or even decades and should be addressed by the legal system on its own terms.[77]

Just as the marketplace is coming to recognize partial autonomy as a legitimate and long-term part of the transportation marketplace, so too should the legal issues arising from partial autonomy get increasing attention. Legal scholars have identified a "regulatory gap" when it comes to supervised autonomy—that is, regulatory officials have focused on Level 3 and higher vehicles, leaving Level 2 vehicles largely ignored.[78] The federal government has taken some small steps toward regulating Level 2 systems, starting with data collection—in particular, NHTSA issued a Standing General Order in 2021 that "requires manufacturers and operators of automated driving systems and SAE Level 2 advanced driver assistance systems equipped vehicles to report crashes to the agency."[79]

The legal issues arising from partial autonomy are not merely a subset of those arising from full autonomy.[80] First, the safety proposition for partial autonomy remains uncertain.[81] There is no evidence yet that ADAS systems improve safety; it's possible that they do, but more

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[77] Rachel E. Sachs, *Regulating Intermediate Technologies*, 37 YALE J. REG. 219, 221 (2020) (identifying "technologies which are intermediate in nature, but which ought to be improved with time").

[78] Tracy Hresko Pearl, *Hands on the Wheel: A Call for Greater Regulation of Semi-Autonomous Cars*, 93 IND. L.J. 713, 730–31 (2018) [hereinafter Pearl, *Hands On*].

[79] NHTSA, *Automated Vehicles for Safety*, https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety

[80] *See, e.g.*, Pearl, *Hands On*, *supra* note 78, at 716 ("U.S. lawmakers have done virtually nothing to regulate or even investigate semi-autonomous cars. Instead, they have focused their efforts on the fully driverless cars that are not yet available to consumers, rather than the partially driverless cars that are already on U.S. roads.").

[81] *See* EDWARD NIEDERMEYER, LUDICROUS: THE UNVARNISHED STORY OF TESLA MOTORS, 133 (2019) ("Though ADAS and autonomous-drive technologies are almost always presented as safety-enhancing features, what people actually want out of them are both the ability to pay less attention when behind the wheel and the high-tech cool factor of a car appearing to drive itself.").

research is needed.[82] At the same time, partially autonomous systems may introduce new modes of failure and therefore additional risk.[83]

Most importantly, we are starting to understand that the collaboration of human and machine in the driving task creates something new. A Department of Defense paper has warned against having a narrow "focus on machines, rather than on the human-machine system."[84] Instead, it points out, "all autonomous systems are joint human-machine cognitive systems," leading to unique problems.[85] Current liability doctrine focuses alternately on product safety and human negligence.[86] Applying these principles to a truly collaborative system is likely to prove challenging. But given that semi-autonomous systems are becoming increasingly common, that is a challenge that the judicial system will need to meet.

II. DECEPTIVE AUTOMATION

It's not surprising that confusion surrounds semi-autonomous features. On the one hand, vehicle manufacturers warn that Advanced Driver Assistance (ADAS) systems are require constant driver attention and are "not autonomous."[87] On the other hand, the sheer number of times that sleeping drivers have eluded police stops for minutes on end without crashing suggests that, in practice, the vehicles can in fact operate autonomously for some time under the right conditions.[88] Recent research

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[82] *See* ADVANCED DRIVER ASSISTANCE, INSURANCE INSTITUTE FOR HIGHWAY SAFETY, July 2022, at https://www.iihs.org/topics/advanced-driver-assistance ("While partial driving automation may be convenient, we don't know if it improves safety.").

[83] *Id.*

[84] DEF. SCI. BD., U.S. DEP'T OF DEF. TASK FORCE REPORT: THE ROLE OF AUTONOMY IN DOD SYSTEMS 4 (July 2012), http://www.fas.org/irp/agency/dod/dsb/autonomy.pdf

[85] *Id.* at 24.

[86] *See infra* Part III.

[87] *See, e.g.*, Tesla, *Full Self-Driving Computer Installations Frequently Asked Questions* ("Will the FSD computer make my vehicle fully autonomous? Not yet. All Tesla vehicles require active supervision and are not autonomous.") *at* https://www.tesla.com/en_eu/support/full-self-driving-computer

[88] *See supra* text accompanying note 5; *see also* Widen & Koopman, *supra* note 70, at 185 ("FSD-beta-equipped vehicles are capable of driving without active physical control or monitoring. Though Tesla's instructions stipulate that

suggests that, from the perspective of the human driver, "subjective autonomy is more important than objective autonomy, and autonomy and moral responsibility are more matters of perception."[89] That is, regardless of how carmakers describe semi-autonomous systems and regardless of what disclaimers they may put in the owner's manual, what matters may be the consumer's subjective experience in driving the vehicle. This section explores two issues of "subjective autonomy" that add to consumer confusion about the safety and reliability of semi-autonomous systems: the ironies of automation and the efforts at autonowashing by industry participants.

A. *Ironies of Automation*

The promise of vehicle autonomation is a promise of safety. Most crashes, after all, are caused at least in significant part by human error.[90] If we can automate systems with better perception, a much faster reaction time, and no fatigue, substance abuse, or excessive speed, why wouldn't that improve vehicle safety? And indeed, research from the Insurance Institute for Highway Safety has concluded that certain forms of automation, including forward collision detection and automatic braking, have unquestionably made modern vehicles safer.[91]

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the human driver must constantly monitor driving, the instruction does not make FSD beta vehicles any less capable of driving without human control or monitoring.").

[89] Peng Liu & Yong Du, *Blame Attribution Asymmetry in Human–Automation Cooperation*, 42 RISK ANALYSIS 1769, 1779 (2022).

[90] NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., DOT HS 812 115, CRITICAL REASONS FOR CRASHES INVESTIGATED IN THE NATIONAL MOTOR VEHICLE CRASH CAUSATION SURVEY (2015); *but see* Phil Koopman, *A Reality Check on the 94 Percent Human Error Statistic for Automated Cars*, SAFE AUTONOMY, June 5, 2018, *at* http://safeautonomy.blogspot.com/2018/06/a-reality-check-on-94-percent-human.html (analyzing the study data and concluding that "the 94% human attribution for mishaps isn't all impaired or misbehaving drivers. Rather, many of the reasons assigned to drivers sound more like imperfect drivers").

[91] Jessica B. Cicchino, *Effectiveness Of Forward Collision Warning And Autonomous Emergency Braking Systems In Reducing Front-To-Rear Crash Rates*, 99 ACCIDENT ANALYSIS & PREVENTION 142, 150 (2017) (concluding that "1 million of the nearly 2 million U.S. police-reported rear-end crashes in 2014 and more than 400,000 injuries in those crashes could have been pre-vented if all vehicles were equipped with systems that perform similarly to the FCW with AEB systems studied").

With more advanced forms of partial automation, however, the ultimate safety impact is much less clear.[92] In 2011 through 2013, the engineers at Google were working on developing an advanced highway driver-assist product.[93] By 2013, the product was developed enough that the company allowed ordinary Google employees to drive vehicles equipped with the product to and from the office—a test program the company referred to as "dogfooding."[94] Interior cameras were installed in the vehicles so that Google engineers could monitor how drivers reacted to the product. Problems very quickly emerged, however:

> Soon after the self-driving-car team began reviewing the video of the human operators, they noticed some troubling behavior: The drivers were tuning out—and far beyond what was safe. One guy pulled out his laptop and did some work. A woman applied her makeup. But what convinced the team to halt testing was the guy who fell asleep, for an astonishing twenty-seven minutes, as he cruised along at 60 mph on the freeway.[95]

Industry professionals concluded that "[i]n one sense, the technology worked *too* well."[96] Operators were so trusting of the technology that they relaxed a little too much at the wheel. Even though no vehicles crashed during testing, the risk of a crash appeared unreasonably high.[97] Google executives "realized that partial automation created a thorny human-machine interaction problem that was in a way almost harder to fully manage than Level 4 autonomous drive technology

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[92] *See, e.g.*, Meg Leta Jones, *The Ironies of Automation Law: Tying Policy Knots with Fair Automation Practices Principles*, 18 VAND. J. ENT. & TECH. L. 77, 112 (2015) ("Automation may increase operator workload, complacency, and situational awareness resulting in a decline of safety and performance.").

[93] LAWRENCE D. BURNS & CHRISTOPHER SHULGAN, AUTONOMY: THE QUEST TO BUILD THE DRIVERLESS CAR—AND HOW IT WILL RESHAPE OUR WORLD 238 (2018).

[94] The term "dogfooding" allegedly refers to Alpo TV commercials in which the actor fed the advertised dog food to his own golden retrievers. *Id.* at 238

[95] BURNS & SHULGAN, *supra* note 93, at 238.

[96] ID.

[97] ID.

itself."[98] Google ended its development of "driver in the loop" ADAS products and instead focused on its "driver out of the loop" Level 4 product that grew into Waymo.

Even though Google abandoned its ADAS product, other manufacturers went forward with theirs. Tesla was one of the first to market with its Autopilot and FSD products, followed by GM's Super Cruise and Ford Motor Company's BlueCruise.[99] As these products grow in popularity, questions about their safety take on greater urgency.

Scholar Lisanne Bainbridge first used the phrase "ironies of automation" to describe the effects of automation on human oversight.[100] In a highly influential article written about industrial processes long before modern vehicle automation, she explained that the goal of industrial automation was to eliminate the "unreliable and inefficient" human operator from the system.[101] But there were two major ironies that her research brought forward: first, the design of the automated system may itself introduce errors. And second, and perhaps more importantly, even with automation the operator is still left "to do the tasks which the designer cannot think how to automate."[102] But "[b]y taking away the easy parts of [the operator's] task, automation can make the difficult parts of the human operator's task more difficult."[103] Bainbridge argued that industrial automation needed to more fully develop "methods of human-computer collaboration" in order to counteract this tendency.[104]

Bainbridge's insights about industrial automation gained renewed attention more than thirty years after she initially published, as interest in vehicle automation took off. Other scholars have pursued questions about how human drivers interact with partially automated vehicles, and the research results have been mixed. One study found that

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[98] Edward Niedermeyer, *Dr AutoPilot and Mr Autopilot: Why We Should Want Waymo's Go-Slow Approach To Win*, THE DRIVE, Sept. 16. 2019, *at* https://www.thedrive.com/tech/29877/dr-autopilot-and-mr-autopilot-why-we-should-want-waymos-go-slow-approach-to-win

[99] Emmet White, *GM's Super Cruise Updates, Ford BlueCruise Follows*, AUTOWEEK, Sept. 14. 2022, *at* https://www.autoweek.com/news/industry-news/a40796393/gms-super-cruise-updates-ford-bluecruise-follows/

[100] Lisanne Bainbridge, *Ironies of Automation*, 19 Automatica 775, 777 (1983).

[101] *Id.* at 775.

[102] *Id.*

[103] *Id.* at 777.

[104] *Id.*

drivers had lower situational awareness when the car's active cruise control was engaged.[105] Another study used simulated vehicles with different levels of automation and found that "driving performance degrades when the level of automation increases," as drivers of the more highly automated vehicles were less likely to stop in time to avoid a collision with a braking vehicle.[106]

It's not entirely clear why human attention falters with increasing automation. Researchers have suggested that "behavioral adaptation" may play a role.[107] Behavioral adaptation is an unconscious process whereby people ordinarily adjust their behavior in accordance with feedback from their environment "by comparing the actual outcome of a response with the expected outcome to that response."[108] Ordinarily this process allows for incremental changes and adjustments. But "when an automated system compensates for faulty behavior," drivers don't get that negative feedback, and so "may be more likely to either continue producing the faulty behavior or adjust behavior to become even more risky."[109]

Over the last several years, the National Highway Traffic Safety Administration has been studying the real-world crashes involving Level 2 automation. The agency released a report examining 392 crashes involving ADAS-equipped vehicles between 2021 and 2022. Of the crashes, eleven caused death or serious injury.[110] Nearly 70% of the incidents involved Tesla automobiles.[111]

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[105] Neville A. Stanton & Mark S. Young, *Driver Behaviour With Adaptive Cruise Control*, 48 ERGONOMICS 1294 (2007).

[106] Niklas Strand, Josef Nilsson, MariAnne Karlsson & Lena Nilsson, *Semi-Automated Versus Highly Automated Driving In Critical Situations Caused By Automation Failures*, 27 TRANSP. RES. PART F: TRAFFIC PSYCH. & BEHAVIOUR 218 (2014) *at* https://www.sciencedirect.com/science/article/pii/S1369847814000436

[107] U.S. DEPT. OF TRANS., FED. HWY. ADMIN, DRIVER ADAPTATION TO VEHICLE AUTOMATION: THE EFFECT OF DRIVER ASSISTANCE SYSTEMS ON DRIVING PERFORMANCE AND SYSTEM MONITORING 1 (June 2022) *at* https://www.fhwa.dot.gov /publications/research/safety/22072/22072.pdf

[108] *Id.* at 1-2.

[109] *Id.* at 2.

[110] NHTSA, SUMMARY REPORT: STANDING GENERAL ORDER ON CRASH REPORTING FOR LEVEL 2 ADVANCED DRIVER ASSISTANCE SYSTEMS (June 2022) *at* https://www.nhtsa.gov/sites/nhtsa.gov/files/2022-06/ADAS-L2-SGO-Report-June-2022.pdf

[111] ID. at 6.

The number of crashes involving ADAS systems is not insignificant. However, the most important question is how these numbers compare to conventional vehicles. On this metric, vehicles equipped with ADAS features have appeared to score well in the past, showing "a 27% reduction in bodily injury claim frequency and a 19% reduction in property damage frequency."[112] However, those reductions don't account for the driving domain (highway miles vs. city miles), the value of the car, or driver differences. Noah Goodall, a researcher with the Virginia Transportation Research Council, developed a methodology for normalizing safety statistics that can allow for a more apples-to-apples comparison of conventional and partially automated vehicles.[113] After adjusting the data, Goodall concluded that "much of the crash reduction seen by vehicles using Autopilot appears to be explained by lower crash rates experienced on freeways." In addition, he noted that driver age, vehicle age and weather could also bias the data toward lower crash rates.[114]

Thus, although the developers of autonomous features hope to make driving safer, it is not entirely clear that these partially-autonomous features are fulfilling that goal.[115] In practice, there may be a risk that the technology's weaknesses magnify, rather than offset, human failings.[116] As one industry professional explained:

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[112] Christopher Elliott, *Are Vehicle Safety Features Actually Reducing Car Accidents?*, FORBES, Sep. 2. 2020 at https://www.forbes.com/advisor/car-insurance/vehicle-safety-features-accidents/

[113] Noah Goodall, *A Methodology for Normalizing Safety Statistics of Partially Automated Vehicles*, Oct. 21, 2021 (preprint) *at* https://engrxiv.org/preprint/view/1973/3986 [now published: Noah Goodall, Normalizing crash risk of partially automated vehicles under sparse data, J. Transp. Safety & Sec., https://www.tandfonline.com/doi/full/10.1080/19439962.2023.2178566

[114] *Id.* at 12.

[115] Starla M. Weaver, Stephanie M. Roldan, Tracy B. Gonzalez, Stacy A. Balk, & Brian H. Philips, *The Effects of Vehicle Automation on Driver Engagement: The Case of Adaptive Cruise Control and Mind Wandering*, 64 HUMAN FACTORS 1086, 1087 (2022) (explaining that the ADAS's consistent speed and gap distance "could have positive effects on driver safety by reducing the risk and severity of collisions").

[116] Legislation requiring human supervision of autonomous features may give an illusion of safety; as Tracy Hresko Pearl has pointed out, "these laws are based on several flawed assumptions about the likelihood and ability of

> You want a driver assist system to be very good, but the better it gets, the easier it is to start forgetting that it has flaws, the easier it is to treat it like a full self-driving system. . . . The better it is, the greater the risk of bad supervision becomes.[117]

B. Autonowashing

The risks of overreliance on automated features are exacerbated by manufacturers' rosy marketing of their autonomous capabilities. Liza Dixon coined the term "autonowashing" to describe how claims of vehicle automation are often inflated, as companies "eager to profit in the short-term might exaggerate the capabilities of a system's automation in marketing materials in order to capture the interest of customers."[118] Dixon identified five signs of autonowashing, including

> (1) vague language about autonomous capabilities that is "poorly defined, misaligned with standards or so broad that its real meaning is likely to be misunderstood by the user";
>
> (2) deception, including "[d]eceitfully making a claim about a system's capabilities," or "[c]laiming to have autonomous capabilities which have not been verified by a third party";
>
> (3) deifying "false idols," where individuals with "influence or authority" publicly model inappropriate reliance on or misuse of autonomous features;

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human drivers to supervise and intervene appropriately and in a timely manner," but "[a] wealth of empirical studies cast significant doubt on the ability of human drivers to do either." Tracy Hresko Pearl, *Fast & Furious: The Misregulation of Driverless Cars*, 73 N.Y.U. ANN. SURV. AM. L. 19, 72 (2017).

[117] Brad Templeton, *Lawsuit Over Tesla Autopilot Fatality Unlikely To Win But It Uncovers Real Issues*, FORBES, May 3, 2019, *at* https://www.forbes.com/sites/bradtempleton/2019/05/03/lawsuit-over-tesla-autopilot-fatality-unlikely-to-win-but-it-uncovers-real-issues/?sh=24d9c4fb6034

[118] Dixon, *supra* note 24, at 2. The term is a riff on "greenwashing," or overstating environmental practices to attract customers. *See e.g.*, Derek E. Bambauer, *Cybersieves*, 59 DUKE L.J. 377, 440 (2009) (explaining that greenwashing, like its technological equivalents, "signifies a shift in expectations about acceptable behavior").

> (4) encouraging "utopian media," featuring "idealized functionality of automated systems operating successfully with little to no human supervision or interaction"; and
>
> (5) hiding the technology's trade-offs by focusing consumer attention on autonomous features, while concealing information about the need for human supervision.[119]

Dixon identified instances of autonowashing from multiple companies. One, however, stood out on all counts: Tesla. The very names of Tesla's products employ vague language to suggest a higher degree of autonomy than the products actually offer. As Dixon points out, Tesla's Autopilot product "implies an unspecified level of human inattention," similar to Autopilot features on airplanes.[120] Its second product, "Full Self Drive," goes even further in suggesting that the product offers full autonomy. The head of the National Transportation Safety Board called the naming decisions "misleading and irresponsible."[121]

This vague language allows Tesla to employ hidden tradeoffs. Tesla's CEO, Elon Musk, has publicized claims about Tesla's autonomous capabilities that were later quietly contradicted or walked back. Musk claimed in a recorded interview in 2020 that Tesla was "very close to level 5 autonomy," and that "I remain confident that we will have the basic functionality for level 5 autonomy complete this year."[122] But just six months later, Tesla's associate general counsel wrote to California regulators that both Autopilot and FSD were "Level 2" systems, which require the driver to "constantly supervise" the systems, including steering, accelerating, and braking "as needed to maintain safety."[123]

Most famously, Tesla released a staged video that purported to demonstrate available autonomous features but has been widely

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[119] *Id.* at 6.

[120] Dixon, *supra* note 24, at 7

[121] Emily Walsh, *Tesla's Use Of The Term Full Self-Driving Is 'Irresponsible,' NTSB Chief Told The Wall Street Journal*, BUS. INSIDER, Sept. 19, 2021, *at* https://www.businessinsider.com/tesla-safety-fsd-term-irresponsible-elon-musk-ntsb-2021-9.

[122] Roberto Baldwin, *Tesla Tells California DMV that FSD Is Not Capable of Autonomous Driving*, CAR & DRIVER, March 9, 2021, at https://www.caranddriver.com/news/a35785277/tesla-fsd-california-self-driving/

[123] *Id.*

criticized as deceptive. The video began with a text screen stating: "The person in the driver's seat is only there for legal reasons. He is not doing anything. The car is driving itself."[124] Much later, however, a Tesla engineer testified in a deposition the video was "staged to show capabilities like stopping at a red light and accelerating at a green light that the system did not have," including capabilities that were not even in development at the time.[125] The video needed to be shot in multiple takes, and contrary to the claim that the driver was only there for "legal reasons," the testimony revealed that drivers intervened to take control multiple times during the filming.[126] According to a lawsuit filed by Tesla customers, "the car had to run the same route over and over again before Tesla got acceptable video that appeared to show a car capable of driving itself," and at one point the car even ran into a fence.[127]

Musk's promotion of the semi-autonomous features sent a mixed message to consumers. Musk's actions "suggested to Tesla customers that they check out this cool new product that allows you to not pay attention on the highway—except while you're using it, you have to pay attention."[128] The video explicitly (if falsely) tells viewers that the person in the driver's seat is there for legal reasons, not for technical reasons. If a Tesla customer takes that statement as true, why should the viewer believe any of the disclaimers telling them that the driver should maintain hands on the wheel and eyes on the road? Customers have long found "examples of silly warnings attached to everyday products" that appear only to exist only for remote fears of liability.[129] In light of the video, the disclaimers appear to be targeted at cautious lawyers or regulators—not at the customers who are willing to trust the technology.

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[124] Tesla, *Autopilot Full Self-Driving Hardware*, at https://vimeo.com/192179726.

[125] Jin, *supra* note 1.

[126] *Id.*

[127] Complaint, Matsko v. Tesla Inc., Case 3:22-cv-05240, Sept. 14. 2022 (N.D. Cal.).

[128] BURNS & SHULGAN, *supra* note 93, at 306.

[129] W. Bradley Wendel, *Technological Solutions to Human Error and How They Can Kill You: Understanding the Boeing 737 Max Products Liability Litigation*, 84 J. AIR L. & COM. 379, 444 (2019) ("Examples include: a sticker on a baby stroller warning, 'Remove child before folding'; a brass fishing lure with a three-pronged hook on the end with a label indicating, 'Harmful if swallowed'; or a cardboard car sunshield completely covering the windshield that warns, 'Do not drive with sunshield in place.'").

Did Tesla's mixed messages about the reliability of its autonomous features encourage customers to take unwarranted risks? Numerous YouTube videos show Tesla customers engaging in enthusiastic misuse of the autonomy features and, in some cases, the level of risk voluntarily undertaken by Tesla owners suggests that they believe the cars are capable of fully autonomous operation. In one such video, filmed before the crash that took Joshua Brown's life, Brown demonstrated "the limitations of Autopilot's capabilities navigating hilly and curved back roads—which, for the record, Autopilot was not supposed to navigate."[130] Another Tesla owner posted photos of himself "sitting on the backseat of his Model 3 while the vehicle operated without a driver."[131] When he repeated the action, he was arrested by the California Highway Patrol and charged with reckless driving.[132]

Even more troublingly, other Tesla owners put their own children at risk. In the summer of 2022, a viral video purported to show Tesla automobiles "plowing into child-size mannequins."[133] In response, some Tesla owners set out to prove that Autopilot and FSD wouldn't run over actual children.[134] One owner had his 11-year-old son stand in a parking lot taking cellphone video as the owner "accelerated the Tesla from the other side of the lot and turned on 'full self-driving,' reaching 35 mph."[135] Another owner performed a low-speed test with two of his children, one just five years old.[136] Luckily, the automatic braking worked in both cases, and no children were hurt.[137] Nonetheless, the National Highway Traffic Safety Administration put out a statement warning that "[c]onsumers

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[130] BURNS & SHULGAN, *supra* note 93, at 308.

[131] Simon Alvarez, *Tesla Owner Arrested Due To Autopilot Abuse Pledges To Continue Autopilot Abuse*, TESLARATI, May 12, 2021, *at* https://www.teslarati.com/tesla-autopilot-abuser-continues-illegal-ap-use/

[132] Joshua Bote, *Bay Area Man Charged With Reckless Tesla Stunt Was Once Declared 'The Most Spoiled Kid In The US'*, SFGATE, May 12, 2021, *at* https://www.sfgate.com/local/article/Tesla-autopilot-Bay-Area-Param-Sharma-Instagram-16172049.php

[133] Matt McFarland, *People Are Now Testing Tesla's 'Full Self-Driving' On Real Kids*, CNN BUS., Aug. 21, 2022, *at* https://www.cnn.com/2022/08/21/business/tesla-fsd-tests-kids/index.html.

[134] *Id.*

[135] *Id.*

[136] *Id.*

[137] *Id.*

should never attempt to create their own test scenarios or use real people, and especially children, to test the performance of vehicle technology."[138]

C. *The Driver's Double Bind*

Manufacturers' mixed messages (encouraging trust in autonomous capabilities while maintaining that safety is the driver's responsibility) put the driver in an uncomfortable double bind. A double bind is a communication pattern between two parties in which the party "with weaker power within a relationship or vulnerable social status," becomes subject to contradictory demands from a more powerful party, creating a no-win situation.[139] Overselling autonomous features communicates to drivers that they should enjoy the benefits of added safety and convenience—but when those autonomous features predictably lull the driver into relaxation, distraction, and foreseeable misuse, the car company turns to its disclaimer: "The driver always remains responsible."[140]

At the present time, it's still an open question whether this double bind will successfully deflect manufacturer liability. Government officials have already begun to crack down on some of the most egregious autonowashing efforts. For example, Tesla's "claims that the company's electric vehicles can drive themselves" have reportedly brought the company under criminal investigation by the Department of Justice.[141] Legislators have also responded to autonowashing concerns; California, for example, recently passed a bill providing that:

> A manufacturer or dealer shall not name any partial driving automation feature, or describe any partial driving automation feature in marketing materials, using

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[138] Ben Zachariah, *Safety Regulator Condemns Use of Children In Tesla Safety Demonstration–Report*, DRIVE, Aug. 20, 2022, *at* https://www.drive.com.au/news/nhtsa-condemns-use-of-children-tesla-fsd-demo/

[139] Michele Goodwin, *Assisted Reproductive Technology and the Double Bind: The Illusory Choice of Motherhood*, 9 J. GENDER RACE & JUST. 1, 7 (2005).

[140] Colin Barnden, *Level 3 Cars? 'No Customer Buys It'*, OJO-YOSHIDA REPORT, January 24, 2023, *at* https://ojoyoshidareport.com/automated-driving-is-a-dead-end/

[141] Mike Spector & Dan Levine, *Exclusive: Tesla Faces U.S. Criminal Probe Over Self-Driving Claims*, REUTERS, Oct. 27,2022, *at* https://www.reuters.com/legal/exclusive-tesla-faces-us-criminal-probe-over-self-driving-claims-sources-2022-10-26/

> language that implies or would otherwise lead a reasonable person to believe, that the feature allows the vehicle to function as an autonomous vehicle.[142]

Civil fraud liability is also a real possibility. A lawsuit currently pending in the Northern District of California seeks to recover for fraud and misrepresentation.[143] Tesla, for its part, argues in a motion to dismiss the civil case that "[m]ere failure to realize a long-term, aspirational goal [of full self-driving] is not fraud."[144] Of course, Tesla is not the only company to engage in autonowashing.[145] Manufacturers will almost certainly argue that autonowashing should qualify as mere "puffery" that does not give rise direct legal liability.[146] It remains to be seen, however, how this attempt to deflect legal responsibility will play out in litigation.

From a public policy standpoint, the driver's double bind creates problematic incentives. One industry publication has suggested that this deflected responsibility encourages car manufacturers to cut back on safety design:

> Some automakers are now developing and deploying poorly designed automated driving technology, safe in the knowledge that when anything goes wrong in real-world operation, their lawyers and PR teams can throw the poor sucker sitting behind the wheel under the bus.[147]

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[142] Calif. S.B. 1398 (2022). The bill took effect at the start of 2023. Viknesh Vijayenthiran, Tesla's 'Full Self-Driving' label is about to become illegal in California, KTLA.com, Dec. 29, 2022 at https://ktla.com/news/california/teslas-full-self-driving-label-will-soon-be-illegal-in-california/

[143] Complaint, Matsko v. Tesla Inc., Case 3:22-cv-05240, Sept. 14. 2022 (N.D. Cal.).

[144] Defendant's Motion to Compel and Stay Pending Arbitration and Motion to Dismiss, Matsko v. Tesla Inc., Case 3:22-cv-05240, Sept. 14. 2022 (N.D. Cal.).

[145] *See* Dixon, *supra* note 24, at 5 (providing an image of a retracted Mercedes advertisement).

[146] *See* David A. Hoffman, *The Best Puffery Article Ever*, 91 IOWA L. REV. 1395, 1400 (2006) ("[S]peech found to be puffery almost always seeks to encourage consumption, making optimistic claims about goods unsupported by observed reality.").

[147] Barnden, *supra* note 140.

Those design questions come to the forefront when individuals suffer injury in crashes involving semi-autonomous systems. In the next part, this article considers how manufacturers' attempts to deflect responsibility onto the driver are likely to play out in tort litigation.

III. TORT LIABILITY AND SEMI-AUTONOMY

How should civil liability be apportioned when a car with autonomous features is involved in a crash that causes personal injury or death? There's no question that autonomous vehicle features raise difficult liability questions. Of course, when there is no human driver in the car, liability for the vehicle's driving errors will likely fall under a products-liability analysis.[148] But when there is a human driver in the car, even if autonomous features are engaged, then there is likely to be a conflict over how liability should be apportioned between driver and manufacturer.[149]

Issues of shared liability arise at the intersection "between two of the most important developments in tort law in the second half of the twentieth century"—that is, between the law of strict products liability and the apportionment of comparative fault.[150] Given the differences between the two doctrines, it can be difficult to determine what share of the liability should be apportioned to each party.[151]

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[148] Vladeck, *supra* note 56, at 141 ("In a fault-based system, drivers will bear the loss when they are responsible for the accident, and manufacturers will bear the loss when the driver-less car they have designed or manufactured fails.").

[149] K.C. Webb, *Products Liability and Autonomous Vehicles: Who's Driving Whom?*, 23 RICH. J.L. & TECH. 9, 78 (2017) ("Certainly, if the AV is in autonomous mode when a crash occurs, as the Google car was, insurance companies will seek to shift liability away from the human driver and toward manufacturers.").

[150] F. Patrick Hubbard & Evan Sobocinski, *Crashworthiness: The Collision of Sellers' Responsibility for Product Safety with Comparative Fault*, 69 S.C. L. REV. 741, 744 (2018)

[151] Some states, such as Ohio, have held that comparative fault allocation should not apply in products liability cases. *See* Bowling v. Heil Co., 31 Ohio St. 3d 277, 286, 511 N.E.2d 373, 380 (1987) ("[P]rinciples of comparative negligence or comparative fault have no application to a products liability case based upon strict liability in tort."). Other states have held that the two doctrines are not necessarily incompatible. Webb v. Navistar Int'l Transp. Corp., 166 Vt. 119, 132, 692 A.2d 343, 350 (1996) ("The comparative approach is fairer to all parties, and properly implemented, will not reduce the incentive to produce safe products.").

This tension comes to the forefront in litigation over supervised autonomy because individual driver liability typically depends on a finding of negligence, whereas products liability for the manufacturer follows a framework of strict liability.[152] Currently, the vast majority of vehicle litigation falls under a negligence framework, with "between 5,000 and 12,000 auto negligence claims" against drivers resolved in each year since 2000.[153] During the same time period, there were only between 50 to 200 products liability cases resolved each year against auto manufacturers.[154] With individual drivers taking on less of the driving burden and autonomous (or semi-autonomous) systems taking on more of the driving burden, we will likely see a shift in the relative proportion of these claims.

Finally, this complexity is confounded by the fact that tort liability is almost entirely a function of state law, and each state has its own approach to products liability and to the apportionment of liability between parties.[155] Although there are many broad strokes of similarity, the differences in the details are significant enough to make it difficult to predict how liability will ultimately play out.[156]

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[152] Bryant Walker Smith, *Automated Driving and Product Liability*, 2017 MICH. ST. L. REV. 1, 4 (2017) ("[V]ehicular negligence refers primarily to personal injury claims against individual motorists or their principals, while product liability includes claims against companies that allegedly made or sold a defective product.").

[153] Gary Marchant & Rida Bazzi, *Autonomous Vehicles and Liability: What Will Juries Do?*, 26 B.U. J. SCI. & TECH. L. 67, 86 (2020)

[154] *Id.*

[155] *See* F. Patrick Hubbard, *"Sophisticated Robots": Balancing Liability, Regulation, and Innovation*, 66 FLA. L. REV. 1803, 1813 (2014) ("Contract law and tort law are largely matters of state law.").

[156] Hubbard & Sobocinski, *supra* note 150, at 762 ("[R]egardless of doctrine, there is virtually no "common law" that is common to all the states. As a result, there will be, at best, a majority view, a minority view, and a group of states in the category of "other"—for example, states that have not addressed an issue.").

A. *Products Liability*

Auto manufacturer liability generally falls under a products liability framework.[157] Products liability law has developed as a subset of tort law. It is often described as form of "strict liability" because liability does not depend on a finding of negligence. Instead, both the product's manufacturer and its retailer can be held liable when the product is defective in a way that renders it unreasonably dangerous and that defect causes harm to an end user.

Such defects can fall into any of three categories: a manufacturing defect, where the product was "not manufactured in accordance with the manufacturer's specifications," a design defect, where a cost-effective change to the product design could have avoided foreseeable injury, or a warning defect, where inadequate instructions led to foreseeable harm.[158] The lines between each of these categories are not sharply defined. In fact, some states have consolidated all three into a single "products liability" cause of action that may arise under any of the three theories of defect.[159]

1. Manufacturing defects

Manufacturing defects arise from "a fault in the production process that fails to meet the manufacturer's design specifications."[160] Automotive case law has long experience analyzing manufacturing defects in non-automated vehicles—classic examples include assembly-line mistakes like an inadequately torqued bolt[161] and production errors such as the use of steel with physical flaws.[162]

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[157] *See* Jeffrey K. Gurney, *Sue My Car Not Me: Products Liability and Accidents Involving Autonomous Vehicles*, 2013 U. ILL. J.L. TECH. & POL'Y, 247, 271 (2013) ("Autonomous technology manufacturers should be liable for most accidents caused when the vehicle is in autonomous mode.").

[158] Hubbard, *supra* note 155, at 1822-23.

[159] *See, e.g.*, Samarah v. Danek Med., Inc., 70 F. Supp. 2d 1196, 1202 (D. Kan. 1999) (noting that "[t]he underlying purpose of the [Kansas Product Liability Act] is "to consolidate all product liability actions, regardless of theory, into one theory of legal liability," and clarifying that "all legal theories of recovery, e.g., negligence, strict liability, and failure to warn, are to be merged into one legal theory called a 'product liability claim.'") (cleaned up).

[160] Ryan J. Duplechin, *The Emerging Intersection of Products Liability, Cybersecurity, and Autonomous Vehicles*, 85 TENN. L. REV. 803, 828 (2018)

[161] Jenkins v. General Motors Corp., 446 F.2d 377 (5th Cir. 1971)

[162] Pouncey v. Ford Motor Co., 464 F.2d 957 (5th Cir. 1972).

Identifying manufacturing defects in products that rely heavily on software is a newer issue, and it is one that has created difficult evidentiary challenges.[163] The classification is important to how the case will be litigated, because manufacturing defects generally give rise to strict liability, whereas design or warning defects are analyzed under a lens of reasonableness or cost-benefit.[164] It is not clear, however, whether coding errors can fit comfortably within manufacturing defect doctrine—typically, manufacturing defects are one-off errors that do not affect every product within the product line.[165] In addition, with software "nothing tangible is being manufactured."[166]

Nonetheless, there are some situations where a coding error could give rise to a manufacturing defect. For example, a mistake in software distribution or a flaw introduced during the software testing process could potentially qualify as a manufacturing defect.[167] A typo-based coding error may also qualify as a manufacturing defect, as when a programmer inadvertently inputs a speed limit as "255 mph" instead of "25 mph."[168]

Even if software defects can qualify as manufacturing defects in theory, however, plaintiffs may have a very difficult time proving the existence of such defects in practice. As one scholar has explained, "with driver-less cars, it may be that the most technologically complex parts—

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[163] *See, e.g.*, In re Toyota Motor Corp. Unintended Acceleration Mktg., Sales Pracs., & Prod. Liab. Litig., 978 F. Supp. 2d 1053, 1097 (C.D. Cal. 2013) (recognizing that proof of a specific defect is difficult when "Toyota's software does not record software failures").

[164] Andrew D. Selbst, *Negligence and AI's Human Users*, 100 B.U. L. REV. 1315, 1324 (2020) ("The consequence of classifying an error that leads to a car crash as a manufacturing defect, design defect, or warning defect is stark: A manufacturing defect leads to strict liability and the others receive reasonableness or cost-benefit analyses. A crash also may not be the result of a design defect at all.").

[165] *See* Richard A. Nagareda, *Embedded Aggregation in Civil Litigation*, 95 CORNELL L. REV. 1105, 1120 (2010) (comparing a "manufacturing defect found on a one-off basis in an otherwise safe product" to design and warning defects that "implicate all those who consumed the disputed product, not just an unlucky few who might encounter an anomalous manufacturing defect").

[166] William J. Tronsor, *The Omnipotent Programmer: An Ethical and Legal Analysis of Autonomous Cars*, 15 RUTGERS J.L. & PUB. POL'Y 213, 256 (2018)

[167] Ryan J. Duplechin, The Emerging Intersection of Products Liability, Cybersecurity, and Autonomous Vehicles, 85 Tenn. L. Rev. 803, 823-28 (2018)

[168] Damien A. Riehl, *Car Minus Driver, Part II*, 73 J. MO. B. 264, 266 (2017).

the automated driving systems, the radar and laser sensors that guide them, and the computers that make the decisions—are prone to undetectable failure."[169]

Indeed, it is hard to know exactly what happened in some of the more high-profile recent crashes, though the evidence suggests that there was some combination of software and sensor error. The leading theory of the crash that killed Joshua Brown was that the vehicle's software misclassified sensor data so that it "interpret[ed] a white semi-trailer as the sky."[170] In the crash that killed Walter Huang, Huang's attorneys claimed that the vehicle had "misread the lane lines on the roadway, failed to detect the concrete median, and failed to brake the car, but instead accelerated the car into the median."[171] In a case involving a crash from unintended acceleration in a Toyota vehicle, the plaintiffs' expert suggested that a coding error in Toyota's software likely caused memory corruption that could lead to "unpredictable results," including to the unintended acceleration at issue in the case.[172]

In each of these cases, it is difficult to know exactly how the problem arose. In some (but not all) states liability would be easier to establish, as such errors would fall under the "malfunction doctrine" supporting manufacturer liability.[173] The Restatement (Third) of Torts supports the view that liability should be presumed in "situations in

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[169] Vladeck, *supra* note 56, at 148.

[170] Riehl, *supra* note 168, at 266; The Tesla Team, *A Tragic Loss*, June 30, 2016, *at* https://www.tesla.com/blog/tragic-loss ("Neither Autopilot nor the driver noticed the white side of the tractor trailer against a brightly lit sky, so the brake was not applied."); *see also* M.L. Cummings, *Adaptation of Human Licensing Examinations to the Certification of Autonomous Systems*, *in* SAFE, AUTONOMOUS AND INTELLIGENT VEHICLES 153, 145-62 ("[P]oor computer vision was a major factor in the death of a Tesla driver who relied on the car's autopilot for obstacle detection. The car could not execute its automated braking rule set, which generally is excellent, because it never 'saw' a tractor-trailer crossing the road ahead and thus was never triggered.").

[171] Faiz Siddiqui, *Tesla Sued by Family of Apple Engineer Killed In Autopilot Crash*, WASH. POST, May 1, 2019, *at* https://www.washingtonpost.com/technology/2019/05/01/tesla-sued-by-family-man-killed-autopilot-crash/

[172] In re Toyota Motor Corp. Unintended Acceleration Mktg., Sales Pracs., & Prod. Liab. Litig., 978 F. Supp. 2d 1053, 1101 (C.D. Cal. 2013)

[173] Mark A. Geistfeld, *A Roadmap for Autonomous Vehicles: State Tort Liability, Automobile Insurance, and Federal Safety Regulation*, 105 CAL. L. REV. 1611, 1634 (2017).

which a product fails to perform its manifestly intended function," the harm "was of a kind that ordinarily occurs as a result of product defect," and "was not, in the particular case, solely the result of causes other than a product defect existing at the time of sale or distribution."[174] For the states that recognize this form of circumstantial evidence, manufacturer liability may be relatively easy to establish.[175]

Other states, however, do not accept the malfunction doctrine and require specific identification of the alleged software failure.[176] A recent Fifth Circuit opinion considering the failure of a software-controlled pacemaker, for example, noted that "Texas law does not generally recognize a product failure or malfunction, standing alone, as sufficient proof of a product defect."[177] The court therefore concluded that the district court had correctly held that the plaintiff had failed to allege a manufacturing defect when the plaintiff alleged that a software failure or calibration failure may have led to the plaintiff's cardiac arrest while attached to the pacemaker.[178] In states like Texas that do not recognize the malfunction theory, the difficulty of identifying software errors with precision may mean that "the traditional manufacturing defect avenue may well be insurmountable for product liability claims involving self-driving vehicles."[179]

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[174] RESTATEMENT (THIRD) OF TORTS: PRODUCT LIABILITY § 3 (Am. Law Inst. 1998).

[175] *See* Bryan Casey, *Robot Ipsa Loquitur*, 108 GEO. L.J. 225, 264 (2019) (explaining that "thanks to res ipsa loquitur, plaintiffs involved in automated accidents can rely on inference to establish fault, even when they lack direct insight into the system's underlying code," and suggesting that such an inference means "plaintiffs will not face nearly as insurmountable an evidentiary burden as some now suggest"); David G. Owen & Mary J. Davis, *Strict Tort Liability—Proof Of Defective Condition—Malfunction Theory*, 1 OWEN & DAVIS ON PROD. LIAB. § 7:20 (4th ed.) ("Courts have permitted plaintiffs to use a res ipsa loquitur-like inference to infer defectiveness in strict liability where there was no independent proof of a defect in the product.").

[176] *See, e.g.*, Watson v. Ford Motor Co., 699 S.E.2d 169, 179 (S.C. 2010).

[177] Harrison v. Medtronic, Inc., No. 22-10201, 2022 WL 17443711, at *2 (5th Cir. Dec. 6, 2022).

[178] *Id.*; Harrison v. Medtronic, Inc., 561 F. Supp. 3d 698 (N.D. Tex. 2021), *aff'd in part, rev'd in part and remanded*, No. 22-10201, 2022 WL 17443711 (5th Cir. Dec. 6, 2022).

[179] Roy Alan Cohen, *Self-Driving Technology and Autonomous Vehicles: A Whole New World for Potential Product Liability Discussion*, 82 DEF. COUNS. J. 328, 332 (2015)

2. Design Defects

Coding errors are probably more likely to be categorized as design defects rather than manufacturing defects, especially when the code itself reflects the manufacturer's design choice.[180] Under the majority approach set out in the Restatement, commonly referred to as the risk-utility test, a product "is defective in design when the foreseeable risks of harm posed by the product could have been reduced or avoided by the adoption of a reasonable alternative design . . . and the omission of the alternative design renders the product not reasonably safe."[181] Whether the alternative design is "reasonable" depends on a cost-benefit test—that is, does the harm caused by the lack of adoption outweigh the cost to implement it?[182]

Some possible alternative designs could apply to any car with autonomous features. For example, a plaintiff may argue that the vehicle's programming creates an undue risk and that the car should have had a "safer algorithm" to control braking or steering.[183] Or, on the other hand, the plaintiff might focus on the vehicle's hardware, arguing that a camera-only sensor system is unreasonably dangerous and that the design should instead incorporate radar or lidar sensors.[184]

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[180] Gurney, *supra* note 157, at 260 ("A traditional manufacturing defect claim will not help plaintiffs with algorithm defects because of the malfunction doctrine's limitations; so, plaintiffs will likely assert design defects."); Geistfeld, supra note 173, at 1633 (arguing that software buys will nearly always be classified as design defects because the software is uniform throughout the product line).

[181] RESTATEMENT (THIRD) OF TORTS: PRODS. LIAB. § 2(b), at 14. Some states also follow a "consumer expectations" test set out in the Restatement (Second), which defines a design defect as one that is "dangerous to an extent beyond that which would be contemplated by the ordinary consumer who purchases it." Restatement (Second) of Torts § 402A cmt. i (1965). Even these states, however, typically analyze reasonable consumer expectations in a way that "is substantively equivalent to the risk-utility test." Geistfeld, *supra* note 173, at, 1642.

[182] Hubbard, *supra* note 155, at 1821-22.

[183] Brian S. Haney, *The Optimal Agent: The Future of Autonomous Vehicles & Liability Theory*, 30 ALB. L.J. SCI. & TECH. 1, 29 (2020)

[184] David K.A. Mordecai *et. al.*, *Objects May Be Closer Than They Appear Uncertainty and Reliability Implications of Computer Vision Depth Estimation for Vehicular Collision Avoidance and Navigation (Part 1 of 2)*, ABA SciTech Law., Fall

Other design disputes may relate more specifically to the particular challenges of partial autonomy. These disputes are likely to focus on the interaction of technology and human factors—and especially on the ironies of automation described above.[185] For example, knowing how tempting it is for people to become distracted or sleepy when using an automated system, how does that vehicle's design minimize those risks? A *Consumer Reports* study looked at some of the differences in how vehicles addressed risks of driver complacency.[186] More than one manufacturer included driver-facing cameras intended to ensure that the driver's eyes are on the road, but the manufacturers programmed different outcomes when camera-input was unavailable.[187] The reporter found that some autonomy systems "will still function even if their cameras are covered, and in some cases the cameras can actually be turned off," whereas others would not allow the autonomy functions to be used when camera input was unavailable.[188] Similarly, although all autonomy features had limited "operational design domains" (ODDs, conditions under which the systems were designed to work), some cars were programmed so that the autonomous features could not be activated outside the ODD. All of these issues are likely to factor into the defect analysis, as the law generally requires manufacturers to account for "reasonably foreseeable misuse."[189]

Paralleling the autonowashing claims described above, Tesla also stood out for its minimal driver monitoring. Tesla's ADAS systems don't "actually monitor whether or not the driver has their hands on the steering wheel," but instead "can detect pressure being applied on the

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2022, at 18, 21 (collecting evidence that "camera-only ADAS" may present "a single point of failure for safety-critical field applications"); Ryan Whitwam, *Tesla May Bring Back Radar Autopilot Hardware, Abandon Vision-Only Approach*, EXTREMETECH, Dec. 8, 2022, *at* https://www.extremetech.com /extreme/341409-tesla-may-bring-back-radar-autopilot-hardware-abandon-vision-only-approach.

[185] *See supra* Part ___.

[186] Mike Monticello, *Ford's BlueCruise Ousts GM's Super Cruise as CR's Top-Rated Active Driving Assistance System*, CONSUMER REP., Jan. 25, 2023, *at* https://www.consumerreports.org/cars/car-safety/active-driving-assistance-systems-review-a2103632203/

[187] *Id.*

[188] *Id.*

[189] Goldenfein *et al.*, *supra* note 58, at 895.

steering wheel."[190] Defeating this monitoring has not proved difficult—for example, one company sold a product called "Autopilot Buddy," described as "a small, weighted device that provides enough torque on the steering wheel to reduce the number of warnings from the vehicle regarding hands-off operation when Autopilot is activated."[191] Although NHTSA issued a cease-and-desist letter on June 19, 2018,[192] versions of the device continued to be sold on Amazon.com over three years later.[193]

These different choices likely make some vehicles safer than others. But a difference in safety, by itself, does not mean that the less-safe model necessarily suffers from a design defect. One industry observer has explained how Tesla's driver assistance product could add to safety overall, even with foreseeable misuse:

> It can be the case that if, say, 90% of drivers use Autopilot correctly, supervising it well, and are 50% safer doing so, and 10% of drivers use it badly, becoming twice as dangerous, the overall result is still safer.[194]

If the partial-autonomy systems are significantly safer overall than conventional vehicles, then a court would be unlikely to find a design defect.[195] It such a case, however, it is still possible that the court could find a warning defect.[196]

When there is evidence to support design-defect liability, design defect cases involving semi-autonomous features are likely to be complex, expensive to litigate, and unpredictable in result. First, at least

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[190] Fred Lambert, *Tesla Plans To Remove A Full Self-Driving Beta Driver Monitoring Feature, Regulators Are Concerned*, ELECTREK, Jan. 9, 2023, *at* https://electrek.co/2023/01/09/tesla-plans-remove-full-self-driving-beta-driver-monitoring-feature-regulators-concerned/

[191] Andrew Krok & Sean Szymkowski, *Amazon Still Sells Versions Of The Dangerous Autopilot Buddy Tesla Accessory*, CNET.COM, Aug. 30, 2021, *at* https://www.cnet.com/roadshow/news/autopilot-buddy-tesla-amazon-accessory/

[192] *Press Release, NHTSA, Consumer Advisory: NHTSA Deems 'Autopilot Buddy' Product Unsafe* (June 19, 2018).

[193] Krok & Szymkowski, *supra* note 191.

[194] Templeton, *supra* note 117.

[195] Geistfeld, *supra* note 173, at 1692 ("Under widely adopted rules of products liability, the programming or design of the fully functioning operating system would necessarily satisfy the tort obligation if the data show that the autonomous vehicle performs at least twice as safely as conventional vehicles").

[196] *See infra* Part III.A.3..

when *res ipsa loquitur* liability is unavailable, such cases will typically require evaluation of the underlying code controlling the feature. That code may be subject to trade secret protection and thus not easily obtainable.[197] Even if made available in discovery, interpretation of the code would require "contentious and costly" expert analysis and testimony.[198] Second, technology is developing so rapidly that it may be difficult to prove that an alternative design available now would have been both available and feasible to implement at the time the product was designed.[199] Finally, just as with manufacturing defects, there is substantial difference in state laws relating to design defects, including on which party bears the burden of proof to establish the existence of a design defect.[200]

3. Warning Defects

The third category of product defect exists when the seller gives "inadequate instructions or warnings" about "the foreseeable risks of harm posed by the product," when such warnings would have "reduced or avoided" the harm caused by that product.[201] Both the foreseeability of

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[197] *See* Abraham & Rabin, *supra* note 74, at 144 ("These esoteric, algorithm-based design differences--which might, in addition, be subject to trade secret protection--would impose overwhelming stress on the premises of conventional analysis.").

[198] *Id.* at 143.

[199] *Id.* at 141–42 (explaining that "[b]ecause automated technology will surely be in a state of continual improvement, state-of-the-art issues that products liability law has put to rest in other contexts may be re-introduced in such situations" and noting that "[l]itigation over the availability of reasonable alternative designs could easily involve challenging and technical comparisons of design risk, utility, and feasibility").

[200] *Compare* Barker v. Lull Eng'g Co., 573 P.2d 443, 455 (Cal. 1978) ("[W]e conclude that once the plaintiff makes a prima facie showing that the injury was proximately caused by the product's design, the burden should appropriately shift to the defendant to prove, in light of the relevant factors, that the product is not defective.") *with* Branham v. Ford Motor Co., 701 S.E.2d 5, 16 (2010) ("The plaintiff will be required to point to a design flaw in the product and show how his alternative design would have prevented the product from being unreasonably dangerous."); *see also* Hubbard & Sobocinski, *supra* note 150, at 762 ("[S]tates may agree on a substantive rule but disagree, for example, on who has the burden of proof on design defect.").

[201] RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 (1998)

the risk and the effectiveness of the warning to reduce that risk are therefore key factors in evaluating warning defects.[202]

Communication of warnings is especially important with "driver in the loop" partial autonomy.[203] The sufficiency of a warning is analyzed by how users foreseeably interact with the product. Thus, a common warning for Level 2 systems that the driver must "stay engaged and at attention"[204] is likely insufficient, given the ironies of automation discussed above.[205] Certainly, Google's experience suggests that even when warned, drivers are often simply unable to maintain the necessary level of attention required.[206]

Of course, it is possible that *no* warning will be strong enough by itself. As the *Restatement* concludes, "instructions and warnings may be ineffective because users of the product . . . may be likely to be inattentive, or may be insufficiently motivated to follow the instructions or heed the warnings."[207] In that case, "adoption of the safer design is required over a warning that leaves a significant residuum of such risks."[208] The analysis would revert to one of design defect, suggesting the need to include the type of driver-monitoring systems and operational limitations described above.[209]

When judging the effectiveness of a warning, questions of how and when information is communicated may be critical. This is especially true when the driver must take over from an automated system.[210] Some Level 2 vehicles "demand that the person not-quite-driving be ready to

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[202] Daniel A. Crane, Kyle D. Logue, & Bryce C. Pilz, *A Survey of Legal Issues Arising from the Deployment of Autonomous and Connected Vehicles*, 23 MICH. TELECOMM. & TECH. L. REV. 191, 282 (2017)

[203] Bobbie D. Seppelt & John D. Lee, *Keeping the Driver In The Loop: Dynamic Feedback To Support Appropriate Use Of Imperfect Vehicle Control Automation*, 125 INT'L J. HUMAN-COMP. STUDIES, 66 (2019).

[204] Marchant & Bazzi, supra note 153, at 99.

[205] *See supra* Part II.A.

[206] *Id,*

[207] RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 cmt. 1 (1998).

[208] ID.; *see also* Marchant & Bazzi, *supra* note 153 at 99-100 (discussing "failure to warn" defects for automated vehicles).

[209] *Supra* Part III.A.2.; *see also* Pearl, *Hands On*, *supra* note 78, at 741 (arguing that "NHTSA should mandate the installation of attention warning systems on all semi-autonomous vehicles").

[210] JASON TORCHINSKY, ROBOT TAKE THE WHEEL: THE ROAD TO AUTONOMOUS CARS AND THE LOST ART OF DRIVING 100-101 (2019).

take over in an instant if the car gets into trouble."[211] Human perception-reaction time, however, simply doesn't work that fast. Studies have shown that "it can take a minimum of two to three seconds to acknowledge that action needs to be taken in response to a warning."[212] And reaction time is higher for drivers engaging autonomous features, as "recent research indicates that the braking reaction time of drivers using Level 1 and Level 2 automation is up to 1.5 seconds longer than drivers who are manually operating the vehicle."[213] A warning that comes too late to be useful cannot be an effective warning.

Recent research suggests that there are ways in which better communication with drivers can increase drivers' ability to provide useful oversight of automated features.[214] One recent study found that "[d]iscrete warnings" tended not to be very useful, as they "strip drivers of natural pattern recognition and burden them with the task of inferring the context of the warning and the reason for its issuance."[215] On the other hand, real-time "dynamic feedback," including continuous display information and "interfaces that remind users of system limitations contextualized to the situation" were more effective.[216] In particular, "redundant visual-auditory" signals gave rise to a faster reaction time, increased trust in the system, and made the driver rate the system as "less surprising."[217]

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[211] *Id.* at 100.

[212] David Cades, Carmine Senatore, John L. Campbell, Ryan Harrington & Daniel Wood, *Automated and Assistive Vehicle Technology Opportunities and Challenges*, AM. BAR. ASSOC. BRIEF, Fall 2019, at 16, 23, *at* https://www.americanbar.org/groups/tort_trial_insurance_practice/publications/the_brief/2019-20/fall/automated-and-assistive-vehicle-technology-opportunities-and-challenges

[213] Nancy Grugle, *Human Factors in Autonomous Vehicles*, AM. BAR ASSOC. TORTSOURCE, Nov. 20, 2019 at https://www.americanbar.org/groups/tort_trial_insurance_practice/publications/tortsource/2019/fall/human-factors-autonomous-vehicles/.

[214] Bobbie D. Seppelt & John D. Lee, *Keeping the Driver In The Loop: Dynamic Feedback To Support Appropriate Use Of Imperfect Vehicle Control Automation*, 125 INT'L J. HUMAN-COMP. STUDIES 66, 78 (2019).

[215] *Id.*

[216] *Id.*

[217] *Id.*

B. Comparative Fault and Deflected Liability

Even if the plaintiff succeeds in establishing the existence of a product defect (whether manufacturing defect, design defect, or warning defect) that caused harm, that is still only the beginning of the liability analysis. In a majority of states, the jury will still have to decide how to apportion liability between responsible parties.[218] This "shift to comparative fault" is a relatively modern trend.[219] Traditionally, liability was an all-or-nothing question, and the defendant would escape liability entirely if the plaintiff's own negligence contributed to their harm.[220] This rule was viewed as particularly harsh to plaintiffs, however, whose negligence may have been minor in comparison to that of the defendant's—and whose pockets were likely to be far shallower.[221]

Comparative fault is likely to play an outsize role in litigating crashes involving partial autonomy. Because there is a driver at least theoretically in the loop, the defendant manufacturer necessarily has an incentive to argue that the driver bears a significant percentage of the fault for any crash.[222] Juries may be primed to accept such arguments, because the type of comparative negligence at issue (playing video games while the car barrels along the highway, speeding, drinking and driving) "are the kinds of errors that human jurors recognize as negligence."[223] Because of the familiarity of such negligence in jurors' everyday lives, they may be tempted to assign greater blame to the misbehaving human occupant of the car even when there is little evidence that the human could have successfully avoided the crash even if following all traffic

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218 Hubbard & Sobocinski, *supra* note 150, at 779.

219 *Id.*

220 *Id.*

221 *Id.* (noting that "[t]he unfairness of this harsh approach was widely criticized").

222 *See* Goldenfein *et al.*, *supra* note 58, at 858 ("If vehicle manufacturers are presumed prima facie responsible for accidents when cars are in autonomous mode under a products liability rather than personal liability approach, they may also desire fine-grained recording of in-cabin behavior during control transitions such that they would be able to subsequently pursue human drivers for negligence.").

223 Matthew Wansley, *The End of Accidents*, 55 U.C. DAVIS L. REV. 269, 272 (2021).

laws.[224] This deflection of responsibility demonstrates what Madeleine Clare Elish has termed the "moral crumple zone"—that is, the tendency to assign blame to human operators "for errors or accidents not entirely in their control."[225]

Interestingly, experimental research suggests that there may be a countervailing effect especially for the allocation of damages—test subjects in one experiment "judged that the victim in the automation-caused crash should be compensated more financially than that in the human-caused one."[226] Another experiment, involving sitting judges from various states, found that when the judges who were asked to evaluate various scenarios they "assigned more fault to the autonomous vehicle than the human driver and awarded more in compensatory damages when the autonomous vehicle caused the accident."[227] It's hard to know whether these effects arise from bias or from an unconscious application of the least-cost avoider principle—that is, did the judges in the scenario believe, even subconsciously, that a manufacturers of the autonomous vehicle were better able to avoid the harm? Likewise, if the "moral crumple zone" effect assigned more blame to the human, was it because the human was viewed to have moral agency that the machine did not? In the long run, these questions are worthy of significantly more study. In the short run, it is clear that lawyers litigating issues of comparative fault will find fertile ground for argument and will need to be wary of hidden biases.

Although comparative fault is likely to be an important issue in litigating semi-autonomy, there are huge differences in how liability is allocated across the different states. First, states differ significantly in how

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[224] Madeleine Clare Elish, *Moral Crumple Zones: Cautionary Tales in Human-Robot Interaction*, 5 ENGAGING SCI., TECH., & SOC'Y 40 (2019).

[225] *Id.* (coining the phrase "moral crumple zones).

[226] Liu & Du, *supra* note 89, at 1779 . This study also fond that test subjects were more likely to blame the automation over the human driver when presented with an experimental scenario in which "the automated driving system sent a take-over request" but that "owing to errors made by the human driver, the driver did not successfully take over the vehicle." *Id.* at 1773. Given that the test subjects were explicitly told that human error caused the crash (but not told what error the human made), this result may suggest that test subjects were skeptical of claims that human drivers can reasonably be required to take over driving responsibility at a moment's notice.

[227] Jeffrey J. Rachlinski, Andrew J. Wistrich, Judging Autonomous Vehicles, 24 Yale J. L. & Tech. 706, 757–58 (2022).

they apportion liability in general.[228] All comparative fault systems reduce the plaintiff's recovery by the percentage of fault attributable to their own negligence.[229] States differ, however, when they would bar the plaintiff from recovering at all—some do not bar the plaintiff from recovery at all, while others allow recovery only when the plaintiff's own negligence is less than or equal to the defendant's, some only of if the plaintiff's own negligence is lesser, and some only if the plaintiff's negligence is "slight" in comparison to the defendant's.[230]

Adding a second layer of complexity and conflict, states also differ in whether they choose to apply a comparative fault analysis to products liability.[231] Some states apply the comparative fault reduction only in negligence cases, not in cases involving strict products liability.[232] Other states, however, apply their comparative fault statutes whenever the plaintiff's negligence contributed to the harm caused by the product defect.[233]

All of these state variations reflect reasonable policy choices.[234] The concepts of negligence and products liability, after all, are in some

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[228] Hubbard & Sobocinski, *supra* note 150, at 787.

[229] *Id.*

[230] *Id.*

[231] George Andrew Rowlett, *Comparative Fault as a Defense in Products Liability Subrogation*, ALM PROPERTYCASUALTY360, Jan. 17, 2014, at https://www.propertycasualty360.com/2014/01/17/comparative-fault-as-a-defense-in-products-liabili

[232] *See, e.g.*, Shipler v. Gen. Motors Corp., 271 Neb. 194, 218, 710 N.W.2d 807, 830–31 (2006) (concluding that Nebraska's comparative fault statute "allows a jury to compare a plaintiff's contributory negligence to the negligence of a defendant or defendants," but "does not provide that the plaintiff's negligence may be applied in the plaintiff's cause of action based upon strict liability in tort"); Hulstine v. Lennox Industries, Inc., 237 P.3d 1277 (2010); Heinrich v. Ethicon, Inc., 2020 WL 1916767 (D. Nev. 2020) (applying Nevada law).

[233] *See, e.g.*, Jahn v. Hyundai Motor Co., 773 N.W.2d 550, 560 (Iowa 2009) ("Unlike many comparative fault statutes which apply comparative fault concepts only in cases involving negligence, Iowa's comparative fault statute expressly states that the fault of other parties is to be compared in cases of negligence, recklessness, and strict liability.") (citations omitted); Morris v. Mitsubishi Motors North America, Inc., 782 F. Supp. 2d 1149 (E.D. Wash. 2011) (applying Washington law).

[234] Abraham & Rabin, *supra* note 74, at 142 ("In the modern era of product-defect liability, the joint-responsibility allocation issues that arise out of such situations have been addressed and resolved--albeit not in a single voice.").

tension with each other. Products liability doctrine is intended to ensure that manufacturers internalize the cost of the risks created by their products.[235] Negligence doctrine, on the other hand, focuses on encouraging people to act with due care.[236]

Reducing the product manufacturer's liability to account for the user's negligence means that the manufacturer will not bear the full cost of product defect. It thus risks disincentivizing the development of safety features that could "reliably anticipate human error and take evasive action."[237] On the other hand, failing to apply comparative fault in products liability cases strikes many as unfair, and potentially carries problematic incentives of its own. In particular, if innovators are priced out of the market, that could deter innovation even when it would provide an overall benefit to society.[238] Because there are no easy resolutions to these questions, it is understandable that states would take different approaches in reconciling the policy interests underlying these doctrines.

C. *Liability Gaps*

Even when the failure of a semi-autonomous vehicle causes harm, it is possible to envision a path that allows the manufacturer to escape

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[235] Keith N. Hylton, *The Law and Economics of Products Liability*, 88 NOTRE DAME L. REV. 2457, 2478 (2013) ("Under strict products liability, the risk cost is internalized to the producer, so that the unit profit of selling the risky model is reduced by the expected liability.").

[236] *See, e.g.*, Herring v. United States, 555 U.S. 135, 153 (2009) (Ginsberg, J., dissenting) ("[A] foundational premise of tort law-that liability for negligence, *i.e.*, lack of due care, creates an incentive to act with greater care.").

[237] *See* Wansley, *supra* note 223, at 272–73 (arguing that "[a] liability regime with a comparative negligence defense only creates incentives for AV companies to develop behaviors that AV technology has already mastered: driving at the speed limit, observing traffic signals, and maintaining a safe following distance," and suggesting that such a regime "won't push AV companies to develop software that can reliably anticipate human error and take evasive action.").

[238] *See* Mark A. Lemley & Bryan Casey, *Remedies for Robots*, 86 U. CHI. L. REV. 1311, 1383 (2019) (arguing that "[w]ithout the addition of a contributory negligence defense," it is likely that "innovators would end up disproportionately bearing costs, human drivers wouldn't be priced off the roads as quickly as they should, and companies would also be apt to spend less on safety from a competitive perspective").

liability. Liability gaps may arise both from substantive law and procedural law. In either case, the existence of a liability gap means that the injured party is likely to bear some—of even all—of the cost of the harm caused by the system.

There are often good reasons for liability gaps—for example, the justice system usually does not assign legal fault to a very young child who commits a negligent act.[239] Nonetheless, the existence of such liability gaps means that innocent parties are likely to bear the cost of others' harm. When liability gaps arise, they should therefore be closely scrutinized and should be no larger than necessary to comport with the underlying policy reasons for those gaps.

1. Harm Without Defect

Liability gaps for semi-autonomous vehicles are likely to arise when no defect can be identified in the vehicle, but it nonetheless crashes or otherwise causes injury.[240] So-called edge cases (that is, "rare occurrences [that] are easily missed and thus are often missing in datasets") are especially likely to give rise to gaps.[241] When state-of-the-art programming has not foreseen a particular difficulty, there's almost certainly no defect under any of the products-liability theories—the issue is unlikely even to reach a jury.[242] The rapid development of autonomous

[239] *See, e.g.*, Dunn v. Teti, 421 A.2d 782, 783 (1980) (upholding the dismissal of a suit for injuries to the six-year-old plaintiff "caused by the negligent swinging of a wooden stick by the minor-defendant, five years and seven months old at the time").

[240] *See, e.g.*, Paula Kates, Note, *Immunity of State-Owned Enterprises: Striking A New Balance*, 51 N.Y.U. J. INT'L L. & POL. 1223, 1224 (2019) (discussing the "accountability-liability gap" that occurs when "the party held legally responsible is not necessarily the one truly responsible for the wrong").

[241] Datagen, *Edge Cases in Autonomous Vehicle Production*, April 13, 2022, *at* https://datagen.tech/blog/how-synthetic-data-addresses-edge-cases-in-production/

[242] *See, e.g.*, Hubbard, *supra* note 155, at 1821 n. 64 (discussing the "state of the art" products-liability defense for autonomous cars); Bryant Walker Smith, *Proximity-Driven Liability*, 102 GEO. L.J. 1777, 1801 (2014) ("The state-of-the-art defense may rely more explicitly on process-oriented functional safety standards developed by industry.").

and semi-autonomous systems means that there will be new challenges and new edge cases with every iteration.[243]

Return to case that led to Walter Huang's death, where the Tesla's Autosteer function steered the car out of its lane and into a concrete barrier at 71 miles per hour.[244] Although there's no real dispute that the software failed to read the road conditions, such failure does not necessarily equate to defect.[245] Especially in states that don't follow the *Restatement*'s "malfunction" approach, it may be difficult for the plaintiff to prove that the vehicle's error rose to the level of product defect. First, there's no indication that the car's programming deviated from its design, making a manufacturing defect unlikely.

Second, although the programming design was likely flawed, the technology is so cutting-edge that there may have been no better alternative design.[246] As edge cases and unusual situations come to light over time, programming (and presumably safety) will improve—but a design defect cannot rest on subsequent product improvements. Even when prone to this type of failure, the semi-autonomous vehicle overall may not be significantly more dangerous than a conventional automobile.

Finally, although the warning issue is likely to be heavily litigated, it is possible to imagine a reasonable jury coming out either way. Perhaps the manufacturer's warnings were clear and timely enough to allow the driver to control the vehicle. Or conversely, perhaps the manufacturer gave mixed messages about the need for oversight and failed to alert the driver of the potential for the high-speed disaster. As the case is litigated, those facts are likely to be more fully developed.

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[243] *See* Lemley & Casey, *supra* note 238, at 1324 (stating that "the number of uncertainties a robot might encounter in most uncontrolled environments approaches infinity").

[244] Michael Laris, *Tesla Running On 'Autopilot' Repeatedly Veered Toward the Spot Where Apple Engineer Later Crashed And Died, Federal Investigators Say*, WASH. POST, Feb. 11, 2020, *at* https://www.washingtonpost.com/transportation/2020/02/11/telsa-running-autopilot-repeatedly-veered-toward-spot-where-apple-engineer-later-crashed-died-federal-investigators-say/

[245] Bryant Walker Smith, *Automated Driving and Product Liability*, 2017 MICH. ST. L. REV. 1, 36 (2017) ("Defect in a legal sense, however, is not necessarily coterminous with failure in a technical sense.").

[246] Jeffrey K. Gurney, *Crashing into the Unknown: An Examination of Crash-Optimization Algorithms Through the Two Lanes of Ethics and Law*, 79 ALB. L. REV. 183, 237 (2016) ("In utilizing a state of the art defense, the car manufacturer would assert that it was not possible for the manufacturer to program its algorithm to prevent the harm to the plaintiff.").

Regardless of how the Huang case turns out, the principles at issue in the case show how a liability gap can arise from the interplay of product-liability law and negligence law. In some cases, drivers (or passengers) will be injured through no negligence of their own. In these cases, there's no guarantee that the manufacturer will be liable merely because the product failed, at least as long as the product's failure doesn't rise to the level of a liability-creating defect. Nor is there any guarantee that insurance will make up the difference, as relatively few states today follow a no-fault compensation system.[247] In cases without legal liability, the injured parties will be financially responsible for their own losses.

2. Forum Selection and Choice of Law

The substantive liability gaps described above rely on intentional policy choices not to ascribe fault in certain situations. Liability gaps can also arise from the procedural doctrines that leave room at the margins, however, making it sometimes difficult for plaintiffs to access legal remedies.[248]

Both forum selection and choice of law are likely to be a large part of any suit involving automated features.[249] First, primary questions of liability depend on the state's doctrinal approach to products-liability law.[250] And second, state law also determines how (and if) the defendant's potential liability will be reduced to account for the plaintiff's negligence.[251]

Although the choice of law issue is an important one, it is not an easy one. Choice of law can be an especially thorny question when the

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[247] *See* Donald G. Gifford, *Technological Triggers to Tort Revolutions: Steam Locomotives, Autonomous Vehicles, and Accident Compensation*, 11 J. TORT L. 71, 113–14 (2018) (explaining that no state has enacted no-fault insurance since 1976 and explaining that "the higher costs of no-fault insurance in part reflects its comparative advantages over traditional liability insurance: compensation of a larger proportion of those injured in automobile accidents, faster claims reimbursement, and greater consumer satisfaction").

[248] *See, e.g.*, Christopher Whytock & Cassandra Burke Robertson, *Forum Non Conveniens and the Enforcement of Foreign Judgments*, 111 COLUM. L. REV. 1444 (2011) (describing how the intersection of forum non conveniens and judgment enforcement procedure leave a "transnational access to justice gap" that can prevent plaintiffs from obtaining redress in any forum).

[249] *See supra* Part III.A.

[250] *Id.*

[251] *See supra* Part III.B.

product's malfunction occurred outside the state in which the product was initially sold.[252] That analysis gets even more complex when cases involve either foreign defendants, foreign product sales, or accidents that happen outside the United States.[253]

Finally, choice of forum presents a closely related challenge. Forum choice can heavily influence the court's ultimate choice-of-law determination and also offers its own set of issues separate from choice of law.[254] In recent years, the United States Supreme Court has diminished the number of available litigation forums by narrowing the application of personal jurisdiction.[255] At the same time, however, the Court's doctrinal changes have left open numerous questions and made it difficult to predict where defendants can be sued.[256]

Going forward, it is likely that suits involving semi-autonomous vehicles will include hard-fought battles over both choice of forum and choice of law, as each side seeks more favorable comparative-fault rules. This litigation may help develop a more coherent approach to these

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[252] Rowlett, *supra* note 231 (noting that "[i]t can matter a lot" what state's law will apply, and that the difference in state law can make the difference between whether the plaintiff or the defendant will prevail).

[253] *See, e.g.*, Ryan Calo, *Robotics and the Lessons of Cyberlaw*, 103 CAL. L. REV. 513, 520 (2015) (exploring the questions attendant to "choice of law and enforcement," and explaining that such questions are arising more often in the Internet age).

[254] *See, e.g.*, Piper Aircraft Co. v. Reyno, 454 U.S. 235, 243 (1981) (explaining the district court's conclusion that due to different states' choice-of-law rules, the defendant product manufacturer would likely to be subject to Pennsylvania law, whereas the defendant component-part manufacturer would likely be subject to Scottish law, and concluding that the jury was likely to find the situation "hopelessly complex and confusing").

[255] Joseph William Singer, *Hobbes & Hanging: Personal Jurisdiction v. Choice of Law*, 64 ARIZ. L. REV. 809, 818 (2022) (explaining how "the Supreme Court has narrowed both general and specific personal jurisdiction law in recent years").

[256] *See* Linda Sandstrom Simard, Charles W. "Rocky" Rhodes & Cassandra Burke Robertson, *Ford Motor Co.: The Murky Doctrine of Personal Jurisdiction*, 5 AM. CONST. SOC'Y SUP. CT. REV. 119 (2021) *at* https://www.acslaw.org/analysis/acs-journal/2020-2021-acs-supreme-court-review/ford-motor-co-the-murky-doctrine-of-personal-jurisdiction/ (acknowledging "the minimal guidance provided by the Court for future cases").

doctrines, but it comes at the expense of added litigation and uncertainty in products liability cases.[257]

In worst-case scenarios, plaintiffs will not be able to obtain personal jurisdiction over all potentially liable defendants (for example, manufacturer and component-part manufacturer) in the same forum. In such a case, the plaintiff may have to engage in claim-splitting, choosing which defendant to sue.[258] Other potentially liable defendants would either be left out of the case (thus escaping liability entirely) or could be sued in a later action, potentially for indemnity or contribution in cases of joint and several liability.[259] The first scenario would leave a classic liability gap; the second, though closing the gap, would result in wasteful duplication of litigation costs.[260]

IV. THE ROAD AHEAD FOR LITIGATION

How should the judicial system incentivize product safety without stifling innovation? Others have persuasively made the case for increasing government regulation of semi-autonomous systems.[261] Certainly, there are some actions that regulators are already taking, including studying the relative safety and effectiveness of different technological systems, evaluating the causes of vehicle crashes in order to identify commonalities suggestive of system defects, and ordering software recalls when such defects are identified. [262] There are other steps

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[257] Alexandra D. Lahav, *The New Privity in Personal Jurisdiction*, 73 ALA. L. REV. 539, 577 (2022) (explaining that "[b]ecause most products are manufactured in one place and used in another, often involving parts manufactured in various places, an accident victim must sue an out-of-state defendant").

[258] Jonathan M. Hoffman, *Claim Splitting in the New World of Several Liability and Personal Jurisdiction*, 86 J. AIR L. & COM. 377 (2021) (explaining that with recent changes in personal jurisdiction doctrine, "finding a single forum with personal jurisdiction over all parties has become more difficult").

[259] *Id.* at 378 (noting "the potential complications of litigating multiple lawsuits in multiple states arising from the same accident").

[260] *Id.* at 381 ("If some tortfeasors cannot be joined in the same action, the remaining defendants face the risk that they might get stuck defending multiple lawsuits in multiple venues, unable to allocate substantial liability to others.").

[261] *See* Pearl, *Hands On*, *supra* note 78, at 756.

[262] *See supra* text accompanying note 110-111.

that regulators could take, such as requiring pre-market approval for advanced driver assistance systems.[263]

While increased regulation may be a good idea, rulemaking takes time. For any changes that require passing legislation, political polarization and gridlock add another level of difficulty. Litigation, on the other hand, plays an immediate role by necessity. Injured plaintiffs are suing right now, alleging they were harmed by the failures of semi-autonomous systems.[264]

In the United States, litigation has long played a significant role in ensuring product safety and promoting public-policy goals.[265] Of course, there is a fine line—while litigation can play an important role in cost allocation, it can also extract rents that add to the cost of product development and are ultimately passed along to the consumer.[266] This Part offers suggests for maintaining that balance—for encouraging safe

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[263] *See* Pearl, *Hands On*, *supra* note 78, at 756 ("Congress should grant NHTSA the ability to create and administer a premarket approval system for semi-autonomous vehicles."); David Zipper, *The Massive Tesla Recall Isn't Just Elon Musk's Fault*, SLATE, Feb. 16, 2023, at https://slate.com/technology/2023/02/tesla-recall-full-self-driving-nhtsa-musk-regulation.html (arguing that "automated car technology [should be] be tested and approved for safety before being offered to the public").

[264] *See* Siddiqui, *supra* note 171; *see also* Christopher Cox, *Elon Musk's Appetite for Destruction*, N.Y. TIMES, Jan. 17, 2023 ("In February [2023], the first lawsuit against Tesla for a crash involving Autopilot will go to trial. Four more will follow in quick succession.").

[265] *See* Harry Surden & Mary-Anne Williams, *Technological Opacity, Predictability, and Self-Driving Cars*, 38 CARDOZO L. REV. 121, 178 (2016) ("Another way in which the legal system might impact the design of autonomous vehicles to make them more predictable, is not directly through explicit regulation, but indirectly through the tort system."); Cassandra Burke Robertson, *The Impact of Third-Party Financing on Transnational Litigation*, 44 CASE W. RES. J. INT'L L. 159, 174 (2011) (noting that "[e]ach country establishes its own balance of regulation and litigation to protect the public interest," and explaining that "[i]n the United States, the balance has historically tilted more toward the litigation side, as the justice system has been used as a tool to vindicate civil rights, promote product safety, and punish wrongdoing through the award of punitive damages.").

[266] A. Mitchell Polinsky & Steven Shavell, *The Uneasy Case for Product Liability*, 123 HARV. L. REV. 1437, 1440 (2010) ("[T]he three beneficial effects of product liability—inducing firms to improve product safety, causing prices of products to reflect their risks, and providing compensation to injured consumers--are, for many products, likely to be outweighed by the litigation and related costs of product liability.").

product development, allocating liability in line with fair principles, and leaving room for a nascent technology to improve in ways that, over time, may add substantial safety protections.[267]

A. *Consider Collaborative Driving as a System*

When courts evaluate claims of design defect and warning defect, it's natural for the lawyers to emphasize the separate responsibilities of manufacturers and drivers. Those parties are, after all, likely to be adversaries in the lawsuit, and liability determinations—especially comparative fault allocations—necessarily pit the parties against each other.[268]

Even though the parties are procedural adversaries in the lawsuit, they are not adversaries when it comes to product use. Partial autonomy is necessarily a form of collaborative driving where—when the system works as intended—both human and machine work together.[269] The advanced driver assistance system relies on the human to provide oversight—either constantly while driving for a Level 2 "eyes-on" product, or at the handoff and return stage for a Level 3 product.[270] It's important, therefore, for lawyers, judges, and juries to consider the

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[267] Safety improvements are especially likely if and when technological improvement of semi-autonomous systems leads to the ultimate development of fully autonomous vehicles—and safety improvements aren't necessarily limited to driving ability alone, but could also have secondary impacts. *See, e.g.*, Jordan Blair Woods, *Autonomous Vehicles and Police De-Escalation*, 114 NW. U.L. REV. ONLINE 74, 77 (2019) (suggesting that "curbing traffic stops (especially pretextual ones) could have significant benefits for members of minority communities, who are disproportionately targeted and harmed by these practices").

[268] *See supra* Part III.

[269] *See, e.g.*, Consumer Technology Association, Panel: Collaborative Driving and the Future of Trust in Mobility, Jan. 5-8, 2023, transcript available at https://www.ces.tech/videos/2020/collaborative-driving-and-the-future-of-trust-in-m.aspx ("Collaborative driving is a phrase is a phrase we have used more and more over the last one to two years because we think that the future will be one where the driver will be involved and engaged in the driving for many, many years to come."); Gary Witzenburg, *"Collaborative" Driving: Sharing Is Caring*, KELLEY BLUE BOOK, Jan. 1, 2019, at https://www.kbb.com/car-news/collaborative-driving-sharing-is-caring/ (defining "collaborative driving" as a system that "lets the car drive itself under ideal conditions but will warn and return control to the human driver on demand and when it senses it should" and falls "somewhere between Levels 2 and 3," on the SAE taxonomy).

[270] *See supra* Part I.

vehicle and human as a single system in evaluating whether the ultimate product is unreasonably dangerous.[271]

Under this approach, the question in a products liability lawsuit is not whether there is a particular defect in the technology, but rather whether there is a defect in the driving system. That is, the technology should not be evaluated under perfect conditions, and the court cannot assume perfect use—instead, the factfinder must evaluate how the system operates in practice with both human and technological contributions.

This approach means that responsibility for foreseeable misuse of the technology should not fall entirely on the driver. Factfinders, whether juries or judges, may be tempted to assign greater blame to the humans due to the "moral crumple zone" effect.[272] Lawyers litigating these cases should work to offset this tendency by explicitly educating factfinders about the ironies of automation.[273] To the extent that it is a natural human reaction to zone out or to place too much reliance on autonomous features, those tendencies must be included in the evaluation.[274] At the same time, to the extent that jurors may be biased against manufacturers, considering the human and the machine as a single system can help prime judges and jurors to consider how both sides contribute that ultimate effort.[275]

Considering perception-reaction time is also key—if the autonomous systems hands control back to the driver more quickly than the driver is mentally able to engage, then that is a fault with the system.[276] Defining the appropriate Operational Design Domain (ODD)

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[271] *See* Wendel, *supra* note 129, at (2019) ("The design-defect analysis of an accident involving a semiautonomous vehicle must therefore consider the vehicle and the human as a system, with each component playing a role in risk creation and mitigation.").

[272] *See* Elish *supra* note 224-225.

[273] *See supra* Part II.A.

[274] *Id.*

[275] *See* Rachlinski & Wistrich, *supra* note 227, at 761 ("[C]areful deliberative explanations could either smoke out indefensible biases that would otherwise impede the development of a safer technology or allow judges to explain why this new technology should be treated differently.").

[276] *See* Ennia Acerra, Margherita Pazzini, Navid Ghasemi, Valeria Vignali, Claudio Lantieri, Andrea Simone, Gianluca Di Flumeri, Pietro Aricò, Gianluca Borghini, Nicolina Sciaraffa, Paola Lanzi & Fabio Babiloni, *EEG-Based*

is closely related to issues of perception-reaction time. It's common for semi-automated systems to have restrictions on when they are safe to engage—for example, on divided highways in good weather, but without bright sunlight.[277] A system that may be relatively safe in such a situation can become unreasonably dangerous when conditions change not because of technological limits, but because of human limits.

For example, one observer criticized a recorded test of one semi-autonomous system, noting that the video showed "[h]ands-off driving at 100 kph, on an undivided winding country road, in close proximity to on-coming heavy trucks, in dazzling sunlight."[278] The author explained that because "[h]umans have a neuromuscular lag of about a half-second," if a problem had arisen "the driver would have to react instantaneously to correct any erroneous automated steering input to avoid a head-on collision with that truck"—a feat "that's essentially impossible with hands off the steering wheel."[279] When a later crash occurred under what appeared to be similar conditions, killing one person and injuring nine others, journalists raised questions about whether the "complete absence of design domain limits leading to the ability to operate hands-off on undivided country roads" contributed to the outcome.[280]

When a violation of the system's ODD can make a system unreasonably dangerous, it's especially important to be sure that the human driver knows when and where it is safe to engage the system. But, as a product evaluator for *Consumer Reports* points out, it's common for manufacturers to communicate this information by providing "pages of

Mental Workload and Perception-Reaction Time of the Drivers While Using Adaptive Cruise Control, *in* HUMAN MENTAL WORKLOAD: MODELS AND APPLICATIONS 236, 226-40 (Luca Longa & Maria Chiara Leva eds., 2019) (reporting the results of an empirical study finding that "[s]ubjects reacted more slowly to a safety-relevant brake task, when using [Adadptive Cruise Control]" and that "[w]hen the Adaptive Cruise Control was active, it caused distraction in the drivers who exhibited long reaction times").

277 *See* MacKenzie, *supra* note 55 (explaining the Mercedes Level 3 operational design domain)

278 Colin Barnden, *Unanswered Questions in the Aftermath of Fatal BMW Crash*, OJO-YOSHIDA REP., Aug. 23, 2022 *at* https://ojoyoshidareport.com/unanswered-questions-in-the-aftermath-of-fatal-bmw-crash/

279 *Id.*

280 *Id.*

legalese" in the owner's manual.[281] The burden is heightened because those instructions often specify where it's not safe to operate the vehicle, leaving the driver to do their best to interpret where it *is* safe.[282]

If the system isn't designed to work under certain conditions, then putting the burden on the driver to determine when the parameters of the ODD have been satisfied simply is "setting them up to fail . . . [and] just playing a game of gotcha."[283] Whenever possible, mechanical limits should preclude the driver from engaging the system in conditions and environments in which it is not designed to operate safely.[284] In a collaborative system, the driver needs reliability and clarity about the intended limits of the system.

B. Evaluate Software Updates

Part of analyzing a products liability claim is identifying the product. Traditionally, with product liability cases arising from car crashes, the product is defined as the car as well as any component part, such as airbags, tires, or seatbelts.[285] Although there is some debate about whether intangible software can qualify as a product,[286] the emerging judicial view appears to allow it.[287] The software running the semi-

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[281] *Kelly Funkhouser on Consumer Reports Active Driving Assistance Ranking*, AUTONOCAST: THE FUTURE OF TRANSPORTATION Ep. #272, Feb. 9, 2023, *at* http://www.autonocast.com/blog/2023/2/9/272-kelly-funkhouser-on-consumer-reports-active-driving-assistance-ranking

[282] *Id.*

[283] *Id.*

[284] *Id.*

[285] Webb, *supra* note 149, at 36 ("To date, automotive products liability law has adapted to cover new technologies as they entered the stream of commerce. At one time seatbelts, airbags, and cruise control were new technologies.").

[286] Ryan Calo, *Robotics and the Lessons of Cyberlaw*, 103 CALIF. L. REV. 513, 535 (2015) (suggesting that "products as understood by contemporary product liability law are by definition tangible—intangible products do not generally give rise to product liability actions").

[287] *See* Holbrook v. Prodomax Automation Ltd., No. 1:17-CV-219, 2021 WL 4260622, at *6 (W.D. Mich. Sept. 20, 2021), motion to certify appeal denied, No. 1:17-CV-219, 2021 WL 5052101 (W.D. Mich. Oct. 15, 2021) (concluding after analysis that because "the PLC programming is either a product itself or a component of the 100 line, also a product, the PLC programming constitutes a product under the [Michigan Product Liability Statute]").

autonomous system is likely to be considered a component product—and with the rise of "software defined vehicles," the software may indeed be the most important part of the vehicle.[288]

The key to a software defined vehicle is that the software can be regularly upgraded over time even without any action on the owner's part, and indeed, even without the vehicle ever leaving the owner's garage.[289] There is therefore "a continuing relationship between the product and the manufacturer," and "consumers' expectations are high that manufacturers must produce software updates."[290]

Evaluating the vehicle's software as a component part (and therefore a relevant product for products liability purposes) has two major impacts on the liability determination. First, it creates an incentive for regular software upgrades that improve safety. If the question in the lawsuit was whether the vehicle was defective when it left the factory floor, then the "state of the art" defense could foreclose manufacturer liability when programming weaknesses were later identified.[291] As the industry rapidly develops and the state of the art changes over time, manufacturers can and should ensure that their software incorporates

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[288] Stefano Lovati, *How Software-Defined Vehicles Are Redesigning Mobility*, EE TIMES EUROPE, Dec. 2, 2022 *at* https://www.eetimes.eu/how-software-defined-vehicles-are-redesigning-mobility/ (explaining that "[t]he transition to an SDV [software-defined vehicle] model will require significant changes from vehicle manufacturers and from anybody who will have to manage the vehicle throughout its useful life," including a requirement that "[t]he software must be continuously developed, and vehicle software updates must be allowed and distributed even after leaving the factory").

[289] Webb, *supra* note 149, at 64 (explaining thatan over-the-air software update "allows manufacturers to send software updates wirelessly as they develop, with little lag time, and at minimal cost").

[290] Robert S. Peck, *The Coming Connected-Products Liability Revolution*, 73 HASTINGS L.J. 1305, 1314 (2022).

[291] Bryant Walker Smith, *Proximity-Driven Liability*, 102 GEO. L.J. 1777, 1805 (2014) (discussing courts' historical skepticism of a post-sale duty to update and how that is changing with technological developments); *see also* Bryan H. Choi, *Crashworthy Code*, 94 WASH. L. REV. 39, 115 (2019) ("[T]he repeated exercise of having to defend how one's software fault tolerance compares to the state of the art would drive manufacturers to inspect and adopt new techniques at a faster clip.")

design principles to account for known safety risks.[292] In one example, Tesla was able to update its Autopilot system to account for foreseeable misuse by adding a feature "that removes the ability of the driver to use the semi-autonomous Autopilot system entirely for the remainder of a drive if the driver repeatedly fails to respond to alerts."[293]

The second effect of evaluating software upgrades individually is that it offers a somewhat broader path for forum selection. By reaching into the forum to upgrade the software, the manufacturer is engaging in jurisdictionally relevant contacts within the forum.[294] Lawsuits arising from or relating to that software could therefore be heard in the forum in which the upgrade occurred, even if the car was originally purchased elsewhere and even if the accident occurred elsewhere.[295] Broadening the available forums in which a lawsuit could be heard increases the chance that the plaintiffs will be able to find a forum in which all potentially liable defendants could be joined in a single suit.[296]

C. Pursue Fraud and Warranty Claims

When vehicle manufacturers engage in autonowashing, lawyers may be tempted to dismiss it as ordinary puffery. But when it comes to consumer vehicles, overpromising autonomous benefits carries a real risk that consumers will place too much trust in those systems, potentially putting at risk their own lives, their children's lives, and the lives of other people on the road.[297] Before such physical injury happens, a products liability claim is likely to be unavailable.[298] A claim for economic damages

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[292] Matthew Wansley, The End of Accidents, 55 U.C. Davis L. Rev. 269, 284 (2021) ("The process of developing AV software takes tremendous time and resources. But the process of implementing fixes to software is almost costless. All it requires is uploading the new code to the AVs' onboard computers.").

[293] *See generally* Pearl, *Hands On*, *supra* note 78.

[294] Ford Motor Co. v. Montana Eighth Jud. Dist. Ct., 141 S. Ct. 1017, 1024 (2021) (explaining that jurisdictionally relevant contacts occur when the defendant "purposefully avails itself of the privilege of conducting activities within the forum State") (quoting Hanson v. Denckla, 357 U.S. 235, 253 (1958)).

[295] *Id.* at 1031 (explaining that jurisdiction is appropriate when the defendant's contacts with the forum "are related enough to the plaintiffs' suits").

[296] *See supra* Part III.C.2.

[297] *See supra* Part II.

[298] Alissa del Riego, *Deconstructing Fallacies in Products Liability Law to Provide a Remedy for Economic Loss*, 58 AM. BUS. L.J. 387, 388 (2021) ("Products

is likely to be one for breach of warranty, fraud, or violation of statutory consumer-protection law.[299]

In recent decades, the judicial system has turned a somewhat skeptical eye to economic claims for defective products even outside of the products-liability context.[300] Because the potential damages are likely to be lower in an economic-loss case than in a personal-injury case, the claims are often brought as class actions.[301] Objections in economic-loss class actions often focus on the undercompensation of the consumers who suffered loss and as well as on the perceived overcompensation of the attorneys bringing the claims.[302] The perception of class actions is often that they are brought for the benefit of the attorneys litigating the case, not for the benefit of the consumers who were allegedly harmed—and that is especially true when the individual consumer harms are relatively minimal.[303]

Vigorous litigation of economic damages cases can have significant benefits, however. First, and most importantly, it can encourage manufacturers to internalize the cost of product defects before consumers are injured or killed.[304] When manufacturers bear the cost of their misstatements, it becomes financially inefficient to misrepresent autonomous capabilities—and that, in turn, can reduce the risk of

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liability law provides no remedy to consumers who suffer a purely economic injury as a result of purchasing defective products, regardless of the gravity of the defect or the manufacturer's knowledge or intent.").

[299] *Id.* at 389-90.

[300] *Id.* (explaining that the economic loss rule and defect manifestation requirements "have been applied to deny consumers compensation under breach of warranty, fraud, unjust enrichment, and *consumer protection laws, effectively denying consumers any recovery in some cases").

[301] *Id.* at 388.

[302] *Id.* at 397-98 (examining the objections to settlement in the Takata airbags litigation).

[303] *See, e.g.*, Andrew Faisman, Note, *The Goals of Class Actions*, 121 COLUM. L. REV. 2157, 2158 (2021) (describing the duelling views of class actions, in which "[o]ne side defends such class actions as a tool for providing access to justice and keeping the powerful in check," and "[t]he other side accuses them of enabling meritless litigation and bleeding money from corporations").

[304] *See, e.g.*, Abraham & Rabin, *supra* note 74, at 153 ("[T]he manufacturer will be in the best position to decide what to invest in designing the system by comparing (among other things) the cost of compensating losses for which it is responsible with the cost of including features that will help to avoid additional accidents").

downstream harm.[305] Lawyers litigating economic-damages cases on behalf of plaintiffs should therefore educate factfinders about the ironies of automation and the risks of autonowashing.[306]

Second, and related to the internalization of costs, the possibility of large-scale compensation for economic harm would likely further incentivize the manufacturer to provide regular over-the-air safety updates before they forced to do so by a regulatory agency. One scholar has explained that a forced software recall would likely result in a plausible warranty or contract claim.[307] And indeed, NHTSA very recently announced a recall affecting more than 360,000 Tesla vehicles equipped with FSD, stating that the feature "may allow the vehicle to act unsafe around intersections, such as driving straight through an intersection while in a turn-only lane," as well as "speeding, rolling through stop signs, and running yellow traffic lights "'without due caution.'"[308] NHTSA has ordered Tesla to "deploy an over-the-air ("OTA") software update at no cost to the customer" within "the coming weeks."[309] It remains to be seen whether Tesla will compensate drivers for the weeks in which they are unable to safely use the FSD features, but customers—who often paid $15,000 just for those features—would likely have a reasonable claim for compensation.[310] One way to avoid these claims is to voluntarily provide over-the-air upgrades as soon as the manufacturer recognizes areas for improvement, rather than waiting until regulatory officials issue a mandatory recall.

Finally, although warranty and fraud claims are not especially simple, judges and juries are likely to find them to be more accessible than

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305 Hubbard, *supra* note 155, at 1812 ("The goal is to create market incentives that internalize the costs of wrongdoing to the wrongdoer.").

306 *See supra* Part II.

307 Matthew Wansley, *Regulating Automated Driving*, 73 EMORY L.J. (forthcoming 2023) *at* https://papers.ssrn.com/sol3/ papers.cfm?abstract_id=4190688 ("If NHTSA were to force Tesla to restrict its ODD, Tesla owners would have a plausible claim that Tesla had breached its contract. In a conventional recall, when a manufacturer cannot repair the vehicle, it must replace it with an equivalent vehicle or refund the purchase price.").

308 Zipper, *supra* note 263.

309 *See* PART 573 SAFETY RECALL REPORT, NAT'L HWY. TRAFFIC SAFETY ADMIN, Feb. 15, 2023, *at* https://static.nhtsa.gov/odi/rcl/2023/RCLRPT-23V085-3451.PDF

310 Zipper, *supra* note 263 (noting the cost of FSD); Wansley, *supra* note 307 (suggesting a potential contracts claim).

products liability claims in automation cases. As scholar Tracy Hresko Pearl as pointed out, when it comes to autonomous features, "the technology outpaces the jurisprudence."[311] She warns that tort litigation can take "years of uncertainty" and that "problematic or nonsensical verdicts are likely to be side effects of this process."[312] A design defect claim, after all, likely requires the factfinder to understand the technology at issue, understand how the technology failed, and understand how it could have been better designed.[313] That's a tall order for non-industry specialists—and, with cutting-edge and quickly moving technology, likely even a tall order for expert witnesses. But contract and fraud claims, on the other hand, involve commercial reasonableness: that is, did the buyer get what he or she paid for?[314] That question is significantly more manageable for laypeople to evaluate.[315]

CONCLUSION

When partially autonomous vehicles crash, automakers have adopted the mantra that "the driver always remains responsible."[316] This deflection of responsibility is the flip side of Elon Musk's claim that "the person in the driver's seat is only there for legal reasons."[317] It was never

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[311] Tracy Hresko Pearl, *Compensation at the Crossroads: Autonomous Vehicles & Alternative Victim Compensation Schemes*, 60 WM. & MARY L. REV. 1827, 1855 (2019).

[312] *Id.*

[313] *See supra* Part III.

[314] Thus, for example, a vehicle can give rise to a breach-of-warranty claim for being unmerchantable due to an overly high center of gravity that creates an accident risk and makes the vehicle unfit for its purpose of "suburban driving and everyday road travel," but at the same time not give rise to a finding a product defect, as the vehicle's utility for off-road purposes outweighs the risk occurring in ordinary daily driving. Denny v. Ford Motor Co., 87 N.Y.2d 248, 259, 662 N.E.2d 730, 736 (1995); *see also* Sean M. Flower, Note, *Is Strict Product Liability in Tort Identical to Implied Warranty in Contract in the Context of Personal Injuries?* Denny v. Ford Motor Company, 62 MO. L. REV. 381, 398 (1997).

[315] *See* Marchant & Bazzi, supra note 153, at 106 (explaining that "[m]any lay people, including jurors, overestimate the risk and danger from unfamiliar, exotic technologies").

[316] *See BMW Confirms Fatal Crash, Says Car Wasn't Self-Driving*, REUTERS, Aug. 16, 2022, *at* https://www.reuters.com/business/autos-transportation/bmw-confirms-fatal-crash-says-car-wasnt-self-driving-2022-08-16/.

[317] *See* Jin *supra* note 1.

true that the car was capable of driving itself safely or without intervention.[318] But as a legal strategy, it is true that automakers are increasingly including advanced autonomy features in consumer cars with the expectation that the human driver will be legally responsible in the event of a crash.[319]

As lawsuits involving partial autonomy increase, the legal system will face growing challenges in incentivizing safe product development, allocating liability in line with fair principles, and leaving room for a nascent technology to improve in ways that, over time, may add substantial safety protections. This Article argues that the legal reality is likely to be less accepting of driver responsibility than the car manufactures might hope. Under current products liability and comparative fault doctrine, judges and juries will need to figure out how to allocate liability between the human driver and the vehicle's manufacturer.[320]

The Article develops a framework for considering how those policy goals can play a role in litigation involving autonomous features. It offers three key recommendations, including (1) that courts consider collaborative driving as a system when allocating liability; (2) that the legal system recognize and encourage regular software updates and (3) that customers pursue fraud and warranty claims when manufacturers overstate their autonomous capabilities. Claims for economic damages can encourage manufacturers to internalize the cost of product defects before, rather than after, their customers suffer serious physical injury.

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[318] *Id.* Even the most advanced ADAS system cannot be safely operated without significant human oversight. *See* Pearl, *Hands On*, *supra* note 78, 755 (2018) (explaining that "semi-autonomous vehicles rely on continuous human supervision to operate safely").

[319] Barnden, *supra* note 140; *see also* Widen & Koopman, *supra* note 70, at 232 (pointing to "[t]he ability to potentially sell advanced automation technology while still holding the driver responsible for any crashes").

[320] *See supra* Part III.