Santa Clara Law Review

Volume 52 | Number 4

Article 6

12-17-2012

The Coming Collision Between Autonomous Vehicles and the Liability System

Gary E. Marchant

Rachel A. Lindor

Recommended Citation

52 Santa Clara L. Rev. 1321

THE COMING COLLISION BETWEEN AUTONOMOUS VEHICLES AND THE LIABILITY SYSTEM

Gary E. Marchant* and Rachel A. Lindor**

TABLE OF CONTENTS

INTRODUCTION

Cars crash. So too will autonomous vehicles, a new generation of vehicles under development that are capable of operating on roadways without direct human control.[1] A critical factor with respect to the feasibility of such vehicles is how often and with what severity such crashes will occur. If autonomous vehicles have statistically more, or more severe, accidents than standard cars, then such vehicles will not be legally viable for widespread use. Judges and juries will

* Gary E. Marchant is a Regents' Professor, a Lincoln Professor of Emerging Technologies, a Law & Ethics Professor, and the Faculty Director of the Center for Law, Science & Innovation at the Sandra Day O'Connor College of Law, Arizona State University.

** Rachel A. Lindor is a graduate of the Sandra Day O'Connor College of Law at Arizona State University, Research Director of the Center for Law, Science & Innovation at the College of Law, and is currently completing her M.D. at the Mayo Medical School.

1. *See generally* Matthew Michaels Moore & Beverly Lu, *Autonomous Vehicles for Personal Transport: A Technology Assessment*, (Social Science Research Network, Working Paper, 2011), *available at* http://www.pickar.caltech.edu/e103/Final%20Exams/Autonomous%20Vehicles%20for%20Personal%20Transport.pdf.

likely treat a vehicle manufacturer who has substituted a riskier autonomous vehicle for a safer conventional vehicle harshly.

On the other hand, if autonomous vehicles reduce the frequency and/or severity of accidents, liability will still be an important and potentially limiting consideration for manufacturers. Liability, in that case, requires an analysis of three key factors. First, who will be liable? Second, what weight will the court's finder of fact give to the overall comparative safety of autonomous vehicles when determining whether those involved in a crash should be held liable? Third, will a vehicle "defect" that creates potential manufacturer liability be found in a higher percentage of crashes than with conventional vehicle crashes where driver error is usually attributed to be the cause? Depending on the answers to these questions, liability has the potential to present a significant deterrent to the development of autonomous vehicles, even though such vehicles would provide an overall safety benefit relevant to today's driver-controlled cars.

This Article assesses the potential interactions between legal liability and autonomous vehicles. It begins in Section I with a discussion of the relevant liability doctrine and precedents from other technologies that may indicate how judges and juries are likely to allocate liability for autonomous vehicle crashes.[2] Section II then examines who might be held liable for an autonomous vehicle crash.[3] Section III assesses the relative risk issues that are likely to be the key determinants of liability.[4] Finally, Section IV discusses some potential liability protections available to manufacturers.[5] These include the assumption of risk defense, potential legislative interventions limiting liability, and federal preemption of state tort claims.

I. LIABIITY DOCTRINE AND RELEVANT PRECEDENTS

There are two key doctrinal issues in determining tort liability for personal injury. First is the theory of liability.

2. *See infra* notes 6–19 and accompanying text.
3. *See infra* notes 20–31 and accompanying text.
4. *See infra* notes 32–56 and accompanying text.
5. *See infra* notes 57–74 and accompanying text.

Potential theories of liability include negligence, strict liability, and breach of implied warranty of merchantability. In the context of automotive crash injuries, negligence and strict liability are the two most common theories, usually raised in the alternative by plaintiffs. A negligence claim considers the reasonableness of the defendant's actions, usually measured in terms of industry standard of care or a cost-benefit analysis. Strict liability, in contrast, historically was intended to apply liability to a party that caused the injury, regardless of fault. Courts, however, have retreated from applying strict liability in its absolute form, instead tempering it with some sort of reasonableness consideration in most applications. To that extent, the standard for strict liability begins to converge with the standard for negligence, and thus the two are considered together in the discussion of defects and liability that follows below.[6]

The second issue in determining liability is the type of defect in the product which gives rise to the liability. The Restatement (Third) of Torts states that product liability requires that a product must be found to have at least one of three categories of "defect" before liability can be imposed.[7] The first category is a manufacturing defect, where the product "departs from its intended design even though all possible care was exercised in the preparation and marketing of the product."[8] This first category of defect is unlikely to apply very often to autonomous vehicles, since modern manufacturing methods, especially for critical components of autonomous vehicles such as the software and navigation systems, can be manufactured with low error rates. A second category of potential defect is a failure to provide adequate instructions or warnings, which applies "when the foreseeable risks of harm posed by the product could have been reduced or avoided by the provision of reasonable instructions or warnings . . . and the omission of the instructions or warnings renders the product not reasonably safe."[9] Most jurisdictions limit this duty to warn of risks that could be "reasonably" known at the time of sale. The manufacturer of an

6. The one difference is in manufacturing defects, discussed below, which does apply a true strict liability standard.

7. RESTATEMENT (THIRD) OF TORTS: PRODUCT LIABILITY § 2 (1997).

8. *Id.* § 2(a).

9. *Id.* § 2(c).

autonomous vehicle may, therefore, have a duty to disclose known risks of failure, including any known or suspected failure modes. Since the manufacturer of an autonomous vehicle will seek to engineer out, or at least understand, any risks involved in the vehicle, system or component failure, the required warnings should be quite limited. As such, the duty to disclose those risks should be relatively easily discharged in most cases.

The third and most significant type of defect for autonomous vehicles, as with many products, is a design defect. The standard for a design defect is that "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."[10] This is called the "risk-utility test."[11] An alternative test, called the "consumer expectation test,"[12] inquires what level of safety a reasonable consumer would expect from the product in question; yet this test is losing favor in many states, and is generally considered particularly inapplicable in cases involving the analysis of technical and scientific information.[13]

Autonomous vehicles have not yet been commercially deployed. Not surprisingly, there has not been any reported personal injury litigation regarding these products to date. There are, however, a number of analogous technologies that have been the subject of litigation. These cases may provide some useful hints as to how courts and juries are likely to apply the product liability doctrine to autonomous vehicles.[14] Industrial robots, for example, have played a role in a large number of employee injuries, resulting in the robots' manufacturers being named in a number of subsequent lawsuits. Though most incidents appear to be attributed to

10. *Id.* § 2(b).

11. Aaron D. Twerski & James A. Henderson, Jr., *Manufacturers' Liability for Defective Product Designs: The Triumph of Risk-Utility*, 74 BROOK. L. REV. 1061, 1065 (2009).

12. Douglas A. Kysar, *The Expectations of Consumers*, 103 COLUM. L. REV. 1700 (2003).

13. *E.g.*, Montag v. Honda Motor Co., Inc., 75 F.3d 1414 (10th Cir. 1996).

14. For additional discussion of such liability, see M. Ryan Calo, *Open Robotics*, 70 MD. L. REV. 571, 594–600 (2011).

the employees' failures to take proper safety precautions[15] or employees' decisions to disable available safety features of the machines,[16] these cases highlight manufacturers' vulnerability to lawsuits in accidents involving their products.

The dozens of suits brought against car manufacturers for accidents attributed to the cars' cruise control systems are more relevant to autonomous vehicles. Plaintiffs are often successful in alleging[17] that the cruise control systems caused the cars to unexpectedly accelerate and fail to respond to braking.[18]

Finally, airplanes capable of flying on "autopilot" (while also manned by a live pilot) provide a close analogy to autonomous vehicles. At least one case involving a collision of an auto-piloted plane has been litigated. While the plane that was controlled by autopilot was found to be the cause of the collision with another plane, the court attributed the error to the pilot rather than the design of the autopilot feature of the plane, with the judge opining that, "[t]he obligation of those in charge of a plane under robot control to keep a proper and constant lookout is unavoidable."[19] Whether these cases will have any relevance to the courts' treatment of emerging autonomous vehicle technology is difficult to predict.

15. *See, e.g.*, Payne v. ABB Flexible Automation, Inc., 116 F.3d 480 (8th Cir. 1997), in which employee was fatally injured by a robot used to construct automobile wheels after he failed to comply with safety measures requiring him to "lock out" the robot and to slow the speed of the robot before entering its 'cell.'

16. *See, e.g.*, Edens v. Bellini, 597 S.E.2d 863 (S.C. Ct. App. 2004), in which employee was fatally injured by a robotic shuttle used to transport wool, after the robot's operator disabled the pressure-sensitive safety mats that signaled the robot to stop automatically if they were triggered by someone stepping on them.

17. *See, e.g.*, Cole v. Ford Motor, Co., 900 P.2d 1059 (Or. Ct. App. 1995) (explaining that the jury awarded $375,000 to plaintiff whose car allegedly accelerated when the driver pushed the brake pedal, causing the driver to lose control and crash into a guard rail).

18. *See, e.g.*, Watson v. Ford Motor Co., 699 S.E.2d 169 (S.C. 2010); Ashley v. Gen. Motors Corp., 666 So.2d 1320 (La. Ct. App. 1996); Lawrence v. Gen. Motors Corp., 73 F.3d 587 (5th Cir. 1996).

19. Brouse v. U.S., 83 F. Supp. 373, 374 (N.D. Ohio 1949).

II. WHO WILL BE HELD LIABLE?

In a conventional vehicle crash, the accident is usually attributable to one of, or a combination of, three primary possible causes: (i) the driver; (ii) a vehicle malfunction or defect; and/or (iii) unavoidable natural conditions (weather, road conditions, animal on the road, etc). Any liability is usually allocated to one or both of the first two potential causes—the driver and the vehicle manufacturer. In a multi-vehicle crash, there may be two or more drivers and vehicle manufacturers involved, each of which could potentially be at fault in whole or in part, and therefore, potentially liable.[20]

Autonomous vehicles are likely to change the dynamics of who may be held liable. In considering these changes, it is first necessary to distinguish partial autonomous vehicles from completely autonomous vehicles. A partially autonomous vehicle could involve a range of various safety systems, such as a warning system that alerts the driver when the vehicle strays out of its lane or a collision avoidance systems that slows or stops the vehicle before it contacts another vehicle or object.[21] These partial autonomous systems will shift some, but not all, of the responsibility for accident avoidance from the driver to the vehicle, presumably reducing the risk of accidents (since that is the very purpose of the system). With a fully autonomous vehicle, however, the responsibility for avoiding an accident shifts entirely to the vehicle and the components of its accident avoidance systems.

The liability implications of an accident that results from a failure of a vehicle's accident avoidance system will be similar, regardless of whether the vehicle is partially or fully autonomous. When the driver has a choice to turn on the autonomous system and exercised that choice negligently, the apportionment of responsibility between the car and driver

20. In a study mandated by Congress of 5471 car accidents, the National Highway Traffic Safety Administration (NHTSA) found that 30.8% of accidents involved a single vehicle, 57.2% involved two vehicles, and 12% involved three or more vehicles. U.S. DEP'T OF TRANSP., DOT HS 811 059 NATIONAL MOTOR VEHICLE CRASH CAUSATION SURVEY: REPORT TO CONGRESS 17 (2008).

21. *See* NIDHI KALRA ET AL., LIABILITY AND REGULATION OF AUTONOMOUS VEHICLE TECHNOLOGIES 3–4 (2009) (California PATH Research Report UCB-ITS-PRR-2009-28); Sven A. Beiker, *Legal Aspects of Autonomous Driving*, 52 SANTA CLARA L. REV. 1145 (2010) (Report for the Center for Automotive Research at Stanford (CARS), Stanford University); Moore & Lu, *supra* note 1, at 6–8.

may be more difficult. For example, if the instruction manual instructed the owner not to use the autonomous vehicle in certain weather conditions, or on specific types of traffic patterns, but the owner does so anyway, the driver may be held at least partially at fault. Similarly, if the driver failed to utilize, or was negligent in utilizing an available over-ride mechanism to assume control of the vehicle,[22] he or she may be allocated some or all of the blame for a resulting accident. In most cases though, especially those involving a dedicated and totally autonomous vehicle, the driver is unlikely to be a factor in the liability determination.

Because drivers are found to be at fault in a large majority of current automobile accidents,[23] removing the driver from the liability equation in autonomous vehicles will have important implications. Of course, by removing driver error as a factor, the frequency of accidents should go down, which is one of the key potential benefits of an autonomous vehicle in the first place. When an accident does occur though, the vehicle manufacturer, or some other party involved in the design, manufacture, or operation of the autonomous vehicle is likely to be held liable for a higher proportion of the accidents. This will be more likely to occur with autonomous vehicles than it currently does with conventional vehicles.[24] In other words, when an autonomous vehicle does crash, most likely something went wrong with

22. Moore & Lu, *supra* note 1, at 8 (discussing switchable on-and-off autonomous control system).

23. In the National Motor Vehicle Crash Causation Survey, NHTSA found that driver factors was the primary cause of the accident in 5096 of 5471 accidents studied, whereas vehicle problems were the primary cause of 130 accidents, and road conditions or weather conditions were the primary cause of 135 accidents. U.S. DEP'T OF TRANSP., *supra* note 20, at 23–26.

24. D. RANDAL AYERS, VA. TRANSP. RESEARCH COUNCIL, VTRC 94-R6, TORT REFORM AND "SMART" HIGHWAYS: ARE LIABILITY CONCERNS IMPEDING THE DEVELOPMENT OF COST-EFFECTIVE INTELLIGENT VEHICLE-HIGHWAY SYSTEMS? 26–27 (1994), *available at* http://ntl.bts.gov/DOCS/ayers.html. There are two primary theories by which a vehicle manufacturer can be held liable for a vehicle accident. The first, and the one most relevant here, is that a "defect" in a vehicle caused or substantially contributed to the accident. The second theory, which may not be appreciably different for conventional and autonomous vehicles, is that deficiencies in the vehicle's "crashworthiness" result in greater injuries from an accident than should have resulted. *See* Haberkorn v. Chrysler Corp., 533 N.W.2d 373, 379–80 (Mich. App. Ct. 1995) (holding vehicle manufacturer had the duty to design its product to eliminate any unreasonable risk of foreseeable injury as a result of a collision).

the collision avoidance system or the vehicle encountered conditions that it was not adequately programmed to address.[25] Unlike a conventional vehicle crash, where the vehicle malfunction involves some sort of defect, such as a tire blowout or gas tank explosion, the malfunction in an autonomous vehicle will usually be a programming error or system failure that could implicate several different potentially liable parties.[26]

If an autonomous vehicle malfunctioned and caused an accident, one or more of several entities could be held liable.[27] The list of potential parties includes the vehicle manufacturer, the manufacturer of a component used in the autonomous system, the software engineer who programmed the code for the autonomous operation of the vehicle, and the road designer in the case of an intelligent road system that helps control the vehicle.[28] The various component parts and their respective roles in causing a malfunction may be hard to discern and separate for the purpose of assigning responsibility.[29] In most cases, it will be the vehicle manufacturer who will, for both practical and doctrinal reasons, be the party held liable for a crash involving an

25. *See* Moore & Lu, *supra* note 1 (discussing that the greatest impediments to autonomous vehicles is decision-making under conditions of uncertainty and operating the vehicle safely under unusual weather and environmental conditions).

26. *See* Beiker, *supra* note 21, at 1152 ("As the vehicle navigates itself through traffic, it makes 'mission-critical' decisions, which, in a narrow range of circumstances, can and will contribute to accidents. Such an event cannot necessarily be classified as a technical failure, however, the same way as, for instance, a damaged tire.").

27. *See* Mark H. Chignell et al., *The Principles of Caveat Vendor, Caveat Emptor and Caveat Operator in Robotic Safety*, 8 J. OCCUPATIONAL ACCIDENTS 79, 83 (1986) (discussing possible liable parties in accident caused by autonomous system generally).

28. This list assumes that the driver is not liable because it had no direct control over the functioning of the autonomous vehicle.

29. Wendell Wallach, *From Robots to Techno Sapiens: Ethics, Law and Public Policy in the Development of Robotics and Neurotechnologies*, 3 LAW, INNOVATION & TECH. 185, 194 (2011); Calo, *supra* note 14, at 597 ("It is extremely difficult to discover whether software, as opposed to hardware, is responsible for the glitch that led to an accident."). An additional complexity is that a truly autonomous system self-teaches new behaviors based on experience. Thus, the vehicle may act based on such self-learning to cause an accident that may have been inconsistent with the initial programming for which the manufacturer was responsible. *See* Robert Sparrow, *Killer Robots*, 24 J. APPLIED PHIL. 62, 70 (2007).

autonomous vehicle.[30] The practical argument is that the vehicle manufacturer will usually have the "deep pockets" that the injured plaintiff will seek to target. From a doctrinal perspective, the vehicle manufacturer, as the party ultimately responsible for the final product, will be the most likely party to be found liable. For example, the manufacturer of a component part is not liable for defects in the final product over which it had no control, although it is liable if the part was defective when the component left the manufacturer. A similar rule is likely to apply to the software engineer.[31] So, unless the component part or software engineer produced a product that was clearly defective, the vehicle manufacturer will be the party most likely to be fingered for liability, although there will likely be cases where other parties are sued.

One other dynamic that may be different in autonomous vehicle crashes is the "who is liable" category in the context of multi-vehicle crashes. In conventional vehicle accidents, an injured person usually sues the manufacturer of his or her own vehicle for failing to provide a crashworthy vehicle. There are scenarios where the first driver's vehicle malfunctions and causes the accident, in which the second driver may sue the manufacturer of the first vehicle for any injuries incurred as a result of the accident. But those scenarios tend to be the minority in conventional crash cases—most of the time an injured driver is suing the manufacture of his or her own vehicle. In a crash between two or more vehicles—where at least one vehicle is an autonomous vehicle, and a malfunction or ill-advised

30. For example, the manufacturer of a component is largely protected from liability for failure to warn when it is integrated into a sophisticated product. *See* RESTATEMENT (THIRD) OF TORTS: PRODUCT LIABILITY § 5 cmt. b (1997) ("The component seller is required to provide instructions and warnings regarding risks associated with the use of the component product. . . . However, when a sophisticated buyer integrates a component into another product, the component seller owes no duty to warn either the immediate buyer or ultimate consumers of dangers arising because the component is unsuited for the special purpose to which the buyer puts it.").

31. Computer programming is a service rather than a product, and thus the actions of a computer programmer will be evaluated under a negligence or malpractice standard rather than under products liability. Frances E. Zollers et al., *No More Soft Landings for Software: Liability for Defects in an Industry That Has Come of Age*, 21 SANTA CLARA COMPUTER & HIGH TECH. L.J. 745 (2005).

maneuver by that vehicle allegedly contributed to the accident—all injured persons in the accident are likely to sue the manufacturer of the autonomous vehicle.

III. RELATIVE RISK ISSUES

Relative risk issues are likely to be the most important variables affecting the liability exposure of autonomous vehicles, and consequently, their economic viability.[32] These relative risk issues apply in several layers. The first layer is the threshold question of whether autonomous vehicles will increase or decrease the frequency and severity of vehicle collisions. One of the key drivers pushing the development of autonomous vehicles is improved safety. It is therefore presumed that an autonomous vehicle would be safer than a conventional vehicle.[33] If, to the contrary, an autonomous vehicle raised net accident risks, it would likely not be viable for widespread use. A manufacturer that substitutes a riskier product for a safer product will generally expose itself to lawsuits and runaway liability.

Thus, absent exceptional circumstances or applications, autonomous vehicles will only be viable if they are safer than the conventional vehicles they replace. This follows from the presumption that safety is one of the primary motivating objectives of creating autonomous vehicles. As a *New York Times* story noted, "[r]obot drivers react faster than humans, have 360-degree perception and do not get distracted, sleepy or intoxicated . . . ."[34] But even if the autonomous vehicles are safer overall, compared to conventional vehicles, they will still be subject to liability when malfunctions or other failures result in accidents and associated injuries. Most accidents involving an autonomous vehicle will be the result of the autonomous system failing, because, as discussed above, there will not be a driver to blame for the accident.[35]

32. Relative risk is the ratio of the risk in the population of interest (in this case autonomous vehicles) divided by the risk in the background or control population (in this case, conventional non-autonomous vehicles). *See* Michael D. Green, *Expert Witnesses and Sufficiency of Evidence in Toxic Substances Litigation: The Legacy of Agent Orange and Bendectin Litigation*, 86 NW. U. L. REV. 643, 647 (1992).

33. *See* Moore & Lu, *supra* note 1, at 3–4.

34. John Markoff, *Google Cars Drive Themselves, in Traffic*, N.Y. TIMES, Oct. 9, 2010, at A1.

35. Of course there will be some accidents involving autonomous vehicles

There are many examples of products that have a net safety benefit that are still subject to liability when an injury results. The litigation against vaccine manufacturers, for example, clearly illustrates this paradox. The public health benefit of vaccines is undeniable, yet they are so frequently the source of lawsuits that federal preemption laws had to be passed to protect their manufacturers.[36] Even with these protections in place, vaccine manufacturers continue to be held liable for the rare instances in which their products cause injuries that do not fall within the protections of the federal legislation.[37] Automobile manufacturers have faced similar liability threats after incorporating various features designed to improve the safety of their automobiles, such as anti-lock braking systems[38] and airbags.[39] General Motors, for example, was sued by a woman and her family after the passenger-side airbags in their vehicle failed to deploy in a collision with an eighteen-wheeler, resulting in permanent and severe injuries to the woman.[40] Despite the fact that passenger-side airbags were not required by the National Highway Transportation Safety Commission at the time, the jury found the airbags to be defective and awarded the woman and her family $18.5 million in damages.[41]

Although the overall safety benefit of autonomous vehicles will not provide a complete liability shield, manufacturers of such products may be able to use this safety benefit in their defense. In many product liability cases, the manufacturer defends the safety of its product, and the plaintiffs attack its riskiness—by comparing the product to

---

that are the fault of the driver of the other vehicle, assuming it is not autonomous. This also assumes that the vehicle is fully autonomous and the passenger had no way to override the autonomous system, or that the vehicle was partially autonomous but the driver was not negligent in his or her failure to prevent or mitigate the autonomous system's error.

36. National Childhood Vaccine Injury Act, 42 U.S.C. §§ 300aa-1–300aa-34 (1986).

37. *See, e.g.*, Strong v. Am. Cyanamid Co., 261 S.W.3d 493 (Mo. Ct. App. 2007) (upholding a jury's $8.5 million verdict to a consumer who contracted paralytic polio from an oral polio vaccine).

38. Baluchinsky v. Gen. Motors Corp., 670 N.Y.S.2d 536 (App. Div. 1998).

39. *See, e.g.*, Morton International v. Gillespie, 39 S.W.3d 651 (Tex. Ct. App. 2001) (affirming trial court's $950,000 award to a woman who was injured when the deployment of her airbag was delayed during an accident); Gen. Motors Corp. v. Burry, 203 S.W.3d 514 (Tex. Ct. App. 2006).

40. *See Gen. Motors Corp.*, 203 S.W.3d 514.

41. *Id.*

alternative designs and competing products on the market. An example is the defense by General Motors ("GM") of its C/K pickup in a series of lawsuits in the 1990s.[42] Plaintiffs in these suits alleged that GM's placement of the gas tank on the side of the model, outside the vehicle frame, created an increased risk of fatal fires after side impacts. GM attempted to defend the safety of its vehicle with comparative analyses, contending that the overall crashworthiness of its vehicles was better than most vehicles on the road. GM further argued that even if its vehicles were prone to a slightly increased risk of fire fatalities from side impacts on the side with the gas tank, they had an equivalent or lower rate of fatalities and fire fatalities from all types of accidents.[43] There is an inevitable trade-off in the placement of the gas tank—putting the gas tank in one location (e.g., side of vehicle) increases the fire risk from impacts in that region of the vehicle, but also decreases the risks from impacts in other regions where the tank could have been located, but was not (e.g., the rear of vehicle).[44] This argument of overall superior safety was largely ineffective with juries, as they returned adverse verdicts against GM, including large punitive damages awards.[45]

Parties have also attempted to use comparative risk evidence in all-terrain vehicle ("ATV") litigation. The courts generally exclude the defendant from introducing comparative risk data showing the relative safety of ATVs compared to other recreational activities, such as riding snowmobiles and motorcycles, on the basis that such comparative risk evidence is irrelevant and unduly

42. *E.g.*, Gen. Motors Corp. v. Moseley, 447 S.E.2d 302 (Ga. Ct. App. 1994). *See* Terence Moran, *GM Burns Itself*, AM. LAW., Apr. 1993, at 68–83.

43. GENERAL MOTORS, EVALUATION OF THE SAFETY OF GM 1973-87 C/K PICKUP TRUCKS, PART I: INITIAL RESPONSE OF THE GENERAL MOTORS CORPORATION TO NHTSA LETTER OF APRIL 9, 1993 (Apr. 30, 1993) (copy on file with author); Moran, *supra* note 42, at 69, 78.

44. Walter Olson, *The Most Dangerous Vehicle on the Road*, WALL ST. J., Feb. 9, 1993, at A16, *available at* http://walterolson.com/articles/gmtrucks.html ("Any possible placement of the fuel tank 'causes' some accidents and averts others. Respectable designers have tried every gas-tank location at one time or another . . . . All have been rejected at other times as unsafe.").

45. Moran, *supra* note 42, at 81; Sam LaManna, *GM Verdict Could Affect Future Cases*, NAT'L L.J., May 3, 1993, at 21, 25; GM v. Moseley, 447 S.E.2d 302, 305 (Ga. App. Ct. 1994). Jury awarded $101 million in punitive damages against GM. *Id.*

prejudicial.[46] In cases where the plaintiff "opened the door" to such evidence by introducing reports on the statistical risks of ATVs, however, the defendant was permitted to introduce its comparative risk evidence to impeach the plaintiff's evidence and to argue against punitive damages.[47] Such comparative risk evidence, when allowed, seems to be effective for the defendant. Plaintiffs appealed (unsuccessfully) a verdict in their own favor, in at least one instance, to challenge the introduction of comparative risk information on rebuttal. The plaintiffs presumably concluded that the comparative risk evidence substantially reduced their recovery.[48]

An autonomous vehicle manufacturer could, therefore, try to defend its vehicle in court by demonstrating that the vehicle is safer overall than the conventional vehicles it replaces. This argument is likely to be unsuccessful when an accident was caused by a clear defect or malfunction in the vehicle design, especially if the defect could have been prevented or fixed by an alternative design. The cost-benefit (or risk-utility) argument will not depend on whether the at-fault autonomous vehicle is better overall than a traditional vehicle, but whether the autonomous vehicle technology could have been tweaked to make it safer. In principle, the cost-benefit analysis is based on the knowledge that the manufacturer had when the vehicle was manufactured. In practice, however, hindsight from the accident that actually occurred will inevitably provide new insights into how the technology could have been made safer, which will then be imputed to the manufacturer. Given the complexity of an autonomous system, a plaintiff's expert will almost always be able to testify (with the benefit of hindsight) that the manufacturer should have known about and adopted the alternative, safer design.

The manufacturer cannot possibly anticipate every possible scenario the vehicle will encounter, especially for a technology as complex as autonomous driving systems. For

46. Bittner v. Am. Honda Motor Co., 533 N.W.2d 476 (Wisc. 1995) (overturning verdict for defense based on improper admission of comparative risk evidence); Kava v. Am. Honda Motor Co., 48 P.3d 1170, 1172 (Alaska 2002) (upholding exclusion of comparative risk data in defendant's case-in-chief).

47. Hulmes v. Honda Motor Co., 960 F. Supp. 844, 864 (D.N.J. 1997); *Kava*, 48 P.3d at 1174.

48. *Kava*, 48 P.3d at 1173–74.

the situations it does anticipate, the manufacturer can usually design the system to minimize the risk of an accident. The problem is that most accidents will result from situations that the manufacturer or designer did not anticipate. This will open the manufacturer to second-guessing by the plaintiff's expert that an adjustment would have provided a safer alternative system that would have avoided the accident in question.[49] The manufacturer will almost always lose the cost-benefit argument, conducted in hindsight in the litigation context, when it focuses at the micro-scale between slightly different versions of the autonomous system. This is because the cost of not implementing the potential improvement will usually be severe—the loss of one or more lives or other serious injury, compared to the relatively small cost of the marginal improvement that might have prevented the accident.[50] The technology is potentially doomed if there are a significant number of such cases, because the liability burden on the manufacturer may be prohibitive of further development. Thus, even though an autonomous vehicle may be safer overall than a conventional vehicle, it will shift the responsibility for accidents, and hence liability, from drivers to manufacturers. The shift will push the manufacturer away from the socially-optimal outcome—to develop the autonomous vehicle.[51]

One final aspect of relative risk in liability determinations will be the jurors' (and to a lesser extent, judges') perceptions about autonomous vehicles. Liability determinations always involve an element of jury emotion and ethical response.[52] It is not clear how juries will respond to autonomous vehicles, especially with hindsight bias *after* the vehicle has been in an accident that has injured the plaintiff sitting before them. Some jurors may value the

49. If the accident was caused by an aspect of the autonomous vehicle that could not easily have been foreseen or fixed, and which involved a tradeoff inherent in moving to the safer autonomous design, the argument against liability will be much stronger.

50. Of course, from a prospective perspective, there are almost an infinite number of improvements that could be made to slightly improve safety. In many cases, these improvements will only appear justified *after* an accident has occurred. As is often stated, hindsight is perfect.

51. *See* KALRA ET AL., *supra* note 21, at 30.

52. *See* W. Kip Viscusi, *Jurors, Judges, and the Mistreatment of Risk by the Courts*, 30 J. LEGAL STUD. 107, 135 (2001); Erica Beecher-Monas, *Heuristics, Biases, and the Importance of Gatekeeping*, 2003 MICH. STATE L. REV. 987.

effort made by manufacturers in producing a complex technology product that provides overall safety and other benefits. Alternatively, jurors could perceive autonomous vehicles as a premature, and even reckless, foray that deserves to be soundly punished and deterred.[53] The latter reaction may be even stronger in the context of a lawsuit over an accident allegedly caused by an autonomous vehicle. There is some evidence that lay persons composing a jury are suspicious of unfamiliar and exotic-edge technologies, regardless of their actual probability of causing harm.[54] This research could be a concern for manufacturers of all novel high-tech products, including autonomous vehicles. Moreover, a phenomenon called "betrayal aversion" finds that people often have a strong emotional reaction against a safety innovation that actually causes harm, even if the net effect of the innovation is to improve safety.[55] For example, the jury verdict against GM for its C/K pickup case, involving an award of over $100 million in punitive damages, suggests that juries are prone to outrage against a high-tech manufacturer because of the increased risk created by one type of accident This result was reached even though the overall crashworthiness of the vehicle was equivalent or superior to most other vehicles on the road.[56]

IV. LEGAL AND POLICY PROTECTIONS

The above analysis suggests that liability may present a serious barrier for the production and development of autonomous vehicles, even if the products are socially beneficial overall. The shift in liability from drivers to manufacturers, notwithstanding the overall decrease in total accidents (and liability), may deter manufacturers from

53. Beiker, *supra* note 21, at 1152 ("Overreaction [by juries] is a clear danger . . . ."); Moore & Lu, *supra* note 1, at 5 (consumers will expect autonomous vehicles to function as safely or safer than driver-controlled vehicles).

54. Paul Slovic & Ellen Peters, *Risk Perception and Effect*, 15 CURRENT DIRECTIONS IN PSYCHOL. SCI. 322 (2006); Yuval Rottenstreich & Ran Kivetz, *On Decision Making Without Likelihood Judgment*, 101 ORGANIZATIONAL BEHAV. & HUM. DECISION PROCESSES 74 (2006).

55. Jonathan J. Koehler and Andrew D. Gershoff, *Betrayal Aversion: When Agents of Protection Become Agents of Harm*, 90 ORGANIZATIONAL BEHAV. & HUM. DECISION PROCESSES 244 (2003).

56. *Id.*

developing autonomous vehicle technologies.[57] Moreover, while manufacturers may be able to transfer some of those costs back to drivers through higher vehicle prices, the risk discounting that consumers apply, in which they undervalue products that reduce future risks, will prevent consumers from investing in such products at a socially optimal level.[58]

There are some possible legal and policy tools that may help protect manufacturers from liability. One such tool within the litigation system is the assumption of risk defense. Outside the litigation system, another tool is the pursuit of legislation that provides immunity or other defenses to manufacturers. Legislation could help minimize liability, or alternatively, the National Highway Safety Traffic Administration ("NHTSA") could promulgate regulations that expressly preempt state tort actions.

A. Assumption of Risk Defense

The assumption of risk defense provides that a product user who knowingly accepts the risks of a potentially hazardous product assumes some or all of the responsibility for any harm that may befall them from use of the product.[59] Such a defense requires that the product user understand and willingly assume the risks.[60] Thus, for such a defense to apply to autonomous vehicles, the manufacturer would have to fully disclose the potential risks of the vehicle, including the likely failure modes and some approximate sense of their probability. Such a defense would be stronger if the driver of an autonomous vehicle signed a written waiver accepting the risk of the vehicle. Even in these circumstances, however, courts often refuse to recognize the defense. Assumption of risk has been merged into the comparative negligence analysis and is no longer recognized as a separate defense in many states. The recent Restatement (Third) of Apportionment of Liability rejects a general non-contractual

57. AYERS, *supra* note 24, at 2.

58. *Id.* at 27–28.

59. Eric A. Feldman & Alison Stein, *Assuming the Risk: Tort Law, Policy, and Politics on the Slippery Slopes*, 59 DEPAUL L. REV. 259 (2010).

60. *E.g.*, Murphy v. Steeplechase Amuse. Co., 166 N.E. 173, 174 (N.Y. 1929) (holding that riders on an amusement ride assume the obvious risk of the attraction); Chepkevich v. Hidden Valley Resort, L.P., 2 A.3d 1174, 1186 (Pa. 2010) (holding that a skier assumed risk of injury from ski lift).

assumption of risk defense.[61] Moreover, even if the defense does apply, it would only extend to the owner and possibly passengers of the autonomous vehicle, not to the occupants of the other vehicle.

B. Legislative Protections

Another line of defense for autonomous vehicle manufacturers would be legislation at either the federal or state level that would protect against, or limit, liability.[62] The rationale for such legislative intervention would be supported by the fact that autonomous vehicles represent a socially beneficial technology that may be hindered by real or perceived liability concerns. Of course, providing such legislative protection from liability has its downside—it diminishes, if not eliminates, the incentives for manufacturers to make marginal improvements in the safety of their products in order to prevent liability. The net value and hence wisdom of such legislative interventions will therefore depend on how they are constructed and the balance they strike between these positive and negative incentives.

While it is relatively rare for legislatures to intervene to protect specific technologies or products from liability, there are some precedents regarding comparative technologies. At the federal level, Congress adopted legislation severely restricting the form and amount of liability that courts could impose from Y2K-related problems.[63] Similarly, Congress enacted the Price-Anderson Nuclear Industries Indemnity Act in 1957 to protect the nuclear industry from excessive liability from nuclear accidents.[64] The Oil Pollution Act of

---

61. RESTATEMENT (THIRD) OF TORTS: APPORTIONMENT OF LIABILITY § 2 cmt. f (2000).

62. *See* Wallach, *supra* note 29, at 194, 196 (discussing incentives of autonomous product manufacturers to seek legislation providing liability protection); Calo, *supra* note 14, at 601–09 (proposing limited immunity from liability for manufacturers of autonomous systems).

63. Year 2000 Responsibility and Readiness Act, Pub. Law No: 106-37 (1999) (limits Y2K liability in two ways: (a) by limiting it to proportional rather than joint and several liability; and (b) by requiring clear and convincing evidence of damage and limiting the amount of damages to the lesser of $250,000 or three-times compensatory damages). Y2K refers to the potential problems that were anticipated to result from computers failing to accurately interpret the date when the calendar reached the year 2000.

64. 42 U.S.C. § 2210 (2006).

1990 created the Oil Spill Liability Trust Fund, which sets caps on liability for oil spills.[65] The Public Readiness and Emergency Preparedness Act of 2005 provides drug makers with immunity from liability for injuries caused by vaccines during declared public health emergencies (e.g., avian flu epidemic).[66] The National Childhood Vaccine Injury Act was enacted in 1986 to limit liability for childhood vaccines, in response to concerns that liability would force many suppliers of such vaccines out of business.[67] The General Aviation Revitalization Act of 1994 immunized manufacturers of small planes and small plane parts from liability for a period of eighteen years in response to the potential for widespread bankruptcy in that industry.[68]

At the state level, several legislatures have adopted laws to limit liability in a number of different arenas. For example, many states have adopted laws that cap allowable damages in medical malpractice actions, largely in an effort to encourage physicians to continue to practice medicine in their states and to lower the overall cost of health care.[69] Similarly, almost all states have taken the initiative to place some limit on the amount of punitive damages that their courts can award.[70] These efforts illustrate states' propensity to ameliorate the liability concerns faced by vulnerable, but promising, technologies like autonomous vehicles.

C. State Preemption

A third possible protection for manufacturers of autonomous vehicles is federal preemption of state tort actions. In particular, a Federal Motor Vehicle Safety Standard, ("FMVSS") adopted by NHTSA, may preempt state tort actions that are in conflict with the standard. There are

65. 33 U.S.C. § 2704 (2006).

66. 42 U.S.C. § 329 (2006).

67. 2 U.S.C. §§ 300aa-1–300aa-4 (2006).

68. Pub. L. No. 103-298, § 2(a), 108 Stat. 1552 (1994) (codified at 49 U.S.C. § 40101 notes (2006) (cited in Calo, *supra* note 14, at 603 n.220).

69. FRED J. HELLINGER & WILLIAM E. ENCINOSA, U.S. DEP'T OF HEALTH & HUMAN SERVS., AGENCY FOR HEALTHCARE RESEARCH AND QUALITY: THE IMPACT OF STATE LAWS LIMITING MALPRACTICE AWARDS ON THE GEOGRAPHIC DISTRIBUTION OF PHYSICIANS 3 (2003), *available at* http://www.ahrq.gov/research/tortcaps/tortcaps.htm.

70. *Punitive Damages Reform*, AMERICAN TORT REFORM ASSOCIATION, http://www.atra.org/issues/punitive-damages-reform (last visited Apr. 20, 2012).

two obstacles to this protection. First, NHTSA has not adopted FMVSSs specific to autonomous vehicles. It is conceivable, however, that the agency may adopt such standards in the future if autonomous vehicles are likely to become prevalent and raise unique safety issues. The second obstacle is that most FMVSSs do not preempt state tort actions.[71] Courts have found preemption only in the narrow context where the state tort action actually interferes with the achievement of the objective of the federal standard.[72] In construing the federal government's objective behind a FMVSS, the courts looked at the regulation's history, NHTSA's contemporaneous explanation of the regulation's purpose, and the agency's current view of its preemptive effect.[73] Thus, if the agency so intended, NHTSA may be able to write and explain future safety standards for autonomous vehicles in a way that preempted some, or all, state tort actions.[74]

CONCLUSION

Autonomous vehicles will increase the safety of vehicle travel by reducing vehicle collisions. Ironically, autonomous vehicles are likely to *increase* the liability exposure of vehicle manufacturers. Autonomous vehicles will shift the responsibility for avoiding accidents from the driver to the vehicle manufacturer. Although the autonomous vehicle is expected to result in a net decrease in the number of accidents, it will create new modes of failure that will be attributed to the vehicle. These failures are likely to generate lawsuits against the vehicle manufacturer and possibly manufacturers of components of the autonomous system.

71. *See, e.g.*, Williamson v. Mazda Motor of Am., Inc., 131 S. Ct. 1131 (2011) (holding that the Federal Motor Vehicle Safety Standard, giving auto manufacturers the choice of installing either simple lap belts or lap-and-shoulder belts on rear inner seats, did not pre-empt state tort claims seeking to impose liability on manufacturer for installing simple lap belts on the rear inner seat of a minivan).

72. Geier v. American Honda Motor Co., 529 U.S. 861 (2000) (preempting state tort action alleging the failure to install air bags when federal standard only requires installation of air bags in some vehicles of the applicable model year).

73. *Id.* at 875–85.

74. It may also be possible to address some of the liability concerns discussed in this Article through innovative insurance policies, but such ideas are discussed elsewhere in this symposium issue.

Plaintiffs will target manufacturers because they will often be most at fault for the malfunction that caused the accident and they have the deepest pockets of all involved parties. Manufacturers of autonomous vehicles are likely to argue that their "fault" should be evaluated in a comparative context, with credit given to the net safety benefits of the autonomous vehicles. The history of such arguments made by manufacturers of other, safer, products suggest that this comparative or net risk assessment is unlikely to succeed. If that prediction comes true, and if autonomous vehicles have a significant rate of failure (likely in the initial years at least), liability may be a barrier that blocks the introduction of this socially beneficial new technology.

If this problem is serious enough, it may require greater use of an assumption of risk defense, legislative liability protection, or preemption, to ensure autonomous vehicles are not unduly impeded by liability concerns. Of course, one disadvantage of these approaches is that by immunizing the internalization of accident costs from vehicle manufacturers, they may reduce the pressure on manufacturers to make incremental improvements in the safety of their autonomous systems. Notwithstanding this limitation, it may be better to have autonomous vehicles sooner rather than later even if they are imperfect, given that even imperfect autonomous vehicles will be safer than vehicles on the road today.