LIABILITY CONSIDERATIONS WHEN AUTONOMOUS VEHICLES CHOOSE THE ACCIDENT VICTIM

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Abstract

In a few years, autonomous vehicles will be prevalent on roadways. These vehicles will be designed to operate without human intervention. Through the use of algorithms, a vehicle's on-board computer will determine who or what is hit by that vehicle if a collision is unavoidable. This article demonstrates that current product liability standards are inapplicable to the new technology of autonomous vehicles, and suggests alternative approaches for compensating the victim chosen by an autonomous vehicle in an unavoidable accident scenario.

I. Introduction

Autonomous vehicles that drive themselves independent of their human occupants are no longer the stuff of science fiction.[2] Semi-autonomous vehicles, *i.e.* those that use computers and sensors to detect

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[2] *See* David F. Klein, *New Roads: Impact of autonomous vehicles on law and insurance*, 28 NO. 41 WESTLAW J. INS. COVERAGE 1, 2-3 (2018) (explaining that as society is entering a new era of automation in transportation, there is a lack of understanding when it comes to the limits of the Level 3 automation available in vehicles); *See also* Matt McFarland, *Autonomous Vehicles are Coming. Now comes the hard part*, CNN TECH (Aug. 15, 2018), *archived at* https://perma.cc/GGS7-PFJ5 (explaining how self-driving cars are common already, and will shortly become a norm in society).

 ISSN 1536-7983.

and avoid potential collisions, are already on the road now and advertised by major car makers. As of 2013, various programs and tests related to autonomous vehicles were being run at 85 Asian locations, 159 European locations, 7 Oceana locations and 149 locations in North America, including in 22 different states.[3] Some experts believe that fully automated vehicles will be common on the roadways shortly after 2020, with 30% of all automobiles in operation being fully automated by 2025, and up to 70% of all vehicles being fully automated by2035.[4]

To be fully automated, a vehicle will have a set of sensors which would will detect and monitor other vehicles, and receive input about traffic flow and volume, road conditions and even weather conditions.[5] Autonomous vehicles will also share data with each other, "learning" from each other about factors which might affect that vehicle's trip.[6] An autonomous vehicle will also have an on-board computer, via the use of algorithms, which will maintain all aspects of the vehicle's operation, such as navigating the best route to the intended destination, or directing that vehicle's responses to hazards encountered during the trip.[7]

However, the software developed by manufacturers of these vehicles will not pre-define a vehicle's response to those hazards.[8]

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[3] *See International Survey of Best Practices in Connected and Automated Vehicle Technology 2013 Update*, CTR. FOR AUTOMOTIVE RES. (Aug. 2013), *archived at* https://perma.cc/2APZ-XEWC [hereinafter *International Survey of Best Practices*] (explaining the countries in the automotive data base include 85 entries from Asia, 159 from Europe, 149 for North America, and 7 for Oceania).

[4] *See* Matthias M. Schubert, *Autonomous Cars—Initial Thoughts About Reforming the Liability Regime*, GEN RE INS. ISSUES (May 2015), *archived at* https://perma.cc/MXU9-P2K9 (predicting that autonomous vehicles will be highly automated starting in 2020).

[5] *See* David C. Vladeck, *Machines without Principals: Liability Rules and Artificial Intelligence*, 89 WASH. L. REV. 117, 126 (2014) (characterizing autonomous machines as stronger, smarter, and sharper analytical programs that can essentially drive cars better than humans do).

[6] *See International Survey of Best Practices*, *supra* note 3 (analyzing how the Michigan Department of Transportation will coordinate data collected by autonomous vehicles).

[7] *See* Aakash Goel, *What Tech Will it Take to Put Self-Driving Cars on the Road?*, ENGINEERING.COM (Oct. 3, 2016), *archived at* https://perma.cc/TWK8-2BML (stating that adaptive cruise control sensors can use on-board sensors and contextual information to self-drive cars more efficiently on the roads).

[8] *See* Jonathan F. Feczko & Zachary J. Adams, *Defensive Driving for Manufactures in the Autonomous Revolution*, 28 NO. 34 WESTLAW J. INS. COVERAGE 02 (2018).

Rather, the software for autonomous vehicles will be given an ultimate goal by the manufacturer, such as (using an oversimplified example) "determine best response to impending collision," and the vehicle will decide via algorithms what the best response to a given situation will be.[9] Moreover, the computer will start learning from its environment the moment that vehicle leaves the sales lot, constantly running scenarios or experiments to determine possible outcomes based on the factors to which the vehicle is exposed.[10] Based on its own analysis of data and outcomes, the computer's algorithm, and thus the vehicle's response, will continually change with a unique response to any situation the vehicle might encounter. [11] The vehicle will also have the capacity to "learn" from other vehicles, and its algorithm will change to incorporate their responses to road situations.[12] As a result, the original manufacturer of an autonomous vehicle will not be able to

(acknowledging that vehicles have been tested to recognize whether they are in real world conditions or a lab, via software). For Volkswagen there is software installed in the car that satisfies government emission regulations if the care was operated in a laboratory setting. *Id*.

[9] *See* Mark A. Geistfeld, *A Roadmap for Autonomous Vehicles: State Tort Liability, Automobile Insurance, and Federal Safety Regulation*, 105 CALIF. L. REV. 1611, 1647 (2017) (purporting that machine-learning algorithms are the best way to achieve desired outcomes when programmers are inputting new software into vehicles of various traffic situations).

[10] *See* Michelle Sellwood, *The Road to Autonomy*, 54 SAN DIEGO L. REV. 829, 837 (2017) (commenting that autonomous vehicles are trained by human drivers to ensure that algorithms are adapted appropriately); *see also* Darrell Etherington, *Drive.ai uses deep learning to teach self-driving cars-and to give them a voice*, TECHCRUNCH (Aug. 30, 2016), *archived at* https://perma.cc/LW3T-KX4Z (reiterating that the more hours a car is driven and the more examples of situations, objects and scenarios the car is introduced to, the better the car can handle unexpected experiences); *see also* Carol Reiley, *Deep Driving*, MIT TECH.REV. (Oct. 18, 2016), *archived at* https://perma.cc/C7PB-CBQR (defining that the concept of "deep learning" addresses artificial-intelligence technology using examples to behave in the most appropriate responses).

[11] *See* Curtis E.A. Karnow, *The Application of Traditional Tort Theory to Embodied Machine Intelligence*, BEPRESS 1, 1-19 (Apr. 2013) (articulating that the software teaches itself by running experiments and implements results accordingly in order to achieve a certain goal).

[12] *See* Thorsten Luettel et al., *Autonomous Ground Vehicles—Concepts and a Path to the Future*, 100 PROC. OF THE IEEE 1831, 1837 (May 13, 2012) (explaining how the autonomous vehicle will have imitation learning capabilities and will have to cope with new situations accordingly); *see also* Karnow, *supra* note 11, at 4(Noting that the next step towards more complete autonomy is the vehicle's "learning how other vehicles look, like, and move").

predict at the time of manufacture the means by which an algorithm will make a decision.[13]

The decisions made by an autonomous vehicle in the face of an unavoidable collision will result in questions of liability that courts and legislatures have not heretofore faced.[14] In a hypothetical scenario, a vehicle driving around the sharp curve of a busy four-lane thoroughfare will confront an elderly lady jaywalking in the vehicle's lane.[15] The vehicle will sense that braking is not an option because the vehicle is going too fast.[16] The vehicle would have to choose among four possible outcomes: 1) hit the elderly lady; 2) cross over to the next lane, thereby crashing and striking a van of young Muslim doctors; 3) cross into oncoming traffic, thereby colliding with a school bus full of elementary children, or 4) run off the road and over a cliff, thereby avoiding the pedestrian and all traffic, but certainly resulting in the serious injury or death of the driver.[17] Any decision will result in grievous harm to someone.[18] The question for lawyers and a court will be who should be liable for the decision process that resulted in that harm.[19]

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[13] *See* Karnow, *supra* note 11, at 1 (discussing how the algorithm results in loops that create unpredictable behavior and the software teaches itself by running experiments to correct for error).

[14] *See* Jeffrey R. Zohn, *When Robots Attack: How Should The Law Handle Self-Driving Cars that Cause Damages*, 2015 U. ILL. J. L. TECH. & POL'Y 461, 473-74 (2015) (examining how civil liability will attach to accidents from autonomous vehicles as the laws relating to autonomous vehicles are passing slowly); *see also* Todd Spangler, *Self-driving cars programmed to decided who dies in a crash*, USA TODAY (Nov. 24, 2017), *archived at* https://perma.cc/M7JT-EJDC (criticizing how autonomous vehicles will prioritize lives of their passengers over anyone outside the car).

[15] *See* Amy Dockser Marcus, *How New Technology is Illuminating a Classic Ethical Dilemma,* WALLSTREETJ. (June 8, 2016), *archived at* https://perma.cc/Z6AN-DFG3 (explaining how the trolley problem, which expands on moral reasoning when saving certain people's lives in a dangerous situation, relates to autonomous vehicles).

[16] *See id*. (discussing the application of the trolley problem by utilizing a fMRI machines to evaluate subjects' brains where humans must decide who to cause personal harm too).

[17] *See id*. (analyzing the outcomes of personal and impersonal scenarios such as flipping the switch and saving the five men while killing yourself, or killing the five men and saving yourself).

[18] *See id*. (expanding on the fact that the trolley problem causes either one person to suffer or multiple people to suffer).

[19] *See id*. (setting forth the principle that our decisions have consequences, and regardless of the outcome lives will be lost).

If the hypothetical collision were the result of an outright defect in the vehicle or the software running the car, contemporary product liability law and legislation like the Uniform Commercial Code already provides the framework to analyze liability and damage issues.[20] Likewise, if the vehicle or software could have been designed to avoid the grievous harm or was below industry standards that would, if met have avoided the harm, legal standards already exist for determining the duty of care expected of the vehicle manufacturer to design a better vehicle.[21]

However, what should be the legal response if the algorithm is working exactly as intended, *i.e.* the vehicle had to be operated such that harm to someone was inevitable?[22] On what basis of liability should a manufacturer be liable because someone was intentionally, albeit correctly, harmed by that manufacturer's product?[23] What if others, whether it be the vehicle owner, a jury, or society in general, argue a different victim should have been chosen, based on economic factors, moral judgments, or even bigoted precepts.[24] Does the chosen victim have *any* grounds for recovery of damages caused by the intentional decision of the vehicle?[25] As will be discussed herein, the current framework of tort law simply cannot address these questions,

[20] *See* Sophia H. Duffy and Jamie Patrick Hopkins, *Sit, Stay, Drive: The Future of Autonomous Car Liability*, 16 SMU SCI. & TECH. L. REV. 453, 457 (2013)(opining that a "driver will be liable for their own actions in causing an accident, such as negligent or reckless operation of a vehicle"); *see also* Vladeck *supra* note 5, at 122 (explaining that vehicle's manufacturers may be liable if there is an accident with an autonomous vehicle, and may seek indemnity or contribution from other responsible parties).

[21] *See* Samir Chopra & Laurence F. White, A LEGAL THEORY FOR AUTONOMOUS ARTIFICIAL AGENTS 126 (Univ. of Mich. Press 2011) ("Software designers and commercial vendors who are negligently responsible for security vulnerabilities in their products could be held liable for the harm caused by cyber rogues who exploit such vulnerabilities.").

[22] *See* Karnow, *supra* note 11, at 1 (discussing the traditional tort theories of liability and how these theories will most likely be applied to the damage caused by robots).

[23] *See* Karnow, *supra* note 11, at 13 ("[T]he essence of the liability is that harm is especially likely to happen, harm that the defendant knows about, or should have known about; that is predictable.").

[24] *See* Marcus, *supra* note 15 (developing theories of liability rules based off the study of "trolleyology," which relates to the numerous problems that revolve around trolleys).

[25] *See* Karnow, *supra* note 11, at 11 (debating compensation of those involved in autonomous vehicle crashes due to the doctrine of strict liability possibly being imposed on members of the distribution chain).

because that framework does not work for products that are meant to change once they leave the manufacturer's control, and are not operated by humans, thus precluding any analysis based on a human-based duty of care.[26]

The most obvious answer is that algorithms will have to be designed to make decisions that are arguably always correct decisions.[27] The most obvious example might be vehicles which are programmed to always save the life of the vehicle's occupant, even if that means crashing into and possibly killing others.[28] Going a step further, what if the algorithm is programmed to make a decision based purely on the subjective desires of the vehicle's owner?[29] With sufficient sensors and computing capacity, a vehicle could determine at least the owner of the other vehicles in the hypothetical accident.[30] For example, a sensor might read the license plates of the van of Muslim doctors and, based on the name of the registered owner, conclude that one of the other vehicle's owners was from an ethnic group the driver hated, and thus that vehicle should face the most harmful outcome.[31] In either example, the algorithm will be working perfectly when it choices the victim.[32] But is introducing any bias into

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[26] *See* Karnow, *supra* note 11, at 14 (evaluating effectiveness of current tort law on the application of autonomous vehicles, which are constantly evolving with use and conform to a specific design).

[27] *See* Luettel, *supra* note 12, at 1832 (stressing the safety implications needed in autonomous vehicle algorithms before the vehicles can be sent out on the road).

[28] *See* Luettel, *supra* note 12, at 1837 (warning that unexpected situations may occur with autonomous vehicles and the vehicles will have to appropriately "cope" with the new situation).

[29] *See* Spangler, *supra* note 14 (suggesting an autonomous vehicle could make decisions based on the vehicle owner's safety, prioritizing the lives of its passengers over anyone outside the car).

[30] *See* Spangler, *supra* note 14 (expressing that there are redundancies for an autonomous car to learn in order to prevent danger).

[31] *See* Marcus, *supra* note 15 (illustrating that an owner's brain activity influences vehicle's decision making).

[32] *See* Luettel, *supra* note 12, at 1831 (discussing how autonomous vehicles can provide major improvements to vehicular traffic, such as creating a faster response time to traffic flow and lower pollution due to less fuel consumption); *see also* Marcus, *supra* note 15 (explaining how the trolley problem relates to autonomous vehicles due to decisions having to be made about harming a person in order to save others).

a decision otherwise based on an objective algorithm a wise choice, and if so, who should decide what is a "good" bias?[33]

Finally, it should be noted that this article focuses on vehicles driven on roadways.[34] However, other types of vehicles will be autonomous, ranging from heavy equipment at construction sites, to equipment used in mining and drilling operations, to ocean-going vehicles far from land.[35] Thus, these issues will be wide-ranging, reaching far beyond the U.S highway system.[36] That, in turn, means that the question of liability for the harm to the chosen victims of autonomous vehicles will become a frequent question in the near future across many societies, each with their own value systems, further complicating the answer to the question of liability for the decisions of autonomous vehicles.[37]

II. Liability for Collisions Resulting from Objective Algorithms: Why Traditional Legal Theories Do Not Work

Any analysis of liability for autonomous vehicle decisions should first start with the current legal theories that would apply to any tort resulting in personal injury.[38] Thus, the lawyer could assert the operation of an autonomous vehicle is an ultrahazardous activity.[39] The lawyer most certainly move beyond this almost archaic legal

[33] *See* Luettel, *supra* note 12, at 1832 (outlining real time capabilities of autonomous vehicles based on algorithms); *see also* Marcus, *supra* note 15 (considering human bias in the trolley problem).
[34] *See* Luettel, *supra* note 12, at 1831-32 (acknowledging the fact the autonomous vehicles are active on the roadways).
[35] *See* Luettel, *supra* note 12, at 1837 (introducing the idea that autonomous vehicles can be applicable in multiple fields such as construction, agriculture, and aquatic environments).
[36] *See* Luettel, *supra* note 12, at 1837 (outlining the obstacles for the intelligence to distinguish successful operations and harsh off-road environments).
[37] *See* Vladeck, *supra* note 5, at 120 (addressing that the issue in determining liability for autonomous vehicle's liability is determining whether the vehicle is the tool of the driver or a separate entity).
[38] *See* Karnow, *supra* note 11, at 14 (concluding that based on an in-depth analysis of both strict liability and negligence theories of liability, neither are well suited to answer questions of autonomous vehicle damages in a tort claim).
[39] *See* Karnow, *supra* note 11, at 14 (explaining that tort theories that depend the least on foreseeability, such as ultrahazardous activity and manufacturing defect, are poorly suited for injury caused by autonomous robots).

theory, and assert liability on the basis of product liability law.[40] The lawyer could argue that the algorithm's decision would be a breach of an express or implied warranty under the Uniform Commercial Code.[41] Finally, the lawyer might claim that an autonomous vehicle's manufacturer must be liable based on either the traditional law of negligence or the more modern law of strict liability for the harm caused by the algorithm's conclusions.[42] Since none of these theories are applicable to a product that is meant to change after it is manufactured, and is operated without human involvement, none of these existing theories can actually provide a basis for recovery by the accident victim.[43]

A. The Operation of an Autonomous Vehicle as an Ultrahazardous Activity?

The first ground, ultrahazardous activity, would create an illogical paradox if applied to the algorithm.[44] An ultrahazardous activity is one that poses a high risk of harm despite the reasonable efforts of a party to reduce risks, and creates a high risk of injury when harm occurs.[45] Those undertaking ultrahazardous activities become strictly liable for all damages arising from ultrahazardous activity, without any need for determining duty or fault. [46] The ultrahazardous

[40] *See* Karnow, *supra* note 11, at 11 (arguing that product liability better applies to the unpredictable actions of robots).
[41] *See* UCC § 2-313 (1977) (providing the definition of "Express Warranties" between seller and buyer); *see also* UCC § 2-314 (1977) (examining the usage of "Implied Warranty: Merchantability; Usage Trade"); *see also* UCC § 2-315 (1977) (defining the expectations of an "Implied Warranty: Fitness for Particular Purpose").
[42] *See* Karnow, *supra* note 11, at 12 (extending the liability for injury to manufacturers for faulty autonomous vehicles that depart from the intended design).
[43] *See* Karnow, *supra* note 11, at 14 (discussing that neither the theory of negligence nor strict liability is enough to punish legal entities dealing with autonomous robots because the defendants are not liable for "unknowable" risks).
[44] *See* Karnow, *supra* note 11 at 14 (rendering that it is illogical to blame the autonomous vehicle's algorithms on ultrahazardous activity because the incidents are foreseeable and therefore known to the vehicle).
[45] *See Ultrahazardous activity*, BLACK'S LAW DICTIONARY (10th ed. 2014) (defining: "An activity with a risk of serious harm that cannot be eliminated by the exercise even of the utmost care.").
[46] *See* Karnow, *supra* note 11, at 12 ("These activities and others are considered so inherently dangerous that the law makes those engaging in them in effect insurers to others who are hurt, without requiring proof of negligence or other types of fault."); *see also* RESTATEMENT (THIRD) OF TORTS: ABNORMALLY DANGEROUS ACTIVITIES

activity doctrine might seem to be appropriate to autonomous vehicles because the risk is inevitable even for the best-engineered autonomous vehicle, and that risk could often be fatal.[47]

However, the ultrahazardous activity doctrine will not apply to autonomous vehicles for two reasons.[48] First, an ultrahazardous activity is one that is uncommon, and in fact the moniker has more recently been changed to "abnormally hazardous" to reflect this element of uncommonality.[49] With autonomous vehicles eventually the primary vehicles on the roadway, decisions made by algorithms in the event of collisions will be daily occurrences, and so in no way "abnormal".[50] Second, and more importantly, an autonomous vehicle's design makes it safer than one driven by a human, since the algorithm controlling the car can act more quickly and more correctly than any human.[51] It is estimated that accident rates could plummet ninety percent as autonomous vehicles become prevalent.[52] It would be illogical to hold that a product that results in such dramatic decreases in accidents could be deemed "hazardous," let alone abnormally hazardous.[53]

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§20 (AM. LAW INST., 2010) (quoting: "An actor who carries on an abnormally dangerous activity is subject to strict liability for physical harm resulting from the activity.").

[47] *See* Karnow, *supra* note 11, at 13 (previewing that foreseeability takes affect with not only the three types of liability but also the doctrine of ultra-hazardous activity).

[48] *See* Karnow, *supra* note 11, at 14 (excluding the theories of ultra-hazardous activity and manufacturing defect applying to injury caused by autonomous robots).

[49] *See* Karnow, *supra* note 11, at 12 (noting that an activity may be deemed ultrahazardous if it is uncommon).

[50] *See* Karnow, *supra* note 11, at 7 (discussing how the autonomous vehicle will make real time decisions in unpredictable environments).

[51] *See* Karnow, *supra* note 11, at 9-10 ("Carelessness or negligence is made out when a reasonably prudent person 'ought to have known' that injury would result from the action.").

[52] *See* Tao Jiang et al., *Self-Driving Cars: Disruptive or Incremental?*, 1 APPLIED INNOVATION REV. 1, 8 (2015) (providing that it is estimated that car accidents will decline by 90% as autonomous cars become more wide spread and the number of product liability claims will decrease).

[53] *See* RESTATEMENT (SECOND) OF TORTS: ABNORMALLY DANGEROUS ACTIVITIES §520(f) (AM. LAW INST., 1977) (calling for a cost-benefit analysis when determining if an action is ultrahazardous); *see also* Kenneth W. Simons , *The Restatement (Third) of Torts and Traditional Strict Liability: Robust Rationales, Slender Doctrines*, 44 WAKE FOREST L. REV. 1355, 1356 (2009) (comparing the multifactor test of the Second Restatement to the straightforward two-factor test of the Third Restatement). For example, in the Third Restatement, eliminating the "value of

Nonetheless, the ultrahazardous doctrine might have some applicability to harm caused by algorithms.[54] Ultrahazardous activity is not banned outright because it has some value to society, even if that activity will inevitably result in damage to those exposed to the inevitable harm of that activity.[55] For this reason, those carrying out ultrahazardous activities are strictly liable for all the damages suffered by those harmed.[56] This same analysis could be applied to the damage caused by an algorithm in a vehicle crash, given that algorithms will reduce harm to society as a whole even as they inevitably result in harm to someone involved in an unavoidable accident.[57] As will be discussed herein, this analysis could be beneficial in determining the allocation of damages caused by an autonomous vehicle that worked as it should, but harmed someone nonetheless.

B. Product Liability

Turning to traditional product liability law, manufacturers of autonomous vehicles might be deemed liable for those harmed by vehicle crashes based on: 1) a manufacturing defect; 2) a design defect, or 3) the failure to warn of an inherent risk in the product.[58] However, before considering these grounds, one must determine if an algorithm which actually will cause the harm is even a "product" under product liability law.[59] An algorithm is, after all, a type of software, and in the

activity" factor in the Second Restatement has created a straightforward two-factor test, "that asks only whether the activity is uncommon and whether, even if all actors use reasonable care, the activity creates a significant residual risk." *Id*.

[54] *See* Simons, *supra* note 53, at 1360 (arguing that it is often difficult for courts to determine whether dangerous activities of questionable social value should have been engaged in at all).

[55] *See* Simons, *supra* note 53, at 1360 (providing how strict liability applies when an activity, such as owning a wild animal, is inherently dangerous).

[56] *See* Simons, *supra* note 53, at 1358 (defining strict liability and why dangerous activities may not be based on purely on negligence).

[57] *See* Simons, *supra* note 53, at 1360 (theorizing that owning a dangerous animal is ultrahazardous). This note suggests owning a dangerous animal is analogous to owning an autonomous vehicle for purposes of liability.

[58] *See* RESTATEMENT (THIRD) OF TORTS: CONTRACTUAL LIMITATIONS ON LIABILITY §2 (AM. LAW INST., 1998) (categorizing types of product defects).

[59] *See* 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) (cautioning that software errors will not apply when something is not a manufactured product).

recent past has been deemed not to result in anything "tangible"[60] and thus not a "product".[61] However, that conclusion has more recently been challenged.[62] Today, software will likely be deemed a product if installed in hardware that creates a tangible "package" of hardware and software at the time of sale.[63] An autonomous vehicle is, after all, hardware for a computer which also has an engine, wheels, a chassis and an interior designed for passengers.[64] Therefore, the algorithm in an autonomous vehicle should indeed be considered a "product" that can be found to contain a manufacturing defect.[65]

1. Manufacturing Defects

With that question answered, one can turn to the first grounds for product liability, a manufacturing defect.[66] One quickly can see that an algorithm cannot be considered to contain a manufacturing

[60] *See* RESTATEMENT (THIRD) OF TORTS: ASSIGNMENT OF RESPONSIBILITY: JOINTLY AND SEVERALLY LIABLE DEFENDANTS §19(a) (AM. LAW INST., 1998) (indicating that for something to be a "product" it must be "tangible").

[61] *See* Jeffrey K. Gurney, *Sue My Car, Not Me: Product Liability and Accidents Involving Autonomous Vehicles*, 2 J. LAW, TECH. & POL. 247, 259 (2013) (noting that the manufacturing defect doctrine does not apply to software because it is not tangible).

[62] *See* Jody Armor & Watts Humphrey, *Software Product Liability, Technical Report*, CARNEGIE MELLON SOFTWARE ENG. INST. (1993) (indicating that there is evidence that most courts will consider a software program a product, and an improperly executed product could have harmful consequences); *see also* Lawrence B. Levy & Suzanne Y. Bell, *Software Product Liability: Understanding and Minimizing the Risks*, 5 BERKELEY TECH. L.J. 1, 3-5 (1990) (discussing courts' recent interpretations of the classifications of software's being considered a good or a service).

[63] *See* Lori A. Weber, *Bad Bytes: The Application of Strict Products Liability to Computer Software*, 66 ST. JOHNS L. REV. 469, 473 (2012) (explaining when software will likely be considered a sale of goods if there is a corresponding hardware package provided). However, if there is custom programming, then the software program may be a service. *Id*. at 473.

[64] *See id.* at 474 (noting that software programs are considered "good" under the Uniform Commercial Code, but it has not been addressed as to whether a software program is a "product" under the *Restatement*).

[65] *See id.* at 474 (addressing that commentators generally have stated that if a software is a "good," then it must be a "product.").

[66] *See* Sunghyo Kim, *Crashed Software: Assessing Product Liability for Software Defects in Automated Vehicles*, 16 DUKE L. & TECH. REV. 300, 304 (2018) (listing that the three categories of defects under the product liability theory are manufacturing defects, design defects, and warning defects).

defect simply because a plaintiff might disagree with the decision made by a vehicle's algorithm.[67] For a product to have a manufacturing defect it must be found to have "departed from the intended design" of the product.[68] That departure can be demonstrated by showing that the product failed to meet manufacturer specifications or industry standards.[69] However, assuming that an autonomous vehicle's sensors worked appropriately and the algorithm processed the data properly, the final decision of the algorithm is not evidence of a defect just because someone was hurt or killed.[70] The "intended design," after all, will be for the vehicle to crash into someone or something if a crash is unavoidable.[71]

Of course, the harmed person could assert that vehicle would have a made a better decision if the algorithm had been designed to process data differently, or that the vehicle sensors could have been able to differentiate potential crash targets.[72] For example, perhaps it would have been better for the vehicle to crash into a bridge abutment rather than run down the jaywalker, because adequately working sensors would have caused the algorithm to conclude the vehicle

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[67] *See id.* at 305 (describing that in order to succeed in demonstrating that a product malfunctioned, a plaintiff needs to prove that the product malfunctioned, the malfunction occurred during proper use, and the product had not been altered or misused in a manner that probably caused the malfunction).

[68] *See* RESTATEMENT (THIRD) OF TORTS: CATEGORIES OF PRODUCT DEFECT § 2(a) (AM. LAW INST., 1998) (outlining the different categories of product defects).

[69] *See* Gurney, *supra* note 61, at 258 (explaining that a manufacturing defect occurs "when the product does not meet the manufacturer's specifications and standards").

[70] *See* 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, 238 (2016) (asserting that the crash-optimization algorithm does not always prove that a car manufacturing defect has occurred); *see also* Justin Thomas, *Putting Programmers in the Driver's Seat: State Tort Systems Applied to Autonomous Automobiles*, 93 U. DET. MERCY L. REV. 553, 554 (2016) (noting that the occurrence of accidents is not necessarily indicative of defects).

[71] *See* RESTATEMENT (THIRD) OF TORTS: CATEGORIES OF PRODUCT DEFECT § 2(a) (AM. LAW INST. 2012) (defining a manufacturing defect as "when the product departs from its intended design even though all possible care was exercised in the preparation and marketing of the product").

[72] *See* Gurney, *supra* note 61, at 259 (indicating that a plaintiff can show a manufacturing defect without proving the specificity of the defect through other circumstantial evidence).

occupant could survive the crash.[73] However, that argument turns the analysis into a standard product liability case because the question becomes about whether the sensors or algorithm met industry standards, as opposed to the decision itself.[74] How both those standards are set could be a challenge, as will be discussed later.[75] In the meantime, assuming the vehicle met industry standards and operated properly within the limitations of the vehicle's sensors and software, the decision cannot be evidence of a manufacturing defect, since that decision was the result of a fully functional algorithm.[76]

Perhaps a more fundamental reason that the decision cannot be considered a manufacturing defect is because the manufacturer of an autonomous vehicle will have had no connection to that decision.[77] A manufacturer is only liable for defects existing "at the time of sale."[78] Indeed, the normal proof of a manufacturing defect is to show that, at the time of its sale, the allegedly defective product deviated from the manufacturer's other products at their time of sale.[79] Algorithms are, by their nature, intended to change over time.[80] In fact, the better the algorithm and the sensors which feed it data, the more that algorithm will make decisions completely independently from the original manufacturer.[81] Moreover, because each vehicle will be exposed to

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[73] *See* Gurney, *supra* note 61, at 261-62 (providing a situation where the algorithmic formula may cause a vehicle to make a detour into an area that may cause damage to your vehicle or the driver).

[74] *See* Gurney, *supra* note 61, at 258 (requiring that in product liability cases a plaintiff must prove that the product does not conform to the industry standards).

[75] *See infra* Section II. A.

[76] *See* Gurney, *supra* note 61, at 261 (explaining that manufacturers need not make "perfectly safe goods," but rather must meet industry standards).

[77] *See* Gurney, *supra* note 61, at 259 (detailing that manufacturers have no connection to software manufacturing defects because nothing tangible is manufactured).

[78] *See* RESTATEMENT (THIRD) OF TORTS: CATEGORIES OF PRODUCT DEFECT § 2 (AM. LAW INST., 2012) (outlining that a manufacturer is strictly liable for harm caused by manufacturing defects that are prior to the sale of the item because the manufacturer is in a better position to correct the problem).

[79] *See* Michael J. Toke, *Restatement (Third) of Torts and Design Defectiveness in American Products Liability Law,* 2 CORNELL J. L. & PUB. POL. 239, 241 (1996) (stating that the defective product can be compared against ostensibly identical units from the same product line).

[80] *See* Harry Surden & Mary-Anne Williams, *Technological Opacity, Predictability, and Self-Driving Cars*, 38 CARDOZO L. REV. 121, 147 (2016) (recognizing that computer algorithms can "learn" or improve in performance over time).

[81] *See id.* at 148 (analyzing that data received through the sensors enable algorithms to learn an association and function on their own).

different driving factors, and share data with different sets of vehicles encountered on the road, every vehicle will inevitably change after it leaves a manufacturing plant.[82] Finally, since the environment to which a vehicle is exposed is completely unpredictable, the algorithm's response to that unpredictable environment will be for the algorithm to become even more unpredictable.[83] So, by the time the collision occurs, the decision that is being challenged would be the result of an algorithm that is different from the one installed by the manufacturer, and that decision would be completely unpredictable by the manufacturer.[84] Therefore, the algorithm could in no way be considered defective "at the time of sale" to the consumer.[85]

The fact that an algorithm is intended to be ever-changing does raise some interesting product liability questions.[86] First, it could be argued that if the algorithm never changed, it in fact would not meet industry standards for autonomous vehicles, and thus would be considered a manufacturing defect.[87] That means the more an algorithm changes in a vehicle, the less likely that it can be considered a defective product, even though each change removes the manufacturer further from liability.[88]

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[82] *See id.* at 142 (articulating how autonomous vehicles perceive and understand their surrounding physical environment). Specifically, an autonomous vehicle will have three primary determinations- where the vehicle is located (both generally and specifically), what objects are around the vehicle, and the major driving features. *Id*.

[83] *See* Karnow, *supra* note 11, at 8 (noting that the adaptive robots will take unpredictable actions that could subject them to tort liability).

[84] *See* Andreas Matthias, *The Responsibility Gap*, 6 ETHICS AND INFO. TECH. 175, 183 (2004) (evaluating manufacturing liability in the context of an autonomous vehicle making decisions based on the programed algorithm outside of an expected and pre-programed scenario); *see also* Karnow, *supra* note 11, at 14 (explaining how manufacturers should not be held liable for manufacturing defects based on the "failure to warn" doctrine).

[85] *See* Matthias, *supra* note 84, at 183 (acknowledging the flaws in system programing and how there will be unavoidable errors in which the operational system cannot be held accountable for at the time of sale); *see also* Karnow, *supra* note 11, at 14 (determining that automatic machines become defective after leaving the manufacturer).

[86] *See* Karnow, *supra* note 11, at 14 (discussing where to impose liability on changing algorithms).

[87] *See* Karnow, *supra* note 11, at 13-14 (noting that the focus is on the foreseeable risk in whether the defendant knew or should have known at the time of sale).

[88] *See* Karnow, *supra* note 11, at 14 (recognizing the difficulty of holding manufacturers liable when an autonomous robot does not conform to the manufacturing defect liability principle).

Second, an algorithm improves as the vehicle senses data, obtains input from other vehicles, and, as a result, modifies its decision-making process over time.[89] However, the ability to undertake these complicated processes would be limited by the vehicle's on-board computer, not the algorithm.[90] Thus, if the collision caused by the algorithm is subject to a claim of a manufacturing defect, the defect could be found in the on-board computer, not the algorithm.[91]

Third, it is conceivable that some vehicles might be manufactured with less powerful computers, fewer sensors, or less robust algorithms in order to make them cheaper and thus more competitive.[92] Under product liability law, a computing device can be found defective if it runs below industry standards, especially in terms of safety components.[93] Thus, those vehicles which were cheaper to the detriment of the algorithms making collision decisions might be deemed defective, because they did not meet the computing standards necessary for an algorithm to make the "right" decision.[94]

Finally, an algorithm needs a "learning curve," during which the algorithm obtains increasing amounts of data, shares information with other vehicles, and runs alternative scenarios.[95] This begs the question, how much time should an algorithm be allowed before it is deemed defectively underdeveloped?[96] Moreover, if the vehicle

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[89] *See* Matthias, *supra* note 84, at 183 (providing that algorithms adapt through their environment).

[90] *See id*. at 183 (expounding on the limitations of autonomous vehicle algorithms and their ability to adapt to dynamic and complex situations and environments).

[91] *See* Goel, *supra* note 7 (stating that computer systems may have radar-based sensors that contain information from satellites).

[92] *See* Eugene Volokh, *Tort Law vs. Privacy*, 114 COLUM. L. REV. 879, 882 (2014) (arguing that when technologies become cheap enough, it becomes plausible to claim that a manufacturer is negligent for designing a deadly machine if it fails).

[93] *See id.* at 882 (acknowledging that manufacturers must take reasonable precautions to prevent harm).

[94] *See id.* at 885 (setting forth the idea that as these technologies become cheaper and more accessible, they will also be the subject of more tort claims for negligent manufacturing).

[95] *See* Matthias, *supra* note 84, at 183 (highlighting that the rules by which autonomous vehicles act are not fixed during the production process but can be changed during operation by the machine itself).

[96] *See* Matthias, *supra* note 84, at 179 (observing that autonomous vehicles adapt their behavior through errors and question the point at which too many errors are a product flaw).

encounters an unavoidable accident before it has fully "matured," is it to be considered defective, or would such algorithms be treated on an escalating scale of expectations, much like analyses under the liability of a minor for a tort?[97]

Again, these queries all ultimately turn on whether the underlying hardware or software meet industry standards, which is not the focus of this article.[98] Despite the modern nature of hardware and software, traditional manufacturing-defect analysis can answer such queries.[99] None of these questions provide an answer to the issue at hand, *i.e.* what if the algorithm functioned properly, but the end result is not what a plaintiff, or even society wants.[100] That issue, for the reasons stated above, is not resolved using a traditional manufacturing defect argument.[101]

2. Failure to Warn

Moving on from a manufacturing defect argument, the next consideration is a claim of a failure to warn.[102] A product is defective if: a) that product has foreseeable risks; b) those risks could have been avoided or lessened had the manufacturer given the consumer adequate warnings and/or instructions to avoid the risks; and c) without those warnings the product is unreasonably unsafe.[103] However, in most jurisdictions, a manufacturer need not warn of an open and obvious

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[97] *See* Matthias, *supra* note 84, at 182 (addressing the issues of fault when comparing autonomous vehicle learning systems as ones that need to progress through experience).

[98] *See* Matthias, *supra* note 84, at 182 (indicating that the programmer loses more and more control over the finished product).

[99] *See* Gurney, *supra* note 61, at 263 (demonstrating how the risk utility test determines a product is defective when the benefits of altering a design are outweighed by the cost of such an alteration).

[100] *See* Gurney, *supra* note 61, at 264 (reasoning that plaintiff's will more likely succeed in cases involving the design of tangible features rather than the vehicle software).

[101] *See* Gurney, *supra* note 61, at 259 (outlining the necessary steps a plaintiff must take to assert a traditional manufacturing defect argument).

[102] *See* RESTATEMENT (THIRD) OF TORTS: CATEGORIES OF PRODUCT DEFECT §2(C) (AM. LAW INST., 1998) (articulating that a design can be defective because of inadequate instructions or warnings when there are foreseeable risks).

[103] *See* Gurney, *supra* note 61, at 264 (illuminating that manufactures can reduce the risk of defective products by providing basic warnings about foreseeable harm).

risk.[104] Since it is inevitable that an autonomous vehicle, faced with an unavoidable accident, will cause someone harm, the risk of the algorithmic response is obvious, and thus the failure to warn doctrine would be precluded.[105]

Even if the open-and-obvious doctrine does not act as a bar to a failure to warn claim, the failure-to-warn doctrine will still be inapplicable because the warning will not affect either the owner or occupant of the vehicle or the product operation itself.[106] Before a warning can be questioned for adequacy, it must be shown that the warning would have altered a user's interaction with the product.[107] However, in the case of a truly autonomous vehicle, any use of the product is completely passive.[108] If a vehicle is operating autonomously, no warning will have any effect on the owner or user of the vehicle.[109] Likewise, since the algorithm will function completely independent of a warning to a human, a warning to a human will never alter the product function in any way.[110] Thus, no warning could make the challenged choice of victim avoidable or less likely to happen, and no liability arises under a failure-to-warn analysis.[111]

The only warning that would prevent the vehicle from making the wrong decision is one that is concurrent with turning control back

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[104] *See* James P. End, *The Open and Obvious Danger Doctrine: Where Does It Belong in Our Comparative Negligence Regime?*, 84 MARQUETTE L. REV. 445, 462-466 (2000) (excluding the warning of an open and obvious risk from the responsibilities of the manufacturer).

[105] *See* Aaron D, Twerski & James A. Henderson Jr., *Fixing Failure to Warn*, 90 IND. L. J. 237, 255 (2015) (iterating that the failure-to-warn doctrine is irrelevant because autonomous vehicles inevitably cause people harm).

[106] *See* Twerski & Henderson, *supra* note 105, at 256 (clarifying the failure-to-warn doctrine is inapplicable because the issue becomes one for the trier of fact).

[107] *See* Twerski & Henderson, *supra* note 105, at 246 (explaining that it must be shown that the owner of the vehicle altered use of the product due to the warning).

[108] *See* Jiang, *supra* note 52, at 3 (contrasting the differences between vehicles that requires human control versus that of an autonomous self-driving car).

[109] *See* Spangler, *supra* note 14 (pointing to the fact that when a car is acting autonomously, the driver does not have an influence on its split-second decision-making).

[110] *See* Spangler, *supra* note 14 (questioning the potential conflict of who is responsible when an accident occurs based on the computerized decision-making inputs).

[111] *See* Spangler, supra note 14 (providing an example of a situation where regardless of the computer's programming, the accident inevitably will result in death).

to the occupant, such as "COLLISION AHEAD! TAKE OVER CONTROL OF VEHICLE!"[112] However, that would only serve to turn control of the vehicle to the less capable driver, which would certainly make the vehicle statistically less safe.[113] Moreover, it is not the warning that would prevent the harm, but rather the physical act of turning the vehicle over to the driver which might result in a different outcome.[114] Thus, a failure to provide this warning would have nothing to do with the harm that was caused, and a failure-to-warn claim is simply inapplicable to the question of liability arising from the decision made by the autonomous vehicle.[115]

3. Design Defect

The final grounds under standard product liability law is a claim of a design defect.[116] A product has a design defect when: a) a reasonable alternative design to the one sold to the consumer was available; b) the failure to adopt the design rendered the vehicle unsafe; and c) the foreseeable risks of harm caused by the product could have been reduced or avoided by an alternative design by the seller.[117] In the case of an autonomous vehicle, a plaintiff might assert that the contested outcome might have been "better" if the algorithm had been

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[112] *See* Olivia Solon, *Who's driving? Autonomous cars may be entering the most dangerous phase*, THE GUARDIAN (Jan. 24, 2018), *archived at* https://perma.cc/4P4D-AZYT (pointing out the limited abilities of computer programming in self-driving cars).

[113] *See id*. ("[W]hen the car encounters a situation where the human needs to intervene, the driver can be slow to react.").

[114] *See id*. (reiterating that when control needs to be returned to the human operator, they "were not monitoring the roadway carefully enough to be able to safely take control when needed").

[115] *See id*. (offering an example where the car is "fully autonomous" and the operator relies too heavily on the autonomy of the self-driving car).

[116] *See Products Liability*, WEX LEGAL DICTIONARY/ENCYCLOPEDIA (2018), *archived at* https://perma.cc/C8X5-Q59D (highlighting that the three types of product defects that incur liability in manufacturers and suppliers are design defects, manufacturing defects, and defects in marketing).

[117] *See* RESTATEMENT (THIRD) OF TORTS: CATEGORIES OF PRODUCT DEFECT §2(b) (AM. LAW INST., 1998) (noting the different categories of product defects); *see also* Twerski & Henderson, *supra* note 105, at 238 (articulating that in order for a plaintiff to succeed in a design defect, the plaintiff must prove that a specifically identified reasonable alternative design (RAD) was available at the time of commercial distribution, failure to adopt the RAD rendered the design not reasonably safe, and adoption of the RAD would have reduced or prevented the plaintiff's harm).

designed differently so the ultimate decision about who was killed in the accident would be different.[118] This claim would fail for several of the same reasons as a manufacturing-defect argument.[119]

First is the problem of "foreseeability."[120] Unless biases are programmed into an algorithm, a fully functional algorithm will never have a foreseeable result because it is constantly changing.[121] If the result is unforeseeable, any particular risks of harm associated with that result must likewise be unforeseeable.[122] In fact, it would be impossible to even consider the option of an "alternative design" to change the outcome of the challenged decision if an algorithm is designed to be completely objective.[123] That algorithm would never be either one design or another, but rather a continuously changing design with a myriad of possible outcomes when the only design is one that allows continual change.[124] Thus, unless society wants to restrict the options available to an algorithm to a predefined outcome, these myriad of outcomes preclude any consideration of an "alternative design".[125]

The one possible design defect in an autonomous vehicle's algorithm would be the inability of the algorithmic program to be

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[118] *See* Staff Editor, *Self-Driving Cars: Negligence, Product Liability, and Warranties*, JIPEL BLOG (Apr. 20, 2018), *archived at* https://perma.cc/X9NN-4K72 (observing that a plaintiff could assert a claim if an autonomous car's programming "lags behind the market").

[119] *See id.* ("[P]roving either design or manufacturing defect was present will be difficult given the complexity and technological detail that goes into the manufacture of these cars and their artificially intelligent software.").

[120] *See* Brown v. U.S. Stove Co., 484 A.2d 1234, 1239 (N.J. 1984) ("[A] manufacturer has a duty to make sure that its manufactured products placed into the stream of commerce are suitably safe when properly used for their intended or reasonably foreseeable purposes.").

[121] *See id.* at 1239 (explaining that a manufacturer will be liable for any damages resulting from "objectively foreseeable" changes).

[122] *See id.* at 1240 (declaring that a foreseeable misuse of a product by a manufacturer is not a request to liability, objective foreseeability of the kind of use of the product is a relevant factor).

[123] *See id.* at 1250 (concluding that alternative designs make it less likely that removal of safety devices will occur).

[124] *See* Matthias, *supra* note 84, at 183 (stressing that machines are constantly changing with their environments).

[125] *See* Brown, *supra* note 120, at 1236-37 (describing the public's acceptance that injuries are inevitable).

readily updated.[126] As autonomous vehicles are involved in more and more unavoidable collisions, expert analysis of those collisions might result in mandatory programming that would require algorithms to act a specific way in a particular accident scenario.[127] Thus, the algorithms would have to be periodically updated, or a plaintiff could claim a design defect in the obsolete algorithm.[128] In other words, manufacturers of algorithm-based products should reasonably foresee the need for software updates, and the failure to provide for the software updates and the means for having automatic updates could be a design defect existing at the time of the original sale.[129]

The problem with this argument is that, even when an update might arguably be needed, what type of update could make the claimed defect—the choice of victim—no longer the wrong choice?[130] After all, the issue in an unavoidable one, and it is about who should the vehicle chose to be harmed in that accident, not how to avoid harm altogether.[131] That decision, to put it bluntly, requires a determination of who should possibly sacrifice his or her life for the others involved in the accident.[132] If that decision is impossible to predetermine, and in fact is not one that should be predetermined, then, notwithstanding the fatality caused by the algorithm's choice, no harm can be found to have arisen caused by any design defect.[133] However, if the choice could not or should not have been a design defect, then no software

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[126] *See* Damien A. Riehl, *Car Minus Driver: Autonomous Vehicle Regulation, Liability and Policy, Part II*, BENCH & BAR OF MINN. (Nov. 4, 2016), *archived at* https://perma.cc/YX8B-M5J3 (comparing design defects of autonomous vehicles to those of other technology manufacturers).

[127] *See* Matthias, *supra* note 84, at 182 (explaining that for machines to adapt, they must learn through mistakes during operation).

[128] *See* Riehl, *supra* note 126 (distinguishing between design defects and developing algorithms).

[129] *See* Riehl, *supra* note 126 (considering the difficulties manufacturers face in attempting to decide the reasonable frequency of updates in order to avoid liability).

[130] *See* Riehl, *supra* note 126 (discussing how plaintiffs will argue that yesterday's state-of-the-art algorithm is today's defective design).

[131] *See* Marcus, *supra* note 15 (noting that virtual technology still it its testing phase is subject to technological glitches).

[132] *See* Marcus, *supra* note 15 (advocating that the act of pulling a lever feels acceptable to most people in order to save more lives).

[133] *See* Matthias *supra* note 84, at 179 (advocating that an autonomous vehicle cannot be liable for a crash when the condition for learning and adapting is not a product flaw).

upgrade would actually be necessary to correct a non-existent defect.[134]

The fundamental question one must ask is whether an autonomous vehicle could ever be designed, *i.e.* programmed, to make the undeniably "right" choice among several possible outcomes.[135] First, the choices available to the computer will be limited by what data the sensors can provide to that computer.[136] How would it be possible for a vehicle's sensors to determine if crashing into a bus would mean a bus full of grade-school children or an empty out-of-service bus driving itself back to a transit garage?[137] Likewise, a vehicle might be expected to identify the owners of vehicles by sensing their license plates or receiving data from those vehicles about the identity of their owners.[138] However, the received data would not tell the vehicle about to crash, who was in the other vehicles, only who owns those vehicles.[139] Without the technology to determine who is in a vehicle, the decision about what vehicle to hit, or if pedestrians are the better option, could not be challenged as a harmful design defect.[140] Even if sensors were capable of determining that a vehicle was occupied, it is highly improbable that a vehicle could determine the characteristics of the other vehicles' occupants, such that the algorithm could possibly undertake the cost-benefit analysis of which deaths

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[134] *See* Matthias *supra* note 84, at 179 (explaining that autonomous machines must make decisions through trial and error even when there is no algorithmic input that has determined the outcome of that situation).

[135] *See* Matthias *supra* note 84, at 182 (finding that since there are so many people and situations that the machine would have to interact with, it would be impossible to predict the "right" outcome).

[136] *See* Gurney, *supra* note 61, at 188 (describing how autonomous vehicles function using sensors to view the road and obstacles).

[137] *See* Marcus, *supra* note 15 (defining "trolleyology" as a high-tech version of an ethical inquiry that is still highly debated today and discussing its impact on thought experiments).

[138] *See* Gurney, *supra* note 61, at 249 (articulating the advanced license plate technology being implemented to identify autonomous vehicles).

[139] *See* Gurney, *supra* note 61, at 259 (describing that it will be difficult for a plaintiff to succeed if there is a software error and that the traditional manufacturing defect theory will be most useful to plaintiffs when the parts did not meet the manufacturing specifications).

[140] *See* Matthias, *supra* note 84, at 176 (asserting that autonomous vehicles are faced with the decision of what actions to take in the event of a possible accident).

would be relatively more or less harmful.[141] After all, no ranking exists in any database of who among all possible victims is the best choice.[142] If no design could result in that level of analysis, then no result of that design could be deemed wrong based on the individuals harmed by the vehicle's choice.[143] As such, the choice could not be proof of a design defect in that vehicle.[144]

For sake of argument, let us presume that a vehicle's sensors would be so sophisticated that it could reliably determine who was in all the vehicles about to be involved in the collision.[145] In the alternative, the vehicle's occupants might be able to identify themselves to the vehicle itself via code swipe cards.[146] If all autonomous vehicles could share data about their owners or occupants, it is possible that the options available to an autonomous vehicle could be restricted as to which of those occupants should be avoided, or worse, selected, and thus the vehicle could be deemed defective if it failed to follow those restrictions.[147] However, to deem that decision defective would require value judgments about who should live or die in an accident.[148] Furthermore, without statutory parameters dictating these value judgments for a jury, that jury would be left to rely on its prejudices, stereotypes, pre-conceived notions, and subjective

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[141] *See* Gurney, *supra* note 61, at 259 (considering that autonomous vehicles cannot articulate the nuances of the occupants in a vehicle).

[142] *See* Matthias, *supra* note 84, at 183 (noting that autonomous vehicles do not contain the same decision-making skills that a human would possess under the same circumstances).

[143] *See* Matthias, *supra* note 84, at 183 (highlighting the gap in liability as car manufactures cannot achieve the same level of control through autonomous cars that a rational human could).

[144] *See* Matthias, *supra* note 84, at 183 (commenting that the gap can no longer be ignored as the increasing number of autonomous learning and acting machines are involved in all areas of modern life).

[145] *See* Patrick Lin, *The Robot Car of Tomorrow May Just Be Programmed to Hit You,* WIRED (May 6, 2014), *archived at* https://perma.cc/6FTJ-S68Q (discussing a vehicle may be programmed for passenger safety and thus may collide into another vehicle).

[146] *See* Gurney, *supra* note 61, at 250 (explaining how the National Highway Traffic Safety Administration is searching for autonomous vehicle technology to aid administrative regulations).

[147] *See* Matthias, *supra* note 84, at 183 (highlighting how the autonomous vehicle's decision-making process is influenced by pre-programed algorithms, adaptations based on prior experiences learned from data shared, and current situational factors).

[148] *See* Spangler, *supra* note 14 (suggesting that autonomous vehicles do not have the moral capabilities of making decisions about fatal vehicular collisions).

assessments, all of which would likely result in an unconstitutional decision process and result.[149]

Dictating the right parameters, however, could create outcomes as problematic as simply leaving the decision to the whim of a jury.[150] Even setting some outcomes based on apparently good parameters would have serious ramifications.[151] Legislation might require that a vehicle be programmed to hit whatever other vehicle is best engineered to be subjected to a collision.[152] However, that requirement would penalize the owners of those better-engineered vehicles, since those owners would be "rewarded" for choosing the safest vehicle by becoming the most often-chosen targets in collisions. [153] In turn, consumers would avoid buying these safer vehicles because being the most common targets might drive up the cost of insurance and maintenance for those models, and give them a reputation as being the targets in any vehicle accident.[154] Ultimately, the safest vehicles would be driven out of the marketplace, although then the second tier of vehicles in terms of safety would then become the target, until a completely undesirable result would be a marketplace made up of vehicles with equally mediocre engineering.[155]

Some leading ethicists on this issue have asserted that, at the very least, a vehicle should be programmed to give first priority to the owner of the vehicle making the decision.[156] Studies show that consumers have conflicting opinions on biases in favor of a vehicle's

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[149] *See* Edmond Awad et al., *Blaming humans in autonomous vehicle accidents: Shared responsibility across levels of automation*, *CoRR* ABS/1803.07170 1, 1-44 (2018) (discussing jury bias in autonomous vehicle liability decisions due to the tort-based regulatory scheme).

[150] *See id.* at 2 (outlining jury decisions based on their reactions to crashes involving machine drivers).

[151] *See id.* at 3 (suggesting federal regulations would have to be adopted for semi-autonomous and autonomous vehicles to prevent jury bias towards machine drivers).

[152] *See* Lin, *supra* note 145 (explaining minimization of potential harm by testing collisions with heavier vehicles).

[153] *See* Lin, *supra* note 145 (summarizing owners' rationale for purchasing larger vehicles).

[154] *See* Geistfeld, *supra* note 9, at 1630 (justifying the increase in insurance costs based on the safety of the vehicle).

[155] *See* Geistfeld, *supra* note 9, at 1630 (concluding that based on insurance cost increases, the safest vehicles would slowly be driven off the market).

[156] *See* Keith Naughton, *Should Driverless Vehicles Make Life-or-Death Decisions?*, AUTOMOTIVE NEWS (June 25, 2015), *archived at* https://perma.cc/Q33L-VBEK (describing autonomous cars' prioritizing driver's life over others).

owner.[157] On one hand, consumers in principle want all autonomous vehicles to make decisions based upon what choice will lessen the overall harm in an accident, or at least what choice will reduce the number of victims in an accident.[158] On the other hand, consumers inevitably want the car they buy to favor them and their occupants in that same accident.[159] This will result in an obvious social dilemma of people making decisions based on their own self-interest, resulting in an overall less safe roadway environment.[160]

In addition to this dilemma, several problems exist with allowing vehicles to be programmed to protect their owners to the detriment of others.[161] First, one cannot presume that any occupants of the vehicle are the owner, so an algorithm that protects the occupant at all costs would be based on a flawed presumption.[162] In fact, if the car is being leased, or the car is being rented on a short-term basis, the choice to protect the car occupants might arguably be a cynical choice to protect the car itself, so the owner would be choosing to avoid damage to its property by hitting the victim least likely to cause harm, such as the little old lady in the cross-walk.[163]

Second, even if the occupant of the vehicle is the owner, favoring the owner/occupant in an algorithmic process does nothing that could be considered ethical or societally valuable.[164] The only reason to program a response that protects the vehicle owner is that this is an easy outcome for an arbiter or judge—did the autonomous

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[157] *See* Jean-Francois Bonnefon et al., *The Social Dilemma of Autonomous Vehicles*, 352 SCI. 1573, 1573 (2016) (noting that consumers of autonomous vehicles disapprove of biases towards the autonomous vehicle's owner).

[158] *See id.* at 1573 (asserting that the autonomous vehicles are predisposed to choose outcomes which will limit the casualties).

[159] *See id*. at 1574 (citing a study which determined that the respondents prefer the self-protective model of autonomous vehicles).

[160] *See* Peter Dizikes, *Driverless Cars: Who Gets Protected?*, MIT NEWS (June 23, 2016), *archived at* https://perma.cc/D523-C5SG (alleging that these competing interests of consumers will inevitably lead to catastrophe on the road).

[161] *See id.* (highlighting the unforeseen consequences that arise from these competing interests of consumers).

[162] *See* Naughton, *supra* note 156 (recognizing that autonomous vehicles still lack the understanding of humans).

[163] *See* Naughton, *supra* note 156 (finding that there are problems to giving an autonomous automobile the power to make consequential decisions).

[164] *See* Dizikes, *supra* note 160 (acknowledging the social dilemma involved with autonomous vehicles).

vehicle operate to protect the occupants?[165] It does nothing to address the broader societal and ethical questions about why exactly a vehicle occupant should be protected above all others.[166]

Third, and foremost, the sheer number of autonomous vehicles on the road would make bias toward an occupant an impossible goal.[167] Eventually, as autonomous vehicles became more common, owners of an autonomous vehicle could be as ubiquitous as owners of cars with seat belts today.[168] As such, it would be impossible to program algorithms to avoid all of those vehicles to save the driver—unless of course society is willing to sacrifice innocent pedestrians, bicyclists or babies in strollers, since they would be the only choices available in a collision situation.[169] Therefore, prioritizing the driver in an unavoidable collision would clearly not be the least harmful option when analyzing a product defect claim.[170]

Finally, it may be impossible to find support for legislation mandating this bias, even if consumers tend to favor it.[171] It is very possible that voters would decry any attempt by a legislature to predetermine the decision-making process of an algorithm.[172] Furthermore, any such legislation might dissuade consumers from buying autonomous vehicles, because the consumers would rather take the risk they can make a decision during an unavoidable collision (regardless of whether they actually could, given their reaction time

[165] *See* Dizikes, *supra* note 160 (contrasting the tension between self-interest and collective interest).
[166] *See* Dizikes, *supra* note 160 (discussing how people prefer to take a utilitarian approach to the ethics of autonomous vehicles).
[167] *See* Naughton, *supra* note 156 (discussing the ethics involved with the protection of the greater good when it comes to autonomous vehicles).
[168] *See* Luettel, *supra* note 12, at 1837 (asserting that the field of autonomous vehicles is gaining momentum and we will experience autonomous vehicles in everyday traffic within the next 10-15 years).
[169] *See* Dizikes, *supra* note 160 (focusing on the preference for autonomous vehicles to operate under the utilitarian approach).
[170] *See* Bonnefon, *supra* note 157, at 1573 (reasoning that potential consumers may be discouraged from buying autonomous vehicles which would prioritize others' lives over their own).
[171] *See* Bonnefon, *supra note* 157, at 1573 (maintaining that consumers will want their autonomous vehicles to prioritize their lives even if it means sacrificing others).
[172] *See* Bonnefon, *supra note* 157, at 1576 (discussing that the proposed algorithms will often run counter to public opinion of the potential consumer).

and flawed operating skills), then be forced to accept a legislated decision.[173]

Another possible prescribed outcome could have even worse implications.[174] It is reasonable to presume that with enough access to driver databases, as well as sensors strong enough to do facial recognition, a vehicle could determine to a reasonable degree the ethnicity, gender or even political affiliation of opposing drivers.[175] Algorithms could be designed to either favor a vehicle's occupants over vehicles inhabited by persons which fit "less desirable" demographics, or more disgustingly, to actually choice who will be the victim based on the likely ethnicity, gender or even registered political status of the occupants of those other vehicles, or even bystanders.[176] White supremacists could thus purchase vehicles programmed to select persons of color as the "best" choice to hit, sexist owners could decide that one gender should be favored over another in a crash, and staunch political party activists could buy cars decided to victimize voters registered in the opposing political party.[177] Truly heinous owners could purchase lists of favored targets in their community who are identified as fitting a certain demographic by those developing the list.[178] For example, a list of same-sex married couples could be derived from marriage license databases, and thus would be the favored victims by those believing such couples are the work of the Devil.[179]

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[173] *See* Bonnefon, *supra note* 157, at 1573 (concluding that consumers prefer to trust their own human abilities in ethical dilemmas, compared to that of autonomous vehicle algorithms).

[174] *See* Naughton, *supra* note 156 (understanding that sensors are still not fully developed to decide what drivers can be targets of an accident).

[175] *See* Naughton, *supra* note 156 (acknowledging that sensors in autonomous vehicles are still early in the developmental process). This note suggests that these sensors could be programmed based on personal biases of the owner.

[176] *See* Patrick Lin, *What Google Cars Can Learn from Killer Robots*, FORBES (July 2014), *archived at* https://perma.cc/73E5-MNPV (opining that autonomous vehicles will inevitably be forced to discriminate in their decisions on potential victims in accidents).

[177] *See* Bonnefon, *supra* note 157, at 1573 (commenting that algorithm programmers have a great deal of power in predetermining how an autonomous vehicle will respond in a potential accident).

[178] *See* Bonnefon, *supra* note 157, at 1573 (discussing the ethics of AVs and how citizens would need to determine the appropriate human values as car owners).

[179] *See* Bonnefon, *supra* note 157, at 1573 (conducting a study inspired by methods of experimental ethic methodology).

Unfortunately, current law does not necessarily make such biased algorithms illegal.[180] Laws against discrimination in commerce forbid a seller from not selling to a buyer based upon certain criteria, *e.g.*, race, religion, national origin, gender, etc.[181] However, those laws were drafted at a time when the product did not make any decision on this basis, and thus the drafting did not take into consideration the possibility that the product itself, rather than the seller of the product, might be acting in a discriminatory fashion.[182] Therefore, as long as the person selling that product makes it available to everyone on an equal basis, no anti-discrimination laws affecting commerce are triggered by how the product operates after it is purchased.[183]

Likewise, few laws exist that apply to the discriminatory intent of a user, rather than the seller, of a product.[184] In fact, the decision of consumers to select products of discriminatory designs has long been allowed to occur without legal ramification.[185] One need only look at the design of public buildings with inadequate women's restrooms, or the highway system designed by Robert Moses which destroyed far more neighborhoods populated by minorities than the system did white

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[180] *See* Bonnefon, *supra* note 157, at 1575-76 (finding that regulations may be placed on AVs, however, the regulations may be faced with fierce opposition delaying technological advancements).

[181] *See Definitions*, 42 U.S.C. § 2000(e) (1991) (providing definitions for the Equal Employment Opportunity statute, which prohibits discrimination based on race, color, religion, sex, or national origin).

[182] *See* Fritz Machlup, *Characteristics and Types of Price Discrimination,* BUSINESS CONCENTRATION AND PRICE POLICY BY NATIONAL BUREAU OF ECONOMIC RESEARCH, INC., 397, 400 (1955) (defining product discrimination as a price discrimination that "selects neither individual customers nor customer groups for different treatment but allows customers to choose freely among different products (qualities) offered at discriminatory prices").

[183] *See id*. at 435 (providing that "if a good case can be made against these discriminatory practices, it may still be inexpedient to outlaw them and to embark on a hopeless task of enforcement; [I]t may be more feasible to attack them indirectly by attacking the monopolistic positions that make them possible.").

[184] *See* Ross E. Elfand, *The Robinson-Patman Act*, ABA (Aug. 27, 2013), *archived at* https://perma.cc/TW7M-N7CR (providing an example of a current law pertaining to the prohibition price discrimination by a seller).

[185] *See* Lena V. Groeger, *Discrimination by Design*: *The many ways design decisions treat people unequally,* PROPUBLICA (Sept. 1, 2016), *archived at* https://perma.cc/DFZ5-6L4S (citing an example of racial discrimination design that was not faced with legal ramifications).

neighborhoods, to see that discriminatory design has been rampant and unchecked by anti-discrimination laws.[186]

The only users who would find themselves prohibited from intentionally choosing products that discriminate via their algorithms would be governmental entities.[187] It is probable that the Fourteenth Amendment of the U.S. Constitution would prohibit a governmental body from buying an autonomous vehicle designed to be biased against protected classes of individuals, since such a purchase would demonstrate a government policy or decision that was racially motivated, and thus unconstitutional[188]. Discriminatory design implemented by a government entity has already been asserted to be a violation of the Constitution.[189]

However, the Fourteenth Amendment proscriptions against governmental entities has never been extended to the decisions of private consumers.[190] Private consumers that intend on buying vehicles that discriminate are free to do so.[191] Perhaps the only legal roadblock to products with biased algorithms might be that a product which society expects to make an objective decision, like an algorithm controlling vehicles in an accident, would be defectively designed if its design actually was aimed at making a biased analysis. However, that would be ignoring completely the fact it was indeed designed to be biased, and the consumer buying it understood that to be the case.

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[186] *See id.* (noting the discriminatory impact of Moses' urban planning in New York City). Historically, infrastructures have been used to segregate communities. *Id.*

[187] *See* Village of Arlington Heights v. Metropolitan Housing Dev. Corp, 429 U.S. 252, 254-55 (1977) (examining governmental rules and regulations concerning fair housing).

[188] *See id.* at 254-55 (applying the Fourteenth Amendment and Fair Housing Act interpretations to racial discrimination in public housing).

[189] *See* Ryan Reft, *From Bus Riders Union to Bus Rapid Transit: Race, Class and Transit Infrastructure in Los Angeles*, KCET (May 14, 2015), *archived at* https://perma.cc/A9BW-968T (explaining riders of the Los Angeles Metropolitan Transit Authority bus system sued, claiming the MTA transportation system design resulted in more funds being used for those parts of the transit systems used by non-minority riders, and thus was designed to discriminate against persons of color).

[190] Alan R. Madry, *Private Accountability and the Fourteenth Amendment; State Action, Federalism and Congress*, 59 MO. L. REV. 500, 501 (1994) (alluding that "state regulation of interpersonal affairs [are] not subject to the [Fourteenth] Amendment" unless the regulation sufficiently "involves the state in the private conduct").

[191] *See id.* at 501 (concluding that private citizens are not bound by discriminatory elements of the Fourteenth Amendment).

Thus, from the consumer's perspective there would be nothing defective in that design, thereby negating any claim of defective design by anyone else.

In the alternative, it might be argued that allowing product liability law to shield the biased algorithm would itself be a discriminatory act. However, to date, criticism of design due to its discriminatory impacts has caused those standards to be overturned.[192] Indeed, algorithms already exist which are intended to discriminate in their results, such as algorithms that direct social media advertising to only some users of that social media, and those algorithms are not prohibited by discrimination laws.[193] In fact, product liability laws themselves have been demonstrated to have a discriminatory effect, but that effect has not caused product liability laws to be deemed illegal.[194] Thus, designing an algorithm to be discriminatory is not a basis for finding that it violates existing anti-discrimination laws.

In short, legislatures would have to amend anti-discrimination laws to include selling products with algorithmic biases against a certain class of citizens. The idea is not far-fetched, since laws have long existed in the United States whereby facilities that are inaccessible to persons with disabilities due to their design are considered a violation of anti-discrimination laws,[195] and in fact laws exist outside the United States prohibiting discriminatory design in buildings that result in biases other than solely against the disabled, including the number of women's restrooms.[196] However, no precedent exists on which to extend case law to prohibit discriminatory

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[192] *See* Rebecca Korzec, *Maryland Tort Damages: A Form of Sex-Based Discrimination*, 37 U. OF BALT. L. F. 97, 98 (2007) (critiquing scholars that "have suggested that both the method of calculating tort damages and tort reform legislation, such as statutory limits on noneconomic damages, harm women").

[193] *See* Clair Cain Miller, *When Algorithms Discriminate*, N.Y. TIMES (July 9, 2015), *archived at* https://perma.cc/ZKV9-BVL4 (stating: "Google . . . showed an ad for high-income jobs to men much more often than it showed the ad to women.").

[194] *See* Korzec, *supra* note 192, at 99 (discussing how tort damages favor men and disadvantages women).

[195] *See* Fair Housing Amendments Act of 1988, 42 U.S.C. §§ 3604(f)(3)(B) (2006) (clarifying the definition of discrimination to include that a "refusal to make reasonable accommodations in rules, policies, practices, or services, when such accommodations may be necessary to afford such person equal opportunity to use and enjoy a dwelling").

[196] *See* Groeger, *supra*, note 185 (suggesting that the legislature permits discriminatory building designs by inadequately adhering to women's needs for satisfactory bathrooms).

algorithms, and it has been asserted that extending existing discrimination laws to cover algorithms "will be difficult technically, difficult legally, and difficult politically."[197]

The only other existing legal basis available to a court would be to find that an autonomous vehicle that is designed to act on discriminatory biases would *per se* be defectively designed based on public policy. However, on closer examination, that argument would be illogical.[198] A court would have to find that a public policy exists to proscribe a built-in bias.[199] However, since public policy has not been able to decide what types of bias are permissible, or even whether the law should make such a conclusion, there would in fact be no public policy forbidding the bias.

Even if legislation could be drafted to prohibit biases in algorithms, recent case law suggests this legislation might not be enough.[200] If a business owner can assert that it should have the right to deny certain healthcare insurance coverage to its employees for treatments that employer deems offensive on religious grounds, notwithstanding federal law requiring such coverage, what prevents a business owner from stating it has a right to design algorithms for autonomous vehicles that choose as the "right" target those persons the business owner deems offensive "sinners"? [201] Could a consumer insist that her religious beliefs require that, if her vehicle must maim or kill someone, that victim should be a non-believer, or someone deemed a sinner by that consumer, and therefore that consumer has a First Amendment right to drive an autonomous vehicle that, all else

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[197] *See* Lauren Kirchner, *When Discrimination Is Baked Into Algorithms*, THE ATLANTIC (Sept. 6, 2015) *archived at* https://perma.cc/U6T4AX6B (quoting Solon Barocas & Andrew Selbst, *Big Data's Disparate Impact,* 104 CALIF. L. REV. 671 (2016) and rejecting that a "plaintiff would only need to demonstrate bias in the results, without having to prove that a program was conceived with bias as its goal").

[198] *See* Zohn, *supra* note 14, at 474 ("[O]ne engaged in the business of selling or otherwise distributing products who sells or distributes a defective product is subject to liability for harm to persons or property caused by the defect.").

[199] *See* RESTATEMENT (THIRD) OF TORTS: DEFINITION OF "PRODUCT" §19(a) (AM. LAW INST., 1998) (quoting Note, *Negligence: Liability for Defective Software*, 33 OKLA. L. REV. 848, 855 (1980) and providing the analysis for public policy considerations of strict liability for software products).

[200] *See* Burwell v. Hobby Lobby Stores, Inc., 134 S.Ct. 2751, 2759 (2014) (discussing whether employers have a choice in deciding what healthcare services can be provided to their employees).

[201] *See id.* at 2759 (holding that demanding employers to offer healthcare insurance may violate The Religious Freedom Restoration Act).

being equal, will choose the victim of the unavoidable crash to be that non-believer or sinner?

The detailed legal analysis of this issue is beyond the scope of this article. However, this note opines that First Amendment legal analysis would ultimately empower legislatures to prohibit algorithms that favor a certain religion-based choice, so long as that legislature would objectively forbid all religion-based choices. Likewise, legislatures would have the constitutional authority to prohibit products which themselves discriminate against a class of persons, just as legislatures may prohibit the sellers of those products from taking such discriminatory actions. This type of legislation is crucial if autonomous vehicles, and ultimately any product which self-determining is based on its software, are not to be used as weapons of hate and divisiveness.

Some commentators argue that, when faced with an inevitable crash, an autonomous vehicle must always surrender control to a human, thereby mooting the question of how to legislate the choice of algorithmic outcomes in an inevitable crash.[202] Those commentators suggest that the decision of a victim is so profound that when faced with an inevitable crash, the vehicle must always surrender control to a human so as to remove the vehicle from the decision entirely.[203] Using Isaac Asimov's First Rule of Robotics[204] that a robot may not harm a human by its action or inaction, some experts argue that a vehicle should not be allowed to make any decision that would threaten a human life.[205] The argument appears to be based on the assumption it is always better for a human, with the ability to use "judgment, mercy, compassion and so on," to have the final say in who will be

[202] *See* Jamie LaReau, *Movement Rises To Keep Humans, Not Robots, In The Driver's Seat*, THE VIRGINIAN-PILOT (2018), *archived at* https://perma.cc/3FQX-BPV3 (citing statistics that many consumers still feel uncomfortable not having any control of their vehicle).

[203] *See id*. (offering that many consumers find it unthinkable to imagine that they would not have any control whatsoever of their vehicle).

[204] *See* ISAAC ASIMOV, I ROBOT 40 (Reprint ed. 2004) (providing that the "Three Laws of Robotics" discusses in detail about how robots are to follow the direction of humans).

[205] *See* Naughton, *supra* note 156 (quoting Wendell Wallach who argued that a vehicle should not make life or death decisions).

involved in the collision than an automated vehicle devoid of these attributes.[206]

But, why is it indeed better to let a human have the last say? Nobody now decides whether a human can obtain a driver's license based on that human's set of ethics or that human's ability to make ethical decisions quickly and wisely. When an accident requires a split-second decision, no human has the capacity to call up judgment, mercy or compassion from within the recesses of his or her brain, analyze the situation, and have the reaction time necessary to aim the car in the direction called for by that analysis.[207] In fact, "trolleyology" studies repeatedly show that humans react slowly, irrationally and inconsistently when faced with this ethical dilemma.[208] Why then would society take the decision away from an autonomous vehicle because that vehicle cannot make an ethical decision, and give it to a human who is just as ill-equipped to do so?[209] Thus, it is irrational to suggest that autonomous vehicles must automatically turn over vehicles to humans immediately if a life-or-death decision has to be made.[210]

Perhaps acknowledging that humans are too limited to be the final decision-maker, a third proposal is that ethical analysis be made a necessary part of algorithmic programming.[211] The argument here is that by enacting legislation requiring an ethical component to algorithms, legislatures would protect the autonomous vehicle industry from having its existence threatened as a result of a particularly

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[206] *See* Lin, *supra* note 176 (noting that it is natural for humans to want a vehicle to make human-oriented decisions).

[207] *See* Lin, *supra* note 176 (stating that humans can assess the situation, while vehicles are stuck with their algorithms).

[208] *See* Marcus, *supra* note 15 (maintaining that humans will react to situations emotionally while a computer will stick to its algorithm).

[209] *See* David Edmonds, *Can We Teach Robotics Ethics*, BBC NEWS MAG. (October 15, 2017), *archived at* https://perma.cc/WKB7-HCF6 (arguing that autonomous vehicles would be better equipped to reduce car accidents because there would no longer be human error).

[210] *See id.* (stipulating that it would be unsatisfactory to expect robots to be responsible for human actions).

[211] *See* Nick Belay, *Robot Ethics And Self-Driving Cars: How Ethical Determinations in Software Will Require a New Legal Framework*, 40 J. LEGAL PROF. 119, 124-26 (2015) (suggesting that a car manufacturer could create vehicles where the ethical standard would be dictated by what the manufacturer chooses, and a situation where the individual could customize their vehicle to fit their own ethical values).

questionable decision that was universally condemned by society, such as choosing to kill a bus-load of children rather than kill one elderly jaywalker.[212] Moreover, the legislature could, via the enactment of ethical requirements, prevent illegal biases from becoming part of algorithmic determinations since, presumably, ethics would proscribe such illegal biases.[213]

In fact, one could argue that an ethical component to a vehicle's algorithm is necessary to truly reflect how a reasonable consumer would expect that decision to be made.[214] As such, a failure to program in ethics would arguablybe the basis for asserting that the vehicle was defective under product liability laws, because the vehicle did not act as a reasonable consumer would expect it to.[215] One could go so far as to say that product liability legal standards applicable to autonomous vehicles can only be successfully created when ethical standards are addressed by manufacturers, the courts and the legislators.[216]

However, this begs the question of what is the proper industry standards of ethics that should be introduced into an algorithm's decision-making process in order to avoid a product liability claim?[217] Even if, as just discussed, biases of consumers should be prohibited as a matter of law, that still leaves the question of what acceptable societal ethical standards for selecting the victims of autonomous vehicle accidents should be introduced to algorithms, if any.[218] To answer that question, one must determine: a) who gets to decide the ethical

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[212] *See* Gurney, *supra* note 70, at 258 (declaring that if there was federal statutes that proscribed ethical rules that algorithm writers had to incorporate into the programming of vehicles, it would give a "safe harbor" for an autonomous vehicle manufacturer).

[213] *See* Belay *supra* note 211, at 126 (suggesting that requiring human intervention would remove ethical considerations from autonomous vehicle algorithms).

[214] *See* Belay *supra* note 211, at 125-26 (implying that since a manufacturer determines the ethical values and the driver has no role in determining the ethical values, the driver should be allowed to determine their own ethical priorities).

[215] *See* Naughton, *supra* note 156 (stating that it is always better to leave the most difficult decisions up to a human as opposed to a "robot car").

[216] *See* Riehl, *supra* note 126 (distinguishing that algorithms have assessed and determined human liability, but lack in the area of machines).

[217] *See* Riehl, *supra* note 126 (reasoning that although many issues presented by autonomous vehicles may not be apparent right now, they will undoubtedly become imminent soon).

[218] *See* Naughton, *supra* note 156 (reiterating that there is a constant ongoing debate about how many ethical considerations should go into the creation of algorithms).

standards that must be reflected in the programming; b) what ethical standards or criteria would have to be part of an algorithm program for the product to be considered non-defective, and c) how does one determine the priority of ethical standards, since an inevitable crash could easily present a conflicting set of ethics-based decisions, and so some ethics would have to be programmed to supersede others.[219] Finally, even if an "industry standard" of ethics is programmed in, is the final product subject to challenge by a tribunal or jury?[220] After all, meeting an industry standard in regard to any other design issue is not an absolute defense to a claim that product is defective.[221]

The approaches ethicists use to create a set of ethical rules might address the second and third question concurrently.[222] The first approach is what ethicists call the "deontological approach".[223] Under the deontological approach, a set of ethical parameters and rules are created, and the outcome of the algorithm incorporating these rules cannot be challenged as long as a vehicle follows those rules.[224] The example often used is Isaac Asimov's Three Laws of Robotics,[225]

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[219] *See* Riehl, *supra* note 126 (opining that many questions remain as to whose responsibility it is in determining these ethical standards which are destined to go into effect).

[220] See Riehl, *supra* note 126 (indicating that courts will continue to play a role in the oversight of autonomous vehicle liability, even if the industry is compelled to make their own standards).

[221] *See* Belay, *supra* note 211, at 129-30 (recognizing that while some measures may be taken to limit liability, adhering to industry standards will not be a solution to all ethical and legal issues).

[222] The author interjects here that this article is not intended to be an in-depth ethical analysis of autonomous vehicle. The author is not an ethicist, and at any rate such an analysis could require a book-long treatise. The author's intent is not to determine what ethics should be introduced into algorithms, but rather to note the possible importance of ethics in algorithm design for product liability analysis.

[223] *See* KEITH ABNEY, ROBOTICS, ETHICAL THEORY, AND METAETHICS: A GUIDE FOR THE PERPLEXED, ROBOT ETHICS 41 (Patrick Lin, Keith Abney & George A. Bekay ed. 2012) (beginning a discussion of moral theories with deontological ethics).

[224] *See id.* at 41 (describing that deontological ethics are: "[A] set of (programmable) rules to follow.").

[225] *See* Isaac Asimov, *Three Law of Robotics*, THE LISTS OF LISTS (2001), *archived at* https://perma.cc/CJ8J-N33Y (defining the three laws of robotics as: "1. A robot may not injure a human being or, through inaction, allow a human being to come to harm; 2. A robot must obey orders given it by human beings except where such orders would conflict with the first law; and 3. A robot must protect its own existence as long as such protection does not conflict with the first or second law.").

whereby a robot's interactions with humans, regardless of the outcome, cannot be challenged provided the robot's actions are in accordance with those Three Laws.[226] Using this approach for the purposes of a product liability analysis is attractive, because it can provide a clear set of ethics for an algorithm, and prioritize those rules for a vehicle to follow in a collision scenario.[227] Any jury, with the assistance of expert testimony, could readily determine if an autonomous vehicle was defectively designed by simply determining if the prescribed rules and priorities were followed by the vehicle's manufacturer.[228]

The problem with the deontological approach is that no set of ethics can be all-inclusive to address every possible scenario a vehicle might face, and in fact might even be self-contradictory in some circumstances.[229] After all, a vehicle will never operate in a totally static road environment, so the best conference of ethicists could never anticipate every possible situation requiring an ethical response.[230] Perhaps more importantly, the ethics programmed into a vehicle will only be one part of the software program that directs the vehicle's response in a collision, the rest being the vehicle's algorithm-based analysis incorporating data from its sensors and other sources.[231] Thus, the possible ethical responses will have to be defined in part, and definitely limited by, the non-ethical analysis undertaken by a vehicle's computer.[232] Since the "amoral" part of the algorithm, as has been discussed, will be ever-changing, an unchanging set of ethical

[226] *See* Abney, *supra* note 223 at 41 (acknowledging that robotics follows the rules enumerated in Asimov's Three Laws of Robotics)
[227] *See* Miller, *supra* note 193 (introducing the concept of machines adjusting based on people's habits).
[228] *See* Gurney, *supra* note 61, at 265 (explaining how a plaintiff proves defectiveness of an autonomous vehicle with expert witness testimony).
[229] *See* Abney, *supra* note 223, at 44 ("[I]t is an impossible demand to calculate the utility of every alternative course of action.").
[230] *See* Abney, *supra* note 223, at 44 (summarizing the various theories held by ethicists on the issue of operating autonomous vehicles).
[231] *See* Belay, *supra* note 211, at 122 (noting that autonomous cars react to situations based on algorithms that implement pre-determined decisions).
[232] *See* Belay, *supra* note 211, at 122 ("[B]y nature of operating in imperfect systems filled with human drivers, pedestrians, and animals that behave unpredictably, autonomous vehicles encountering these ethical calculations is all but guaranteed.").

rules could never fully complement an ever-changing set of responses to sensors and mechanical responses.[233]

In fact, one could argue that pairing an unvarying set of ethical parameters with a continuously variable set of non-ethical parameters in an algorithm will inevitably lead to some situations causing internal contradictions.[234] But, as applied to a product liability analysis, how can an algorithm designed with this unavoidable flaw nonetheless be considered good product design?[235] Presumably, a manufacturer could assert this program flaw is unavoidable, and thus the manufacturer could provide a product warning just as a manufacturer can with any unavoidable hazards.[236] Unfortunately, that simply means every deontological based set of ethics will not result in an algorithm immune from product liability challenges, but rather will be constantly resulting in design defect litigation challenging these unavoidable and inevitable flaws.[237]

The alternative approach used by ethicists to develop a set of ethics is the "utilitarian approach."[238] Under this approach, the rules of ethics used in an algorithmic analysis would have to aim toward an outcome that creates the most happiness for society.[239] If a collision were inevitable, the algorithm would have to determine for whom society would feel the least upset if that person or persons were the

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[233] *See* Miller, *supra* note 193 (creating an inference that due to the amoral aspect of the algorithm, there will never be a blanket set of rules for all the ethical issues that may arise).

[234] *See* Miller, *supra* note 193 (providing an example of the constant battle between ethical and non-ethical parameters that will inevitably lead to internal strife).

[235] *See* Belay, *supra* note 211, at 122-23 (recognizing the innate issue that product liability analysis presents in relation to good product design).

[236] *See* Twerski & Henderson, *supra* note 105, at 247 (analyzing underutilized precautions and their relationship with plaintiffs' harm).

[237] *See* Twerski & Henderson, *supra* note 105, at 242 (arguing that the cost of engineering the new risk-reducing design and the cost of prosecuting the claim in court are likely to be substantial when a plaintiff claims that a defendant who manufactures motor vehicles should have included features that would give occupants a greater chance to survive high-speed collisions).

[238] *See* Belay, *supra* note 211, at 127-28 (introducing the need for the utilitarian theory). For example, "one of the fundamental tenants of an insurance provider is to pool risk and minimize loss." *Id*.

[239] *See* Abney, *supra* note 223, at 44 (relating ethics with the economic theory of cost-benefit analysis, where happiness is maximized).

victims in the crash.[240] The critique of the utilitarian approach is that the algorithm will inevitably use a database that will be too incomplete to determine what outcome would make the most people happy.[241] For example, presuming that a vehicle's sensors are capable of identifying and analyzing every possible victim in a collision, no database will ever contain enough data to weigh what decision would make society the most happy.[242] One of the potential victims might be a newly pregnant woman who had failed to become pregnant for years before now, and had not even had a chance to tell her partner of the pregnancy.[243] One of the victims might be the president of a well-respected non-profit organization whose embezzlement activities might not come to light until after that president's death.[244] The algorithm would never have access to this information, and thus the results of the algorithm could never meet the required goal of resulting in the "happiest" society.[245] In fact, the limitations of data and data analysis for any vehicle would most certainly mean that the algorithmic design would be more susceptible to a product liability attack than one designed using a deontological approach.[246]

Even assuming that a set of ethics could be designed that are not inherently flawed as to process, the larger question is what factors

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[240] *See* Abney, *supra* note 223, at 44 (following the utilitarianism theory under the "Greatest Happiness Principle" (GHP): One ought always to act so as to maximize the greatest amount of net happiness (utility) for the largest number of people.").

[241] *See* Abney, *supra* note 223, at 44-45 (reasoning that a utilitarian robot will fail in ways such as determining the appropriate action within a certain time or uses insufficient information and leaving the question of "what is left of utilitarianism" when it is incalculable by robots).

[242] *See* Abney, *supra* note 223, at 45 (describing the "scapegoating objection," which notes that "maximizing utility may demand injustice," such as drivers assuming liability for the actions of autonomous vehicles).

[243] *See* Abney, *supra* note 223, at 45 (surmising that "in [utilitarianism's] basic form, [it] cannot readily account for the notion of rights and duties or moral distinctions between, e.g., killing versus letting die, or intended versus merely foreseen deaths, or other harm . . . ").

[244] *See* Abney, *supra* note 223, at 45 (reaffirming concerns about the capacity of robotic decision-making to handle the large computational loads that would be required to apply top-down theories).

[245] *See* Abney, *supra* note 223, at 45 (recognizing the "frame problem" as a flaw of a top-down theory, such as utilitarianism). The "frame problem" addresses how to prioritize information in terms of relevance to moral decision-making. *Id.*

[246] *See* Abney, *supra* note 223, at 45 (furthering that the utilitarianism approach "reinforces the worry that top-down theories require an impossible computational load for robot decision making").

could an ethicist introduce into an algorithmic process that would be legally legitimate?[247] Unfortunately, the most obvious factors that an ethicist might incorporate could probably be unconstitutional ones.[248] While no specific case law related to the constitutionality of ethical factors in autonomous vehicles currently exists, the constitutional issues are readily evident.[249] If the ethicist selected certain religious teachings to determine the more worthy survivor of a collision, and the ethicist's conclusions became part of product liability law, that law could not survive a First Amendment religious establishment challenge because it would be based on a choice favoring one set of religious tenets over another,[250] and would clearly be "an excessive government entanglement with religion."[251] Certainly, the ethicist would have to avoid any ethical analysis incorporating immutable characteristics of the possible victims, or the mandated ethical rules would not survive a Fourteenth Amendment equal protection challenge.[252] Even completely arbitrary or irrational ethical standards adopted by an ethicist that becomes law would be challenged under

[247] *See* Abney, *supra* note 223, at 45-46 ("[T]he legal system assumes that moral agency does *not* require a normal, properly functioning emotional 'inner' life.").

[248] *See* Abney, *supra* note 223 at 46 ("Psychopaths/sociopaths, rational agents with dysfunctional or missing emotional affect, are still morally and legally responsible for their crimes; whereas those who have emotional responses, but cannot exercise rational control are not.").

[249] *See* Lemon v. Kurtzman, 403 U.S. 602, 602 (1971) (holding that religion clauses of the First Amendment were violated); *see also* Frontiero v. Richardson, 411 U.S. 677, 685 (1973) (holding as violating the "due process clause of the Fifth Amendment insofar as they require a female member to prove dependency of her husband"); *see also* Walz v. Tax Commission, 397 U.S. 664, 673 (1970) (holding that a New York statute "exempting from real property tax reality owned by association organized exclusively for religious purposes is not unconstitutional as an attempt to establish, sponsor or support religion or as an interference with free exercise of religion").

[250] *See* Lemon, 403 U.S. at 640 ("[T]he use of taxpayers' money to support parochial schools violates the First Amendment, applicable to the States by virtue of the Fourteenth.").

[251] *See* Walz, 397 U.S. at 674 ("[E]limination of exemption would tend to expand the involvement of government by giving rise to tax valuation of church property, tax liens, tax foreclosures, and the direct confrontations and conflicts that follow in the train of those legal processes.").

[252] *See* Frontiero, 411 U.S. at 686 (recognizing: "Nevertheless, it can hardly be doubted that, in part because of the high visibility of the sex characteristics, woman still face pervasive, although at times more subtle, discrimination in our educational institutions, in the job market and, perhaps most conspicuously, in the political arena.").

substantive due process grounds.[253] Ultimately, any set of ethics used to decide who gets hurt in a collision orchestrated by autonomous vehicles will run headlong into a Constitution written to prevent people from being treated differently under the law.[254]

Ultimately, introducing ethical considerations into an algorithm may be a huge technological and legal step backward.[255] Absent ethical considerations, an algorithm analyzes data obtained from sensors and makes decisions based on an objective and amoral algorithmic process.[256] The autonomous vehicle never decides what is the "right" decision from a moral perspective, but only what is a "right" decision based on this amoral analytical process.[257] If a collision is inevitable, no one can claim personal or societal bias played a part in the process. Thus, not only is that decision technologically the best outcome possible within the limitations of the sensors and on-board computer, but from a legal standpoint, the judgment of non-liability will be consistent, unbiased, rational, and not subject to successful product liability claims.

In contrast, if one introduces an ethical element to the algorithmic process, then plaintiffs can challenge the algorithm's chosen outcome on the basis of the programmed set of ethics and the product which incorporated that program, because the product did not reflect consumer or societal expectations. The harm caused by each inevitable collision will be open to debate by a jury or tribunal, and even an attempt to limit a jury's discretion will itself introduce more questions about the acceptable ethical outcome on which the jury can

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[253] *See* Rosalie Berger, *Reining in Abuses of Executive Power Through Substantive Due Process*, 60 FLA. L. REV. 519 (2008) (analyzing substantive due process as applied to arbitrary government decisions).

[254] *See* AUTONOMOUS DRIVING: TECHNICAL, LEGAL, AND SOCIAL ASPECTS 70 (Markus Maurer, J. Christian Gerdes, Barbara Lenz, & Hermann Winner ed. 2016) (highlighting the constitutional implications of autonomous vehicles making ethical decisions to avoid accidents).

[255] *See* John Markoff, *Should Your Driverless Car Hit a Pedestrian to Save Your Life?*, N.Y. TIMES (June 23, 2016), *archived at* https://perma.cc/HZ2V-QSTA (quoting: "The new research could take autonomous vehicle manufacturers down a philosophical and legal rabbit hole [a]nd since the autonomous vehicle concept is so new, it could take years to find answers.").

[256] *See* Miller, *supra* note 193 (proclaiming that there is a widespread belief that software and algorithms rely on objective data).

[257] *See* Naughton, *supra* note 156 (stating that autonomous car makers will have to program the cars to make difficult decisions with both pedestrians and the driver in mind).

make its analysis. Even if a legislature attempts to provide limits to the jury's discretion by legislating the ethical considerations and proscriptions, that legislature itself would be subject to societal or personal biases within its body. Worse, that legislation could change with each election, causing an ethical "standard" to be as variable as election outcomes. In a worst-case scenario, an autonomous vehicle manufacturer would have to recall its products with every new legislative session in order to re-program the ethical components of the algorithm.[258] Gone would be any objective technological result, to be replaced by a continually questionable and ever-changing standard.

If product liability claims reach that point, one of two possibilities arise. First, faced with an ever-changing bar, autonomous vehicle manufacturers might simply choose to stop making a product.[259] In the alternative, the courts may find that *no* set of ethics is sufficiently better than any other, and thus one cannot assert that the choice of one particular algorithm design over another was unreasonable.[260] Indeed, if a panoply of ethical choices does not make the choice of crash victim any more palatable or defensible then a decision made by an amoral algorithm, the decision is on equal footing and cannot be deemed the result of a defective design.[261] Thus, the

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[258] *See* Kim, *supra* note 66, at 308 (proposing that plaintiffs could use software updates or failure to update software as a design defect).

[259] *See* Austin Craig, *Self-Driving Cars Will Fail*, SEEKING ALPHA (Jan. 9, 2017) *archived at* https://perma.cc/Y28T-3ND9 (suggesting that "[p]erhaps in the end it will come down to legal liability vs profit potential"). "Assuming the mentality of an insurance company, it may simply be cheaper to just push forward and pay out claims as accidents happen. However, when claims exceed profits." *Id*.

[260] *See* Gurney, *supra* note 70, at 238 (arguing that "courts should ensure that a jury does not punish a car manufacturer nearly out of disagreement" with manufacturing decisions about crash-optimization algorithms).

[261] *Compare* Peter Nowak, *The Ethical Dilemmas of Self-Driving Cars*, THE GLOBE AND MAIL (Feb. 2, 2018), *archived at* https://perma.cc/8MP6-7KY8 (arguing that creators of self-driving cars have to program them to make decisions that human drivers never had to learn to make when learning to drive), *with* Miller, *supra* note 193 (quoting academic scholars who argue: "[T]he amoral status of an algorithm does not negate its effects on society" and adding that "even if [algorithms] are not designed with the intent of discriminating against those groups, if they reproduce social preferences even in a completely rational way, they also reproduce these forms of discrimination.").

choice of, or lack of, an ethical component in an algorithm design will not rise to the level of a design defect.[262]

4. Conclusion—Traditional Product Liability Does Not Resolve Liability Claims Related to an Algorithm's Choice

Traditional product liability law will not be applicable to the claims of victims chosen by autonomous vehicles in unavoidable collisions.[263] Product liability law was developed for products that were basically unchanged after the products left the manufacturer, and were actively used or controlled by a consumer.[264] Autonomous vehicles defy all those presumptions, literally taking both the manufacturer and consumer out of control over the end product.[265] Thus, when an algorithm chooses with what or whom the vehicle will collide, whatever criticism there may be of that choice, it will not be the basis for liability under traditional product liability standards.[266]

C. Other Causes of Action

It may be useful at this point to step back and consider other possible grounds for liability. Preliminarily, it should be noted that the reporters of the Restatement (Third) of Torts tried to avoid the "doctrinal differences" of "strict liability, negligence and warranty" completely, and instead focus in "[functional] terms directly addressing the various kinds of defects."[267] Thus, it is quite possible

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[262] *See* Toke, *supra* note 79, at 284 (citing Banks v. I.C.I. Americas, Inc., 1994 WL 677536 (Ga. 1994) and stating that finding a design choice does not constitute a design defect if "the design choice was a reasonable one").
[263] *See* Twerski & Henderson, *supra* note 105, at 242 (concluding that products liability law should not apply to claims of victims chosen by autonomous vehicles in unavoidable accidents because "both the cost of engineering the new risk-reducing design and the cost of prosecuting the claim in court are likely to be substantial"). [264] *See* Toke, *supra* note 79, at 266 (citing Azzarello v. Black Brothers Co., Inc., 391 A.2d 1020, 1027 (Pa. 1978) and holding product liability exist where the product "left the suppliers control").
[265] *See International Survey of Best Practices*, *supra* note 3 (explaining how autonomous vehicles do not require human control).
[266] *See Products Liability*, *supra* note 116 (describing that products liability claims can be based on negligence, strict liability, or breach of warranty of fitness).
[267] *See* Toke, *supra* note 79, at 245 (citing RESTATEMENT (THIRD) OF TORTS, § 1, cmt. a. (AM. LAW INST., Tentative Draft No. 2, 2004) and discussing the drafting process of the Restatement (Third) of Torts).

any of these separate causes of action could be merged out of existence of the common law by the time autonomous vehicles actually hit the roadways. Still, these other grounds should be factored into this analysis of liability for the chosen victims in a collision involving autonomous vehicles.

1. Negligence

First is the most traditional of all theories, that of negligence. In order for a manufacturer to be found negligent toward the harmed party, that manufacturer had to have owed some duty to the harmed party.[268] That "duty," in turn, is premised on a finding that the manufacturer should have reasonably foreseen that the harmed party would be injured by the manufacturer's product.[269] Put another way, a manufacturer will have violated a duty to the harmed party if the manufacturer had a choice between alternate courses of action, and chose the action which by some standard should be considered harmful.[270]

When the choice, however, is being made by a fully functional algorithm that changes its decision-process over time, it will be impossible to find that the manufacturer had violated any duty to the chosen victim of an unavoidable accident. First, the only choice the

[268] *See* RESTATEMENT (SECOND) OF TORTS: STATEMENT OF THE ELEMENTS OF A CAUSE OF ACTION FOR NEGLIGENCE § 281 (AM. LAW INST., 1974) (defining the elements of tort liability as "(a) the interest invaded is protected against unintentional invasion; (b) the conduct of the actor is negligent with respect to the other, or a class of persons within which he is included; (c) the actor's conduct is a legal cause of the invasion; and (d) the other has not so conducted himself as to disable himself from bringing an action for such invasion."); *see also* RESTATEMENT (SECOND) OF TORTS: BURDEN OF PROOF § 328A (AM. LAW INST., 1974) (stating "[I]n an action for negligence the plaintiff has the burden of proving (a) facts which give rise to a legal duty on the part of the defendant to conform to the standard of conduct established by law for the protection of the plaintiff; (b) failure of the defendant to conform to the standard of conduct; (c) that such failure is a legal cause of the harm suffered by the plaintiff; and (d) that the plaintiff has in fact suffered harm of a kind legally compensable by damages.").

[269] *See* David G. Owen, *Figuring Foreseeability*, 44 WAKE FOREST L. REV. 1277, 1277-78 (2009) (elucidating that the role of foreseeability defines the nature and scope of responsibility in a tort)*; see also* Palsgraf v. Long Island Railroad. Co., 248 N.Y. 339, 344 (1928) (holding that a duty is defined by the risk reasonably identified).

[270] *See id.* at 1280 (stating that one is liable when he neglects to minimize or mitigate potential harm by choosing a riskier course of action).

manufacturer made was to use a functional algorithm. A court could not rationally hold this choice to be wrong by any standard, since the algorithm was, by definition, state of the art. More fundamentally, the choice of the victim was made by an ever-evolving algorithm, and as previously stated, was not foreseeable by the manufacturer. Thus, the victim could never prove that the manufacturer violated a duty to that victim, and a case based on the manufacturer's negligence could never succeed.[271]

One might be tempted to focus on whether the choice of that specific victim was "unreasonable" considering other possible choices. However, assuming the algorithm was not mandated to include an ethical component that should have precluded the choice of that victim, the vehicle's choice would be a completely objective one. Whether the choice can be attacked or praised as morally right, it could not be deemed unreasonable because morality was not an element of that choice. Since the manufacturer did not make any choice about the victim, and because that choice was completely objective, the manufacturer cannot be liable to that victim under a negligence theory.[272]

Section 7 of the Restatement (Third) of Torts, Liability for Physical and Emotional Harm, has materially altered the analysis of duty, however, even this alteration could not create any new standard of liability against the manufacturer: "(a) An actor ordinarily has a duty to exercise reasonable care when the actor's conduct creates a risk of physical harm [and] (b) [i]n exceptional cases, when an articulated countervailing principle or policy warrants denying or limiting liability in a particular class of cases, a court may decide that the defendant has no duty or that the ordinary duty of reasonable care requires modification."[273]

The wording of Section 7 is even more explicitly in favor of the autonomous vehicle manufacturer than the Restatement (Second),

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[271] *See* Karnow, *supra* note 11, at 15 (providing a similar analysis about the foreseeability of harm by autonomous robots).

[272] *See* Owen, *supra* note 269, at 1280 (observing the Restatement (Third) of Torts' movement away from a moral-based definition of foreseeability).

[273] *See* RESTATEMENT (THIRD) OF TORTS: DUTY §7 (AM. LAW INST., 2016) ("[A]n actor ordinarily has a duty to exercise reasonable care when the actor's conduct creates a risk of physical harm.")

since a manufacturer's "conduct" would in no way have a nexus with the action that created the harm to the chosen victim, that being the decision made by the ever-changing algorithm. Thus, the manufacturer could not be deemed liable under a claim of negligence.

2. Warranty

Any attempt to assert a warranty claim would face the same roadblock as a negligence claim—the manufacturer is too far removed from the product to be found liable. An express warranty requires an "affirmation of fact or promise made by the seller to the buyer."[274] Unless the manufacturer had promised an accident-proof vehicle, the manufacturer can never anticipate either the specific accident scenario involving the victim, or the choice made by the algorithm. Thus, that final choice could in no way be connected to an "affirmation" from the manufacturer giving rise to an express warranty.

Similarly, an implied warranty of fitness for a particular purpose requires that the "seller at the time of contracting has reason to know of a particular purpose "[275] The manufacturer could never anticipate the exact scenario in which the vehicle is now involved, and thus could not be found to have known of the "particular purpose".[276]

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[274] *See* U.C.C.: EXPRESS WARRANTIES BY AFFIRMATION, PROMISE, DESCRIPTION, SAMPLE §2-313 (defining the different express warranties as "(1) Express warranties by the seller are created as follows: (a) Any affirmation of fact or promise made by the seller to the buyer which relates to the goods and becomes part of the basis of the bargain creates an express warranty that the goods shall conform to the affirmation or promise; (b) Any description of the goods which is made part of the basis of the bargain creates an express warranty that the goods shall conform to the description; and (c) Any sample or model which is made part of the basis of the bargain creates an express warranty that the whole of the goods shall conform to the sample or model.").

[275] *See* U.C.C.: IMPLIED WARRANTY: FITNESS FOR PARTICULAR PURPOSE §2-315 (defining implied warranties purposes: "Where the seller at the time of contracting has reason to know any particular purpose for which the goods are required and that the buyer is relying on the seller's skill or judgment to select or furnish suitable goods, there is unless excluded or modified under the next section an implied warranty that the goods shall be fit for such purpose.").

[276] *See* Belay, *supra* note 211, at 122-23 (asserting that perhaps the one exception would be if the owner of the vehicle was looking for a vehicle that would at all costs protect that driver); *see* Gurney, *supra* note 61, at 258 (discussing that if there is any legislation that should be enacted to address the ramifications of autonomous vehicle algorithms, it should include a prohibition against algorithms that protect the driver at all costs).

As such, no implied warranty of fitness for a particular purpose could ever arise.

Finally, an implied warranty of merchantability requires that a manufacturer's product act in accordance with the parameters either set by or agreed to by the manufacturer.[277] A good algorithm will act in accordance to what it "learns" from its experiences on the road, and the feedback from other autonomous vehicles. Thus, the parameters of an autonomous vehicle's actions will be completely proper, and in fact the harm will arise in the course of proper actions under proper parameters. Therefore, the manufacturer could not be found to have violated an implied warranty of merchantability in favor of the chosen victim.

III. How to Compensate the Chosen Victim—Moving Away from Current Theories of Product Liability

Based on this analysis, the future of litigation involving unavoidable accidents could look bleak for the victim. Through no fault of his or her own, that victim has been chosen to be the harmed party, but that choice does not trigger any of the grounds by which a victim of a product's operation is normally compensated. Yet, if society is going to embrace the benefits of autonomous vehicle technology, how can it allow the innocent victims of that technology go unprotected? Given that modern precepts of product liability were never developed to address a product that is neither static as to its design or operation, nor subject to the choices and control of the consumer using that product, it is time to move on from product liability principles that seek to place the burden of harm on either the manufacturer or the consumer of the product.

Before going any further in this analysis, one must ask the most basic question—is this industry worth "saving"? If nothing is done to account for these liabilities except to foist them on the manufacturers of this technology, manufacturers could cease offering autonomous vehicles.[278] That outcome would ignore the fact that the harms are not

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[277] *See* UCC § 2-314, *supra* note 41 (stating the parameters for merchantability claims).

[278] *See* Craig, *supra* note 259 (commenting that some analysts think that this liability will ultimately doom autonomous vehicles); *see also* John Villasenor, *Products Liability and Driverless Cars: Issues and Guiding Principles for Legislation*, CTR. FOR TECH. INNOVATION AT BROOKINGS (Apr 24, 2014), *archived at*

the inevitable side effects of a necessary but dangerous technology or business, but in fact the result of a technology meant to lessen the total number of incidents causing harm. Indeed, the reason that traditional product liability concepts will no longer work in the case of autonomous vehicles is that the harm will not arise from anything the manufacturers did, or indeed could have done, to prevent the harm. Therefore, one must presume that the traditional means of assessing liability will not attain the proper balancing and allocation of risk and liability, but at the same time the autonomous vehicle industry must be shielded from shouldering all the liability for those harms.

A. *The Legal Framework Under Which Liability is to be Determined*

Some analysts suggest that an entirely new legal framework must be developed to deal with this new technology and the new legal issues facing the inevitable accident victims. It is true that, as previously discussed, these products will not be the same products at the moment the liability arises that they were when manufactured, and traditional product liability law does not address self-changing products. That does not mean, however, that new technology needs an entire new legal system. The more general traditional U.S. legal framework, notwithstanding contemporary product liability law, will still work to address these liability issues. [279]

It is time to consider that our society has come full circle in the theoretical discussion of liability. In the early years of the Industrial Revolution, the legal system recognized that some players in this new economy were in essence a necessary evil, coined for them the term “ultrahazardous” or “abnormally dangerous,” and then identified the elements to determine liability for an accident involving such activities, and to compensate victims of that accident. The rise of these new ultrahazardous activities did not, however, require a new legal system. Rather, the legislature began adopting proactive government regulations which reduced or eliminated much of the risk that was otherwise ignored by businesses as an unavoidable cost of business.

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https://perma.cc/RR9B-PQMG (reaffirming that liability with regards to autonomous vehicles could be the demise of the self-driving car movement).

[279] *See* Gary Silberg & Richard Wallace, *Self-Driving Cars: The Next Revolution 21*, KPMG (2012), *archived at* https://perma.cc/5V4Z-X4ZJ (delving into the legal framework necessary to deal with liability issues and autonomous cars).

Concurrently, the court system developed a common law concept of strict liability against an owner of an ultrahazardous business operation, meaning that victims did not have to prove the operator had owed or breached a duty to the plaintiff, but only that the damages for which the victim was demanding compensation were attributable to the accident.[280] That, in turn, pressured businesses into investing in the proper design and manufacturing of products, so that over time many "unavoidable" risks were in fact ameliorated. For those remaining ultrahazardous activities, the insurance sector developed products that allowed businesses to account for these costs, and spread the risk over an entire industry, so that innocent victims could obtain compensation. By using these same three sectors of the modern legal system, i.e. the legislatures, the current court system, and the insurance sector, the liability issues raised by the decisions of autonomous vehicles can be addressed without the need for a new legal system.

1. The Role of the Legislature

The legislative/regulatory sector's role will have to be focused and specific. The legislature certainly cannot prevent victimization from occurring completely, since the only way to prevent autonomous vehicles from being responsible for hurting anyone would be to prevent autonomous vehicles from having any response to any accident. As previously stated, that would only mean more fallible humans would replace objective algorithmic decisions. However, if a legislature attempts to act, this technology is so new that it is hard to define or describe, let alone address via legislation.[281] The premature and broad regulation of either the machinations of this technology or the results of those machinations would only lead to "poor laws and even worse technology". [282]

[280] *See* Ronald B. Standler, *Elements of Torts in the USA*, RBS2 5 (2011), *archived at* https://perma.cc/ZP67-JBQV (citing RESTATEMENT (SECOND) OF TORTS §519 and explaining that "there are a few, but important, torts in which liability is imposed without finding fault with the defendant's conduct [and] [t]hese so-called *strict liability* torts include . . . abnormally dangerous activities").
[281] *See* Andrew Burt, *Leave A.I. Alone*, N.Y. TIMES (Jan. 4, 2018), *archived at* https://perma.cc/T5CY-5695b (elaborating on the difficulty of defining and regulating artificial intelligence).
[282] *See id.* (considering the implications of regulating technology without defining it).

Rather than trying to prohibit the inevitable victim from occurring, the legislature can enact laws that specifically complement good algorithm-based responses to an accident. First, governments should be responsible, as they are now, for the maintenance and improvement of transportation infrastructures, keeping in mind that infrastructure should include wireless and satellite systems that are both accessible to all autonomous vehicles and prevent any "dead" zones without those systems.

Second, governments should mandate, in conjunction with other jurisdictions, the type of databases maintained by autonomous vehicles, and the technological standards used by autonomous vehicles to collect and respond to those databases.[283] The "type" will determine what data is collected, ranging from road conditions to the ability of a vehicle to sense specifically the make and model of the other vehicles about to be involved in the accident. Mandating the type is necessary, since that, in turn, will dictate the infrastructure in the form of the type and level of technology for sensors.[284] The "technological standards" upon which governments should agree will range from standardized bandwidths for sensors, to standardized mapping processes so cars can "agree" on where they are at any given moment, to standardized communication software and hardware by which cars will share information and coordinate responses in the middle of an accident.[285] The standards will also have to define the "Operational Design Domain (ODD)" in which these vehicles will be expected to collect data, including the weather conditions and the geographical elements,

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[283] *See id.* (suggesting an international treaty whereby these standards are developed. Otherwise, the industry faces having to develop technologies that work in multiple systems, akin to the days when movies had to be released that played on both Beta and VHS machines, and worse, cross-border transportation vehicles would face the deleterious prospect of the supporting infrastructures being incompatible from country to country). *Id.*

[284] *See* Douglas B. Lenat, *CYC: A Large-Scale Investment in Knowledge Infrastructure*, 38 COMM. OF THE ACM 33, 36 (Nov. 11, 1995) (dissecting how the presentation of a CYC system depends on the types of word associations it can invoke).

[285] *See International Survey of Best Practices*, *supra* note 3 at 44-68 (listing the wide range of technological issues that need to be standardized); *see also* Silberg, *supra* note 279, at 12 (contending that there remain a number of technological issues that have yet to be resolved).

and even the types of roads that will fall under the ODD.[286] Otherwise, the industry will be forced to develop technologies that work across multiple systems, akin to the days when movies had to be compatible with both Beta and VHS machines. Worse, cross-border transportation vehicles would face the deleterious prospect of the supporting infrastructures being incompatible from country to country.[287]

The third area in which governments should act would be to pass laws that would prohibit any technology that would interfere with objective algorithmic decisions, in other words biased autonomous vehicles.[288] As stated previously, the only way to ensure that the choice of victim is the objectively proper choice is to prevent that choice from being biased.[289] Otherwise consumer demand, whether for vehicles that protect the consumer occupant at all costs, or for vehicles that are more nefariously biased, will inevitably lead to biased-based autonomous vehicles. The National Highway Traffic Safety Administration has already raised the need for this regulation:

> Since these decisions potentially impact not only the automated vehicle and its occupants but also surrounding road users, the resolution to these conflicts should be broadly acceptable. Thus, it is important to consider whether HAVs [Highly Automated Vehicles] are required to apply particular decision rules in instances of conflicts between safety, mobility, and legality objectives. Algorithms for resolving these conflict situations should be developed transparently using input from Federal and State regulators,

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[286] *See Federal Automated Vehicles Policy*, NAT'L HIGHWAY TRAFFIC SAFETY ADMIN. 1, 1-116 (2016) (discussing that standards must provide transparency in how they are collecting their operational data).

[287] *See International Survey of Best Practices*, *supra* note 3, at 71 (concluding that manufacturers will be forced to provide blueprints which will operate universally, as opposed to product-specific).

[288] *See* Press Release, U.S. Senator Maria Cantwell, Cantwell, Bipartisan Colleagues Introduce Bill to Further Understand and Promote Development of Artificial Intelligence, Drive Economic Opportunity (Dec. 12, 2017), *archived at* https://perma.cc/6DZA-MFT4 (summarizing the findings of multiple senators that legislation must be passed to promote the further development of artificial intelligence technologies).

[289] *See infra* Section II. C. (noting additional causes of action).

> drivers, passengers and vulnerable road users, and taking into account the consequences of an HAV's actions on others.[290]

However, as previously explained, governments should avoid enacting legislation that defines the "right" choice of victim, and instead should set regulatory parameters to ensure that algorithms use only objective criteria.[291] Likewise, though some industry leaders have suggested the governments defer to "institutional review boards" established by the industry itself to determine these parameters, there is no reason to believe an industry panel could ultimately be any more successful in doing so.[292] The best course is for the government to prohibit any biases from controlling algorithmic outcomes, and to proscribe such biases from being introduced by either regulators or the industry.[293]

Finally, some professional organizations have suggested that government regulation go so far as to set a standard for autonomous vehicles, including algorithmic outcomes, which, once met, would create immunity from any liability on the part of manufacturers.[294] So, presumably, so long as the computer system in a vehicle met certain minimum standards, and the algorithm met a minimum standard of software design, the victim identified by the autonomous vehicle would have no right to sue under any tort theory.[295] The problem with this broad approach is that, first, if the technology is not definable, a legislature cannot set minimum acceptable standards for that

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[290] *See Federal Automated Vehicles Policy*, *supra* note 286, at 26-27 (maintaining that the creation of algorithms should be transparent and guided by federal transportation regulation).

[291] *See infra* Section II. C. (noting additional causes of actions).

[292] *See* Jonathan Handel & Grady Johnson, *Self-Driving Cars: the first potentially deadly robotics?*, FORTUNE INSIDER (Feb. 25, 2015) *archived at* https://perma.cc/BQ25-5PZF (explaining that self-driving cars Institutional Review Boards should uphold the same standards as boards in medicine).

[293] *See* Kirchner, *supra* note 197, at 2 (challenging whether the "disparate impact" theory can be applied to policies that have a discriminatory effect on certain groups of people).

[294] *See* Joseph R. Herkert, *Professional Societies, Microethics and Macroethics: Product Liability as an Ethical Issue in Engineering design*, 19 INT'L J. OF ENG'G EDUC. 163, 166 (2003) (suggesting stronger limits on product liability to create the effect of eliminating the manufacturers' burden).

[295] *See* Ian Bogost, *Can You Sue a Robocar?*, THE ATLANTIC (Mar. 20, 2018), *archived at* https://perma.cc/36GC-9XJ7 (outlining proposed law and minimum standards for autonomous vehicle liability).

technology. Furthermore, it is a given that regulatory standards are often the result of industry lobbying, and thus the outcome is based on political influence rather than good science. Even if the initial legislation or regulation was well-drafted, this legislative process would have to be on-going as technology improves and thus autonomous vehicles become more advanced. As this advancement occurred, the minimum standards defined by regulation would become laughably low or, worse, those standards might inadvertently preclude a better technology that unexpectedly fell under the proscriptions of the old legislation.

Finally, under accepted common law principles, a government standard does itself normally give rise to absolute immunity even if that standard is met, and those principles apply to software.[296] Trying to pass broad immunity from liability from an unavoidable accident is both scientifically unsound and over-reaching. Thus, the focus of legislatures should be on sound infrastructure, compatible technological standards across borders and preventing bias from entering algorithmic functions, and the government should have no significant role in determining liability from autonomous vehicle accidents.

2. The Role of the Courts

The court system has been, and will remain, the sector that should determine liability for such accidents and the compensation to be paid. It is perhaps ironic that, given the unrest in the product liability arena caused by autonomous vehicles, autonomous vehicles will make the process of determining the tortfeasor in vehicular accidents much easier under existing tort law principles. If no one is driving the vehicles involved in an accident, no occupant of an autonomous vehicle can be deemed to have had a causative role in the accident, nor to have breached a duty to the plaintiff.[297] That alone will eliminate almost every person who now would presumptively be a possible defendant in a vehicular accident. Furthermore, assuming the vehicle and software worked properly, no manufacturer will be

[296] *See* Brocklesby v. U.S., 767 F.2d 1288 (9th Cir. 1985) (describing when a manufacturer is strictly liable); *see also* Villasenor, *supra* note 278 (highlighting common-law standard of products liability).

[297] *See* Schubert, *supra* note 4 (highlighting negligence issues with fully autonomous vehicles).

liable under product liability laws for the reasons stated previously, and thus no manufacturer can be held liable under traditional product liability principles.[298] In short, the court system will not have to be used to identify any party liable for the victim of an unavoidable autonomous vehicular accident, since none will exist.

That is not to say that the court system will simply become obsolete regarding vehicular accidents. As a reminder, the query here is limited to when an autonomous vehicle has caused harm despite operating correctly in the course of an unavoidable collision. If the cause of the injury was because vehicle's mechanical systems did not work properly, or the result of a malfunctioning computer software program, the court would be adjudicating a harm based on traditional product liability law. If the accident were caused by an individual who was not in an autonomous vehicle, such as a bicyclist pedaling down the middle of an interstate highway, or a pedestrian that decided to take a short-cut through the middle of rush-hour traffic, the court would be overseeing a case involving traditional negligence law. Thus, judges need not fear that they will be superfluous in any case involving vehicular harm.

Furthermore, the court will be the proper venue for resolving disputes about damages. Ignoring for the moment who would pay those damages, the means of determining how much damages the plaintiff incurred can still be resolved by the court using statutory and common law rules for determining the amount of damages the plaintiff suffered. In certain cases, the judge might also need to preside over affirmative defenses to those damages, such as contributory negligence. Of course, if the plaintiff were in an autonomous vehicle when the accident occurred, the plaintiff could not be deemed to have contributed to his or her harm for the same reason no other occupant of an autonomous vehicle could be considered a possible defendant—the plaintiff was not driving and thus cannot be deemed to have contributed to the accident. Once again, this leaves non-vehicle plaintiffs, such as bicyclists or pedestrians, as the only type of plaintiff against which contributory negligence could be asserted. So, the court system will still have the vital, albeit easier, role of resolving disputes over determining the amount of damages to which the plaintiff is entitled.

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[298] *See* Herkert, *supra* note 294, at 166 (proposing laws to hold manufacturer's blameless when existing standards are met).

But, this still does not answer the question of who the chosen victim turns to for compensation. If no tortfeasor cannot be identified by traditional tort analysis, because even relatively modern concepts of product liability law are archaic relative to autonomous algorithm technology, then the answer is to avoid wasting the court system's time trying to identify the tortfeasor. Rather, the legal system should focus on who is the best party to pay for the damages, considering issues of fairness and economics. Whoever is so identified should be deemed absolutely liable for the unavoidable, but objectively correct, accident. One possible outcome is for the consumer who purchased the vehicle that, in turn, struck the victim, to be liable for the damages. The consumer would be encouraged to pay more for a vehicle with better sensors, software and on-board computers in order to minimize exposure to the claim.[299] There are two problems with this approach, however. First, the presumption that this will encourage consumers to make better choices is based on the presumption the consumer has enough knowledge to make this economic decision. In reality, the average consumer will most certainly *not* have enough knowledge about what is the best software, sensors and algorithms to make this decision.[300]

Moreover, this ignores the fact that the person(s) in the vehicle at the time of the accident could very well not be the owner of the vehicle. Actually, autonomous technology might result in lower vehicle ownership and greater reliance on on-demand vehicles.[301] This creates a "double disconnect" with regard to assessing liability. On one hand, the owner would be completely removed from the accident that happened while someone else was driving the owner's vehicle. If, instead, the liability was shifted to the occupant, not only would the occupant not be the cause of the accident in any way, but the occupant would not have even played a role in selecting the vehicle based on is safety features.

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299 *See* Eric Roberts, *The Economic and Ethical Foundations of Liability Law*, OUTLINE OF SOFTWARE LIAB. REP. (Sept. 26, 2016) *archived at* https://perma.cc/5574-35GZ (highlighting consumer behavior in choosing safety over affordability).

300 *See id*. (arguing that market assumption of consumer and producer's perfect knowledge of associated risks is incorrect).

301 *See* Silberg, *supra* note 279, at 28 (positing the impact self-driving vehicles will have on vehicle ownership).

Ultimately, the exposure to liability of a consumer, whether in the guise of the owner or the occupant, could at worst be simply the result of happenstance, and at best, the result of the amount of miles that consumer's vehicle was on the road, since the biggest variable affecting exposure could simply be the amount of time the consumer was in a position to be exposed to an accident. Assessing liability based on these factors would not result in any benefit to society, and could be a disincentive to participating in societal and economic interactions.[302] This would harm the marketplace because it would interfere with consumer discretionary spending, and would lead to claims that the very freedom that comes from having access to a vehicle would be nullified by the fear that an innocent occupant would be liable for harm to the innocent victim.

The next option is for the manufacturer of the vehicle that struck the victim to be responsible. Some manufacturers have actually announced this to be the option they prefer.[303] By assuming liability, manufacturers could avoid the possibility of a hodge-podge of regulations all aimed at reducing or allocating damages, but via differing means and with differing successes, and with no guarantee that regulatory compliance would give them total immunity from liability.[304] The manufacturers would be free to spend money on building the safest autonomous vehicles, rather than regulatory compliance by way of developing the best possible sensors, mechanical systems and algorithms, because the better these systems are, the more likely that all harm could be avoided by quick and adept

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[302] *See* Jack Boeglin, *The Cost of Self-Driving Cars: Reconciling Freedom and Privacy with Tort Liability in Autonomous Vehicle Regulation,* 17 YALE J. L. & TECH. 171, 178 (2015) (discussing possibility that autonomous vehicles will face resistance from enthusiasts because enthusiasts love being in control of a powerful machine, and taking away the wheel takes away "whatever joy there is to driving," stripping cars of their "symbolic and emotional value"). Boeglin argues that autonomous vehicle technology should not infringe on user privacy unless the social good outweighs the social costs "incurred by forfeiting these values." *Id.* at 201.

[303] *See* Kirsten Korosec, *Volvo CEO: We Will Accept All Liability When Our Cars are in Autonomous Mode,* FORTUNE MAG. (Oct 8, 2015), *archived at* https://perma.cc/9DUV-9N37 (quoting President and CEO of Volvo Car Group who stated that Volvo would take full responsibility when one of its vehicles is in autonomous mode).

[304] *See id.* (discussing possibility that the reason Volvo made a statement assuming liability in automated vehicle accidents was because Volvo wanted to avoid an incentive for U.S. lawmakers to enact burdensome regulations).

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collision avoidance.[305] The problem with this is that, if the accident is unavoidable even with expensive technology, the vehicle manufacturer would be penalized by having to pay the victim's damages even though the vehicle is outfitted with more expensive, autonomous components.[306] Either the manufacturer would avoid paying for the better technology because it did not sufficiently lower the manufacturer's liability exposure, or, if the manufacturer factored both the cost of the better technology and the exposure to damage claims into the vehicle cost, consumers would opt for a lower priced vehicle and the manufacturer would go out of business.[307] Since society would not benefit from either result, there is no economic reason for placing this burden on the manufacturer of a vehicle that hit the plaintiff, and so, despite the claims of some manufacturers, the manufacturer should not be deemed absolutely liable for the plaintiff's damages.[308]

Perhaps a better answer would be to move away from finding a single person or entity liability based solely on their particular status, and assigning liability for all unavoidable accidents to any entire group of persons or entities. In philosophy this joint liability has been called

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[305] *See* Duffy & Hopkins, *supra* note 20, at 475 (arguing the enforcement of strict liability would "encourage manufactures to push forward the adoption of [autonomous vehicle] technology"); *see also* Weber, *supra* note 63, at 479 (citing legal scholars who argue that strict liability on software manufactures provides an "incentive for ensuring the safety of computer programs").

[306] *See* Levy & Bell, *supra* note 62, at 1 (stating even with the use of powerful computer systems and software available to the public and businesses a manufacturer would "face increasing exposure to lawsuits alleging that software did not perform as expected").

[307] *See* Eric Roberts, *The Economic and Ethical Foundations of Liability Law*, SOFTWARE LIAB. REP. (Sept. 26, 2016), archived at https://perma.cc/7UU3-CZN6 (claiming that the concept of incentives is essential to liability law, and that with autonomous vehicles the goal should be to ensure that "software producers are producing software that is both safe and affordable to customers"); *see also* Levy & Bell, *supra* note 62, at 14-15 (mentioning possibility that "the application of strict liability theory might hinder the development of software" and that prudent software vendors "should be cognizant of the risks" of their software and take actions to limit their legal exposure.); *see also* Weber, *supra* note 63, at 479-80 (cautioning that strict liability on automated vehicle software could result in increased insurance rates as high as "1500% per year" and arguing it would be "unlikely that manufactures of high-risk or new products would be able to obtain or afford the necessary insurance coverage").

[308] *See* Klein, *supra* note 2, at 131 (proposing a no-fault insurance system for manufacturers of autonomous vehicles).

"collective moral responsibility".[309] In product liability cases, this has been dubbed "enterprise liability"[310] or "market share liability".[311] For example, the entire industry of a particular type of autonomous vehicle could be assessed liability for all the damages arising from all the unavoidable accidents involving that particular type of vehicle. The philosophical and legal theories underlying this collective liability is that, when a group of businesses works within a similar industry, develop their own products based on the product experiences and testing results of others in that market, and share a common industry standard of safety, the different entities in this market each contribute to the actions or inactions that result in the harmful product.[312] Collective moral responsibility has been deemed particularly appropriate when the group assessed the liability share a common profit motive.[313]

However, this theory of collective liability fails in the case of autonomous vehicles. First, collective liability presupposes that each business created a similar product that could have contributed to the victim's harm. However, the accident that harmed the victim could have been caused in part by members of the collective, i.e. autonomous vehicles, but the accident could have included pedestrians, motorcyclists, and others not part of that collective, not to mention weather conditions and roadway design. The *Sindell* court specifically

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[309] *See* Lighthouse Services, *Corporate Moral Responsibility and Ethics of Product Usage:Expanding Notions of Corporate Responsibility for Personal Injury*, LIGHTHOUSE SERVS. NEWSL. (Mar. 2013*)*, *archived at* https://perma.cc/6ZHS-XTEY (reiterating the definition of collective moral responsibility as "arrangements appropriate for addressing widespread harm and wrongdoing associated with the actions of groups"); *see also* A.H. Vedder, *Accountability of Internet Access and Service Providers*, 3 ETHICS & INFO. TECH. 67, 72 (2001) (identifying a need for collective moral responsibility). It is effective to collectively blame and praise organizations because it motivates them to learn from and to modify their behavior. *Id.* at 72.

[310] *See* Hall v. E. I. Du Pont de Nemours & Co., Inc., 345 F.Supp. 353, 371 (E.D.N.Y. 1972) (defining enterprise liability: "[T]he policy of assigning the foreseeable costs of an activity to those in the most strategic position to reduce them.").

[311] *See* Sindell v. Abbott Labs, 26 Cal. 3d 588, 617 (1980) (Richardson, J., dissenting) (explaining how market share liability makes each party's liability proportionate to its market share).

[312] *See* Hall, *supra* note 310, at 371 (discussing the effects of setting an industry-wide safety standard).

[313] *See* Vedder, *supra* note 309, at 72 (reasoning that internet and service providers are interdependent, so they can only be assigned collective responsibility and not individual liability).

held that where the collective on which liability was imposed did not include virtually all of the parties that could have caused the harm, the court could not assess liability because too many participants in the harm would be left out.[314] Since autonomous vehicles were not the sole cause of the harm, they cannot be held liable under the joint enterprise theory.

An additional problem is that the autonomous vehicles cannot collectively have controlled the harm which befell the victim, because it was in fact the best option using objective algorithms. Collective responsibility requires that the collective be able to control or check the harm giving rise to the liability.[315] Collective moral responsibility will not work to address harm unless all the members of the group can respond to the liability with corrective action.[316] Since the autonomous vehicle industry will have done nothing wrong to the victim, it will not be able to respond with any corrective action. Thus, arbitrarily placing all the liability for the victim's damages accomplishes nothing—the industry will be assessed damages it cannot eliminate by any industry actions, and the industry will be assessed damages that could be attributable to non-industry participants in the accident. The only reason to place damages on the industry is to end the search for someone to assume the burdens of those damages.

3. The Role of the Insurance Sector

Because no economic or legal rationale exists for making any particular person, manufacturer or industry responsible for harm that befell the victim, the search is, ultimately, simply a search for a party voluntarily assuming the liability of that victim. That party has been, and can continue to be, the third sector of the modern legal system, the insurance company. Insurers exist because they are willing to pay for the damages from accidents involving their insureds based on contract terms, not legal theories of liability. They pay despite the risk that they

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314 *See* Sindell, *supra* note 311, at 612 (concluding that if plaintiff sues the manufacturers that produced ninety percent (90%) of the market share of the drug that harmed her, there is still a ten percent (10%) chance that the actual offender would evade repercussions).

315 *See* Vedder, *supra* note 309, at 71 (arguing that liability can only be found in parties with the capability to prevent harm).

316 *See* Vedder, *supra* note 309, at 72 (contending that it is unlikely that collective responsibility cannot be distributed amongst individuals).

will not be able to recover contributions from all responsible third parties, and pay to third parties without requiring their insureds to prove the insured were liable to the third parties. Thus, where our legal system wants someone to pay for the wronged victim, the insurer is the obvious choice.

Unlike individuals or manufacturers or even collectives, sound economic reasons exist for relying on insurers to pay a victim's claims from an autonomous vehicle crash. The insurance companies will, as they do now, charge lower premiums to those owning vehicles that suffer less in collisions because of their design or safety features. Those cost savings will encourage consumers to pay more for safer vehicles, which in turn will encourage the autonomous vehicle industry to design better algorithms and more powerful computers. Insurers will also have the resources unavailable to individual vehicle owners to invest in studies ranging from algorithmic design to road design to lower their exposure to claims. The combination of better products and better infrastructure will result in autonomous vehicles operating such that unavoidable accidents are even less likely to happen, thereby lowering the overall exposure to everyone.

Insurance companies will also have economic incentives, as they do now, to investigate accidents, even those that appear to be solely the result of objective decisions. If the real result turns out to be defective products or bad infrastructure, then insurers will have the resources to uncover these hidden problems and make sure they are addressed, thereby exposing harms that otherwise would be covered up by shrugging shoulders and saying, "it was inevitable." Finally, insurers will be able to spread the cost of compensating a victim across a wide consumer base, meaning that society will share in the cost via insurance premiums for the harm to be victim chosen in order to save others in that society.

So, the ultimate answer to the question of what theory of liability should result in compensation to the victim who is unavoidable harmed is simply absolute liability. If the plaintiff is the chosen victim as a result of properly designed and operating autonomous vehicle algorithms, that plaintiff should be compensated without any need to determine the basis of liability for that compensation. Furthermore, the damages should simply come from insurers, rather than requiring the plaintiff to spend time and money to sue all possible tortfeasors in order to recover compensation.[317]

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[317] *See* Schubert, *supra* note 4 (purporting that product liability claims activity would not be beneficial to anyone besides the lawyers involved).

B. *Who's Insurer?*

The only question remaining is whose insurer should be paying the claim. Since the insurer will be paying for the victim's damages without any consideration of traditional liability standards, there is in fact no need to develop an insured payment system that extracts payment from an insured based on that insured's liability. Indeed, the occupants of the vehicle will not be in any way connected to the liability, so there is no need for the insurance to be tied to the owner or occupants of the vehicle.

Rather, the insurance should be tied to the vehicle itself. Some commentators have reached this conclusion by extending traditional concepts of personhood to vehicles, and thus making the vehicles personally liable.[318] However, requiring a car to be a "person" is only necessary if one retains the traditional theories of product liability, *i.e.* that some "person" must be found liable for insurance coverage to be triggered, and that failing to find a "person" liable will allow tortfeasors to avoid responsibility.[319] If liability and responsibility is no longer a necessary part of adjudicating damages, since no one is responsible for the victim other than the autonomous vehicle's algorithm that has independently evolved over time, then that vehicle is the proper source of the insurance.

Furthermore, there would be no need to determine who must pay for the vehicle's insurance. The law should only require that the vehicle, in fact, be insured.[320] That, in turn, would mean that market forces would determine who bears insurance costs independent of any regulatory structure or common law theories. Individuals or families wishing to own a vehicle could pay for that continually existing vehicle insurance as they do now. As an alternative, with the increase in temporary-lease vehicles, consumers would only pay for insurance when they are leasing a car, since in fact the leasing entity would be paying for the insurance and passing that cost along on a limited, per diem basis. Vehicle manufacturers could even pay for the insurance as part of sales promotions, like how they offer free maintenance fora specified period after a car purchase. This will greatly simplify the

[318] *See* Alexis A. Madrigal, *If a Self-Driving Car Gets In an Accident, Who—or, What—Is Liable*, THE ATLANTIC (Aug 13, 2014), *archived at* https://perma.cc/93U2-3AN2 (suggesting that self-driving cars would need to be insured like people).

[319] *See id.* (asserting that it is unlikely that a company or corporation, such as Google, would take on the liability of insurance of their products).

[320] *See id.* (stressing that insuring cars alone would provide for faster payouts to victims). This will eliminate the current common problem of uninsured drivers on the roads, since the drivers will not be the ones being insured. *Id.*

claims process, while at the same time virtually guaranteeing that the victim will be able to obtain compensation from an insurance company.

IV. Conclusion

The rise of autonomous vehicles means that "trolleyology" is not just a philosophical mind game, but an inevitable occurrence. Autonomous vehicles will face unavoidable collisions, and the algorithms in the vehicles' on-board computers will result in some innocent person being selected as the victim of the crash. Current theories of tort liable will not sufficiently address this situation, because those theories look for a liable party based upon control of the vehicle's design or manufacture, or the use of the vehicle by a consumer, neither of which will apply to an autonomous vehicle. The legal system will have to move beyond current legal theories in order to ensure that victims of autonomous vehicles are compensated, while at the same time protecting the autonomous vehicle industry, which will be a clear benefit to society, from debilitating absolute liability.

Instead, the legal system should find that the innocent victim is entitled to compensation without any finding of fault or responsibility. The governmental sector should focus on making the infrastructure in which the autonomous vehicle functions a better environment for that vehicle, and prohibiting any product designs that impede unbiased, objective algorithmic functions. The court system can be used to determine the amount of damages, if that issue is in dispute, and can also return to current concepts of product liability law if the harm was not the result of an objective algorithmic decision, but rather mechanical or software defects or the intentional acts of a third party. Ultimately, the insurance sector should pay the victim the compensation he or she deserves, and the autonomous vehicle itself should be the source of insurance to pay those damages. Who pays for that insurance can simply become another aspect of operating autonomous vehicles, similar to determining who pays for the source of power for that vehicle, as well as maintenance and parts. The autonomous vehicle market can thrive within these new legal parameters, thereby further reducing the harm to society from vehicular collisions overall. The victims of autonomous vehicle accidents will still be fully be compensated for their harm. "Trolleyology," from a legal perspective, will become a moot point.