

## **Autonomous Vehicles and the Ethics of Driving**

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**Abstract:** In this paper, we argue that if a set of plausible conditions obtain, then driving a standard vehicle rather than riding in an autonomous vehicle (AV) will become analogous to driving drunk rather than driving sober, and therefore impermissible. In addition, we argue that a ban on the production, sale, and purchase of new standard vehicles would also become justified. We make this case in part by highlighting that the central reasons typically offered in support of state-mandated vaccination will also support mandating AV use. Finally, we discuss some of the implications of our argument for the obligations of vehicle-producing firms.

**Keywords:** autonomous vehicles, drunk driving, markets, risk imposition, vaccination

### **1. Introduction**

Motor vehicle collisions (MVCs) are among the most common causes of premature death. More people die in MVCs each year than are killed by HIV/AIDS, tuberculosis, or diarrhea (World Health Organization 2018a: 5). If expected life years lost matter for evaluating the badness of deaths, then because MVCs are the leading cause of death in children, teens, and young adults (World Health Organization 2018a), they plausibly provide grounds for greater moral concern than even many of the most fatal diseases. In addition, the number of deaths associated with MVCs is steadily rising. MVCs therefore constitute a growing problem for global public health (Centers for Disease Control and Prevention 2019; World Health Organization 2018b: 2).

Despite all of this, both the ethics of driving and the ethics of markets in vehicles have received only limited critical attention from philosophers (Evans 2008; Fahlquist 2009; Husak 2004; Smids 2018; Vanderheiden 2006). Indeed, it is widely assumed that driving is a clear example of permissible risk imposition (Fried 2012: 506; Hansson 2003: 292; Kumar 2015: 27; Oberdiek 2009: 375). Showing that an otherwise plausible account of the ethics of risk imposition would not permit driving would be taken by most to amount to a *reductio* of that

account, rather than as providing a reason to take more seriously the possibility that driving might at least sometimes be impermissible. Similarly, markets in vehicles are generally taken to be a clear example of permissible markets (Satz 2010: 3). If an otherwise plausible theory of the ethics of commodification entails that vehicles are not the kind of good that can permissibly be bought and sold, that would be thought by most to show that the theory should be rejected, rather than to provide reason to reconsider the permissibility of markets in vehicles.

Perhaps all of this should be unsurprising. The deaths and injuries caused by MVCs, after all, have plausibly been regarded as an unavoidable, though unfortunate, price associated with living in a society that relies on and benefits from automotive travel. We have, that is, assumed that in our current conditions the value of the ends associated with automotive travel is sufficient to justify both markets in vehicles and the risk of injury and death imposed on others by those who drive. For the purposes of this paper, we will accept this assumption.<sup>1</sup>

Importantly, this assumption does not imply, nor has it generally been thought, that the risks imposed by driving do not provide legitimate grounds for public policy interventions. When measures are available that can predictably and reliably reduce the harms caused by MVCs, we have at least often required that those measures be adopted. We have, for example, implemented laws requiring manufacturers to install seatbelts and airbags in the vehicles that they produce. Relatedly, when there are identifiable behaviors that increase the risk of death and injury due to MVCs, we have prohibited those behaviors. We have, for example, banned driving while intoxicated and instituted speed limits.

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<sup>1</sup> While we acknowledge that there may be plausible grounds for skepticism about the permissibility of at least some ordinary driving in current circumstances, we do not rely on these in making our argument. This is because we can establish our central conclusions even while granting the assumption that ordinary driving is currently permissible. To the extent that we succeed in making that case, our arguments would be strengthened by compelling reasons to reject the permissibility of at least some ordinary driving.

These policy interventions are plausibly justified by the principle that, other things being equal, if we can eliminate, reduce, or prevent increases in the risk of death and injury due to MVCs, while preserving all or most of the benefits associated with automotive travel, we should do so. If we accept this principle, however, we may soon need to revise our views on the ethics of driving<sup>2</sup> and on the permissibility of markets in vehicles. In particular, we will argue that so long as certain widely held expectations about the relative safety and reliability of autonomous vehicle (AV)<sup>3</sup> use in comparison with human driving turn out to be correct, once AVs become commercially available and comparable in cost to standard, non-autonomous vehicles, this will, at least after a certain period of time, both (1) render the driving of standard vehicles morally impermissible; and (2) justify a ban on markets for standard vehicles.

We proceed in the remainder of the paper as follows. In section 2, we describe the central empirical conditions that would have to obtain in order for our normative arguments to imply that driving standard vehicles has become impermissible, and that banning markets for such vehicles is justified. And we briefly note some reasons to think that it is reasonably likely that these conditions will in fact obtain. In section 3, we present our argument for the view that when the relevant conditions obtain, driving a standard vehicle is impermissible. Specifically, we argue that in such circumstances, driving a standard vehicle rather than traveling in an AV is morally on a par with driving drunk rather than driving sober in present conditions, and therefore impermissible. In section 4, we appeal to some important similarities with the case for state-mandated vaccination (Brennan 2018; Flanigan 2014; Giubilini and Savulescu 2019; Pierik

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<sup>2</sup> In this paper, we use the terms ‘driving’ and ‘drive’ to refer to humans driving standard, non-autonomous vehicles.

<sup>3</sup> For the purposes of this paper, ‘AVs’ will refer only to vehicles that qualify for the Society of Automotive Engineers’ level 5 automation rating. The Society categorizes vehicles using a scale ranging from 0 to 5, with 0 representing no automation and 5 representing full automation. Vehicles with a rating of 5 do not require any human attention during use, whereas vehicles with a rating of, say, 3, have some automated features, but nonetheless require some human attention during use.

2018) in order to argue that when the conditions that we describe in section 2 obtain, the state will be justified in banning the production and sale of standard vehicles. We suggest that the type of case that we offer in defense of such a ban differs in important ways from those generally found in the literature on the moral limits of markets, and that cases of this kind will likely require greater attention as technology continues to advance. Section 5 highlights some central theoretical and practical implications of our discussion. Section 6 concludes.

## **2. Empirical Conditions: AV Availability, Cost, Reliability, and Safety**

Our central arguments are aimed at establishing that if certain plausible empirical conditions regarding AVs obtain at some point in the future, then driving standard vehicles will become impermissible, and banning markets for standard vehicles will become justified. Because our focus (and our expertise) lies in the normative domain, we do not argue in detail for the claim that these empirical conditions will in fact obtain. Instead, in this section we highlight what these conditions are, and note some reasons to think that it is reasonably likely that they will obtain. The likelihood that they will obtain, in combination with the obvious moral significance of what could be achieved if they do, together explain much of the growing interest in AV ethics generally, and provide sufficient grounds for pursuing our argument on the terms that we have described.

The conditions that must obtain in order for our argument to imply the impermissibility of driving and the justification for banning markets in standard vehicles are the following:

- (1) AVs must be as readily available to consumers as standard vehicles.
- (2) AVs must be comparable in cost to standard vehicles.

- (3) AVs must be comparable to standard vehicles in their effectiveness and reliability as means to the ends that individuals generally pursue using automotive travel.
- (4) AV use imposes less risk of death and injury on others than driving a standard vehicle.<sup>4</sup>

The range of firms pursuing the development of AVs, along with the significant resources that they are investing, provides at least defeasible grounds for thinking that there is a fairly widely held expectation among those in the industry that AV technology will eventually be sufficiently well-developed that widespread use will be both feasible and desirable.<sup>5</sup> It provides similar grounds for thinking that there is a widespread expectation that AVs will be commercially viable, which suggests an expectation that firms will be capable of producing them in large numbers and offering them to consumers at prices that they will be willing to pay. This, in turn, suggests that there are reasons to think that it is at least reasonably likely that conditions (1) and (2) will obtain. And because consumers are unlikely to be willing to purchase AVs if they are not comparable to standard vehicles in their effectiveness and reliability as means to the ends that

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<sup>4</sup> An anonymous reviewer suggests that an additional condition that might be necessary is that AVs are programmed to behave in ways that make it sufficiently likely that many individuals will purchase them, and that this might require that they are programmed in ways that would at least reduce the overall safety advantages of AVs in comparison with standard vehicles (Bonneton, Shariff, and Rahwan 2016). We reject this as a condition on an individual obligation to travel by AV rather than driving a standard vehicle, however, because in our view there is no plausible justification for driving so long as our four conditions are met and traveling by AV is not riskier for the individual decision-maker than driving. And so long as AVs are generally safer than standard vehicles, even a fully impartial, utilitarian approach to AV programming will ensure that occupants are subject to less risk in an AV than they would be driving a standard vehicle.

<sup>5</sup> As an anonymous reviewer points out, there are possible alternative explanations for this investment, such as that it is being made largely to attract investment dollars from those who are (perhaps overly) optimistic about the technology, or that it is being made because decision-makers in the relevant firms expect aspects of the technology to be useful for other purposes even if they are never able to produce AVs for the market. While we agree that these alternative explanations would also account for the observed levels of investment, we think that the most likely explanation is that there is a widely held expectation that AVs will be developed and successfully marketed to consumers.

they pursue via automotive travel, there is also good reason to think it likely that condition (3) will obtain.<sup>6</sup>

It is perhaps slightly more speculative to suggest that it is likely that condition (4) will obtain. After all, conditions (1)-(3) require only that AVs become comparable to standard vehicles in some relevant respect, whereas condition (4) requires that they become *superior* in safety to standard vehicles. There are, however, significant reasons for optimism about the potential safety benefits of AVs. First, we can note that it is estimated that at least 90% of vehicle accidents are caused by human error (National Highway Transportation Safety Administration 2015; Smith 2013; Sun et al. 2017; Taeihagh and Lim 2019). While AV programming is extremely complex and requires navigating a range of logistical challenges, our success in using computer programming across a range of domains in order to avoid or reduce the negative effects of human errors suggests that we are at least reasonably likely to succeed with AVs as well, given the significant intellectual and financial resources that are being invested.

Despite the reasons for optimism, it is important to note that AVs will not eliminate the risk of death and injury due to MVCs entirely.<sup>7</sup> This is why a great deal of the focus in AV ethics has been on how AVs should be programmed to respond in cases in which there is no way that deaths or injuries can be entirely avoided, and an AV's programming will determine which people, and how many people, are killed or injured (Hüber and White 2018; Keeling 2020; Leben 2017; Lin 2015; Martin 2017; Millar 2016; 2017; Santoni de Sio 2017; Scharding 2021).

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<sup>6</sup> While we think that there are grounds for thinking it at least reasonably likely that our four conditions will obtain, our argument does not require that one accept this claim. This is because the argument, strictly speaking, is merely that *if* those conditions obtain, driving a standard vehicle will become impermissible.

<sup>7</sup> This is widely accepted in the literature on AV ethics – see Marchant and Lindor (2012); Goodall (2014a: 58-59); Goodall (2014b); Hevelke & Nida-Rümelin (2015: 620); Lin (2015: 71-72); Nyholm and Smids (2016: 1275); Fleetwood (2017: 534); Gogoll and Müller (2017: 682); Kelley (2017: 171, 179); Millar (2017: 22); Bergmann et. al. (2018: 2); Coca-Vila (2018: 60); Hübner and White (2018: 685-86); Nyholm (2018: 1); Borenstein, Herkert, and Miller (2019: 388-89).

Questions about how AVs should be programmed to respond in the cases in which deaths or injuries cannot be entirely avoided would, however, be of little practical interest if we did not have good reason to expect that AVs will be, on the whole, safer than human-driven vehicles. After all, if AVs turn out to be less safe than human-driven vehicles, then we will have strong reasons to reject their introduction onto our roads. Because of this, the view that there is reason to expect AVs to significantly reduce the number of deaths and injuries on the road functions as a background assumption in much of the AV ethics literature (Bergmann et. al. 2018: 1; Etzioni and Etzioni 2017: 14; Faulhaber et. al. 2019: 400, 412; Fleetwood 2017: 532; Gogoll and Müller 2017: 682; Goodall 2014: 58; Gurney 2017: 51; Hübner and White 2018: 685; Kelley 2017: 167; Nyholm and Smids 2016: 1275; Sparrow and Howard 2017: 208-09; Wolkenstein 2018: 163, 165, 167). The prospect of increased safety is plausibly the most significant reason to support investing significant resources into the development of AVs,<sup>8</sup> and if there were not grounds for optimism about this prospect, we would have powerful reason to refrain from pursuing the development of AVs, since the resources currently devoted to their development could be better directed elsewhere.

If AVs do turn out to be safer than standard vehicles, then once AVs are commercially available, imposing present levels of risk of death and injury due to MVCs on one another by driving will be optional. Because of this, we must ask whether doing so might become impermissible. We take up this question in the following section. For ease of exposition, we will proceed on the assumption that the four conditions noted in this section will in fact obtain, and we formulate our arguments accordingly.<sup>9</sup>

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<sup>8</sup> There are, of course other reasons as well. For example, AVs would provide those who are unable to drive with the opportunity to travel by car without a driver.

<sup>9</sup> If our argument in this paper is correct, then it is important to consider whether individuals would be obligated to refrain from driving, and whether policy interventions to ensure the use of AVs would be

### 3. The Impermissibility of Driving

The view that ordinary driving is permissible is simply taken for granted by most people, despite the fact that it imposes risks of death and injury on others. Perhaps this is not unreasonable. The benefits that automotive travel facilitates, we might think, are clearly significant enough to justify the risks that are, in our current circumstances, unavoidably imposed on others by those who drive. Even if we accept this claim, however, there is, as we suggested in the previous section, reason to think that once AVs become commercially available, much of the risk currently imposed by driving will no longer be unavoidable.

The argument for the impermissibility of driving once our four conditions are met runs as follows:

- (1) For any end that one might pursue, if one available means to that end imposes a significantly higher risk of death and injury on others than another equally available, comparably effective, and comparably costly means, one is obligated to refrain from using the riskier means.<sup>10</sup>
- (2) Driving standard vehicles in order to pursue the ends associated with automotive travel imposes a significantly higher risk of death and injury on others than traveling in an AV.

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justified, in a range of conditions in which our conditions (1) – (3) are not all satisfied, while condition (4) is satisfied. Space does not permit us to take up these questions in this paper, although it seems to us clear that if traveling in an AV were only very slightly more costly and less convenient than driving, and the risk to others was very much lower, then individuals would, at least in general, be obligated to refrain from driving, and certain policy interventions to deter or even prevent driving would be justified. We are grateful to an anonymous reviewer for encouraging us to discuss this issue.

<sup>10</sup> It is important that this claim only implies that one is obligated to use a less risky means if using the riskier means would impose a significantly higher risk of death and injury *on others*. It does not imply, for example, that individuals are obligated not to drive motorcycles so long as there are alternative means that are comparatively effective and costly but would impose less risk on themselves. We are grateful to an anonymous reviewer for encouraging us to clarify this.

- (3) AVs are at least as effective as means to the ends associated with automotive travel as driving a standard vehicle.
- (4) So, if AVs are as readily commercially available as standard vehicles, driving a standard vehicle as a means to the ends associated with automotive travel imposes a significantly higher risk of death and injury on others than another comparably effective means to those ends (from 2 and 3).

Therefore,

- (5) Once AVs are readily commercially available and comparable in cost to standard vehicles,<sup>11</sup> individuals are obligated, when pursuing the ends associated with automotive travel, to refrain from driving a standard vehicle (from 1 and 4).

So long as our four conditions obtain, the success of the argument depends entirely on premise (1). And while this premise is independently plausible, the reasons to accept it can be further highlighted by noting that a slightly stronger, and therefore at least slightly more controversial, version of the premise provides the best explanation of the wrongness of drunk driving.<sup>12</sup>

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<sup>11</sup> While the most salient way in which the cost of traveling in an AV might fail to be comparable to the cost of driving a standard vehicle is monetary (e.g., the purchase price of an AV might be significantly higher than the purchase price of a standard vehicle), the principle articulated in (1), and which is being applied here, does not refer only to monetary costs, but instead to anything that sets back or hinders the satisfaction of a person's interests. For the purposes of the principle, then, factors such as increased inconvenience can be a cost.

<sup>12</sup> How restrictive the implications of accepting this premise are depends on what ought to count as a "significantly higher risk." We do not aim to offer a precise formula here, but it seems to us that any plausible view will count even a 5 or 10% greater risk of death or serious injury imposed on large populations as significant. If this is correct, then driving will impose a significantly higher risk than traveling in an AV even if AVs fall well short of the expectations of many of their proponents in terms of the increased safety that they will offer.

It is uncontroversial that drunk driving is both morally impermissible and ought to be a criminal offense.<sup>13</sup> Indeed, while (as noted above) driving is often cited as a paradigmatic example of a permissible risk imposition, *drunk* driving is widely cited as a paradigmatic example of an *impermissible* risk imposition (Altham 1983: 22-23; Kumar 2003: 103; Oberdiek 2012: 342; Parr and Slavny 2019; Steinbock 1985: 278, 283, 286; Stuart 1989: 112). Any account of the ethics of risk imposition that does not imply that drunk driving is wrong in virtue of the risks that drunk drivers impose on others would rightly be viewed as unacceptable. Because of this, if the reasons that explain why drunk driving is wrong also provide grounds for requiring that individuals travel by AV rather than driving, then we must accept that driving will be impermissible if the four conditions described in section 2 all obtain.<sup>14,15</sup>

In her discussion of drunk driving, Bonnie Steinbock plausibly claims that at least part of the explanation of the wrongness of drunk driving consists in the fact that “[i]t is not unreasonable to require people to undergo great inconvenience to avoid killing other people”

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<sup>13</sup> Even those who have argued that drunk driving is a less serious wrong, and ought to be treated as a less serious criminal offense than others have claimed agree that it is impermissible and rightly prohibited by law (Husak 1994: 60, 64; Stuart 1989: 112-14).

<sup>14</sup> Robert Sparrow and Mark Howard suggest a similar argument, claiming that once AVs become safer than human-driven vehicles, a “human driver will be the moral equivalent of a drunk robot” (2017: 209), and that because of this driving will be impermissible. They do not, however, offer anything further in the way of an argument for this claim. Despite the fact that it is far from clear that even highly sophisticated robots are moral agents that can properly be said to act wrongly (drunk or otherwise), our discussion in this section can be understood as providing a systematic argument for the claim that they appear to be asserting.

<sup>15</sup> An anonymous reviewer suggests that the wrongness of drunk driving might be explained by the fact that it involves operating a vehicle in an improper way, or in a way that it is not intended to be operated. This, it is suggested, distinguishes drunk driving from operating a standard vehicle in circumstances in which our four conditions are met, since one could still drive a standard vehicle properly, in the way that it is intended to be driven. It is unclear, however, why we should think that this distinction is morally important. In our view, there are no reasons to accept that imposing a certain amount of unnecessary risk on others is less morally problematic when doing so involves using a product in the proper, intended manner, than it is when it involves using a product in an improper, unintended manner. The suggestion, then, does not seem to provide any reasons to doubt premise (1) of our argument. In addition, it is not clear that we can specify the boundaries of a product’s proper as opposed to improper use without an independently motivated account of the conditions in which its use is morally permissible. Premise (1) of our argument constitutes, we claim, a part of any acceptable account.

(1985: 209).<sup>16</sup> Refraining from driving drunk is, at least typically, not even *greatly* inconvenient. In normal circumstances it is at most somewhat inconvenient – those who plan to drink will often need to identify a trustworthy designated driver, and those without access to a sober driver will sometimes have to wait until they are sober to drive. Despite these potential inconveniences, however, virtually no one will deny either that drunk driving is morally impermissible, or that the state is justified in legally prohibiting it.

The claim that driving will become impermissible if our four conditions obtain should, on reflection, seem even less controversial than the claim that drunk driving is impermissible.<sup>17</sup>

Drunk driving is impermissible because of the additional risks that it imposes on others in comparison with driving sober. It is impermissible to impose these additional risks even in cases in which it is somewhat less convenient for one to refrain from driving drunk than to drive in that condition. This suggests that we should accept the following slightly stronger version of premise (1):

(1\*) For any end that one might pursue, if one available means imposes a significantly higher

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<sup>16</sup> Although Steinbock does not explicitly phrase this claim in terms of risk imposition, she is most plausibly interpreted as claiming that we are obligated to accept significant inconveniences in order to avoid imposing (at least) significant risks of death on others.

<sup>17</sup> How compelling this claim is depends, at least to some extent, on how much safer than standard vehicles AVs can be expected to be. Nevertheless, the force of the analogy more generally does not depend on the reduction in risk that AVs provide in comparison to standard vehicles being comparable in magnitude to the reduction in risk that driving sober provides in comparison with driving drunk. And the claim that it should be less controversial that driving is impermissible if our four conditions are met than that drunk driving is impermissible relies not on the claim that AVs offer greater risk reduction compared to driving than sober driving offers compared to drunk driving, but instead on the claim that there will generally be less at stake in terms of convenience for individuals in traveling by AV rather than driving than there might be in refraining from driving drunk.

risk of death and injury on others than another equally available and comparably effective means, one is obligated to refrain from using the riskier means, even if using the less risky means is modestly more costly.

If traveling in AVs will impose a lower risk of death and injury on others than driving in precisely the same way that driving sober imposes a lower risk of death and injury on others than driving drunk, then the same kind of reason that explains the wrongness of drunk driving supports the claim that driving rather than traveling in an AV will be wrong once AVs become available and comparable in cost to standard vehicles. In addition, traveling in an AV rather than driving will involve none of the additional inconveniences that sometimes attend refraining from driving drunk – the quick transportation between two locations at a time of one’s choosing that is available when driving will be fully preserved with the use of AVs.

Since (1\*) provides the best explanation of the wrongness of drunk driving, and (1\*) entails (1), we ought to accept (1). And if (1) is correct, then we must accept that once AVs become available and comparable in cost to standard vehicles, it will be wrong to drive a standard vehicle. Put in a slightly different way, insisting on driving a standard vehicle once AVs are commercially available and comparable in cost to standard vehicles will be impermissible because it will amount to a gratuitous infliction of a significantly higher risk of death and injury on others.

With the core of the argument for the claim that driving will become impermissible if AVs become available and comparable in cost to standard vehicles now in place, a few clarifications are in order. First, it might be suggested that even now – well before the commercial availability of AVs – we could use public transportation to achieve the ends

associated with automotive travel, and that this would significantly lower the risk of death or injury imposed on others (not to mention lowering the pollution associated with automotive travel).<sup>18</sup> At least for many of us, this is correct. Neither (1) nor (1\*), however, requires reducing the risk of death and injury imposed by our activities as a general matter; instead, these principles require only that we adopt less risky means of accomplishing our ends when doing so is both equally effective as, and at most modestly more costly than, using riskier means.<sup>19</sup> And at least in many cases, we might plausibly think that certain aspects of public transportation (e.g. the lack of flexibility in schedules, the lack of privacy, the potential crowds and difficulty of finding comfortable seating, the added travel time, etc.) make it both a less effective and more than modestly costlier way of achieving the ends associated with automotive travel. Accepting our argument for the impermissibility of driving once AVs are available and comparable in cost to standard vehicles, then, does not require accepting that in current conditions driving rather than taking public transportation is impermissible.<sup>20</sup>

Second, it is important to note that our argument has no implications to the effect that we are obligated to sacrifice the pursuit of intuitively permissible ends in order to reduce the risk of death and injury to others. (1) and (1\*) imply only that insofar as we pursue ends, we are required to do so using less risky rather than riskier means whenever using the less risky means would involve no more than modest additional costs to ourselves in comparison with using the

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<sup>18</sup> For discussion of the claim that the view that drunk driving is a serious offense might suggest that sober driving is also at least often wrong, see Husak (1994: 55-60).

<sup>19</sup> Because our argument relies only on (1) and (1\*), which require at most that agents accept modest costs in order to avoid imposing significantly greater risk of death and injury on others, we do not need to take any position on the difficult questions surrounding exactly how much precaution individuals are obligated to take in order to avoid imposing various types and degrees of risk on others. The fact that our argument can succeed by appeal to only rather modest and highly plausible claims such as (1) and (1\*), rather than requiring reliance on and defense of stronger and more controversial claims about the nature and extent of our precautionary obligations, is a significant advantage of our argument.

<sup>20</sup> It may nevertheless be the case that at least many instances of ordinary driving are currently impermissible. If this is the case, however, it is for reasons that go beyond the truth of (1) or (1\*).

riskier means. Because the argument does not commit us to the impermissibility of pursuing any of the ends typically associated with automotive travel, and does not require that we accept more than modest costs in order to reduce the risks that we impose on others, it is not subject to the “demandingness” objections that are often raised against views on which we are required to make significant sacrifices in order to reduce the risks of death, injury, and suffering faced by others (e.g. Singer 1972).

Third, thus far we have suggested that there is reason to expect that AVs will be equally effective means to all of the ends for which standard vehicles are currently employed, while also reducing the risk of death and injury due to MVCs. But this claim is, strictly speaking, too strong. This is because many people derive pleasure from driving itself, and AVs will not be means to this pleasure, let alone equally effective means.

The fact that traveling in an AV rather than driving will, for some, involve the loss of the pleasure that they would have experienced from driving, does not, however, provide sufficient justification for imposing the additional risk of death and injury on others that driving entails. This is because this loss of pleasure amounts, at most, to a modest cost, so that the same explanation of the wrongness of drunk driving, namely (1\*), implies that driving rather than traveling in an AV will also be wrong.<sup>21</sup> We would certainly not accept an argument claiming to justify drunk driving on the basis that, for example, refraining from driving drunk would, for many, involve the loss of the pleasure associated with the consumption of a significant amount of alcohol.

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<sup>21</sup> Our claim here also implies that in our current conditions driving on public roads merely for the pleasure of driving, or for other reasons such that the costs of refraining from driving are similarly modest, will at least often be impermissible. We accept these implications, and believe that our current norms with respect to driving fail, at least to some extent, to properly reflect the moral importance of the risks imposed on others.

In addition, just as one can experience the pleasure of consuming a significant amount of alcohol at other times, when one does not need to drive, one can permissibly experience the pleasure of driving without imposing risk of death or injury on others. Nothing in our argument implies, for example, that driving on private roads or designated race tracks is impermissible.<sup>22</sup> It is, plausibly, entirely permissible to take on an increased risk of death and injury for oneself in order to obtain the pleasure that driving can provide (Sparrow and Howard 2017: 209). The fact that one would obtain such pleasure, however, does not justify imposing an unnecessarily high risk of death or injury on others. Insisting on driving on public roads once AVs are available, comparable in cost to, and safer than standard vehicles would amount to a wrongful imposition of risk of serious harm and death on other members of the moral community.

Finally, it is important to clarify the conditions in which it would be the case that AVs are, in the relevant sense, comparable in cost to standard vehicles, so that an individual who chooses to drive is, according to our argument, acting impermissibly. Because (1\*) requires agents to use less risky means rather than riskier means to their ends if using the less risky means is at most modestly more costly *to them*, the relevant comparison is between the cost to a particular agent of driving a standard vehicle and the cost to that agent of traveling in an AV. Driving will not, then, necessarily become impermissible for any particular agent when, for example, the retail price of an AV becomes comparable to the retail price of an otherwise similar standard vehicle. This is because there are many reasons why driving may remain significantly less costly for a number of agents even after the purchase prices of AVs reach rough parity with the purchase prices of standard vehicles. For those who already own standard vehicles, for

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<sup>22</sup> If one owns or has access to a vehicle that can be set to either an autonomous mode or a standard, human-driven mode, our argument implies that using the human-driven mode on public roads is impermissible. Using that mode on private roads or designated race tracks, however, at least might be permissible.

example, the cost of continuing to drive those vehicles for a period into the future will likely be significantly lower than the cost of purchasing and then traveling in an AV during that period.

In order to assess whether any particular instance of driving is impermissible, we must assess whether the trip would have been no more than modestly more costly for the agent had she taken it in an AV instead.<sup>23</sup> If, for example, one is renting a vehicle for a road trip, and the cost of renting an AV is identical to the cost of renting a standard vehicle, then clearly choosing to rent and drive a standard vehicle would be impermissible. For similar reasons, if one is purchasing a vehicle to use regularly, and the purchase price of an AV is identical to the purchase price of a standard vehicle, then purchasing a standard vehicle and driving it would be wrong.<sup>24</sup> There will, of course, be cases that are more complex than these, but our argument provides the framework necessary to address them. Specifically, for any act or set of acts that involves driving, if one could travel by AV instead and incur no more than modestly greater costs, then one is obligated to do so.

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<sup>23</sup> We do not, in this paper, offer an account of the conditions that determine whether any particular difference in cost between a trip in a standard vehicle and a trip in an AV is modest or greater than modest. On any plausible account, however, there will be relevant factors beyond the absolute or proportional difference in price. Five dollars might, for example, be a modest additional cost for a long road trip, but a greater than modest additional cost for a trip to the nearby supermarket. And an AV trip that is 25% more expensive than a standard vehicle trip might involve a modest additional cost for a wealthy person, but a greater than modest additional cost for someone who is much less well off.

<sup>24</sup> Strictly speaking, the expected costs of operating and maintaining the vehicles (e.g., the cost of fuel, insurance, regular maintenance, expected repairs, etc.) would have to be taken into account as well, so that even if the purchase price of an AV is identical to that of a standard vehicle, if the expected costs of using it going forward make the total expected cost of doing so more than modestly greater than the total expected costs of purchasing and driving a standard vehicle, it at least may not be wrong to purchase a standard vehicle. Importantly, however, if one does wrongfully purchase a standard vehicle at a time at which the total expected costs of its use going forward are not sufficiently lower than the total expected costs of the purchase and use of an AV, then all of one's future driving of the standard vehicle will be impermissible, despite the fact that once the purchase has occurred (and the cost of the purchase is not recoupable), it will become more than modestly less costly going forward for one to drive rather than traveling in an AV. One cannot make future driving permissible by wrongfully making it the case that such driving will be more than modestly less costly than traveling in an AV.

#### **4. Banning Markets for Standard Vehicles**

In the previous section, we argued that if the four conditions described in section 2 obtain, driving will become impermissible. If our argument is correct, there is reason to consider whether, and if so in what conditions, the state would be justified in enacting various policies aimed at ensuring that standard vehicles are replaced on our roads with AVs. There are a range of policies that, if adopted, could reduce and, over time, perhaps eliminate driving altogether. The most restrictive policy, and so the one that is perhaps the most difficult to justify, would be a complete ban on the sale of standard vehicles for use on public roads.

Virtually everyone agrees that there are some things that potential sellers ought to be legally prevented from selling on the open market. There should not, for example, be legal markets for nuclear weapons, or assassination services, or positions of public authority. With respect to a range of other goods, services, and other things that can in principle be bought and sold (e.g., permits of various kinds), there is much debate about whether markets should be legally permitted, and if so under what conditions.

One important reason that a type of product might become an appropriate target of new restrictions is that a substitute good has been developed that can provide for all of the same benefits (including affordability), while causing less unintended harm to either users or others. Insofar as this is a compelling reason for restrictions, if the four conditions described in section 2 come to be met, the development of AVs will make it the case that the state is justified in moving, over time, toward banning both the sale and use of standard vehicles on public roads.

It is important to note that even if AVs do become safe to bring to market and are made available for purchase at roughly comparable expense to standard vehicles, it will not be acceptable for the state to *immediately* institute a legal prohibition on driving standard vehicles.

This is primarily because most people lack the financial resources to immediately purchase an AV.<sup>25</sup> Many of these people will need to continue to drive standard vehicles to work and for other ends that, we have assumed for the purposes of this paper, are important enough to make it permissible to impose the present levels of risk of death and injury caused by driving on others. Instituting a legal prohibition on driving as soon as AVs become commercially available and comparable in cost to standard vehicles would leave many, especially those in regions lacking access to reliable public transportation, without adequate means to get where they need to go. It seems clear, then, that even once AVs are available, there will need to be a potentially significant period during which many will continue to drive standard vehicles (call this the “transition period”).<sup>26</sup>

Once our four conditions are met, we will be in a position to significantly reduce the risks of death and injury due to MVCs by working toward eliminating the use of standard vehicles. Because of this, there will be strong reasons to hasten the transition period.<sup>27</sup> It seems likely,

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<sup>25</sup> Some predict that the development of AVs will dramatically reduce rates of vehicle ownership, and that users will instead typically purchase individual rides (Huffman 2018; Standage 2018) for all of their vehicle transportation. Even if this prediction is correct, however, it is likely that purchasing individual rides for all of one’s vehicle transportation will, at least for a period of time, be more expensive than continuing to drive a standard vehicle. And if this is correct, then there will be some people who, at least for a period of time, will not be able to afford to purchase AV rides for all of their vehicle transportation, but would be able to afford to (continue to) drive a standard vehicle. Our claim that it will not be acceptable to ban driving standard vehicles as soon as AVs are available for purchase at a cost comparable to that of standard vehicles does not, then, depend on the assumption that private vehicle ownership will remain the norm (Etter et al., 2019: 936). If, however, purchasing individual AV rides for all of one’s vehicle transportation becomes no more expensive than continuing to drive a standard vehicle immediately upon the release for purchase of AVs that are cost comparable with standard vehicles, then the argument that we develop in the remainder of this section does imply that an immediate ban on driving standard vehicles would be appropriate.

<sup>26</sup> For endorsement of this claim in the literature on AV ethics – see Goodall (2014a: 59); van Loon and Martens (2015); Sparrow and Howard (2017: 210); Hübner and White (2018: 686); Nyholm and Smids (2018).

<sup>27</sup> There may be countervailing reasons that speak against making the transition period as short as possible. For example, removing many vehicles from the road well before they are no longer functional could result in more vehicles being manufactured than otherwise would have been, which could generate more environmental damage than would otherwise have occurred. In addition, policies that involve the use of government funds would have opportunity costs, including potentially opportunity costs in terms of increasing safety on the road. If the suite of policies that would make the transition period as short as

however, that there will be a period in which AVs are more expensive than standard vehicles, so that our condition (2) is not yet met. In these conditions, there are various policies short of a ban on the sale of standard vehicles that could be adopted with the aim of hastening the transition period. First, governments could offer tax credits in order to incentivize purchases of AVs, akin to those currently offered by several governments in order to incentivize the purchase of hybrid or electric vehicles. Second, the state could levy an additional tax on the purchase of standard vehicles in order to disincentivize such purchases (akin to the “sin taxes” imposed on cigarettes). Finally, a buyback program could be implemented through which the government purchases standard vehicles from their owners. This would be akin to the assault weapons buyback programs proposed by some defenders of assault weapons bans (though a buyback program can, of course, be implemented even in the absence of a ban).

While all of these policies could help to hasten the transition period, the reduction in deaths and injuries that could be achieved through widespread adoption of AVs would be sufficient to justify the state’s banning the production, sale, and purchase of new standard vehicles for use on public roads.<sup>28</sup> Some key reasons for endorsing this view can be helpfully highlighted by considering the case for state-mandated vaccination.<sup>29</sup>

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possible does not represent the optimal use of resources for increasing road safety in the long run, then surely we ought not adopt that suite of policies. We believe, however, that there will likely be reason to pursue at least moderately aggressive policies to hasten the transition period. In any event, neither our suggestions for candidate policies, nor our argument in defense of an eventual ban on the sale of standard vehicles, requires assuming that we will have reason to make the transition period as short as possible.

<sup>28</sup> We do not claim that a ban on the sale and purchase of used standard vehicles ought to be implemented as soon as AVs can be safely brought to market at a cost comparable to standard vehicles, since at least for a period of time it can be expected that, for many individuals, purchasing and driving used standard vehicles will remain more than modestly less costly than purchasing or otherwise traveling in AVs. In addition, strictly speaking, we do not object to markets for new standard vehicles tout court. If standard vehicles will be used solely as showpieces (e.g. in a shopping mall or museum), or driven exclusively on private roads or racetracks (and will be transported to such locations on an AV’s trailer), our argument does not imply that their production, sale, and purchase should be prohibited.

<sup>29</sup> The case for state-mandated vaccination is, of course, contested. Our argument, however, does not rely on the assumption that the case for mandated vaccination is ultimately compelling; rather, we highlight the central considerations that are generally appealed to by defenders of mandatory vaccination, note that these

Vaccinations allow us to dramatically reduce or eliminate the risks of death and injury that accompany a number of viruses. It is widely (though not universally) accepted that individuals are morally obligated to vaccinate themselves and those under their guardianship. In addition, a number of philosophers have recently argued that there is sufficient justification for legally mandating vaccination (Brennan 2018; Flanigan 2014; Giubilini and Savulescu 2019; Pierik 2018). One important reason that arguments in defense of mandatory vaccination are widely regarded as compelling is that there are public good and collective action dimensions to vaccination: the success of a vaccination initiative depends on widespread vaccination. Securing the benefits of herd immunity, that is, immunity for those who are not candidates for vaccination (e.g. the very young, the sick, and the elderly), or those who opt out of vaccination, from especially contagious viruses requires that more than 90-95% of the population be vaccinated (Sadarangani 2016). Even those who are vaccinated benefit from higher overall vaccination rates: the greater the percentage of vaccinated individuals in a community, the greater the probability of immunity from disease for any particular individual, vaccinated or not. Herd immunity is what allows viruses to be eliminated even when not everyone is vaccinated; achieving herd immunity, however, requires that the overwhelming majority of a population be vaccinated.

The failure to vaccinate oneself, then, does not merely reduce one's own probability of immunity, but reduces the efficacy of the relevant vaccination initiatives more generally. It prevents others from enjoying a reduced risk of death and increases the risk of outbreak, since the unvaccinated remain potential virus transmitters. Even if there is nothing objectionable about

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considerations also support banning the production and sale of standard vehicles when our four conditions are met, and, most importantly, argue that the central reasons that critics appeal to in order to resist the case for mandatory vaccination are either entirely absent or significantly weaker in the case of mandatory AV use.

accepting a greater level of risk for oneself by failing to get vaccinated, it is much more difficult to see what could justify the risk of harm that would be imposed on *others*. The fact that failing to vaccinate oneself would impose this risk on others provides a plausible justification for a legal obligation to vaccinate oneself and those within one's custody.<sup>30</sup>

The reasons that support imposing a legal obligation on individuals to vaccinate themselves and those within their custody provide similar grounds for prohibiting markets in standard vehicles in circumstances in which our four conditions are met.<sup>31</sup> Crucially, just as achieving herd immunity requires widespread vaccination, there is reason to expect that dramatically reducing death and injury due to MVCs will require widespread adoption of AVs. A recent European Commission report indicates that achieving the safety-related benefits of systems of AVs “depends on the number of vehicles and/or roads that are equipped with [the relevant] technology...the user cannot take advantage of the functionality until sufficient other road users also have it” (2018a: 18-19). Similarly, a Victoria Transport Policy Institute report notes that “most external benefits (reduced traffic congestion, *crash risk*, pollution, and infrastructure costs imposed on others) can only occur when [AVs] are common, and some

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<sup>30</sup> While this justification relies, in some sense, on considerations of the public good, even those who are not generally sympathetic to such grounds for government intervention have defended mandatory vaccination. For example, Brennan (2018) has argued that mandatory vaccination can be defended on libertarian grounds. However, for an argument that Brennan's view is not in fact grounded in libertarian principles, see Bernstein (2017).

<sup>31</sup> Note that this claim does not require assuming that prohibiting markets for standard vehicles would prevent as much harm as a general policy of mandating vaccinations. This for at least two important reasons. The first is that even if mandating vaccinations in fact prevents more harm than prohibiting markets for standard vehicles would, there would remain a strong case for mandating vaccination even if it prevented significantly less harm. To see this, imagine that we initially believe that vaccinations save 100,000 lives per year in our society. If new evidence convinces us that the diseases that we vaccinate for would in fact only cause 25,000 deaths, it seems very unlikely that anyone who initially supported mandatory vaccination would withdraw their support. The second reason is that we can ask not only whether a general policy of mandating vaccinations is justified, but also whether we should mandate vaccination for any particular disease. And surely there are some diseases that would cause less harm in the absence of mandatory vaccination than could be prevented by prohibiting markets for standard vehicles when our four conditions are met. This means that there are at least some mandatory vaccination policies such that the harm-based reasons that support them are weaker than the harm-based reasons that would support prohibiting markets for standard vehicles when our four conditions are met.

require that highway lanes be dedicated to autonomous vehicle platoons” (Litman 2017: 26; emphasis added; see also Martin et al. 2019: 307; Milakis, van Arem, and van Wee 2017: 328; van Nes and Duivenvoorden 2017: 25; Zmud and Sener 2017: 2502).

One reason that achieving some of the potential benefits of AVs depends on high adoption rates is that a critical mass of AVs is required in order for the network effects associated with the communicative and cooperative dimensions of AVs to generate significant gains in safety. The network effects dimension of AV safety is clearly explained in a report from KPMG and the Center for Automotive Research:

To work well, connected vehicle technology requires a large network of vehicles equipped with similar, or at least interoperable, communication systems. With high degrees of vehicle autonomy comes the need for higher degrees of cooperation and, hence, higher levels of adoption density to deliver the technology’s full value and potential. Density is critical for [vehicle to vehicle] safety applications and for automated driving (2012: 20).

With greater adoption levels of AVs, increased efficiency in information processing becomes possible, which in turn allows AVs to coordinate with each other in ways that can benefit users. For example, the coordination facilitated by widespread adoption can allow vehicles to “travel at the same speeds, avoid collisions, and choose efficient routes” (Stoeltje 2017: 2; see also Kockelman et al. 2016: 1). For our purposes, the crucial point is that a significant portion of the safety benefits that AVs can potentially provide require widespread adoption of AVs.

It is, then, expected that there will be a non-linear relationship between the number of human-driven cars that are replaced with AVs and the reduction in risk of death and injury due to MVCs. The European Commission (2018b: 2) cites estimates that “for AV penetration rates of 10%, 50%, and 90%, a corresponding 1,100, 9,600 and 21,700 lives saved per year in the US can be expected.” An individual’s refusal to transition to traveling by AV would, then, not merely prevent her from herself enjoying a lower risk of death and injury due to MVCs; it would also limit the extent to which those who have transitioned to traveling by AV benefit from a lower risk of death and injury. A prohibition on the production, sale, and purchase of new standard vehicles for use on the road, then, is supported by the same kinds of reasons that are widely thought to justify a legal requirement to vaccinate oneself and those within one’s custody.<sup>32</sup>

In addition, there is reason to think that, if anything, the prohibition on the production, sale, and purchase of standard vehicles will be even more strongly justified than mandatory vaccination. This is because the reasons that are most commonly offered for rejecting state-mandated vaccination are either entirely absent or significantly weaker in the case of mandated AV use. For example, some cite the small health risks that accompany vaccination as a reason why the state ought not require individuals to be vaccinated. While there is, of course, broad scientific consensus that vaccinations are safe, the limited risks that one assumes when getting vaccinated are at least partially distinct from the risks associated with contracting the disease that

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<sup>32</sup> It is worth noting that while the fact that (as with vaccination) the rate of risk reduction is expected to increase as adoption levels rise contributes to the case for banning the production and sale of standard vehicles, it is not the case that achieving *any* risk reduction is expected to depend on a sufficiently high rate of adoption. Just as an individual getting vaccinated tends to reduce the risks faced by those who come into direct contact with her regardless of the overall rate of vaccination, an individual choice to travel by AV rather than drive should be expected to reduce the risks to those who encounter one on the road, even if it makes only a very small difference to the overall risks faced by those on the road in the aggregate. The thought that individuals cannot be obligated to travel by AV, and the related thought that the state ought not mandate that they do so, because no individual choice to drive makes a significant enough difference, is, then, mistaken, even if the fact that a high level of adoption is required for optimal risk reduction per adopter makes the case for a mandate especially compelling.

a vaccination protects one from. Even though the risks associated with contracting the disease are generally much higher, some argue that the state ought not force individuals to take on a particular risk, even when doing so is necessary in order to avoid a different, greater risk (or to prevent risks to others). While we find this argument unpersuasive in the case of mandatory vaccination, the important point for our argument in this paper is that it is not even available in the case of prohibiting markets for standard vehicles. This is for two reasons. First, preventing individuals from driving does not require them to take on any particular risk in the way that mandating vaccines requires them to take on the small risks associated with vaccination. And second, the risks that individuals would face from traveling in AVs are simply reduced risks of the same kind that they would face by driving. While it is not obviously implausible that the state should not force individuals to take on risks of one kind in order to avoid risks of another kind, it is extremely implausible that the state ought not force individuals to adopt an equally effective means to their ends that simply reduces the magnitude of the particular risks that they would otherwise face, while at the same time reducing similar risks for others.

Secondly, some argue that mandatory vaccination limits bodily autonomy in an objectionable way. Bodily autonomy is widely regarded as an especially important value that can only be infringed with particularly strong justification. Generally, in the absence of consent, it is quite seriously wrong to, for example, inject another person with a needle. Though we, like many others, are persuaded by arguments for mandatory vaccination, it is important to take seriously that these arguments must overcome a strong presumption in favor of bodily autonomy. A prohibition on the production, sale, and purchase of standard vehicles, on the other hand, would not limit bodily autonomy in any way. Such a policy would not license any state-mandated intrusion into anyone's bodily sphere. Instead, it would merely require that individuals use a

safer means rather than a less safe means of exercising their autonomy via automotive travel. Surely the justificatory burden for a policy of this kind is lower than that for a policy that involves a significant limitation of individuals' bodily autonomy.

## **5. Implications**

There are several implications of our discussion thus far that are worth highlighting. First, while a number of scholars have emphasized the importance of attending to the ethical issues raised by new technologies in order to avoid what Richard DeGeorge (1999) calls the “head in the sand” syndrome, these cautionary pronouncements typically emphasize the importance of avoiding being blindsided by the *negative* effects of new technologies. Our discussion, however, highlights that it is essential to attend not only to the potential negative effects of new technologies. We must also think carefully about the ways in which the potential of new technologies to provide *benefits* (in comparison with existing technologies) might affect the normative status of using and selling the familiar products that those new technologies are capable of replacing.

Second, and relatedly, while we have focused on the potential implications of the development of new technologies (i.e. AVs) for the ethics of driving and the permissibility of restricting markets for standard vehicles, it is important to recognize that our argument might have at least some revisionary implications regarding current driving practices and markets for vehicles. For example, it might be suggested that our premise (1) implies that driving a large SUV is at least often impermissible, since driving a smaller vehicle will, it might be claimed, often be an equally effective and no more costly means to the ends that drivers are pursuing. Strictly speaking, however, our argument does not have this implication. This is for at least two

reasons. First, a large SUV will in fact sometimes be a more effective means to certain ends that individuals pursue via automotive travel than a smaller vehicle that would impose less risk on others. For example, large SUVs can typically fit more cargo, and can tow some trailers that smaller vehicles cannot. So in at least some cases, it will not be true that a smaller vehicle would be an equally effective means to the relevant ends, and therefore our argument will not imply that driving a large SUV is wrong.<sup>33</sup>

The second reason that our argument does not imply that driving a large SUV in current conditions is wrong is that, for any individual who is currently choosing which type of vehicle to drive, his or her own safety (and that of any passengers) will be better protected in a large SUV than in a smaller vehicle, especially given that many other vehicles on the road are large SUVs. There is, then, an important cost, namely the increased risk of death and injury, that those who drive smaller vehicles face in current conditions. This also makes it the case that our premise (1) does not imply that driving a large SUV in current conditions is impermissible.<sup>34</sup>

These points highlight just how modest premise (1) is. The latter point, for example, makes it clear that it is only if AVs offer increased safety not only for others on the road, but also for passengers themselves, that this premise implies that if all four of our conditions are met, driving is impermissible. Nevertheless, it is worth noting that our argument does imply that there are likely some current circumstances in which driving certain vehicles, such as especially large military-style vehicles (e.g. a Hummer), would be impermissible. In addition, it implies that there

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<sup>33</sup> There might, of course, be other grounds on which we should conclude that driving a large SUV is wrong, even in cases in which doing so is a more effective, or even a necessary means to particular ends that individuals would like to pursue. The important point is that our argument does not commit us one way or the other on this issue.

<sup>34</sup> It is worth clarifying once again that premise (1) of our argument only requires that individuals avoid imposing avoidable risks *on others*. It does not, then, imply that there might be a moral obligation to refrain from driving a small car because doing so is less safe for oneself than driving an SUV. So it does not, as an anonymous reviewer suggested it might, provide any support for the thought that the state might be justified in banning small cars in order to prevent people from imposing avoidable risks on themselves.

are some reasons that many might take to constitute a sufficient justification for driving such a vehicle that are in fact insufficient.

Consider, for example, a person with access to both a Hummer and a smaller vehicle. He or she is going to drive one of them, in pursuit of a goal for which each would be an equally effective means, in an area with many pedestrians, but virtually no other vehicles on the road. In this case, our argument implies that it would be wrong to drive the Hummer, since doing so would impose greater risks on the pedestrians (D'elia and Newstead 2015). This seems to us to be the correct conclusion.

Similarly, our argument implies that an individual's mere preference to drive a Hummer, or the fact that she would derive more pleasure from doing so than from driving a smaller vehicle, is an insufficient reason on its own to justify imposing greater risks of death and injury on others. While this may conflict with many people's current views, we believe that it is also a conclusion that we should accept.

With respect to the question of whether our argument suggests that governments should restrict markets for Hummers and large SUVs, similar points apply. The fact that large SUVs are often more effective means to the ends that individuals pursue via automotive travel, along with the fact that they provide increased safety to users in current conditions, makes it the case that our argument does not, strictly speaking, imply that restrictions are justified. There may be other reasons that support greater restrictions than are currently in place.<sup>35</sup> We are not, however, committed to a position on this issue just in virtue of our argument in this paper.

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<sup>35</sup> For example, the fact that large SUVs are both more expensive than most smaller vehicles and generate gains in safety for users and increased risks for others means that permitting markets for large SUVs predictably leads to poorer people facing significantly greater risks of death and injury on the road than wealthier people. There is at least a plausible argument to be made that this constitutes a significant reason for the state to restrict markets for large SUVs.

Third, an important theoretical implication of our argument is that, in at least many cases, and in particular in cases involving new technologies, the permissibility of a market for a particular good or type of good cannot be assessed in isolation. Assessments of the permissibility of markets are often developed primarily by asking whether the nature of a particular good (e.g. sex, kidneys, or votes) makes it unsuitable, morally speaking, to be bought and sold. However, our discussion shows that contingent facts, such as the development of a new technology, can make it the case that particular goods ought not be bought or sold, despite the fact that there is nothing in their nature that makes them in principle unsuitable for market transactions. Often, then, we cannot assess the permissibility of a market by attending only to the nature of the good in question, since the presence of markets in substitute goods must also be considered. Insofar as a substitute good brings about less harm, this generates a reason to reject the market for the more harmful good.

Finally, it is worth highlighting two implications for managers at automotive firms that are suggested by our discussion. First, consider that some consumers might prefer that their AV be equipped with a switch or option that allows them to drive the vehicle in a non-autonomous mode. Indeed, some may be willing to pay more to have such an option. However, the first firm that provides users with the added option to drive in a non-autonomous mode may generate a state of affairs in which all firms producing AVs are under competitive pressure to offer that option. But to the extent that consumers use the non-autonomous mode in order to, for example, enjoy the pleasure of driving, this would undermine the achievement of the benefits associated with the widespread adoption and use of AVs. Just as [redacted for blind review] has argued that once AVs are available, firms should not provide consumers the option to select crash preferences that involve prioritizing the lives and safety of passengers in the vehicle, similarly,

once AVs are suitable for widespread adoption, firms ought to refrain from providing users with a non-autonomous mode that can be used simply for the pleasure of driving.<sup>36</sup> Managers, then, should resist providing this option, even if some consumers prefer having it.

Second, managers at automotive companies must recognize the extent to which the widespread adoption of AVs will require cooperating with competitors. This is because for the purposes of vehicular pooling, traffic coordination, and so on, it will be critical for the vehicles to have a shared communication and network apparatus. So, just as Tesla gave away its patents for its charging station and electric car technologies to competitors so that they can more quickly transition to electric vehicles (Musk 2014), it will be particularly important for automotive companies working on AVs to be open to information and technology sharing with competitors, at least with respect to the dimensions of AVs that will require operating in concert with other AVs.

## **6. Conclusion**

The impending availability of AVs raises challenges for the ethics of driving standard, non-autonomous vehicles, and for the ethics of markets in standard vehicles. While driving is presently regarded as a paradigmatic example of permissible risk imposition, we have argued that if AVs become readily commercially available, comparable in cost to, and safer than standard vehicles, then driving standard vehicles will become impermissible. Furthermore, just as mandatory vaccination is plausibly justified at least in part by the fact that the benefits of vaccination are, to a large extent, conditional on widespread vaccination, we have argued that a ban on markets for standard vehicles would become justified, since much of the reduction in the

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<sup>36</sup> This is not to say that there should not be a manual override that can be used when the car detects being on a race track, off-road, on a construction site, etc.

risk of death and injury due to MVCs that AVs could provide would be achievable only if there is widespread adoption of AVs. While the market for vehicles is sometimes offered as a clear example of a permissible market, if our four conditions obtain, there will be powerful grounds for eliminating markets for standard vehicles.

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