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Various Vulnerabilities in Highway Hierarchies:

Applying the UK Highway Code's Hierarchy of Road Users to Autonomous Vehicle Decision-Making

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ABSTRACT

In 2022 the UK government introduced extensive updates to the Highway Code. This includes making specific reference to autonomous vehicles (AVs) on UK roads as a present reality, as well as providing a clear 'hierarchy of road users.' This order of road users is based on the code's understanding of their relative vulnerability and, therefore, their need for protection. In the context of AVs and crash scenarios, the subject of relative value among road users has arisen – often in the form of trolleyology. Considering the new code offers a simple approach to this question, with a clear hierarchy of users, it may be argued that the code goes some way to address the public's concern. This article explores the new code, its approach of using vulnerability to create a hierarchy of road users, and its implications for programming AVs in crash scenarios.

KEYWORDS

Ethics of Crash Scenarios, Hierarchy of Road Users, Highway Policy, Self-Driving Cars, Trolly Problems, UK Highway Code

INTRODUCTION

This article discusses the concerns of autonomous vehicles (AVs) and trolley problems in light of the new highway code introduced by the UK government in 2022. This code "is essential reading for all road users, including pedestrians, mobility scooter users, cyclists, horse riders, drivers and motorcyclists" (Department for Transport [DfT], 2022a). Two aspects of this new code interest us here. The first is its explicit "hierarchy of road users" (DfT, 2022a, p. 6). The old code implicitly affirmed a hierarchy by recognizing that the "most vulnerable road users are pedestrians, particularly children, older or disabled people, cyclists, motorcyclists and horse riders" (DfT, 2015).[1] Yet the new code explicitly clarifies and formalizes this hierarchy. In particular, the new hierarchy describes a

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clear order of vulnerability and implicitly prioritizes certain classes of road users. Second, the new highway code is the first in the UK to refer to AVs as if they are already a present reality on UK roads. In this sense, the new highway code introduces a basic code of conduct by which AV operators, programmers, and developers must adhere when on public roads. This includes what operators can and cannot do in fully autonomous mode and how these cars should interact with other road users (such as pedestrians and cyclists).

Considering the extensive discussions on value hierarchies involving AVs and crash scenarios (Awad et al., 2018; Awad et al., 2019; Evans et al., 2020; Wang et al., 2023), the manner in which the highway code presents a hierarchy of road users is fascinating and begs the question of whether such a simplistic hierarchy of vulnerability and priority should be used to plan the motion of an AV in a crash scenario. This brief, hypothetical, and purely heuristic position paper explores some implications of applying the new highway code's hierarchy of vulnerability and priority to AV decisions in a crash scenario. It must be noted that the code does not thoroughly discuss the types of ethical standards that should be followed. Consequently, this paper is not an in-depth qualitative analysis of the underlying philosophy or preconceptions of the new highway code or algorithm ethics. These debates are extensive, with numerous researchers discussing the application of moral philosophical theories—such as utilitarianism, deontology, and other values—that might be integrated into AV decision matrix algorithms (Evans et al., 2020; Faulhaber et al., 2019; Geisslinger at al., 2023; Kumfer & Burgess, 2015; Lim & Taeihagh, 2019; Nyholm & Smids, 2016; Shah et al., 2021; Umbrello & Yampolskiy, 2022; Zhu et al., 2022). Nor does this paper present clear solutions to the highly complex problem of programming AVs in crash scenarios, which have plagued these debates for the last decade. Instead, we ask whether or not the implicit approach presented in the UK's new highway code (of identifying the vulnerable parties and giving them priority) offers a potential solution to the conundrum of planning decisions for AVs in crash scenarios. We merely consider one possible solution—a hierarchy of road users—that may be interpreted as arising from the new highway code.

With this in mind, we will begin this paper with a brief introduction to the new highway code, its hierarchy of road users, and various ethical issues worthy of independent consideration. Having done this, we will turn our attention to the issue at hand: self-driving cars in the new code, their position in the hierarchy, and a brief discussion on how to interpret the highway code's responses to common crash scenarios that have captured the public's attention.

THE (NOT-SO) NEW HIGHWAY CODE AND A HIERARCHY OF ROAD USERS

Building on the 2015 version, the 2022 UK Highway Code explicitly prioritizes various road users. While the previous code mentions the most vulnerable road users without determining who should be most protected, the 2022 code presents a clear approach to the question of who is most vulnerable and, therefore, should be most protected. Its approach to who has priority is based on who is "most at risk" (DfT, 2022a, p. 130) and, consequently, who has right of way in certain circumstances (such as intersections). While a number of other road users are mentioned (such as trams), broadly speaking (and in order of vulnerability/priority), the code mentions pedestrians, cyclists, equestrian-related users (horse riders/horse-drawn vehicles), motorcycles, cars, and larger vehicles (such as trucks, vans, and minibuses).

The code argues that not all road users are equally vulnerable to injury or death in a collision: "The road users most at risk from road traffic are pedestrians, in particular children, older adults and disabled people, cyclists, horse riders and motorcyclists. It is particularly important to be aware of children, older adults and disabled people" (DfT, 2022a, p. 130). Implicitly, these users have the right of way in most circumstances simply because of their explicitly stated vulnerability. Cars, conversely, are given lower priority (second only to larger vehicles such as trucks).

The code explicitly states that while all road users "share" (DfT, 2022a, p. 4) responsibility, it implies that those at the bottom of the vulnerability rung (i.e., those least vulnerable) have the greatest responsibility when it comes to protecting other road users (DfT, 2022a, p. 6). For example, a car and its driver bear more responsibility for the safety of others than a small child. Similarly, a cyclist bears more responsibility than a pedestrian and a horse-rider more than a cyclist. Implicit in this hierarchy is that with more vulnerability comes less responsibility and greater priority for protection. We expand on this below.

At first glance, this seems rational. After all, a driver traveling at speed, fully protected by a one-ton steel cage, has a minimal personal risk of harm, while the danger posed to a pedestrian or cyclist is severe. Here, we must concur with the code: "Those in charge of vehicles that can cause the greatest harm in the event of a collision bear the greatest responsibility to take care and reduce the danger they pose to others" (DfT, 2022a, p. 6). It is incumbent on vehicles to take extra precautions to avoid collisions and, when a collision takes place, to enact decisions that minimize risks to the most vulnerable. This mimics Amsterdam's approach, where the city's Mobility Implementation Plan prioritizes pedestrians in large parts of the city and treats cars as simply "guests" (Dijksma, 2021; Gemeente Amsterdam, 2013). Thus, the code's general principle seems to represent a more widely shared consensus.

Nevertheless, the new code's underlying approach of applying a single simple rule (e.g., the least vulnerable must look out for the most susceptible) presents several challenges. We draw attention to three challenges in particular: First, the ability of a larger vehicle to prohibit a collision is inversely proportionate to its vulnerability. That is to say, often, the larger the road user, the lower its ability to react in time to a crash. A pedestrian can stop in a few centimeters, while a car (even one traveling at a responsible speed) takes several meters to come to a complete halt, and a sizeable semi-articulated truck takes much longer. Pragmatically, the larger the vehicle (i.e., the least vulnerable), the less control it has in a crash.

For this reason, parents are concerned about young children near the road, not only because of reckless drivers who disobey the rules, but more pragmatically, because a child or an elderly pedestrian might unexpectedly move, and a vehicle may not be able to prevent harm to the vulnerable child or adult. One must consider the broader context of the traffic system. This includes traffic signs, lights, barriers, crosswalks, and safety education efforts. The combination of all these elements makes a system more or less effective in preventing collisions. Simply saying that vulnerable pedestrians have priority over larger road users may not be a practical means to prevent collisions in all circumstances. Nonetheless, the code has limited pedestrian right-of-way priority to pedestrian crossings only. This may be why drivers are asked to slow down near schools and sometimes facilities for older people.

Second, the images and examples presented in the UK Highway Code, and presumably the kinds of scenarios the writers of the code had in mind, are simplistic approximations of actual road situations. For example, the code presents simple scenarios of pedestrians crossing a road or cyclists in the cycle lane about to cross an intersection into which a car would like to turn. In reality, however, the road is a complex place, especially in urban areas. Often, numerous agents are involved in an interaction. The road comprises different kinds of pedestrians, cyclists, motorcyclists, and other cars interacting in intricate ways. Rarely does an agent play a passive or stationary role in isolation from the others. Many are motivated to go in different directions and cross each other's paths at various times. For example, pedestrians respond to other pedestrians, cyclists, cars, children, or their mobile phones. They interact in a myriad of ways.

Since the urban built-up area can be chaotic and challenging to navigate at the best of times, a single rule—the least vulnerable are responsible for the most vulnerable—may not always lead to appropriate responses in such situations. Pedestrians can and do wander onto the road at inconvenient places, such as between parked cars, behind buses, and at unclearly marked junctions. Indeed, the highway code expressly warns drivers that "children are more interested in ice cream than traffic and may run into the road unexpectedly" (DfT, 2022a, p. 131). This often places an impossible requirement upon larger road users to come to an immediate stop, often with unforeseen consequences for other users. For example, a cyclist who must swerve for a child running toward ice cream may enter the road unexpectedly, causing a car to sharply apply its brakes so that the articulated truck following the car must slam on its brakes. Even if the car and truck drivers act responsibly, someone may get hurt.

While crashes do happen, and the highway code makes clear that everyone has a responsibility to be mindful, the emphasis on larger road users giving way to smaller road users may provide a false sense of security to smaller road users, which in turn might change their behavior (Fyhri et al., 2011; Kummeneje & Rundmo, 2020). They may feel others need to watch out for them, not *vice versa*. Many of us are all too familiar with the possible consequences. In a parking lot, for example, where pedestrians and even other cars may have the right of way over reversing cars, they must still pay attention and not walk behind a reversing vehicle, as reversing cars have limited fields of vision and may inadvertently cause an injury. Even if they have the right of way, pedestrians often must give way in many situations.

The highway code acknowledges this challenge. For example, it encourages pedestrians not to cross between parked cars (DfT, 2022a, pp. 13, 16) or in front of or behind buses (DfT, 2022a, p. 24). It also states that everyone is responsible for avoiding harm, and therefore, those who act in this manner are acting against the code. Nevertheless, the fact that this hierarchy does not always hold raises questions about the suitability of the highway code's simplistic approach to the question of self-driving cars in crash scenarios. Let us turn to this now.

APPLYING A HIERARCHY OF ROAD USERS TO AV DECISIONS

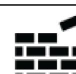
As mentioned above, one interesting feature of the new code involves its reference to self-driving cars (DfT, 2022a, pp. 4–6). Although it only dedicates a single section to the issue, this section appears at the very beginning of the code, implying that the rest of the code applies to AVs in the same way that it does to other road users. The inclusion of AVs indicates that the UK government takes seriously the possibility of fully autonomous vehicles on UK roads. In fact, the code uses the present tense and points to a list of vehicles approved for use in Great Britain (UK Government, 2022),[2] indicating that the UK government already perceives fully autonomous cars to be a reality on UK roads and that their use and presence will only increase in the coming years. Furthermore, the statement that "these vehicles are capable of safely driving themselves when the self-driving function is correctly turned on and the driver follows the manufacturer's instructions" (DfT, 2022a, p. 4) implies that manufacturers will comply with the code—and, by implication, the hierarchy within it. The UK and Scottish Law Commissions recently produced a report on autonomous vehicles, which acknowledges that the "transition from analogue road rules designed for human drivers to a set of digital road rules fit for purpose to guide the behavior of automated driving systems is challenging," and recommended that the government establish a forum for formulating such rules (Law Commission (UK) 2022, section 3.30). Bin-Nun et al. (2022) have made similar recommendations.

The most significant aspect of the new highway code and its reference to self-driving cars is its implied value/priority hierarchy that may be applied to crash scenarios. Readers are likely familiar with the trolley problem–like scenarios often presented in the context of AVs and crashes. What action should a self-driving car take in a crash scenario when faced with an ugly choice between two pedestrians and a cyclist or between an older person and a child?

Recognizing that the new highway code does not address the debate about which person to kill in a crash scenario—and certainly does not give an explicit solution—it does present an approach to traffic management on public roads that, hypothetically, has implications for these debates. The code explicitly states that those who can cause greater harm have a particular responsibility. It presents a hierarchy of vulnerable road users and draws on the understanding that the most susceptible require the greatest consideration. This underlying approach in the new code may offer a straightforward solution to the debates around self-driving cars and crash scenarios. From the code's statements, we can infer a particular approach to collision scenarios by translating the code's notion of those at risk to understand them as being vulnerable or needing protection. We could conclude that the code's notion that certain road users should "give way" to others implies a prioritization among road users. Understood this way, we may argue that if an autonomous vehicle found itself in the unfortunate position of having to choose between a pedestrian, a cyclist, a horse rider, or another car, its choice is clear: It should determine who is most vulnerable and act in a manner that best protects them. Should a zero-win sum present itself, the AV's hierarchy of "targets" may be stated as follows: First, the AV should attempt to choose a safe exit, or failing that, a wall or other obstruction, then another car, then the horse and rider, then the cyclist, and finally the pedestrian. Even within the category of pedestrians, the UK Highway Code notes that particularly vulnerable groups should be prioritized or given special protection: young, elderly, and disabled individuals (DfT, 2022a, p. 130), as listed in Table 1. While the code deems these three sub-categories as deserving greater protection than other pedestrians, it gives no order of priority to differentiate between them. Beyond this limited priority, it regards pedestrians as having equal value.

Such a clear hierarchy, based on vulnerability, presents us with a potential solution to the trolley problem conundrums that have driven this debate since self-driving cars became a realistic option on public roads. Rather than a utilitarian approach that saves the most years or people, it gives the most vulnerable protection and priority. Indeed, this approach is not new to the question of trolley problems (Jenkins et al., 2022). What is new is its codification in a highway code that applies to self-driving cars and possibly presents us with a clear order of whom to kill when faced with a zero-win sum situation. Understandably, one might welcome such a clearly stated order of priorities. Indeed, it would make programming AV decisions in crash scenarios easier: The self-driving car should aim for another vehicle, then a horse rider, then a cyclist, then a pedestrian. However, prioritizing *between* young, old, and disabled pedestrians would require a more advanced hierarchy than that provided by the code. Furthermore, rather than prioritizing those with high social status—as some cultures seem to prefer (Awad et al., 2018)—it takes seriously the responsibility to protect those who need the most protection. These are laudable grounds for its implementation.

Table 1. UK Highway Code's Hierarchy of Road Users: Note: this hierarchy may be used to produce an order of priority for 'targets' in a zero-win sum crash involving an AV and other road users

Hierarchy of vulnerable users		
1	Physical object (wall)	
2	Another vehicle	
3	Horse and rider	
4	Cyclists	
5	Pedestrian (adult)	
6	Vulnerable pedestrian (young, elderly, or disabled)	

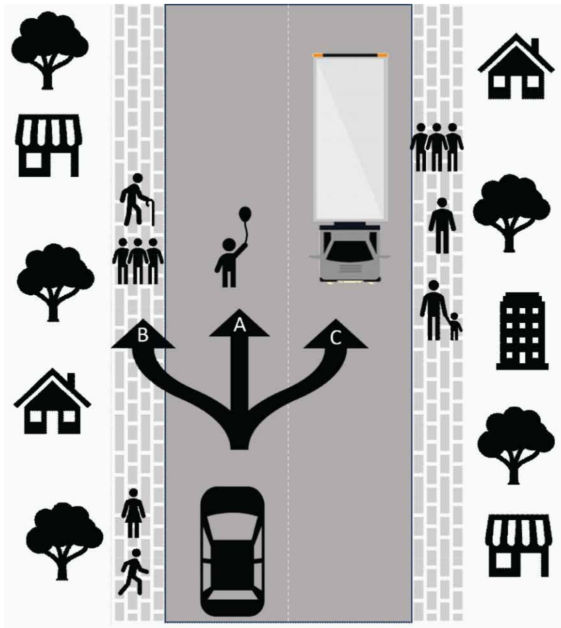
However, we should note three important points concerning different types of risk and vulnerability. First, the code equivocates between two types of risk and, hence, two types of vulnerability. Pedestrians, in general, are more at risk than those in vehicles because they are not protected by a car's chassis and safety systems. This means that if they are involved in a crash, they are more likely to be harmed than car users. In contrast, the code draws particular attention to the subset of pedestrians comprising children, older adults, and disabled people because they are *more likely to experience a crash* than other pedestrians. Rule 207 states that children and older pedestrians may struggle to judge a car's speed and may take longer to cross a road. Thus, while all pedestrians are vulnerable because they are unprotected, this subset of pedestrians is more vulnerable because they are more likely to experience crashes. The code states that "the 'hierarchy of road users' is a concept that places those road users most at risk in the event of a collision at the top of the hierarchy" (DfT, 2022a, introduction to rule H1). It further specifies that "the road users most at risk from road traffic are pedestrians, in particular children, older adults and disabled people, cyclists, horse riders and motorcyclists" (DfT, 2022a, rule 204). Note that rule 204 should not be read as implying that horse riders and motorcyclists are in the same category of risk; as rule H1 states, "Cyclists, horse riders and drivers of horse-drawn vehicles likewise have a responsibility to reduce danger to pedestrians" (DfT, 2022a).

Rule 204 also states, "It is particularly important to be aware of children, older adults, and disabled people" (DfT, 2022a). While this does not pose an issue for the hierarchy set out in the code, as it does not specify that drivers should favor one type of pedestrian over another, any further specification of prioritization between pedestrians would have to be clear about the specific rationale for favoring particular groups. On the basis of which type of risk (being hurt or causing a crash) is the prioritization being made?

Second, and more importantly, pedestrians are not always at the highest risk of serious injury in a given scenario. Context significantly influences the decisions that drivers and AVs must make. Consider, for example, a residential road with pedestrians on both sidewalks. A one-ton AV is traveling at the speed limit of 30 mph. A careless 12-year-old child runs across the road toward the ice cream shop on the other side. The AV has three options: a) strike the child at 30 mph, b) swerve onto the pavement and strike multiple pedestrians, or c) swerve into the other side of the road and engage in a head-on collision with a truck also obeying the speed limit at 30 mph (see Figure 1). In this case, the highway code clarifies that the child and pedestrians are most vulnerable and, therefore, have priority. According to the highway code, option c) is the best. However, hitting a two-ton truck in a head-on collision where both vehicles are traveling 30 mph is equivalent to hitting a brick wall at 60 mph with a force of 13,410 N. This will have severe consequences for the car's occupants and the driver of the truck. Although they would have airbags, seatbelts, and a steel cage as protection, depending on the age and condition of the car, more than one person is likely to sustain serious injuries. On average, however, a pedestrian has only a 10% chance of death when hit by a car at 30 mph. Children aged 1–14 have a 7% chance of death, while adults older than 60 have a higher chance. Even at 40 mph, the risk of death is 25%. Over the last 40 years, this risk has decreased—presumably due to improved car design and better medical care—with the most recent study conducted over a decade ago (DfT, 2010).

Or take, for example, a car traveling around a blind bend at a reduced speed of only 10 mph. Directly around the bend is a stationary horse ridden by a young child with an adult holding the bridle. The car can brake but will likely bump into the horse or the adult. In this case, it might be better to hit the adult than the horse, which is sure to bolt or buck, throwing the young child to the ground. A pedestrian struck by a car at a low speed is unlikely to sustain serious injury, but a rider thrown off a horse has a high risk of injury, especially if they are young or frail. This example reminds us that cyclists and horse riders may belong to the most vulnerable group (children, elderly, or disabled). Similarly, a bus full of children, elderly, or disabled people may be more vulnerable than a sturdy, athletic pedestrian who is carelessly walking across traffic. In other words, pedestrians are not necessarily the most vulnerable agents in every crash scenario.

Figure 1. A zero-win collision scenario



Third, and following the second point, vulnerability at the population level also differs from vulnerability at the individual level. Road crashes and deaths are notoriously difficult to quantify (Rune, 2019). However, depending on which measurement one uses (e.g., injury/death per trip, per person, per kilometer traveled), car occupants arguably bear the most significant risk on the road. Over 50% of all fatalities in the US between 1970 and 2020 were car drivers (Rodrigue, 2020, chap. 3). In 2020, in the UK, 618 car occupants were killed compared with 346 pedestrians, 285 motorcyclists, and 141 cyclists (DfT, 2021). Naturally, this analysis compares scenarios involving different agents, such as car-on-car collisions and lone motorcyclist crashes. Nevertheless, based on numbers alone, more car occupants die on the road than pedestrians.

Furthermore, one study found cycling to be approximately 1.5 times more deadly for children than walking when using a death-per-mile measure (Sonkin et al., 2006). Interestingly, gender has a significant influence on road injury and mortality. For example, one study found biking to be safer than walking for women but not men. In this study, men were more than four times more likely to die on a bike and almost three times as likely to die walking than women, as seen in Table 2 (Beck et al., 2007). This is particularly relevant for children. Wardlaw (2007) noted that 90% of all childhood cycling deaths involve boys, which caused a higher fatality rate for cyclists than pedestrians per mile. Consequently, male child cyclists are arguably at greater risk of death than pedestrians.

Another interesting comparison concerns cyclists and horse riders. Almost 79,000 horse riders are injured every year in the US compared to 130,000 cyclists (CDC, 2022; Leueen, 2017). However, there are just seven million horse riders compared with 47.5 million cyclists (Statista Research Department, 2021). This means 11.4 injuries occurred per thousand horse riders but only 2.73 per thousand cyclists. In other words, horse riders are four times more likely to sustain an injury than cyclists. In brief, these statistics seem to indicate that horse riders are more likely to be harmed than cyclists, while male child cyclists are more likely to be killed than pedestrians in general. Consequently, we can argue that, statistically, one is at a greater general risk of death and injury overall as a horse rider or as a male cyclist than as a pedestrian, even if pedestrians tend to be the most vulnerable when involved in a crash scenario. These different senses of vulnerability—in terms of (i) risk of having a crash and risk of being injured in a crash, (ii) actual vulnerability of those involved in a crash scenario, and (iii) vulnerability in terms of overall risk across the population of road users—should be borne in mind when considering implementing any hierarchy based on vulnerability.

We must raise one more issue before concluding. If the clear hierarchy given in the highway code is to be used as the basis of AV decision-making in crash scenarios, cars will likely be programmed to deprioritize occupants in comparison to pedestrians, cyclists, horse riders, and motorcyclists and to prioritize occupants in comparison to truck drivers. For example, an AV that sacrifices a pedestrian to protect its occupants may be in breach of the code—although not necessarily the law, as not all aspects of the code are backed up by actual legislation (the parts of the code that say "you must" have the force of law; the parts that say "you should" are only recommendations, but failure to follow them could be taken into consideration if charged with a crime). Like the false sense of security mentioned above, this can have unforeseen consequences. There is general agreement that self-driving cars may reduce the number of road deaths (Bauman & Youngblood, 2017; Etienne, 2021). However, to realize this, the public must adopt self-driving vehicles. Programming cars to deprioritize occupants may cause public resistance to adopting this new technology (Bonnefon et al., 2016). If the approach taken by the UK Highway Code (giving priority to the vulnerable) is to be adopted in developing self-driving cars, it may endanger the endeavor altogether. Consumers may be reluctant to purchase AVs if they know the vehicles will deprioritize them.

The evidence regarding whether this is a realistic concern remains inconclusive. This is not only a question of economics—ultimately, self-driving cars may be far more convenient and cheaper than traditional cars and, therefore, consumers will be compelled to use them—but one may also hope that society recognizes the benefit of protecting vulnerable pedestrians above car occupants.

CONCLUSION

Our analysis of the explicit hierarchy given in the highway code and its implicit relation to crash scenarios involving AVs indicates that a simple solution is far from our grasp. We cannot simply designate clear categories of vulnerability and then assign them protection or priority on this basis. The context of the highway, especially in urban and built-up areas (where numerous agents intersect in dynamic ways), implies that AV decisions are more complex than simple hierarchies of categories. AVs need more than a simple command, such as "pedestrians are more vulnerable than cyclists or horse riders; therefore, always avoid them." Even if pedestrians were always the most vulnerable to injury and death (which is disputable in some cases), it does not follow that an AV should avoid them at all costs. In some cases, striking a pedestrian at a low speed may be better than striking a heavy truck at a similar speed.

The UK Highway Code presents a straightforward approach to managing traffic on the roads and preventing injury and death: taking the vulnerability of a class of road users as the starting point and prioritizing the most vulnerable at critical times. Intuitively, it makes sense that pedestrians have the right of way on a pedestrian crossing (DfT, 2022a, p. 122) and that a car should not cut in front of a cyclist when turning (DfT, 2022a, pp. 134–135). This approach may present an attractive option when programming AV decisions in crash scenarios. Indeed, we fully agree with its emphasis on protecting the most vulnerable, provided the caveats about different types of risk and vulnerability in individual situations and across populations are considered.

Crash scenarios, however, are highly complex, with numerous moving parts. The weight and speed of a vehicle, the number of agents involved, and even how these agents respond during the incident must be considered. This does not lead to an easy solution. Ideally, the rules of the road should be understandable to the ordinary road user. To ask a driver to instantly calculate the potential of killing or maiming a pedestrian while traveling at 30 or 50 mph, all while taking into consideration the weight of the vehicle, would be inappropriate. However, an AV and its programmers have the advantage of foresight, not to mention the computing power of modern artificial intelligence and silicone microchips.

Moreover, even if humans could make such rapid calculations, a simplistic approach to these problems is arguably unrealistic. While we have presented hypothetical arguments in the context of AVs, they could equally apply to non-autonomous vehicles. Even human drivers who find themselves in such complex scenarios cannot be expected to rely on simple hierarchies for solutions. Pedestrians are not always more vulnerable than horse riders, nor are motorcyclists always more robust than cyclists. The questions about how the motion of a car is planned and programmed must be taken seriously and cannot be solved by applying a simplistic hierarchy of road users.

COMPETING INTERESTS

The authors of this publication declare there are no competing interests.

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ENDNOTES

1 For a comparison between the old and new codes, see (DfT, 2022b).

2 Although at the time of writing none were listed.

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