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ARTICLE

Law and tech collide: foreseeability, reasonableness and advanced driver assistance systems

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ABSTRACT

Recently, many scholars have explored the legal challenges likely to be posed by introduction of automated and autonomous vehicles. Minimal attention has focused on the legal implications of advanced driver assistance systems (ADAS) in vehicles already currently available. These can warn of external dangers, monitor driver behavior and control how a vehicle brakes, accelerates, maintains speed or position on the road. The dynamic driving task is no longer reliant simply on the physical interaction of human driver with that vehicle. Instead, the vehicle may act apart from human direction as it senses other objects in the immediate environment or monitors the human driver's behavior or biometrics. These technological tools, which reduce the opportunity for human error, can be described as augmenting human driving capacity. Increases in safety promised by ADAS, arguably already evidenced by data, may require a reassessment of the risks posed by 'un-augmented' human drivers, what is now foreseeable given the data generated by ADAS and wearable driver-monitoring technology, and whether 'un-augmented' driving is any longer a reasonable response to that risk.

KEYWORDS

Automated vehicles; liability; ADAS; foreseeability

Introduction

Broader issues of governance of artificial intelligence and autonomous systems inevitably are worked out in the detail of regulatory regimes, including legislation passed by parliaments and its subsequent interpretation and application by courts. In their decisions, arguably the practical outworking of governance, judges 'make the law', yet must 'grapple with the fundamental problem of determining the limits of judicial law making responsibility' particularly when faced with the 'novel and ... difficult questions generated ... by astonishing scientific and technological advances and the great social and economic changes wrought by globalisation and the spreads of international human rights' (Sackville, 2001). Adopting a narrower perspective to those regarding theoretical approaches to governance outlined earlier in this issue by Ulnicane et al. (2020), Radu (2020) and Gahnberg (2020), this paper focuses on application of regulation in the context of automated vehicles. In this context, automation, machine learning and algorithmic decision-making transport humans and cargo, sometimes colliding and causing damage. These technological agents 'perceive', 'decide', act and finally move,

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impacting not only a digital environment but also a highly complex physical one. This physical environment demands abstract theoretical considerations about governance are outworked in highly specific rules and practical decision-making (Gahnberg, 2020). The law has been used historically as a policy lever to pursue social goods such as safety, penalise the taking of unacceptable risks and either encourage or stifle emerging technological innovations. This paper will consider how common law concepts such as reasonableness, practicability and foreseeability and their use in apportioning liability might be applied to the challenges posed by automated vehicle technologies already in use, and how this can inform future approaches to regulation of highly and fully autonomous vehicles.

Recently many scholars have explored the legal challenges likely to be posed by introduction of automated and autonomous vehicles – described as ‘a qualitatively distinct affordance’ (Calo, 2019, p. 86). Vehicles with conditional, high and full levels of automation are projected ‘to result in [even more] significant community benefits including reduced road trauma and increased mobility, productivity and environmental efficiencies’ (National Transport Commission, 2017; Haratsis, 2019), but they are not yet widely available, and it remains to be seen whether performance will live up to prediction.

A variety of advanced driver assistance systems (ADAS) are already deployed in vehicles in use on our roads. These can warn of external dangers, monitor driver behavior and provide additional control of braking, acceleration, speed or position on the road. ‘At the highest level of intervention, ADAS either take action independently or override the action of the driver’ (Lindgren, Chen, Jordan, & Zhang, 2008), and ‘represent an evolution in vehicle sensing, intelligence and control that will ultimately lead to self-driving cars’ (Estl, 2015, p. 2). The dynamic driving task no longer relies simply on the physical interaction of human driver with that vehicle. Instead, the vehicle may act apart from human direction as it senses other objects in the immediate environment or monitors the human driver’s behavior or biometrics. These technological tools, which reduce the opportunity for human error, augment human driving capacity – and as ‘humans and machines work together’ our ‘traditional conceptions of control and responsibility’ may need to change (Elish, 2019, p.9, p. 22). Despite increasing interest in legal issues arising from fully or highly automated vehicles, minimal attention has focused on the legal implications of ADAS in vehicles already currently available.

In jurisdictions where access to compensation for injuries requires proof of fault, this has significant legal ramifications. In a September 2019 High Court of Australia decision, DNA on a deployed airbag was critical evidence in determining who was driving the vehicle at the time of collision: Lee v Lee; Hsu v RACQ Insurance Limited; Lee v RACQ Insurance Limited [2019] HCA 28 (4 September 2019). Increased safety promised by ADAS, arguably already evidenced by data, now requires reassessment of risks posed by ‘un-augmented’ human drivers, and whether ‘un-augmented’ driving continues to be reasonable. Recalibrating risk assessments in this way may act as a policy lever to encourage more widespread adoption of newer safer vehicle technologies – particularly as insurers, fleet managers and parties to the chain of responsibility for heavy vehicles reassess their exposure to negligence claims in light of data about vehicle and driver performance (Heavy Vehicle National Law (Queensland), 2012). Such recalibration can also inform legal approaches to risks posed by conditional, high and full levels of vehicle automation.

Part I looks backwards briefly to consider how tort law has responded to technological change in the past. Part II explains the widely used SAE taxonomy for automated vehicles (Levels 0–5 vehicles, with automation ranging from none, driver assistance, or partial, to conditional, high or full) before delving more deeply into advanced driver assistance systems [ADAS] and driver-monitoring devices currently available. Part III outlines the Australian fault-based liability system and in particular how the elements of reasonableness and foreseeability operate in the context of driving. Part IV explores challenges to existing conceptions of reasonableness and foreseeability posed by ADAS, including those which operate to override a human driver's capacity to direct the vehicle's operation. These issues may inform how the law responds to level 3, 4 and 5 vehicles where an automated driving system monitors the driving environment.

Part I: tort law and technological change

The common law has always formulated, modified and changed legal rules to achieve public policy goals, (Kaczorowski, 1990, p. 1199) 'constantly adapt[ing] to technological change' (Bennett Moses, 2003, p. 395). Tort law has been underpinned by a 'fundamental moral principle' that one who violated community standards of reasonable behavior and injured another was morally and therefore legally bound to compensate the victim' (Kaczorowski, 1990, p. 1128). Historically it has been used 'to make people behave in morally appropriate ways by holding them to community standards of reasonable behavior in the circumstances in order to minimize injuries and losses, and to promote honesty and fairness in economic relationships' (Kaczorowski, 1990, p. 1128).

Tort law is no stranger to the challenge of apportioning liability for harms caused by emerging technologies. 'Technological change occurs against a backdrop of social, cultural, and economic forces that in turn shape the trajectory of the technology itself' (Calo, 2019, p. 90). The tort of negligence developed and expanded 'in the wake of the Industrial revolution' (Crootof, 2019, p. 8) and rising rates of injuries caused by emerging technologies such as railroads, mechanized factories, horseless carriages, and mass produced consumer products. Some argue it responded to protect those driving such progress (e.g. railroad companies, and large scale manufacturers) by limiting their liability (Crootof, 2019, p. 8). Tort law has thus shaped and been shaped by 'the risks created by technological innovation but also by the alternative compensatory and regulatory "technologies" that were introduced to control those risks or mitigate their effects' (Oliphant, 2014, p. 821). Nevertheless, 'it takes time for any innovation to become fully assimilated within everyday tort law', and 'the precise timetable for this process, or its final results' is impossible to accurately anticipate (Graham, 2012, p. 1242). This leads some to argue 'that traditional tort theory is inadequate to address the expanding scope of risks in the post-industrial world' and that risks 'finding their way into litigation are more complex and less intuitive to establish' (Guzelian, 2005, p.1034). Responses to these concerns have led to introduction of compulsory third party insurance and more recently of no-fault motor accident compensation systems (Fronsko & Woodrooffe, 2017), especially for catastrophic injuries (Australian Government The Treasury, n.d.). They form only part of an increasingly complex regulatory framework aimed at ensuring safety: road design guides (Austroads, 2017); standards for road traffic, signs and signals (Standards Australia, n.d.; United Nations,; United Nations, 1968); national standards for vehicle safety (Motor Vehicles Standards Act (1989); *Australian Light Vehicle Standards Rules (2015)*; Road Traffic (Light Vehicle Mass and Loading Requirements) Regulations, 2013; Road Traffic (Light Vehicle Standards) Variation Rules, 2016 (SA); Road Traffic (Light Vehicle Mass and Loading Requirements) (Light Vehicle Standards Rules) Variation Regulations, 2018 (SA); Road Traffic (Light Vehicle Standards) Rules, 2018 (SA)); driver training and licensing (Motor Vehicles Act, 1959 (SA)); road rules which prescribe driver behavior and use of safety devices such as seatbelts, helmets, vehicular lights and warning devices (*Australian Road Rules* as adopted by the Road Traffic Act, 1961(SA); criminal offences relating to driving or vehicle use (Criminal Law Consolidation Act, 1935 (SA) s, 19A, 19AB, s.19AC, s.19AD; Road Traffic Act (1961))); separate regulation for heavy vehicles (National Transport Commission, n.d.); vehicle roadworthiness (Road Safety (Vehicles) Regulations, 2009 (Vic)); repairer licensing (Motor Vehicle Repairers Act, 2003 (WA)); and second hand motor vehicles sales (Second Hand Vehicle Dealers Act, 1995 (SA)).

Where crashes have involved vehicles in completely autonomous mode, the tendency still seems to be to blame the human involved, even though there may be plausible reasons for characterizing the technology as at fault (Crootof, 2019, p47; Elish, 2019; Graham, 2012, pp.1260–1266; Calo, 2016b). Guzelian (2005, p. 990) claims tort law 'does not sufficiently accommodate the expanding scope of contemporary risks and the accelerating pace of risk assessment and risk discovery,' and that 'society can only arbitrarily delineate which risks to address and which to ignore' (2005, p. 1012). Crootof (2019, p. 69–70) suggests '[o]ur choices now will determine whether law evolves to preserve or constrain industry's new, tech-enabled powers.' The more humans interact with automated vehicles, and augment our capability with technological tools such as ADAS, the more knowledge and experience we will have in predicting their behavior. This may allow for more accurate risk prediction (Guzeklian, 2005, p.1034; Karnow, 2013, p. 18), and more effective risk management (Lyndon, 1995, pp.141–142) – not only of risks posed by machines but of risks posed by humans interfacing with them. '[S]ocial norms and expectations' have a role in integrating emerging technologies into existing legal frameworks and then in 'legal interpretations' of that technology (Elish, 2019, p. 17–18). Crootof (2019, p. 51) describes this as an interactive process:

> 'Just as technological development can spur legal evolution, legal defaults and tech-enabled capabilities influence social norms and expectations … Once social norms are established, they affect how legal questions are evaluated.'

The tort of negligence embeds notions of reasonableness and foreseeability at progressively narrower levels of specificity at various stages of legal assessment (Minister Administering the Environmental Planning and Assessment Act 1979 v San Sebastian Pty Ltd, 1983; Osborne Park Commercial Pty Ltd v Miloradovic, 2019). Assessment of and response to risk are thus key elements. But 'truly novel affordances tend to invite reexamination of how we live' (Calo, 2019, p. 90). When automated systems control how a vehicle or its driver respond to the surrounding environment or to other road users, or when detailed data about individual vehicle performance and driver behavior is available in real time, this may force reframing of assessments about what can and should be foreseen, by whom, when, and what precautions a reasonable person would and should take in response to foreseeable risk.

It is important to acknowledge that negligence is only one tool for apportioning liability for harm caused by motor vehicles. In those jurisdictions with no-fault compensation schemes for motor accident personal injuries (Brady, Burns, Leiman, & Tranter, 2017), proving third party fault remains a key determinant for recovery of property damage, with third party property insurance optional. In Australia, while 'safety of transport activities relating to a heavy vehicle is the shared responsibility of each party in the chain of responsibility for the vehicle' (*Heavy Vehicle National Law (South Australia) Act 2013*, s.26A (1)), assessment of whether that statutory safety duty is met involves considerations of 'public risk' and what is a 'reasonably practicable' response (Heavy Vehicle National Law (South Australia) Act 2013 (SA) Heavy Vehicle National Law Schedule 26A(1), 26C). 'Due diligence' includes 'acquir[ing], and keep[ing] up to date, knowledge about the safe conduct of transport activities' and 'gain[ing] an understanding of … the hazards and risks, including the public risk, associated with [the legal entity's transport] activities' (s.26D). Assessment of risk and reasonable practicability thus remain relevant, even if not required to prove fault in negligence. A similar general safety duty on an automated driving system entity is currently under consideration by Australia's National Transport Commission. (National Transport Commission, 2019). By contrast, the UK's (*Automated and Electric Vehicles Act 2018*) (s.2) makes insurers liable for death, personal injury and property damage 'caused by an automated vehicle when driving itself on a road or other public place in Great Britain' without the necessity for considering fault or reasonableness.

Part II: vehicle automation and ADAS

Legal issues raised by ADAS occur within a broader context of vehicle automation. The Society of Automotive Engineers (SAE) International Standard J3016, widely used internationally as a taxonomy for automated vehicles, is 'descriptive and not intended to be prescriptive [and is] technical rather than legal' (Eliot, 2017).

In SAE Level 3, 4 and 5 vehicles, an automated driving system (as opposed to a human driver) monitors the driving environment. Although often referred to as driverless or autonomous, (Calo, 2016b, p.215, 227) prefers the term 'emergent',

> 'because autonomy … connotes an intent to act that is actually absent in robots. Emergent behavior refers to the ability or tendency of a system to behave in complex, unanticipated ways … the idea is that the system will solve a problem (or create one) in ways the programmers never envisioned.'

Full automation (Level 5) is defined as 'full time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver' (Society of Automotive Engineers, 2014). High automation (Level 4) is defined as 'the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task even if a human driver does not respond appropriately to a request to intervene' (Society of Automotive Engineers, 2014). Conditional automation (Level 3) is defined as 'the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene' (Society of Automotive Engineers, 2014). Risks posed by humans handing over and taking back control of Level 3 vehicles might suggest a move directly to Level 4 and particularly Level 5 vehicle is more likely, rather than incrementally moving through Level 3 (Eliot, 2017). Some have even proposed that 'on failure of the self-driving function in the vehicle, the system could return control to a remote human driver located in response centers distributed across the world' (Lei Kang, Zhao, Qi, & Banerjee, 2018).

This contrasts with SAE Levels 0, 1 and 2, where the human driver monitors the driving environment. Level 2 (partial automation) envisages 'specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the human driver perform all remaining aspects of the dynamic driving task' (Society of Automotive Engineers, 2014). The boundary between Level 3 and Level 2 is blurry – 'autonomy is a matter of degree' (Karnow, 2013, p. 4). It may depend on whether the driver can and should rely on a Level 2 automated system (that in 'some instances … operates exclusively subject to driver-monitoring' e.g. 'normal highway driving cruise control') or whether the driver should take back control of a Level 3 system 'that monitors the roadway "under some circumstances"' to negotiate 'narrow mountainous terrain' or in 'exceptionally hazardous weather conditions' (Abraham & Rabin, 2019, p. 140).

Level 1 describes vehicles with driver assistance, when the driving mode is 'specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the human driver perform all remaining aspects of the dynamic driving task' (Society of Automotive Engineers, 2014).

> 'In the Level 1 and Level 2 stages, these systems can briefly take active control of the car to assist in parking, prevent backing over unseen objects and avoid collisions by braking or swerving. Sometimes the system actively controls an individual feature of the automobile, such as adapting front headlights automatically to upcoming curves and other changing conditions' (Sagar, 2017, p. 3)

Level 0 vehicles have no automation with 'the full time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems' (Society of Automotive Engineers, 2014).

Current vehicles with increasingly sophisticated ADAS safety features might be described as Level 1 driver assistance or even Level 2 partial automation (Society of Automotive Engineers, 2014).

ADAS include:

- Crash Avoidance Safety Features: Electronic Stability Control (ESC)[1] *; Auto Emergency Braking (AEB) (Higher speed, Lower speed, Pedestrian); Traction Control; Intelligent Speed Assist; Active Braking Systems
- Car Safety Features: Driver attention detection (monitoring both eye-gaze and emotion (e.g. SmartEye, n.d.)); Antilock Braking System (ABS); Reversing camera; Forward Collision warning; Active Cruise Control; Brake Assist System; Blindspot

[1]* 'Electronic Stability Control (ESC) helps drivers to avoid crashes by reducing the danger of skidding, or losing control as a result of over-steering. ESC becomes active when a driver loses control of their car. It uses computer controlled technology to apply individual brakes and help bring the car safely back on track, without the danger of fish-tailing.' http://www.howsafeisyourcar.com.au/Electronic-Stability-Control/

Warning System; Lane departure Warning; Lane Keep Assist; Precrash Safety System.

Other safety features currently available include vehicle telematics and tracking systems; alcohol/drug ignition interlock devices (e.g. VicRoads, n.d.; Kaufman & Wiebe, 2016, pp.865–871), programmable smart keys, tyre pressure monitoring, electronic data recorders (onboard diagnostic devices), trailer stability control, and self-parking (e.g. BuyaCar, 2020). Various proprietary aftermarket systems using GPS can track vehicle location and operation in real time (including driver behavior and style) (e.g. Vipertrak, 2019; de Vries, de Koster, Rijsdijk, & Roy, 2017; SmartEye, n.d.) and assist with driver fatigue management. Driver-monitoring 'systems may use biometric technology … to identify the characteristics of individual drivers and create a history of their driving performance in order to measure short and long-term fluctuations in drivers' performance' (Tsapi, 2015 citing Turetschek, 2006). Wearable technology attached to the driver's body (not the vehicle) can increase safety too: smart headsets can '[capture] fatigue and distraction in real time and pre-alerts drivers at the first signs of risk' (e.g. Maven Machines, n.d.); smartwatches monitor biometrics in real such as heart rate, stress and drowsiness (e.g. Cassey, 2016; Fujitsu, 2015; Garmin, 2019; Russey, 2018). External technologies, such as vehicle activated and intelligent signs, are also designed to increase safety and prevent crashes (e.g. Westcotec, n.d.). UK Police are piloting mobile phone detection products to identify drivers using their phones (BBC News, 2019; Westcotec, n.d.; and e.g. L&G International, 2019).

Although not Level 3, 4 or 5 vehicles, these ADAS features may effectively override human drivers' capacity to direct vehicle operation. Some prevent drivers from operating the vehicle at all, some become active when drivers lose control, others alert drivers to imminent risks, and yet others shut down the vehicle or other devices when being operated unsafely.

This demonstrates just how far vehicle safety has come. Seatbelts were one of the first safety technologies fitted to motor vehicles (Defensive Driving, 2016). Australia led the world in introducing 'legislation for compulsory wearing of seat belts', in 1970 – first in Victoria, then followed within 14 months by the other Australian states (McDermott & Hough, 1979). Even though 'surveys of usage show that the public lagged behind for decades before wearing became almost universal' (BITRE, 2010, p. 3) introduction resulted in a 'dramatic fall in fatalities and in the number and severity of injuries', and claims that seatbelts would lead to an increase in risk taking behavior were not borne out by empirical evidence (Luntz, Hambly, Burns, Dietrich, & Foster, 2013, pp.344–345; BITRE, 2010, p.3; Centers for Disease Control and Prevention, n.d.). More recently, airbags and ESC together are estimated to have reduced the fatality rate per kilometre travelled by 23%, relative to a base case without these technologies (BITRE, 2015). The effectiveness of ESC in 'reducing single-vehicle crashes, particularly run-off-road crashes' (BITRE, 2015, p. 2), is particularly important given that in 2015–2016 44% of all crashes on Australian regional and remote roads were single vehicle run-off crashes; the road death rate per 100 000 population on regional and remote roads (11.8) was almost five times that in major cities (2.5); and 66% of road deaths occurring in regional and remote areas (BITRE, 2018). These statistics raise questions about whether risks of motor vehicle injury should be calibrated differently depending on whether the vehicle was fitted with

ESC. As data generated by ESC and other ADAS features grows, and evidence of safety impact builds, this will become more pressing for governments, insurers and others seeking to reduce levels of road trauma.

ADAS features tend to 'appear initially in high-end models, then migrate to midrange vehicles and eventually become available on all new cars (Estl, 2015, p. 3). Price points for high-end models place them out of reach for many, especially younger or elderly drivers, who may be statistically most at risk of involvement in a crash. '[W]here safety is concerned, insurance companies, regulatory bodies and legislatures normally become involved, accelerating phase-ins through favorable premiums and legal mandates' (Estl, 2015, p. 3). Although yet to occur in any real way in response to ADAS in Australia, some Australian insurers have now indicated they will no longer insure 'any vehicle with less than a four-star Australasian New Car Assessment Program crash rating' (ANCAP Safety, 2012; WhichCar staff, 2017).

In Australia, the average age of all vehicles is 10.1 years, with passenger vehicles slightly younger, both averages significantly older than those in similar countries (Potterton & Ockwell, 2017, p. 6). Vehicles significantly older than average may have little more than seatbelts. Others will have only low end 'Crash Protection Features' such as crumple zones[2] *; strong occupant compartment; impact protection; airbags; seat belts; and head rests (TAC, n.d.). Although vehicles with more sophisticated ADAS will increase over time with fleet regeneration, because of price, few may be fitted with the full complement of ADAS available at any time, and even then will be continually superseded by new models, in many cases before optimum replacement cycles.

Operating ADAS successfully to increase vehicle safety will '[depend] largely on the users' ability to correctly work with the systems, [and] be aware of their potential and limitations in order to take full advantage of them' (Tsapi, 2015, p.vi). But Australian learner drivers do not require training in how to most effectively 'interact with these technological innovations' (Tsapi, 2015, p.vi; Regan, Prabhakharan, Wallace, Cunningham, & Bennett, 2020). Apart from medical assessments for senior licence holders (NSW Centre for Road Safety, 2015), unrestricted licence holders have limited or no requirements to regularly update driving skills to include correct operation of new safety features (Austroads, 2020). Any training received is likely to be at point of purchase from a salesperson, rather than from a professional driving instructor (Regan et al., 2020, p. 72–73). Training for professional driving instructors in Australia does not explicitly refer to competency in operating ADAS (Australian Government, n.d.a). ADAS features differ across vehicles, magnifying risks due to lack of familiarity. If drivers do not understand how systems work (Abraham, Reimer, & Mehler, 2017), or do not trust results they produce (e.g. 'false alerts from less reliable systems' (Kidd et al., 2017), they cannot or will not use them appropriately – resulting in over-reliance, under-reliance, expecting 'a system to work outside of its operational design domain' (Abraham et al., 2017, p. 1954), or choosing not to use them at all (Kidd et al., 2017, p.S44).

This is further complicated as Australia no longer has a domestic auto-manufacturing industry. All vehicles and ADAS made after October 2017 (Ladd, 2017) will have been

[2]* '[C]rumple zones are areas of a vehicle that are designed to deform and crumple in a collision. This absorbs some of the energy of the impact, preventing it from being transmitted to the occupants'. Ed Grabianowski, 'How Crumple Zones Work'. *how stuff works* https://auto.howstuffworks.com/car-driving-safety/safety-regulatory-devices/crumple-zone.htm

designed and manufactured elsewhere, with systems optimised for different traffic conditions. However, '[d]river behavior differs from one culture to another,' and 'situations that might be considered dangerous' in one country 'seen as quite typical' to drivers in another, even when 'traffic rules and regulations are similar' (Lindgren et al., 2008). Not accounting for such differences in both design and training may be 'potentially dangerous' (Lindgren et al., 2008) – possibly unanticipated by either system designers in one country or drivers in another. Studies highlight that this can result from statistical bias, where the data used to train the vehicle is 'not statistically representative' of the population in which it is deployed, which could lead to the vehicle learning 'localized patterns' that do not apply in other contexts (Lim & Taeihagh, 2019). For example, where forward collision warnings optimized for one market sound continually in another, when drivers in the latter would consider the situation 'normal or safe', those warning systems become increasingly ineffective, annoying and likely to be shut off (Lindgren et al., 2008). As Radu, 2020 has identified, the 'centrality of the national state' and 'concepts such as territory' remain 'deeply embedded' in discourse regarding governance of AI, although as evidenced here, policies and design choices optimising performance of autonomous systems for one governance environment can play out very differently when applied elsewhere.

Part III: fault-based liability, reasonableness and foreseeability

Australian '[r]oad accident victims are far more likely to make claims and receive tort compensation than any other group', with compensation managed through a patchwork of state and territory legislation. Some jurisdictions allow access to compensation on a no-fault basis (National Transport Commission, 2018, p.8). This Part however focuses on fault-based jurisdictions, where claims for compensation are founded in negligence (National Transport Commission, 2018, p.99). In these jurisdictions, almost half of those injured are not compensated, with 'large claims . . . more likely to be rejected or to lead to an allegation of contributory negligence', reducing awards of damages (Luntz et al., 2013, p. 10).

The common law duty to take reasonable care owed by one road user to another has been clearly recognized in Australian law (*Cook v Cook,* 1986; *Imbree v McNeilly*, 2008). It arises because it is reasonably foreseeable that the actions of one road user could cause harm to a determinable class, namely other road users. Notions of reasonableness and foreseeability are essential. Foreseeability is assessed prospectively, without the benefits of hindsight (*Roads and Traffic Authority of NSW v Dederer*, 2007), at 'the duty, breach and remoteness [scope of liability] stages . . . which progressively decline from the general to the particular' (*Minister Administering the Environmental Planning and Assessment Act 1979(1983)* v *San Sebastian Pty Ltd*, 1983; *Osborne Park Commercial Pty Ltd -V-Miloradovic, 2019)*. The test of foreseeability is 'undemanding' (*Shirt v Wyong Shire Council*, 1978, 542): 'any risk, however remote or even extremely unlikely its realisation may be, that is not far-fetched or fanciful, is foreseeable', although 'the line between a risk that is remote or extremely unlikely to be realised, and one that is far-fetched or fanciful is a very difficult one to draw' (Koehler v Cerebos (Australia) Ltd, 2005, 57).

The standard of care required is that of a reasonable person in the driver's position in possession of all information the driver either had, or ought reasonably to have had, at the time of the incident out of which the harm arose (Civil Liability Act, 1936, s32). This reasonable person* is 'of ordinary intelligence and experience … independent of the idiosyncrasies of the particular person whose conduct is in question',[ii] not 'unduly timorous' nor 'nonchalantly disregarding obvious dangers', 'free both from over-apprehension and from over confidence' (Glasgow Corp v Muir, 1943). The standard is not lowered for inexperienced or unqualified drivers (Cook v Cook, 1986; Imbree v McNeilly, 2008). Courts require motorists to drive defensively, alert to potential dangers (Luntz et al, 2018, p.351), and drivers cannot rely on the safe driving of others (Sibley v Kais, 1967). This standard of care focuses on what can reasonably be expected of the human driver and their act of driving, not on the performance capabilities of the vehicle they were driving or the technology they were using. As Gahnberg (2020) has noted, the presence of formal rules (road rules) and informal norms (community expectations as to safe driving) 'carry the meaning of what is good or acceptable behavior' in [this] context'.

Once the standard has been established, legislative tests must be applied to determine whether it has been breached (e.g *Civil Liability Act 1936*, s.24). The test for breach, largely similar across Australian jurisdictions, codifies an earlier common law test (*Wyong Shire Council v Shirt,* 1980) and explicitly incorporates both reasonableness and foreseeability.

32 – Precautions against risk

(1) A person is not negligent in failing to take precautions against a risk of harm unless –
  (a) the risk was foreseeable (that is, it is a risk of which the person knew or ought to have known); and
  (b) the risk was not insignificant; and
  (c) in the circumstances, a reasonable person in the person's position would have taken those precautions.
(2) In determining whether a reasonable person would have taken precautions against a risk of harm, the court is to consider the following (amongst other relevant things):
  (a) the probability that the harm would occur if precautions were not taken;
  (b) the likely seriousness of the harm;
  (c) the burden of taking precautions to avoid the risk of harm;
  (d) the social utility of the activity that creates the risk of harm. (Civil Liability Act, 1936 (SA))

A driver will be negligent if they do not meet the standard of care required. Examples could include failing to keep a proper lookout, failing to comply with road rules or signage, being distracted while using a mobile device, or failing to exercise sufficient control of their vehicle.

Proving causation is a two-step process requiring consideration of both factual causation, and scope of liability. Tests for factual causation do not involve either reasonableness or foreseeability. Where it is alleged that harm has been caused by the absence of appropriate traffic warnings or road signage, the plaintiff must prove that the driver would have complied with any speed limits or other traffic directions indicated if signs were present (*Roads and Traffic Authority v Royal*, 2008; *Commissioner of Main Roads v*

*who is apparently not gendered, although Bender, Finlay and other scholars suggest that the substitution of 'person' for 'man' has 'concealed other 'masculine' values inherent in the concept (Luntz et al, 2013, p.212).

Jones, 2005; ; *Roads and Traffic Authority of NSW v Dederer*, 2007; *March v E & MH Stramare Pty Ltd, 1991)*. Determination of whether responsibility for the harm is within the scope of defendant's liability (See for example *Civil Liability Act 1936* (SA) s.34(1)(b) and (3)) draws on common law tests for remoteness (i.e. whether the kind of damage suffered was foreseeable as a possible outcome of the kind of carelessness alleged) (*Overseas Tankship (UK) Ltd v Morts Dock & Engineering Co Ltd (The Wagon Mound (No 1), 1961)*.

Once liability is proved, an injured person may face an allegation that they failed to 'exercise reasonable care and skill for their own protection', and thus were contributorily negligent (Civil Liability Act 1936 (SA) s.3) If this can be proved by the defendant on the balance of probabilities, damages may be reduced on the basis of a 'just and equitable apportionment' reflecting comparative culpability (See e.g. Law Reform (Contributory Negligence and Apportionment of Liability) Act 2011 (SA) s.7; Pennington v Norris (1965)). Failure to wear a seat belt has since 1976 been generally regarded as contributory negligence, resulting in reduction of damages (Froom v Butcher, 1976) and more recently will give rise to a rebuttable presumption of contributory negligence with fixed reductions (see e.g. Civil Liability Act 1936 (SA) s.49; Motor Accident Injuries Act 2017 (NSW) s 4.17; Civil Law (Wrongs) Act 2002 (ACT) s.97). Failure to wear a safety helmet as required, or travelling whilst not in the passenger compartments give rise to similar presumptions (see e.g. Civil Liability Act 1936 (SA) s. 49). Driving while intoxicated, or relying on the care and skill of a driver known to be intoxicated also give rise to statutory presumptions of contributory negligence resulting in a sliding scale of reductions (see e.g. Civil Liability Act 1936 (SA) s. 46 and 47).

Part IV: ADAS – new questions about foreseeability and reasonableness

Even small reductions in human error when operating motor vehicles will save significant lives, prevent injuries and property losses. In 2018, road traffic was 'the eighth leading cause of death globally … [claiming] more than 1.35 million lives each year and [causing] up to 50 million injuries' (World Health Organization, 2018). Australia estimates the national annual economic cost of road crashes at $AU27 billion per annum, with 1226 deaths in 2017. At least 90% of traffic collisions are caused by human error, with the vast majority rear end crashes. Yet large numbers of drivers still admit to undertaking unsafe behaviors when driving – including using mobile devices, driving while fatigued, and falling asleep at the wheel.

Should humans only be allowed to drive a motor vehicle if their capacity to do so is 'augmented' appropriately by technology? Should users of vehicles that are not so equipped be regarded as putting themselves and the community at unacceptable levels of risk? Should drivers be required to wear devices that monitor behavior or biometrics? Although of little import in jurisdictions where access to compensation does not depend on proving that another driver was at fault, in fault-based jurisdictions, where negligence must be established before compensation can be recovered, these questions go to both foreseeability and reasonableness and so will be critical. Assessing appropriate responses to risk in this era of augmented human driving capacity poses new challenges. This is 'the puzzle of how to deal with the contingency of technology and its social impacts' (Calo, 2019, p. 88), even for Level 0,1 and 2 vehicles without greater levels of automation or autonomy. Those challenges will intensify for Level 3 and 4 vehicles, if human drivers can hand over and resume control.

The data outlined above raise new questions about whether it continues to be reasonable to operate vehicles on Australian roads without ADAS (at a minimum, without airbags and ESC) or without driver-monitoring technology. Tort law's response to seatbelts might suggest that even where safety features have not yet been mandated legislatively, contributory negligence might still be found where drivers failed to use features that were available. Data from vehicle telematics and driver – monitoring now allows for granular assessment of specific risks – i.e. risks posed by an individual driver with a particular driving history operating a vehicle with specific features in a particular locale or under particular conditions both internal to the driver and external to the vehicle. This data might be accessible to the driver, owners, fleet managers, insurers or others in real time. Usage-based insurance is already pricing data-driven risks differently (Allied Market Research, 2016; Smith, 2019; Tselentis, Yannis, & Vlahogianni, 2017), and is predicted to develop significantly in future, moving towards a 'predict and prevent methodology' (Balasubramanian, Libarikian, & McElhaney, 2018, p. 18). Vehicle telematics tools are widely used by fleet managers to manage costs and productivity and boost safety. Approved security camera systems are mandated in Australian taxis (see e.g. Department of Transport and Main Roads, n.d.), and in many other international jurisdictions (Topham, 2019). At a more personal level, many people already wear personal fitness trackers, smartwatches heart rate sensors and carry smartphones with GPS location tracking. In a world where behavior is already impacted by the data generated by such devices, it may not take much for the community to accept the need for 'augmented driving', or conclude that failing to increase safety by augmenting human capacity with the use of available technology breaches the duty of care owed to other road users.

This makes articulating the standard of care now required of a reasonable driver difficult. Where fault must be proved, linking liability to foreseeability imposes a key limiting principle, derived from the necessity of assessing the morality of an action (Hardie, 1992), – only holding 'defendants accountable if they did know or should have known that they could cause harm' (Calo, 2016b, p. 231). As sophisticated ADAS increasingly change the level and nature of risk posed by vehicles, the community's perception of risk or the standard of care required may no longer be accurately informed. Lack of knowledge about, and therefore lack of capacity to foresee the extent to which ADAS reduce risks posed by common driver behavior (e.g. distraction, speed, position on the roadway, etc.) may mean the risk posed by a human driver in an older car is rated no higher (by courts or by drivers themselves) than a human driver in a car with all of the safety features currently available, even though data may suggest a very different assessment should be made. Existing legal tests construct the reasonable driver as a person in the defendant's position with all the information the defendant either has or ought reasonably to have had (Civil Liability Act 1936 (SA), s.31). Most drivers and passengers will have very little knowledge about how ADAS work. ADAS are proprietary systems with significant commercial value to their designers and manufacturers, so the public may have very little access to detailed information about how those systems operate in any event (Selbst, 2020, p. 50). Gahnberg (2020) describes this as 'artificial agency' – ADAS effectively operate as 'decision-makers' to regulate driving behavior in ways that may be ‘unpredictable and opaque’ to human road users. The following discussion considers possible alternative approaches.

Firstly, the standard of care could take account of the age and capabilities of the vehicle. This begs the question: Should drivers of newer safer cars therefore be expected to know how to operate its ADAS most effectively, even if that required undertaking extra training? Given that such training is not yet required to obtain a driver’s licence, or even to qualify as a professional driving instructor, this may not be considered reasonable by current community standards, and therefore would be unlikely to be adopted by the courts as a legal standard of care. It could also mean that a reasonable driver in a vehicle with none of those features might not be expected to have undergone such training or to have considered the use of wearable monitoring devices, even though such wearables would still significantly improve safety. Perversely, this would impose higher standards on drivers choosing safer new technology, while providing no incentive to mitigate the risks of using older technology which posed great risks of harm to the community, advancing neither interests either of injured road users or the broader community who inevitably also share the costs of road trauma.

As more vehicles have more automated or autonomous elements, perceptions will change: ‘When the reallocation of a function from human to machine is complete and permanent, then the function will tend to be seen simply as a machine operation, not as automation’ (Parasuraman & Riley, 1997, p. 231). This creates a conundrum. Vehicles with ADAS are not the same as vehicles without – and perhaps could be described as a partially ‘qualitatively distinct affordance’ (Calo, 2019, p. 86). If, however, ADAS are seen simply as vehicle ‘operation’, despite lack of widespread understanding about their capacity to override or augment human driving, this qualitative difference is ignored, effectively simply equating ADAS with earlier safety technologies in applications of legal tests.

A second approach to setting the standard of care might focus primarily on the reasonably experienced qualified human driver in the position of driving in the circumstances external to the vehicle (i.e. at night, in heavy traffic, in wet weather) – rather than focussing on the vehicle’s level of automation or ADAS. This second approach poses its own challenges. What should be required when humans interface with vehicle safety systems optimised for different traffic conditions? Most drivers will have little understanding of how ADAS systems have been optimised and for what conditions. This lack of knowledge has already been identified as potentially dangerous – i.e. ‘use, misuse, disuse, and abuse of automation’ (Parasuraman & Riley, 1997, p. 233). If a reasonable driver is required to have this information, this will significantly impact on driver training and upskilling and appropriate induction for use of different vehicles. Increasing awareness of AI and knowledge regarding its use has therefore been emphasised in recent AI policy documents as a key responsibility of governments to maximise AI’s social benefits and minimise its misuse and risks (Ulnicane 2020).

Assuming these difficulties can be overcome, and an appropriate standard of care can be identified that aligns with community expectations, the next step is to consider whether that standard has been breached. Assessing whether the standard of care has been met requires consideration of whether a reasonable person facing a foreseeable risk would have taken ‘any action to avoid or reduce the risk of harm’ against that risk of harm.

Data shows it is foreseeable that human error is likely to cause motor vehicle crashes and that ADAS can significantly reduce both likelihood of collision and the capacity for that error to adversely impact vehicle operation. Given this foreseeable risk, what precautions should a reasonable person take in response? Is it unreasonable to continue to use vehicles without ADAS either as a driver or passenger, or not to enhance safety in older vehicles with driver-monitoring technology unreasonable? If this approach is adopted, then presumably drivers and passengers could not be expected to use only vehicles with the highest available levels of safety, necessitating consideration of what minimum levels of ADAS or wearables are required. Costs of high-end vehicles might place this technology out of reach for many, including drivers posing the highest risks. This may mean the burden of adopting vehicles with ADAS outweighs the probability and likely seriousness of the risks of harm posed by un-augmented human drivers, and thus is an unreasonable precaution. Social utility (Civil Liability Act 1936(SA), s.32(2)d)) is also relevant in determining whether precautions should be taken, posing a further challenge: safer vehicles benefit the whole community, not just individual road users. A finding of negligence for failure to use a vehicle fitted with commonly available ADAS would have significant ramifications for the value of existing fleet; the second-hand motor vehicle industry; compulsory third-party, and first-party and third-party property insurance. Reducing road trauma would have significant impacts on hospitals and the health system. Arguably, any move towards this should be a legislative rather than judicial mandate (Estl, 2015, p. 3). Australian legal responses to seatbelts are instructive here – statutory reductions for contributory negligence were introduced after the road rules had made failure to wear a seatbelt an offence, and after common law decisions to that effect.

Statistics regarding single vehicle run-off crashes make a compelling argument that it is no longer reasonable to drive 'un-augmented' for journeys on regional, rural and remote Australian roads (i.e. without smart headsets or smartwatches that might alert distracted or fatigued drivers) – particularly if these tools are available at accessible prices. Earlier experience of introducing safety technologies might again provide a guide here. As evidence of safety benefit mounts, choosing vehicles with un-augmented drivers for these types of journeys could be regarded as contributorily negligent, leading to a reduction in damages. Such approach could lead to disproportionally adverse consequences for those who live in regional and rural areas, particularly those who cannot afford to purchase such technologies, and for passengers where no other means of transport is available (e.g. children, the elderly, and persons with a disability). However, seat belts are not a direct analogue here – their method of operation is transparent to all users, they require almost no instruction, no software or system updates, imposing little obligation on vehicle occupants other than momentary pressure or discomfort. Requiring human drivers to wear monitoring technologies generates granular data about personal behavior or intimate health information that might subsequently be accessed by employers, fleet managers, insurers, law enforcement, or other government entities, and so impacts far more broadly on other rights, such as informational privacy, as well as raises other ethical issues regarding the potential use of 'vehicle-generated data' by government agencies for surveillance of citizens (Lim & Taeihagh, 2018; National Transport Commission, 2020).

Human drivers, often not able to accurately assess their own performance (Parasuraman & Riley, 1997, p. 237), may overestimate their own driving competency, and underestimate the real risks of harm they pose to themselves or others. Vehicle tracking systems showing patterns of behavior such as harsh braking or accelerating may identify specific and increased risks. Should drivers review the data generated by their vehicles about their own behavior? If so, would a driver who chooses not to review data about their own performance be negligent? Data analysis may require special skills, adding further complexity – who should be expected to have those skills? Driver-monitoring technology can alert drivers who are distracted or fatigued. Not only is it foreseeable that human drivers might be distracted or fatigued, these devices potentially go further – identifying exactly when a particular driver is not paying sufficient attention to the road ahead, and thus exactly when the risk of collision increases. When should that data be analysed – in real time, hourly, daily, weekly, annually? If a significantly increased risk of specific harm is identified in real time, could and should this enliven a legal obligation to take precautions, and by whom? If such analysis can be performed, reasonable precautions might range from ensuring a particular driver receives additional training, or is prevented completely from driving either immediately or in future. This has potential to extend liability beyond drivers to fleet managers, data analysts or even those reviewing transport infrastructure data from cooperative intelligent transport systems (C-ITS), an extension further complicated by the use of algorithms and AI tools to review large traffic datasets, making the identity of the person liable even less clear.

There is 'a social tendency to overestimate the capacity of machines and underestimate the abilities of humans ' (Elish, 2019, p. 14) as automated processes are widely perceived as 'objective and fair' (Lim & Taeihagh, 2019, p.5791; Taeihagh, 2020). Ulnicane et al. (2020) highlights the importance of expectations and hypes surrounding emerging technologies in shaping the overall governance of the technology. In particular, unrealistic expectations of ADAS safety could have significant implications for the standard of care being applied to determine negligence liability. Regular use of ADAS such as forward collision warnings, reversing cameras, lane departure warning or blindspot warnings could have the unintended result of deskilling drivers, and leading them to expect they can always rely on the vehicle even when they should not do so. Perversely, this could increase both the risk of human error and the number of crashes. Conversely, the community may be 'unwilling to accept from machines what we have come to expect from humans' (Coren, 2018, 2016; International Communication Association, 2016), a view subsequently likely to feed into assessments of breach.

> 'One overarching theme in human–automation trust research is that humans generally expect automation to be "perfect" (i.e., with an error rate of zero), whereas a human is expected to be imperfect and to make mistakes.' (Prahl & Van Swol, 2017, p. 693)

Could this mean that unless all ADAS features were shown to be 100% safe 100% of the time, reliance on those features would be perceived by a reasonable person as an unacceptable risk. This would mean that any choice to use such a vehicle instead of a human driver may be an unreasonable response to a foreseeable risk. If so, this would expose the driver or vehicle user to a finding of negligence. What happens when the ADAS results in vehicle behavior that is unexpected, or deviates from usual human responses or traffic ethics, even if it ultimately produces safer vehicle operation? (compare Selbst, 2020, p.25; Taeihagh, this issue). Unexpected driving behaviors are already an issue for highly automated vehicles due to the use of unpredictable and probabilistic algorithms that have already resulted in fatal crashes (Lim & Taeihagh, 2019, p. 19). Approaches to answering these questions may inform future legal responses to level 3,4 and 5 vehicles too.

Conclusion

Road trauma is incredibly costly – in lives, injuries, and broader losses, with human error the leading cause. Automated and autonomous vehicles are predicted to bring significant safety advances – with the dynamic driving task no longer reliant simply on the human driver. Getting the regulatory frameworks 'right' can assist emerging vehicle technology to be further 'developed and used in socially beneficial ways and [avoid] potential harms' (Ulnicane et al., 2020). Level 3 vehicles allow humans to hand over control to an automated driving system in certain circumstances. Level 4 vehicles perform all aspect of driving, even where the human does not respond to requests to intervene. Level 5 vehicles remove human drivers altogether. Whether the purported safety benefits of these vehicles transpire remains to be seen, and governments, regulators and scholars are wrestling with the implications of these future transport modalities. The bright light of this novelty may overshadow emerging ADAS and driver-monitoring technologies, including those already available and in use, especially when they significantly increase in safety and may have the effect of overriding a human driver's capacity to direct the vehicle's operation. This article has raised questions about the implications of this 'augmented driving capacity'.

ADAS and driver-monitoring technologies pose challenges for jurisdictions where access to compensation for road traffic trauma depends on establishing negligence or where a general safety duty includes consideration of 'reasonable practicability'. Reasonableness and foreseeability are central in determining both the standard of care in negligence and the precautions against risk of harm that should be taken to meet that standard. Data generated by these technologies already show their use brings substantial safety gains, thus forcing reassessment of what can be foreseen and what is reasonable to expect of drivers, passengers, vehicle owners, and others such as insurers, fleet managers and vehicle data analysts. Critical questions therefore arise about whether it continues to be reasonable to for 'un-augmented human drivers' to operate motor vehicles. While the experience of earlier safety technologies like seatbelts can be instructive, ADAS and driver-monitoring technologies are qualitatively different, demanding a different response. It also brings into sharp relief the even more complex issues in store in relation to level 3, 4 and 5 automated and autonomous vehicles. Understanding the risks and benefits of ADAS and driver-monitoring devices presents an opportunity to recalibrate more accurate community perceptions of driver safety, encourage wider adoption of safer technologies, and act as a legal and policy lever to create legal frameworks that better fit 'the expanding scope of contemporary risks and the accelerating pace of risk assessment and risk discovery' (Guzelian, 2005, p. 990).

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