

*How people, not technology, will shape
the success of autonomous vehicles*

August 2017

Nudging people into autonomous vehicles





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Executive summary

The evolution of the automobile to some form of autonomous vehicle is seen as almost inevitable. A fully autonomous vehicle is one that is capable of operating without human input and can range in size and purpose. The progressive roll-out of autonomous vehicles on Australian roads, evolving from semi-autonomous to fully autonomous operation, will impact the breadth of transportation activities and will impact for example: our commutes to work on public transport; visits to shopping centres; and the transportation of goods across large distances in autonomous trucks; and so on.

This sense of inevitability stems from the scale of potential benefits that autonomous vehicles are seen to offer:

- with as many as 90 per cent of vehicle accidents eliminated there is a potential saving to the Australian economy of \$31.9 billion annually
- increased mobility for the young, the elderly and people with disabilities

- more efficient traffic flows and hence reduced congestion. While difficult to quantify the savings at this stage, the 'size of the prize' is a reduction in the \$17.7 billion in annual Australian congestion costs
- reduced fuel use because autonomous vehicles can drive in a more efficient manner, plus the near elimination of accidents mean that vehicles can be constructed without the need for heavy accident prevention measures
- fewer parking spaces means that more space will be available for improving the built environment in our cities.

Technological and legal hurdles to the adoption of autonomous vehicles appear to have the most public attention¹ and are currently being addressed by corporates and governments. However, people's willingness to adopt autonomous vehicles continues to be a challenge and it is here that 'behavioural economics' can play an important role.

Behavioural economics is a challenge to the implicit assumption that people are rational decision makers who assess all information available to them in coming to a welfare maximising (ie good) decision. The discipline encourages policymakers to understand how

important behavioural biases arise in different decision moments so that they can be reduced, harnessed or countered.

Leveraging behavioural economics principles offers a potentially cost-effective means to support greater knowledge, awareness and engagement with autonomous vehicles. There are a number of behavioural economics-inspired interventions that can serve to

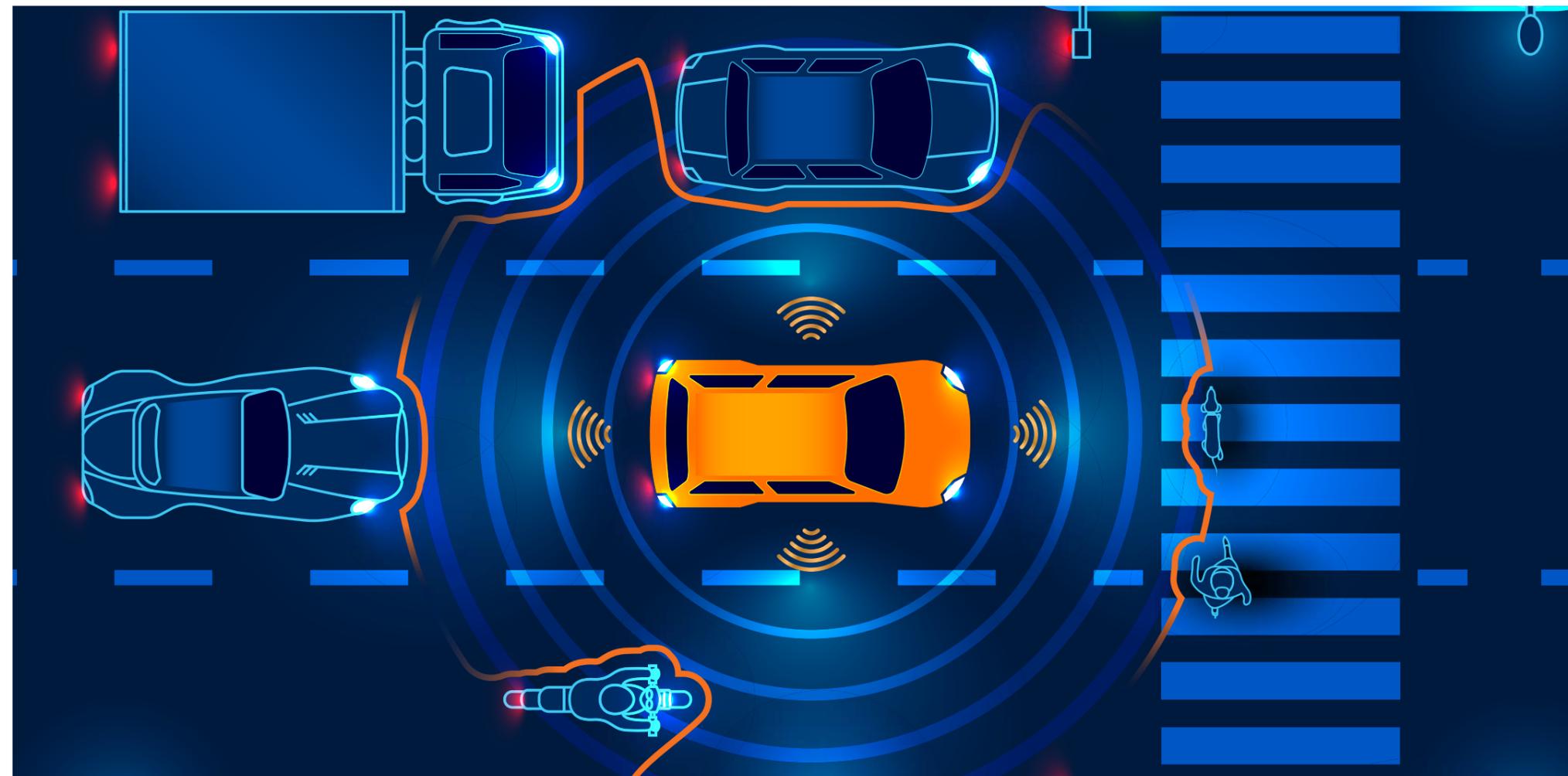
combat misinformation about the risks associated with autonomous vehicles. The interventions can include, for example, leveraging the behavioural economics principles of:

- social norms (we like to follow what other people actually do) – it can involve using visual promotional material that shows a wide variety of demographics using autonomous vehicles (eg age and gender). This intervention relies on using everyday individuals (instead of well known personalities) so that the general population can identify/associate themselves in a similar situation

- feedback (at critical moments promote or send information that next steps are underway) – this can involve engaging the population by promoting critical achievements in policy milestones, types and sizes of vehicles to be rolled-out and available locations
- vivid future (speaking about the future in vivid terms helps people to see themselves in those moments and then plan for better behaviours) – this can involve the Government showcasing how close to a wide autonomous vehicles roll-out areas of Australia are. This will help people in all

areas to understand how close Australia is to a 'futuristic' reality of sharing roads with autonomous vehicles.

These interventions should feature as a part of a comprehensive community engagement strategy. This strategy should target the entire population to facilitate the ultimate goal of increased autonomous vehicle usage and acceptance that the 'future' of sharing roads with driverless vehicles is in fact only a short distance away.



1. See James M. Anderson, Nidhi Kalra, Karlyn Stanley, Paul Sorensen, Constantine Samaras, and Tobi A. Oluwatola 2016, *Autonomous Vehicle Technology: A Guide for Policymakers*

The potential benefits from autonomous vehicles

It is hard to have a discussion about the future of cities without autonomous vehicles featuring.

An autonomous vehicle is one that is capable of operating without human input. With the progressive roll-out of autonomous vehicles on Australian roads, evolving from semi-autonomous to fully autonomous, the breadth of vehicle size and purpose will likely expand to cover the breadth of transportation activities. This may include for example: work commutes on autonomous buses or personal vehicles; visits to shopping centres in standard sized or shuttle passenger vehicles; the movement of goods across large distances in autonomous trailers.

This reflects the common view that the widespread adoption of autonomous vehicles offer potentially significant and broad-ranging benefits, both for the users of the vehicles and the broader community. These benefits include:

- fewer vehicle accidents as human driving error is eliminated – while the incidence of fatal accidents and crashes has fallen over the past three

decades (see Figure 1), more than 1200 people continue to die on Australia's roads and the economic cost of all road crashes in Australia is approximately \$35.4 billion annually.² With an estimated 90 per cent reduction in accidents from the introduction of fully autonomous vehicles³ the potential savings to the Australian economy is \$31.9 billion annually

- increased mobility for the young, the elderly and people with disabilities – autonomous vehicles will increase mobility for segments of the population that currently have limited ability to drive vehicles, which may improve their wellbeing through improved job opportunities and social interaction
- more efficient traffic flows and hence reduced congestion – congestion is one of Australia's most significant handbrakes on economic growth, with an estimated cost of \$17.7 billion in 2015 rising to \$42.8 billion in 2028 (\$ in 2010-11).⁴ This reflects the four specific congestion-derived impacts: travel time delays; reduced

travel time reliability; increased vehicle operating costs; and increased environmental costs. The impact of autonomous vehicle usage is multifaceted in terms of congestion impacts, with:

- an ambiguous impact on the degree of congestion – the potential for increased vehicle usage (ie distances travelled), which may increase congestion, but the vehicle technology can also enable increased throughput on roads because of more efficient vehicle operation (and reduced delays from crashes)
- a reduced cost of the actual congestion – autonomous vehicle technology can substantially reduce the cost of congestion because vehicle occupants can undertake other activities
- reduced energy usage – energy usage is reduced because of two factors:
 - autonomous vehicles can be operated in a more efficient manner (avoiding more congested routes, driving more smoothly, etc)

- the near elimination of accidents mean that vehicles can be constructed without the need for heavy accident prevention measures and hence reduce fuel use (whether fossil fuels, gas, electricity, etc)

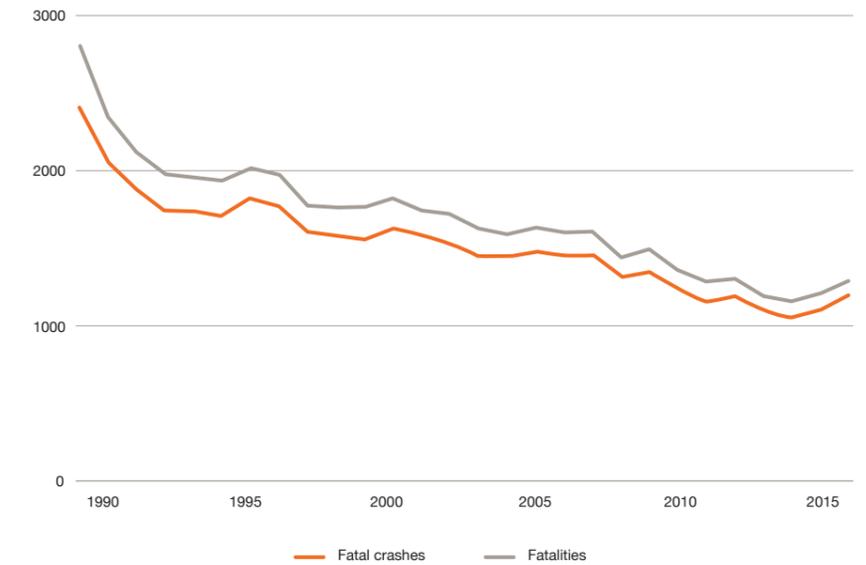
- improved land use – fewer parking spaces (publicly available on or off street parking facilities) will be necessary and hence more space will be available for improving the built environment. This will occur because autonomous vehicles will be able to drop off passengers in dense areas (eg CBDs, commuter hubs, shopping centres, etc) and then proceed to remote parking locations until required to return to pick up the passengers

- in the case of some forms of commercial vehicles (e.g. taxis), potentially lower labour costs.

In some cases these benefits are self-reinforcing. For example, CISCO estimates that 30 per cent of all traffic congestion in urban areas is caused by drivers looking for available parking spaces.⁵ As autonomous vehicles reduce the need for parking, and hence enhance potential urban amenity, they also reduce the costs of congestion.

A key feature of the potentially significant benefits is that they do not just accrue to those who

Figure 1 Australian fatal crashes and fatalities



Source: BITRE 2017, Australian Roads Deaths Database, https://bitre.gov.au/statistics/safety/fatal_road_crash_database.aspx

purchase and use autonomous vehicles. Instead, a significant portion of the benefits accrue to the public at large. Avoiding 1,200 deaths a year would be a vast improvement in social welfare, but it may not motivate individuals to pay the added cost of the vehicle. Similarly, some of the costs associated with these vehicles (such as the possibility of increased congestion or the decline in public transit revenues) are imposed on others. In such an environment it is to be expected that the uptake of the autonomous vehicles will be less than optimal.

While the focus of policy thinking to address this 'market failure' has concentrated on the potential for subsidies and taxes to help equalise the public and private benefits, it may be that there are less costly means to support the uptake of autonomous vehicles. This is a potential role for 'behavioural economics'.

2. Derived from World Health Organization 2015, *Global Status Report on Road Safety 2015*, p.85

3. NRMA 2016, *Accelerating our Smart Transport Future*, p.14. Even adoption of partially autonomous vehicles is estimated to eliminate around 40 per cent of accidents

4. PwC 2016, *Modelling of Potential Policy Reforms*, p.29

5. CISCO 2014, *#SmartConnectedCity Series: A Smart Move for City Transport*

What is 'behavioural economics'?

Public policy is often developed under the implicit assumption that people are rational decision makers who assess all information available to them in coming to a good decision. The main tools to change behaviour under the rational framework include incentives, greater choice and more information.

Fifty years of behavioural economics research and evidence has found many weaknesses with this framework.⁶

Behavioural economics argues that individuals are prone to important behavioural biases and if we can understand how these biases arise in different decision moments we can work to reduce, harness or counter them. Behavioural economics insights have found, for example, that individuals:

- do not have unlimited cognitive ability
- make decisions based on their emotions and prefer to copy the behaviour/actions of others instead of relying on their own judgement or using statistics and facts
- usually prefer smaller but immediate rewards instead of larger delayed ones
- are also highly sensitive to the way choices are framed and don't understand value in objective terms.
- choice architecture, where we can change the decision environment to work with human psychology. People may still be free to choose as they always were, but those who do not think carefully or understand will err in good directions rather than bad. This technique can be effective (often more than disclosure and incentives), relatively inexpensive, and yet non-prescriptive or coercive
- making traditional economics tools more effective. For example, incentives can be made more powerful through the way they are presented. Disclosure can be improved by designing it in a way that people understand.

The ability of behavioural economics to identify how people make decisions provides a new suite of tools for policymakers, including:

Governments nudging individuals towards desired behavioural outcomes is not a recent phenomenon; the Behavioural Economics Team of the Australian Government (BETA) for example undertakes numerous projects to advance the government's policy priorities and improve public well-being.⁷ A growing number of Australian States and Territories including New South Wales and Victoria are adopting similar models to enhance the wellbeing and the decision making processes for their own populations.

6. Alain Samson 2017, *The Behavioral Economics Guide 2017*

7. Department of Prime Minister and Cabinet 2017, *BETA Registered Trials*

Interventions to encourage the uptake of autonomous vehicles

A key consideration to encourage the uptake of autonomous vehicles should be how to keep the general population engaged with important developments. This wide group should include all individuals who

will experience driverless autonomous vehicles and witness them in operation and are in addition to the relatively smaller subgroup of those with the means to afford personal autonomous vehicles.

Figure 2 shows results from a recent Australian survey that highlights the general population's existing concerns with autonomous vehicles. In summary, the majority of those surveyed expressed little awareness of autonomous vehicle features and expressed strong concerns about their safety and privacy.

Figure 2 The public's perception of autonomous vehicles

Survey question	Approx. survey result
<i>Respondents who 'have never heard' of specific autonomous vehicles functions</i>	
Autonomous vehicles can change lanes by themselves	65%
Autonomous vehicles can automatically adapt their speed to changing speed limits	46%
Autonomous vehicles can navigate themselves to desired destinations (find locations and follow routes)	44%
Autonomous vehicles can stay within lanes by themselves	43%
<i>Perceived concerns from respondents who said they were 'concerned' or 'very concerned'</i>	
The possible scenario of being legally and financially responsible if an autonomous vehicle is involved in an accident or makes mistakes (eg speeding)	91%
The ability of autonomous vehicles to perform safely in all conditions	78%
Autonomous vehicles moving by themselves from one location to another while unoccupied	77%
Being able to have your autonomous vehicle's location and destination tracked	72%

Source: Australian Driverless Vehicle Initiative 2017, *Preliminary findings from the first Australian National Survey of Public Opinion about Automated and Driverless Vehicles*, pp.13-16

The strategy to address the general population's concerns with autonomous vehicles should involve leveraging behavioural economics principles so that they are both informed and engaged. Figure 3 outlines some behavioural biases and accompanying behavioural economics principles that could be used as part of this strategy.

The behavioural economics-inspired interventions outlined in Figure 3 are designed to target all individuals so that in the short to medium term there is greater knowledge and awareness of autonomous vehicles, and an ultimate goal of increased autonomous vehicle

usage. A strategy that targets only specific subsets of a population can lead to misinformation about autonomous vehicles' benefits and risks isolating many Australians by failing to address their perceived concerns.

Figure 3 Interventions to support the uptake of autonomous vehicles

Behavioural principle	Potential behavioural economics interventions to confront biases
Framing: Choices can be presented or worded in a way that draws attention to the positive or negative aspects of the same decision	Highlight the significant benefits of autonomous vehicles compared to current transportation methods. Benefits can be presented within autonomous vehicles where they can further function to reassure passengers of their safety and privacy. Simple and accessible 'Did you know' style statements for example have a proven track record of effectiveness (eg 'Did you know that on average commuters save X hours annually by using autonomous vehicles? That's Z more days to spend outdoors or with your family').
Pro-social: We like to show others (and ourselves) that we are doing good for the world	Help individuals who use autonomous vehicles to promote that they are using a safer and more innovative method of transportation. This could be achieved by encouraging users to upload social media posts with accompanying statements (eg 'My autonomous vehicle trip today helped me/others to...'). Example statements and benefits should be included within autonomous vehicles (ideally in a digital format so that they can be updated regularly).
Reciprocity: Small kind gestures can trigger positive reciprocating behaviours	Reward individuals who promote their use of autonomous vehicles with token and inexpensive (but 'exclusive') benefits. In the initial roll-out period of public transportation autonomous vehicles for example, send a select group of random but very regular commuters 'single use priority passes' whereby small autonomous vehicles (4-8 seaters) prioritise their pickup location (within reasonable means).
Social norms: We like to follow what other people actually do	Use visual promotional material that shows a wide variety of demographics using autonomous vehicles (eg age and gender). Ensure that these are everyday individuals so that the general population can identify/associate themselves in a similar situation.
Feedback: At critical moments promote or send information that next steps are underway	The general population is unlikely to be aware of policy advancements to facilitate the roll-out of autonomous vehicles on Australian roads. Engage the population by promoting critical achievements in, for example, policy milestones (eg see Box 1), types and sizes of vehicles to be rolled-out and the growing number of available locations. This type of information should be available to all individuals and not just subscribers so that a base level of engagement/information is created.
Progress: We like to feel like we are heading towards the end of a process rather than starting from scratch	Similar to the 'Feedback' intervention, promote how far advancements in policy milestones and autonomous vehicle roll-outs have come to date, and importantly, how close Australian roads are to a wider roll-out. Critically, the communication of this timeline should indicate (when pertinent) that the ultimate goal of a wider roll-out is close to achievement rather than in the distant horizon.
Vivid future: Speaking about the future in very vivid terms will help people to see themselves in those moments and then plan for better behaviours	Further leverage the 'Progress' intervention by showcasing how close to a wide autonomous vehicles roll-out areas of Australia are. This will help people in all areas to understand how close Australia is to a 'futuristic' reality of sharing roads with autonomous vehicles.
Regret aversion: People go out of their way to avoid feelings of regret	Appeal to a wider population base by noting the benefits that their family/friends/peers/neighbours are experiencing by using autonomous vehicles that they could be missing out on (eg 'Did you know that everyday more Australians like you are using autonomous vehicles and saving X days of commuting every year? You could start planning what you could do on these days as soon as you take your first autonomous vehicle trip'). Similarly, promote the fact that benefits of autonomous vehicles can only be comprehensively realised if more and more people switch to this transportation method over time (eg 'Every additional person that uses an autonomous vehicle helps to improve the traffic congestion in our city').
Foot in the door: Asking someone to do something small, and then escalating that to something big can see more cooperation that when simply asking for something big straight away	Keep interested individuals engaged with smaller autonomous vehicle related developments via a simple and straightforward registration process. For example, provide an option for individuals to register their interest by submitting their email address on a dedicated website. These individuals can then be sent regular updates (eg monthly) via a newsletter (or podcast) that encourages them to take some action. This action could be directly linked with the objective of getting their family/friends/peers to trial autonomous vehicles so that whole communities can experience their benefits.



Box 1 NSW trial of an autonomous shuttle



A two-year trial of the state's first automated Smart Shuttle at Sydney Olympic Park will start in August 2017.

Once the first stage of tests and safety checks are completed in a secure, off-road environment, the trial will extend to public use at Sydney Olympic Park.

Transport Minister Andrew Constance said the ultimate goal of the trial was to find the best way to harness the next generation of driverless technology – ‘Today we drive our cars but the reality is, cars will soon drive us and while we are not there yet, we need to be prepared for this change and we need to stay ahead of the game’.

Minister for Roads Melinda Pavey said the trial was about connectivity, as well as automated vehicles:

‘We want to use the trial to help develop the systems that will enable automated vehicles to be connected to our infrastructure, like traffic lights, and to our customers through their devices and applications... It’s the combination of connectivity and automation that will provide the safety and mobility benefits we are looking for.’

Source: NSW Government 2017, Olympic Park to trial NSW's first driverless Smart Shuttle

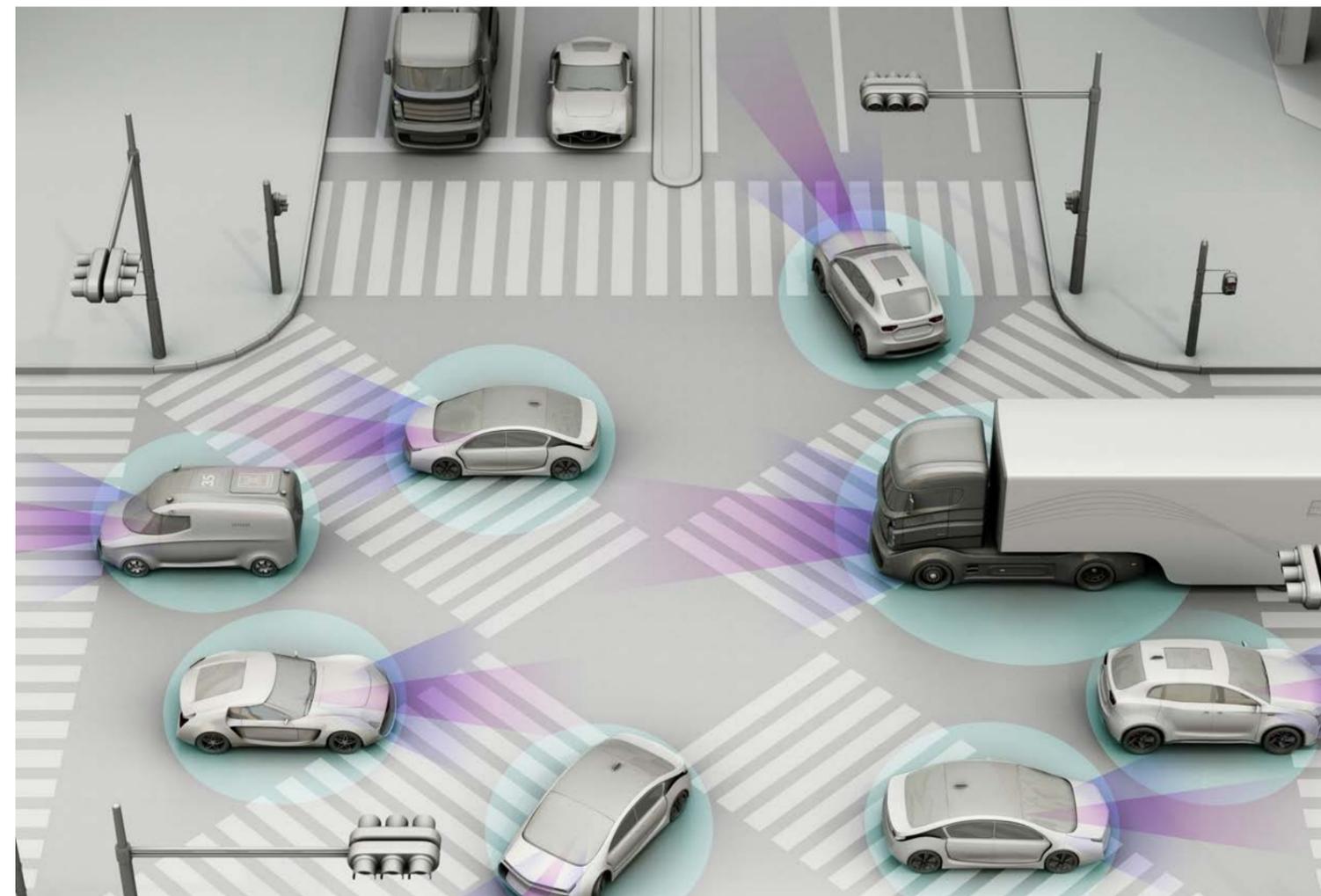
A comprehensive engagement strategy that incorporates behavioural economics principles can facilitate the uptake of autonomous vehicles by helping the general population to overcome their behavioural biases. The risk of public perceptions towards autonomous vehicles remaining consistent could involve a more difficult or prolonged uptake of public engagement and trust in a policy area that the Australian Government is increasingly investing its attention and resources. A successful strategy could allow for a greater likelihood for public acceptance of a ‘future’ that they should be involved with and excited about because of the many benefits.

Successfully engendering public trust in autonomous vehicles could potentially lead to similar engagement strategies with other transformative ‘smart city’ features. ‘Smart roads’ for example can involve artificial intelligence and sensors so that roads can rapidly respond to changes in their use and their environment. Opportunities for behavioural economics insights and interventions for this advancement could therefore involve framing the:

- benefits of improved traffic flow to regular commuters
- positive environmental impacts (from reduced travel times and therefore less emissions) for an increasingly environmentally aware population

- potential for safer commutes for families
- improved response times for emergency services.

As with autonomous vehicles, this sample of interventions is designed to appeal to the entire population so that all Australians are given the opportunity to appreciate the Government’s role in these advancements.



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