

A fork in the road

The future of driving
in an ageing society



Infrastructure
Built environment
Transport
Health and care
Connections
Inequalities

About the ILC

The International Longevity Centre UK (ILC) is the UK's specialist think tank on the impact of longevity on society. The ILC was established in 1997, as one of the founder members of the International Longevity Centre Global Alliance, an international network on longevity.

We have unrivalled expertise in demographic change, ageing and longevity. We use this expertise to highlight the impact of ageing on society, working with experts, policy makers and practitioners to provoke conversations and pioneer solutions for a society where everyone can thrive, regardless of age.

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Foreword

The way we drive is rapidly changing, and the pace of change will only increase as we get closer to the adoption of fully autonomous vehicles. While we have some idea of what the future holds for this new type of vehicle – what they will be able to do, what they will look like – what we don't yet know is the impact that they might have on society, and in particular an ageing society.

LV= General Insurance is therefore pleased to be able to sponsor this timely report which looks at some of the policy areas that will need to be considered as we move closer to automation – including the growing mobility divide which could be seen between rural and urban areas, and the impact that this new way of driving could have on health and wellbeing.

While the day when we see fully autonomous vehicles on our roads may be some time away, we are already seeing the beginning of the journey with the growing pace in the switch to electric cars. However, we are still at a relatively early stage, with electric cars currently only representing 1.6 per cent of new car sales.

With manufacturers switching to electric and getting closer to autonomous cars, it is essential that there is greater investment in this new technology. Furthermore, when proposing and implementing policy, all levels of government should consider the impact of their decisions on future generations in order to address some of the issues highlighted in this report. If we make the right decisions now,

We can go some way towards ensuring that this new way of driving leads to better outcomes for all. After all, for many the car is a lifeline which can lead to increased levels of wellbeing and a better quality of life.

Steve Treloar

CEO, LV= General Insurance

Summary

At ILC our aim is to understand the impact of longevity on society and what happens next. To do this we need to understand what the future will look like and to think about the questions that will arise as a result of living in an ageing society.

In this report, sponsored by LV= General Insurance, we consider the future of driving. Since the widespread adoption of private cars in the second half of the twentieth century, driving has become an integral part of how people commute, travel and live their lives, shaping where we live, work, shop and play.

As the number of older people (aged 65 and older) in the population has grown and our lives have grown longer, the number of people still driving later in life has increased, and this is set to continue. The story of the future of driving, is a story about older drivers.

Driving is also changing – our cars are different and when we drive, who drives and where we drive is changing. Our research has identified three significant trends. These are:

- The shift toward electric vehicles.
- The emergence of new digitally-enabled models of mobility, including mobility-as-a-service.
- Increasing automation of driving.

Having considered how these trends will interact with our ageing society, we predict the following shifts in how we move around:

- Our 'driving lifespans' will extend – but some people will miss out, as a result of cost and other barriers to adopting new driving technologies.
- Automation will reduce the risks of driving for older drivers, supporting longer driving lifespans – we anticipate that we may see insurance products changing in response to the emergence of some new forms of automated assistance (e.g. autonomous emergency braking).
- However, vehicle connectivity will lead to new risks, including around data breaches and cyber-attacks, which will need to be mitigated.

- We anticipate a significant shift away from the private car, the result of a combination of government action to reduce congestion and emissions, changing social attitudes and norms related to climate change and carbon, and the rising cost of increasingly sophisticated vehicles. In place of private car journeys, ride hailing, and car hiring will become more popular, and new forms of ride sharing and shared mobility will emerge.

These shifts will have real implications for our society. We predict:

- Electric vehicles will lead to improved air quality, with positive impacts on health and quality of life especially in urban areas.
- As our 'driving lifespans' extend, more older people will be able to maintain their social connections for longer.
- As new forms of mobility increase commuting speeds, the suburban outer ring around cities and urban centres will expand still further, with house prices increasing in these newly commutable places.
- The rise of shared mobility may encourage the development of other shared services.

However, we also envisage some profound challenges ahead:

- While those who can afford them will benefit from significant new developments in vehicle technology and mobility, costs will rise, even for shared services, and so we anticipate a growing mobility gap between rich and poor.
- We expect to see a growing mobility divide between urban and rural areas, with older people particularly affected.
- People who are in poor health or have additional needs will face ongoing mobility challenges – particularly in travelling the 'last ten yards' from kerb to door.
- As new forms of shared mobility emerge, there is a risk that some individuals and groups will be excluded, either because they are already discriminated against on the grounds of their ethnicity, age, gender, disability or other characteristic, or because their personality or behaviour are not well suited for sharing.
- People who are digitally excluded will be increasingly at risk.

If we act now, there are opportunities to mitigate these risks and ensure that more people benefit from new technology and new forms of mobility as they age.

It will be vital that **older adults are included in thinking through and managing the implications of changes to how we drive in future**. Older adults should be actively included in policy discussions around the future of mobility.

In addition, we need:

- Investment in transport infrastructure in rural areas, potentially using new 'Section 106' type levies or other forms of revenue generation / redistribution.
- Investment in innovation to support people's mobility across the 'last ten yards' – through the Future of Mobility Challenge Fund.
- Action to promote age-friendly, inclusive and accessible alternatives to car use including public transport, and shared mobility through:
 - Devolution of greater powers to local authorities to enable them to promote the development of inclusive and accessible places and services.
 - Government action to ensure that mobility-as-a-service or other shared transport solutions are accessible, and affordable for older people – potentially by extending the free bus pass to cover shared-mobility services.
 - Action by local authorities and transport planners to promote shared mobility through infrastructure and traffic management.
- Action to support people to embrace alternative forms of mobility, and to support a shift away from the car – addressing the practical, emotional and cultural issues around driving cessation among older people in particular.
- Collective action by government, insurers, manufacturers, regulators, police and road safety agencies, charities and others to support the development and adoption of new standards around automated vehicles.
- Collective action by insurers and car manufacturers along with the IT and telecoms sector to find ways to protect connected vehicles and connected infrastructure from cyber attack.
- Action by the insurance industry to develop new products suitable for shared use and/or ownership.

Contents

Introduction	8
Driving in an ageing society	10
Driving is changing	13
The future of driving – possibilities and implications	19
The future of driving for older drivers	23
The future of driving and our ageing society	31
The policy and social response to the future of driving in an ageing society	37
Recommendations	39
Conclusion	42
Annex: About this report	44

Introduction

At ILC our aim is to understand the impact of longevity on society and what happens next.

In all our work we seek to answer three big questions.

- How do we maximise the benefits of longevity for individuals, the economy and society?
- How do we make sure longer lives are good for everyone?
- How do we future proof policy and practice in the face of long-term demographic change?

To answer these questions, we need to understand what the future will look like and to help decision makers across the public, private and voluntary sector to understand the particular questions that arise in the context of an ageing society.

This report focuses on the future of driving. Since its widespread adoption in the twentieth century, driving has become an integral part of how people commute, travel and live their lives.

As the number of older people in the population has grown and our lives have grown longer, so the number of people still driving at greater ages has increased. For many older people the car is not just a convenience - it is a passport to leisure, activity and social connection.¹

The story of the future of driving is a story about older drivers. But our cars, and the ways we use them, are changing. These changes have been driven by technological and commercial developments, from electric cars and ride-hailing services to connected and autonomous vehicles. Government has recognised the significance of these trends, introducing legislation around autonomous and electric vehicles in 2018,² and is increasingly seeking to stimulate and support change, for example through the Industrial Strategy Grand Challenge on the Future of Mobility.³

Yet we still need to consider how these changes will impact older drivers. What do trends such as the rise of automation, the increasing interplay of digital services with transport, and the shift towards, often more expensive, but more environmentally friendly, electric vehicles mean for how we drive in later life, and what happens when we stop driving?

In this report we examine the changes we are seeing in driving in the light of what we know about older people today and in the future and consider how we can age-proof the future of driving.

We focus on the actions and decisions we can take now to ensure that future changes in driving take account of our ageing society, and ensure better outcomes for all.

This report sets out the findings of our literature review and the results of consultation with expert stakeholders, and draws out a set of policy implications.

Driving in an ageing society

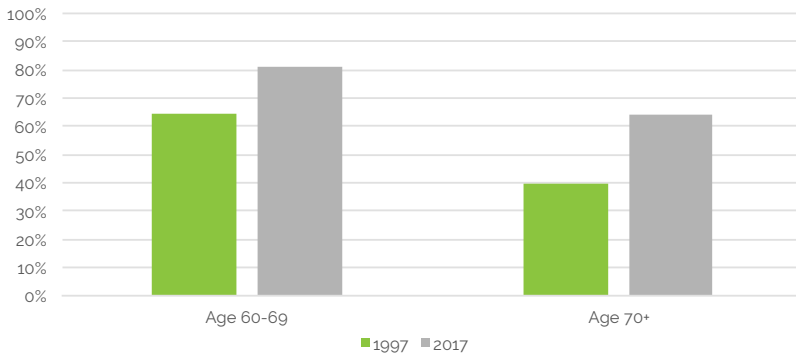
We live in a time of significant and continuing demographic change. More people are living longer than ever before, creating an overall ageing of society.

A large body of research has found a positive link between mobility and health status in later life, with those who are able to independently meet their mobility needs reporting increased levels of wellbeing, and overall quality of life.⁴ Research has also found that, for many older people, driving is absolutely central to their lives and lifestyles.⁵

Older people travel for a wide range of reasons, but for many driving provides a vital way of keeping up leisure travel. There is clear evidence of the importance of these trips for people's wellbeing.⁶

As the population has aged more people have continued to drive, for longer. For example, 64 per cent of people aged 70 and over held a full UK driving licence in 2017, compared to only 39 per cent in 1997. This pattern is also consistent among 60-69-year olds, with driving licence holders in this age bracket increasing from 64, to 81 per cent between 1997 and 2017.⁷

Proportion of older people with full licences



Source: Department for Transport, 2018

The future of driving is older, and therefore, driving plays a critical role in supporting older people's mobility and their wider wellbeing.

Driving is seen as a convenient, cheap and quick form of transport. Convenient, because journeys are typically door-to-door, and can be made on demand, without planning or additional effort.

Cheap, because per mile costs are perceived to be cheaper than other options. Quick, because there are no waiting times and journey times are perceived to be lower than other forms of transport.⁸

Recent years have seen significant advances in the comfort of cars for older adults – a trend which started with the redesign of the Ford Focus by designers wearing suits to simulate age-related physiological change.⁹ The growing recognition of older drivers as a significant market can be seen in the driving press – for example in 2018 Car Keys listed the top 10 cars for older drivers, including those which are comfortable and easy to access, which also have built-in automatic features such as parking assist.¹⁰

However, age-related changes, such as deteriorating vision and hearing, decreased muscle strength and range of motion, and cognitive decline, can make it hard for people to keep driving in later life.¹¹

Driving cessation leads to a range of negative outcomes in terms of mental health and quality of life, with older people commonly experiencing depression, loneliness, and even increased mortality after giving up driving.¹²

These effects are not necessarily tempered with access to other transport forms. In a recent study, older people were found to be particularly resistant to giving up vehicle ownership and private driving, even when presented with potential alternatives to private driving – such as ride sharing and hailing services.¹³

On average, older drivers do not transition easily to public transport or to new forms of transport technology.¹⁴ Older people's resistance to change in driving is one factor in this, but also relevant is the fact that these services have not been designed with older people in mind, and may not be age-friendly.¹⁵

Crucially, older people are less likely to use public transport, or take taxis or lifts, for travel that they perceive as less urgent or important. A third of older people have 'unmet travel needs' – and these are mostly related to social or pleasurable travel rather than travel for practical needs.¹⁶

Extending people's driving lives could make a significant contribution to people's overall health and wellbeing in later life, however it will also be important to consider how we support those who will not be able to drive in future.

It will also be important to consider the significant health and socioeconomic inequalities across the older population in the UK. Gains in life expectancy in recent times, have not been matched by commensurate improvements in health in later life (particularly in more deprived areas). And while older adults on average are wealthier than younger cohorts, this masks significant income and wealth inequalities within generations.

Rural areas and smaller towns are ageing fastest – the combined result of younger people moving away to cities and older people moving to the countryside, on top of the ageing of the rural population. This geographical pattern of ageing will have significant implications for the future of driving.

Driving is changing

The future of driving looks to be driven by three main trends:

- Electrification.
- Digitally-enabled models.
- Automation.

Electrification

“An electric car is an alternative fuel automobile that uses electric motors and motor controllers for propulsion, in place of more common propulsion methods such as the internal combustion engine (ICE). Electricity can be used as a transportation fuel to power battery electric vehicles (EVs).”¹⁷

Electric vehicles are becoming more and more popular in the UK. The last four years have seen a remarkable surge in demand for electric vehicles, with new registrations of plug-in cars increasing from 3,500 in 2013, to more than 223,000 by July 2019.¹⁸ There has also been a huge increase in the number of pure-electric and plug-in hybrid models available in the UK with many top manufacturers now offering EVs as part of their model range.

The carbon emissions associated with electric vehicles are largely dependent on the fuels that are used to generate the electricity in the first place – if EVs are charged with electricity from coal-fired power stations, their lifetime carbon emissions are similar to those of cars using an internal combustion engine.¹⁹ However, as electricity generation decarbonises, EVs will become an important part of reducing overall transport emissions. We therefore expect ongoing public and private action to promote their use over petrol and diesel vehicles.

Over recent years, the projected growth in electric vehicles has been getting consistently faster. Between 2013 and 2015, National Grid predicted that there would be around 5 million (5m) EVs on UK roads by 2035. It raised that 2035 outlook to 8m in 2016, and to 10m in 2040. In 2019 National Grid predicted there could be up to 25m EVs by 2035 and 36m by 2040 – at which point EVs will reach saturation point, with all possible vehicles electrified and new EVs replacing old ones as they retire.²⁰

However, a recent study by the Transport Research Laboratory found that only one in four people would consider buying an electric vehicle in the next five years. One of the barriers to uptake is the range EVs can travel between charging points. The number of public charging points is growing steadily with, for example, a new partnership to deliver charging points between Podpoint, VW and Tesco, and the BP Chargemaster offer. However, the distance between charging points, particularly in rural areas, remains a key issue.²¹

A House of Commons inquiry in 2018 found that the cost of EVs to the consumer is another key barrier to uptake in the UK.²² Currently, the UK government provides a direct discount of £3,500 for EVs,²³ but this is not sufficient to overcome current differences in price, with a House of Commons report highlighting the comparison between the costs of a VW Golf (starting price c. £18,000) and its electric equivalent the e-Golf (starting price c. £32,000).²⁴

In one survey younger people were found to be more accepting of EVs than older people. With 50 per cent of drivers aged 34 and under saying they would like to own an electric car, compared to just 25 per cent of drivers aged 65 and over.²⁵

Digitally-enabled models

Digital technology underpins some of the most significant trends in changes to transport that have been observed in recent years, such as:

- Ride hailing services.
- Shared mobility.
- Mobility-as-a-service.

These growing services and transport models depend on digital underpinnings. As a result, they are largely only available to those with access to digital technology. Nearly 5 million adults aged 55+ are not online, primarily people who are poorer and/or socially excluded in other ways.²⁶

Ride hailing

Ride hailing services offer on-demand private hire vehicles, typically ordered through a smartphone or other connected device, and paid for using a pre-registered payment card. Essentially a more efficient form of minicab, these kinds of services include Bolt, Kapten and Hailo. Probably the most familiar is Uber, which currently operates in 20 cities in the UK. Once the user enters a destination, they are matched with a driver nearby.²⁷ Potential advantages include lower costs and reduced

booking and waiting times as compared to conventional taxis or minicabs.²⁸

Ride hailing may have the potential to support continued travel for those who give up driving – in particular, enabling older adults to continue to make spontaneous trips for leisure activities, and to keep up social connections.²⁹

While ride hailing has rapidly become popular, concerns have been raised about potential barriers to older people's use, in particular the need to access the service online.³⁰ There are also concerns that older adults may be less willing to trust online services. In a European study on the use of ride hailing initiatives, it was found that older adults were more comfortable using more conventional transport options, such as a traditional taxi service, as they felt safer.³¹

Shared mobility

The term 'ride sharing' has been used to describe a range of ways in which groups of travellers organise common trips by car or van. Ride sharing is different from ride hailing, taxis and other forms of private hire, in that where money is exchanged it is only intended to cover the driver's cost.³² However, there are both formal and informal forms of ride sharing, with formal versions involving sharing among strangers, where informal arrangements tend to be made within existing networks such as family, friends and neighbours. Ride sharing can help ease congestion, reducing air pollution, fuel costs, and parking fees.³³ A number of online platforms support ride sharing including GoCarShare and BlaBlaCar.

Car clubs and car sharing services are another form of shared mobility, where a single vehicle is shared among multiple drivers, each using it for their own personal travel. These services range from shared ownership and maintenance through membership of a car club to what is essentially online and on-street forms of car hire, such as ZipCar. Recently, digital platforms such as Turo have been launched to enable people to rent out their own car to other drivers.

Some councils are encouraging shared mobility, for example, Dorset Council have introduced signs in congested areas with slogans such as *"Seat to spare? Think car share!"*, and a number of councils provide free parking to car club / car sharing vehicles.³⁴

Ride sharing may have potential to support older people who have given up driving. A number of studies have found that once older people give up driving, getting lifts with other people is the most

popular alternative form of transport.³⁵ One recent study found that older people were motivated to accept lifts from within their informal networks when they and the driver were interested in accessing the same destination – such as a local supermarket – as this helped them feel less of a burden.³⁶ Informal sharing was also found to support social engagement.³⁷

However, studies in the UK, North America and Europe have shown that older people are currently the least likely group to use car sharing.³⁸ Other research among older people has demonstrated that they have trouble with sharing services, and this was especially true of those who were drivers and owned their own vehicles. There was very little appetite for moving away from ownership and private space.³⁹

Mobility-as-a-service

Better transport integration has long been a promise of successive UK and EU governments but despite some advances (especially in smart ticketing), it remains an aspiration. However, technology has the potential to change this. Mobility-as-a-Service (MaaS) is a way of managing transport systems through digital technology. As the United Kingdom's Transport Catapult describes it, MaaS is *"using a digital interface to source and manage the provision of transport related service(s) which meets the mobility requirements of a customer"*.⁴⁰ We are seeing steps towards the development of MaaS, such as the Citymapper app, which includes live bus, tube and train information as part of its London journey planning. While new examples point the way forward, they still stop short of fully realising the MaaS concept. For example, Citymapper has recently introduced a subscription pass which can be used for public transport and Santander bikes, but this relies on TfL's existing integrated ticketing system. A full MaaS offer could integrate different transport provision (for example different bus companies, train operators, taxis, shared vehicles, private vehicles), different levels of interchange (parking, bus stop location) and place them together as a package for providing a door-to-door service. The promise of one ticket, one payment, one journey, would ease the burden of travel for older people, enable a more efficient transport system and potentially offer mobility services based on needs and demand.

Travel integration is potentially very beneficial for older people, as it can reduce the cognitive and physical strain associated with

changing modes or long waiting times between services, or having to remember and understand different ticketing types. However, there is at present very little research on MaaS for older people. In focus groups with older people, MaaS was found to be appealing to older people, who thought that it could help drive down cost and make public transport easier to plan for and to use.⁴¹

Automation

While much discussion about automated vehicles focuses on autonomous (self-driving) cars, the reality is that there are different degrees of automation, some already widespread. True Car have set out five levels of automation:⁴²

Level 1 – Driver assistance: features such as cruise control and lane assist, which use radar and onboard cameras to ensure safe distance between vehicles, and features such as automatic braking when traffic slows. While these systems assist drivers, the driver remains in control. Many cars available on the market already have level 1 automation.

Level 2 – Partial automation: including assistance with speed and steering. These systems help with stop-and-go traffic by maintaining the distance between cars and support drivers by centring the car within the lane. Examples of partial automation include Volvo Pilot Assist and Audi Traffic Jam Assist.⁴³

Level 3 – Conditional automation: These vehicles can drive themselves under very limited ideal conditions, including lane dividers, limited access and limited speed. Although hands are off the wheel, the driver still needs to take over should road conditions fall below ideal. The next generation Audi A8 is an example of this driving system.

Level 4 – High automation: These vehicles can drive themselves without human interactions, although a driver is still needed to take control in more crowded situations. Waymo is testing vehicles which it claims meets this level of automation.⁴⁴

Level 5 – Fully autonomous - The final level of vehicle automation would be completely driverless cars, able to monitor and manoeuvre through all road conditions, requiring no human interventions whatsoever, eliminating the need for a steering wheel and pedals.

Industry press and publicity material regularly claim that highly automated vehicles are not far from appearing on public roads.⁴⁵ However, recent reviews suggest that this level of automation is still a long way off, and vehicles are likely to continue to need a driver to respond or take over in difficult or emergency situations.⁴⁶ These include situations which a human driver can manage easily, such as intersections with complex traffic lights, and shopping centre parking.⁴⁷ Manufacturers' projections for when self-driving cars will emerge continue to be pushed back.⁴⁸

However, the concept of self-driving cars has gained widespread traction, with the result that many drivers find the language around automated driving confusing. For example, a Euro NCAP and Thatcham Research survey with over 1,500 motorists, found that 71 per cent of motorists wrongly believed that autonomous cars are already on sale today, and one in 10 said they would consider taking a nap when a driver assistance system is activated.⁴⁹

The Centre for Connected and Autonomous Vehicles (CAVs) was founded in the UK in 2015, to work with government, industry, academia and regulators to make the UK one of the world's leading development locations for CAVs. Since 2014, the government has invested £120 million in CAV research and development, with a further £68 million from matching industry contributions.⁵⁰

To date, there has been limited research on the potential impacts of vehicle automation on people and communities.⁵¹ Some have suggested that more autonomous vehicles will lead to older people, disabled people and non-drivers travelling more.⁵² Automation and driver assistance has obvious advantages for older people who are beginning to struggle with driving. Older people who have given up driving tend to be positive about the potential for automated vehicles to support them in continuing to make journeys as they are used to do.⁵³

The future of driving – possibilities and implications

Changes in driving have profound impacts on how we live. From commuter suburbs to out-of-town shopping centres, industrial estates and holiday parks, the places we live, work, shop and play have all been profoundly reshaped by the private car over the last century. The wider environment has also been significantly impacted, both by visible changes such as large-scale road projects, and less obvious ones, such as driveways replacing front gardens to the extent that they now represent a major flood risk.⁵⁴ In social terms, the huge increase in female drivers from the 1970s on was a key practical element of women's independence.

To explore the possible implications of future trends in driving for our ageing society, we considered four scenarios, each assuming different levels of investment into and regulation of new forms of driving:

- All hail – low investment, low regulation
- Slow traffic – low investment, high regulation
- Flying cars – high investment, low regulation
- Automatic for the people – high investment, high regulation

We considered the implications of these different future scenarios for older drivers and society more widely, highlighting a series of opportunities and challenges these throw up. Some are common across multiple scenarios, while others are only likely in certain futures but are still worth considering as their impact would be significant if they did happen.

The future for older drivers

- Driving lifespans get longer, but not for everyone.
- Automated vehicles reduce the risks of driving.
- Connectivity introduces new risks.
- More expensive cars lead to the growth of hailing and hiring.
- New forms of sharing emerge.
- Rural drivers will be left behind, and older ones especially.

The future for our ageing society

- Extended driving lives extend our social lives.
- Electric vehicles improve air quality, urban space and health.
- Houses and offices continue to follow the car.
- Easier commutes increase suburban house prices.
- Shared mobility impacts older workers.
- Shared mobility enables shared services.
- The 'last ten yards' still matter.

These implications are discussed in more detail in the next section of this report.

All hail



'All hail' describes a future where the most visible current trends have developed further, but otherwise there has been little major change in driving – in particular, we envisage no major advances in automation, although all new cars will have (level 2) driver assistance technology.

This scenario would see a continued growth in electrification with most cars running hybrid or electric engines, and range extended to 250+ miles. It would also see the trend (already visible in London) of private hire vehicles replacing personal cars on the roads extending across the country. With this significant shift in the main mode of transport and a projected increase in the cost of owning and running a car, we expect a move away from widespread personal ownership. However, with trips largely made in private hire vehicles, we would still expect to see high levels of urban congestion.

With limited public sector investment or regulatory action, we would expect to see reduced bus services, with those that still operate connected to journey planning and ride hailing services, and very patchy infrastructure for cycling, walking and other forms of active travel.

Slow traffic



In 'Slow traffic' we see a similar level of technological development – widespread electrification and driver assistance, but no major advances in automation. With a stronger public sector role in transport, there will be greater integration of all forms of transport (buses, trains, private hire, sharing, and cycling) into shared journey planning / payment. We would also expect to see better public transport coverage of rural areas.

However, with limited innovation and a regulatory clampdown on forms of ride hailing which seek to evade employment and/or tax responsibilities, there will be continued dependence on and growth in private car ownership. As a result, congestion will become a major issue in urban areas.

Flying cars



This scenario describes a future which has significant advances in automation, with most cars able to drive themselves in the right conditions (Level 3 to 4). As a result, infrastructure in major urban areas will be adapted to automated driving, with high levels of connectivity / smart traffic management, and segregation from pedestrians and cyclists. The cost of cars will rise significantly, in line with these advances in technology, and personal ownership will be increasingly rare. Most journeys within towns and cities will take place using ride hailing services, primarily in private hire vehicles. With this significant mode shift, new business models will be developed to enable ride hailing, sharing or vehicle hire for long distance journeys, but we can anticipate that cost will be a major issue.

Automatic for the people



In our final scenario, significant advances in automation (to Level 3 or 4) take place in a context of active regulation and public involvement, leading to the development of highly integrated, automated public transport systems. These systems will include a range of vehicles with some degree of automation, from connected e-bikes and smart shared pods for local urban transit to long range electric buses for rural journeys. In this scenario private car ownership will be increasingly rare, although shared vehicle use would be supported as part of the wider Mobility-as-a-Service offer. With a reduced number of vehicles, largely used for shared travel and connected to smart traffic management systems, congestion will be hugely reduced.

The future of driving for older drivers

Our review of the existing evidence and possible future scenarios suggest that changes to driving will have significant impacts on our ageing society, and how we experience later life. Some of these shifts are consistently likely across a range of possible futures, while others will play out very differently depending on the choices and actions of citizens / consumers, businesses and policy makers today.

Driving lifespans get longer, but not for everyone

One of the clearest trends we have identified is the continued extension of 'driving lifespans'. Whether through increased automation, widespread hailing / sharing or the development of Mobility-as-a-Service, more people will continue to drive, and/or use cars as their primary means of getting around, for much longer into later life.

However, this does not mean we will all drive forever. The average age of driving cessation will increase, and so those not driving / using cars will either be very old (85+), or they will be poorer people who cannot afford to use cars for much of their lives.

In one plausible future, the extension of driving lives for the majority could lead to the assumption that the problem of driving cessation has been solved. Policy makers at national and local level will need to ensure that people who can no longer drive are still able to get to the places they want and need to be.

Automated vehicles reduce the risks of driving

Increased automation is likely to be a major factor extending our driving lives. Even relatively low levels of driver assistance will allow people to continue driving despite age-related reductions in visual acuity or reaction speeds.

With over 80 per cent of road traffic accidents attributable to driver error, higher degrees of automation may also contribute to increased road safety, through technologies to manage speed, improve braking and avoid collisions.⁵⁵ While older drivers have similar risk profiles to younger drivers, they are more likely to be injured if they are involved in a collision.⁵⁶ Increased road safety

would also be particularly relevant for older pedestrians, with pedestrians aged over 70 among the highest risk groups for death or serious injury (along with those aged 10-19).⁵⁷

If we see sustained reductions in the number of road accidents this may have implications for insurance premiums, although the rising value and complexity of vehicles (and thus the cost of damage or replacement) will also be a factor pulling in a different direction.

One possibility is that in future we may see older drivers being asked to demonstrate that they are using higher levels of driver assistance in order to access cheaper premiums or to retain their licence.

As automation becomes standard in newer models, older drivers who are not using driver assistance technology, either because they have older vehicles, or choose not to use it, may struggle to purchase car insurance.

While full automation remains far off, we can expect systems to go beyond assistance and augmentation to occasionally stand in for the driver. If assistance becomes more personalised – for example adjusting to a driver’s vision – older drivers will need to adjust it as their capabilities change. Having a system in-car is not the same as using it, and it remains to be seen how older drivers will react to this level of automation – as a welcome source of help, or as an intrusion on their own autonomy. However, with vehicles ever more connected, insurers may be better able to assess whether technology is being used and to price insurance accordingly.

Automated systems are increasingly a source of data on driver behaviour. Data from driver assistance technology could be used to monitor reaction times or calculate visual acuity. This could make the process of assessing older drivers more streamlined, but currently, older drivers often put off eye tests or resist the loss of their licence. There is an open question around the willingness of older drivers to undergo this kind of surveillance. It will be important to ensure that drivers are clear about who owns this data and how it can be used.

These kinds of development would also reinforce the potential for inequality, forcing poorer older people to stop driving earlier than those who can afford newer technology.

Connectivity introduces new risks to driving

Automation is increasingly synonymous with connectivity – from GPS location services to software updates, higher levels of vehicle automation are reliant on connection to the internet.

As noted above, connectivity introduces new potential for surveillance of older drivers by government and / or insurers – which may be something older people resist – but connectivity brings other risks and challenges.

As with any connected device, a connected vehicle is potentially vulnerable to hacking or security breaches, creating a whole new class of risks which drivers, manufacturers and insurers will need to manage. For example, a 2015 WIRED magazine investigation found that a Jeep Cherokee with internet connectivity could be remotely hacked and the engine stalled while moving.⁵⁸

The software industry response to this kind of security risk comes in the familiar form of regular updates and security patches. It's easy to imagine a world in which starting your car involves a 10-minute wait to update and restart the software before you can drive away. It's equally easy to imagine people lacking the time or patience to wait, but could we see a world where updating software becomes a requirement of insurance policies? Similarly, if the operating systems for older cars are no longer maintained, will these cars become effectively uninsurable? This would be another factor leading towards a more unequal future, where only those who can afford newer cars or retrofitted operating systems will be able to drive.

Today's older people are more likely than younger people to be concerned about the risk involved in online activity, especially those who are not current internet users.⁵⁹ While people are unlikely to see driving a connected vehicle as 'going online', high profile stories of automated / connected vehicles going wrong could easily create a wider sense of concern among older drivers. This could exacerbate the tendency for older people to adopt new technology later, delaying the uptake of driver assistance and other automated technologies among older drivers. As a result, it may take longer than anticipated for automation to significantly extend driving lives.

More expensive cars lead to growth in hailing and hiring

We anticipate that both these major trends in vehicle technology – electrification and automation / connectivity – will result in cars becoming relatively more expensive. Electric vehicles are currently significantly more expensive, not least because the raw materials required for batteries, such as lithium and rare earth minerals, are scarce and costly to extract, though costs are expected to fall in the next few years.⁶⁰ However, keeping up with new technologies is likely to drive cost for individual drivers.

Automation opens up enormous new opportunities for manufacturers to develop and sell new functionality, in the form of new vehicles and/or retrofitting firmware into existing vehicles. In either case, the emphasis will be on newer, more expensive models. Components and servicing will also become more specialised, and therefore probably more expensive – for electric vehicles, as well as automated ones. As we've seen, these trends are also likely to create insurance conditions which may make it harder to keep older, less sophisticated vehicles on the road.

Alongside rising costs, we expect to see continued action by policy makers to promote electric vehicles and reduce single driver car journeys through electric-only parking, sharing lanes, congestion charges and similar incentives – to manage congestion and air quality, as well as emissions.

One plausible response to these trends will be for fewer people to own a car. This is likely to include the growth of relatively familiar forms of shared use, such as ride-hailing services or on-street car hire, essentially digitally enabled versions of traditional taxis and car hire firms, where the vehicle is owned by a driver or firm who is paid per trip, alongside public transport. Ride-hailing drivers tend to be older (~70 per cent of Uber and Lyft drivers in the US are over 50).⁶¹ At the same time ride-hailing users tend to be younger. If ride-hailing becomes a significant component of the overall transport mix, we may see a situation where disproportionately older drivers are driving mostly younger passengers.

Ride-hailing and car hire appear more expensive than using your own car on a trip-by-trip basis (i.e. setting aside the cost of car ownership) and are more expensive than public transport. Significant growth in these kinds of digital hailing / hiring will therefore tend to exclude poorer older people, not least because they are also more

likely to be digitally excluded.⁶² If this comes hand-in-hand with significant increases in the costs of car ownership, there is a risk of entrenching and exacerbating transport inequalities.

New forms of sharing may emerge

There may also be an increase in models where costs are more genuinely shared, such as lift-sharing or carpooling. However, these new social forms of driving / shared mobility may not prove fully inclusive either. Recent research suggests that older people are much less comfortable with getting into a stranger's car – even when using more 'intermediated' arrangements such as ride-hailing.⁶³ People who are already socially isolated are likely to find these kinds of options very challenging.

Where people access lift shares or carpools through digital platforms, rather than through existing relationships, all parties will need some way of assessing the other people involved and deciding whether or not to get into a car with them. This could take the form of a 'star rating' for sharers, similar to that used by ride-hailing services, or perhaps a 'badge' or other guarantee, but this would require an intermediary, playing the vetting role that local authorities fulfil in issuing taxi licences.

If these shared driving models rely on ratings from fellow drivers / passengers, then people with cognitive impairments or mental health problems may well face barriers to access. Social ranking systems can also be vulnerable to biases related to race, gender, sexuality, age etc. With an increasingly diverse older population, there are likely to be significant constraints on who can participate in shared driving.

At the 'most shared' end of the spectrum, we may see growth in mutual use / ownership of a single vehicle among multiple households, allowing them to share costs of use and upkeep. With people over 60 most likely to own a car already, we can easily imagine an increase in 'family cars', used by older adults, their adult children and their grandchildren.⁶⁴ This is probably a model most applicable to people in the lower-middle of the income range, wealthy enough to own a car but still keen to share costs.

It's also possible that this model could be extended beyond family groups to 'neighbourhood cars', although this would require a significant cost increase or other incentive to overcome people's

attachment to vehicle ownership. For example, we could see these schemes emerging in retirement communities. Indeed, more expensive retirement villages, with their gated / enclosed environments, low traffic volumes and simple road layouts may be one of the first places in which we could see automated pod vehicles being adopted as 'runarounds'.⁶⁵

An intermediate model could see people renting out their own cars through digital platforms. With older people using their cars less on average, they should be the logical target market for third-party sharing platforms, however there may be challenges in marketing these ideas to older adults.⁶⁶ Furthermore, there may be barriers to the growth of this kind of shared mobility due to challenges around managing payment, insurance and quality / safety assurance mechanisms.

These different forms of sharing are not mutually exclusive - the owner of a minivan might shift over the course of a single day from taking her grandchildren to school, to working for several different ride-hailing platforms, and then joining a dynamically managed bus route to add capacity. So as we consider the future of driving, we may need to develop more flexible models of insuring, owning and managing our vehicles, to better accommodate the range of ways in which they will be used.

Rural drivers will be left behind, and older ones especially

Whether future shifts in driving are primarily related to electrification, automation, platforms and hailing / sharing, or some mix of all of these, they are likely to drive change far more quickly in urban as compared to rural settings. This will be particularly significant for older drivers, as the population of villages and smaller towns is much older than that of urban areas, and rural areas are ageing faster as younger people leave and older people move in.

While we anticipate significant increases in battery life in future years, such that range will cease to be a major limitation on electric vehicle travel, there will be other challenges in using electric vehicles in rural areas.

It is unlikely that rural charging infrastructure will develop as quickly and comprehensively as urban or motorway charging, and so we can expect to see people continuing to make short trips to the countryside or longer trips through it, from town to town.⁶⁷

People in rural areas will either need home charging stations, or to travel into larger towns to charge. Electric vehicles in these communities will be limited to those with the money and space to install a charging point and/or the willingness to make regular charging trips. We can therefore expect much slower uptake in rural areas, with a real risk of an urban-electric / rural-combustion divide developing in the relatively near future.

Once we have reached mass urban electrification, many older drivers in rural areas may find that they can no longer access petrol / diesel fuel, as there are fewer and fewer filling stations, nor afford an electric vehicle, and as a result are unexpectedly unable to drive at all, with all the negative impacts of unplanned driving cessation.

Rural roads are typically narrower, less straight, less flat and less well-lit than urban roads or motorways / A-roads. Rural connectivity is also typically more limited, preventing vehicles from using digital mapping or connecting with each other to avoid collisions or manage distance. Any one of these factors would limit the scope for automation and, taken together, they will limit both the kinds of vehicle automation that can be used in rural areas, and the value that automation will bring to older drivers in these areas.

As a higher degree of automation becomes standardised, we can expect that an increasing number of cars will cease to operate at full functionality in rural areas. Most road traffic fatalities already occur on rural roads – as we increasingly rely on automation to maintain road safety, we may expect to see an even wider rural / urban safety gap.⁶⁸

When it comes to automation, the rural / urban divide will apply to anyone who moves, or even drives, to the countryside. Older drivers, reliant on automated systems in the urban environment, will find that these no longer function in rural areas. This may limit the benefits we would otherwise expect to see from extended driving lives, as older drivers are less able to travel for leisure or pleasure because of these limitations. Older people living in rural areas may be unable to use newer vehicles even if they can afford them. If a degree of automation becomes a requirement for older drivers to access insurance or retain their licence, as we suggest earlier, older rural drivers are likely to be affected more sharply and more negatively.

Rural populations and amenities are more spread out than urban ones, and as a result journeys in rural areas are typically longer. This

means that taxis, ride-hailing or car hire will all be more expensive, if they are available at all. In areas with a sparser population and lower levels of overall demand, digital platforms can't generate efficiencies for drivers and firms through constant deployment of vehicles, with no downtime. These challenges also limit the potential for cost-sharing models – with fewer people around, the chances of finding someone to share a lift or carpool are significantly reduced. Given the cost savings involved, we might expect to see more shared ownership solutions in rural areas. However, the fact that many people will need to drive to work, making the shared vehicle unavailable for large chunks of time, may well militate against this. On balance, rural hailing / sharing seems likely to be very limited.

Rural drivers – predominantly older drivers – are therefore at significant risk of being left behind by technological developments and shifts in the nature of driving. It is easy to imagine a growing rural-old / urban-young divide, with people living in rural areas facing increasing barriers to mobility and becoming ever more isolated.

The future of driving and our ageing society

Changes to how we get around will also have significant implications for where and how we live, work and play, for the wider public realm, and for our health and social connections as we age. Of course, shifts in driving are only one factor affecting society, and these changes may play out very differently in different scenarios.

Extended driving lives extend our social lives

As noted in the previous section, we anticipate a significant extension of driving lifespans, with most people continuing to drive until much later in life.

Most people in their 70s and 80s will, therefore, still be able to travel for leisure, family and social purposes – the kinds of activities that are currently 'unmet travel needs' for a sizeable minority of older people. We can expect to see older people maintaining their family and social connections by themselves for significantly longer, rather than having to be visited. They will also be able to drive for pleasure or to take part in leisure activities, without having to ask anyone else to help them. The evidence suggests that the loss of these kinds of independent travel is a major factor in the declining quality of life experienced by older people once they stop driving.⁶⁹

Although we anticipate that most older people will therefore avoid the negative impacts of driving cessation until much later in life, it's important to underline that there is no guarantee that we will be able to avoid them altogether. Instead, we may simply defer them, meaning that there will be a continued need for consideration around how to support people in later life to transition from driving to other forms of mobility.

Electric vehicles improve air quality, urban space and health

Across all the scenarios we considered, we expect a significant increase in the proportion of electric vehicles on the roads. Manufacturers are responding to pressure from consumers and policy makers to reduce emissions of carbon and other pollutants. The growth in electric vehicles looks set to continue.

Majority electrification will have a relatively immediate impact in terms of reduced air pollution. Road traffic is currently responsible for around a third of nitrogen oxides emissions and 12 per cent of particulate matter pollution in the UK.⁷⁰ Older people, especially

poorer older people, are already more likely to have underlying cardiovascular or respiratory conditions which are exacerbated by these kinds of pollutants – indeed this is the main way in which pollution contributes to increased mortality. There is evidence from the US that increased use of electric vehicles reduces exposure to air pollution in urban areas.⁷¹

Research into how older pedestrians experience different kinds of urban space shows that quieter streets with cleaner air have a significant impact on older people's likelihood of walking and spending time outside.⁷²

This suggests that high levels of electrification will have a positive impact on health and life expectancy among older people in urban areas, in particular among poorer older people – both from reduced exposure to air pollution, and from increased activity and time outdoors.⁷³

Houses and offices continue to follow the car

While we cannot be sure exactly how future changes in driving will change the built environment, we can be confident that they will have a major impact.

With automation much more reliable in predictable, purpose-built environments, we can expect to see a continuation of ribbon development along motorways / A-roads – for housing and possibly workplaces. Shops, services and amenities tend to be more spread out in these kinds of development, with no centre or 'high street' to speak of. Older and poorer people are likely to be disproportionately affected by a lack of walkable neighbourhood amenities, as they will be both less able to travel, and less able to afford delivery or call-out costs.

In the event of significant reductions in private car use and congestion, we would expect to see growth in infrastructure for other forms of travel, including scooters and micro-vehicles, connected buses and public / private hire vehicles, as well as walking, cycling and rail. If there is significant growth in connected and automated vehicles, we would expect to see dedicated 'smart vehicle' infrastructure, segregated from pedestrian environments for safety reasons.⁷⁴ While this might enable the development of more dedicated infrastructure for non-car / active travel, history provides enough examples of cities built for the car to suggest that this is in no way guaranteed.

Easier commutes increase suburban house prices

Most of the scenarios we've considered involve fewer cars in private ownership. In some cases, this is part of a significant reduction in the total number of cars, while in others we see private cars replaced by shared / hired vehicles. Alongside an overall reduction in cars, we can expect to see a corresponding reduction in congestion and journey speeds – especially if automation / connectivity allows for more efficient management of traffic flows.

This will primarily impact commuters. Driving still dominates travel to and from work – in 2018, 68 per cent of people in the UK commuted to work using a private vehicle – and peak congestion is created by commuter drivers.⁷⁵ Historically, faster speeds have led to longer commuting distances, with people moving further from urban centres while maintaining similar journey times. While there is some evidence that older workers prefer shorter commuting distances – especially those who continue to work past State Pension Age – in general we would expect to see drivers aged 50-70 following this pattern of commuting further if traffic allows.⁷⁶

In this situation, we would expect to see an increase in demand for housing at the new outer commuting limit, and a corresponding increase in house prices and growth in wider rings of commuter housing around larger cities.⁷⁷ There might also be a balancing reduction in pressure on city centre housing, at least for cities where an increased commuting range brings a significant volume of 'new' houses within their footprint.

Older people seeking to retire away from the city, or looking for a 'penultimate' move to a suburban property with more space, will increasingly find themselves in competition with younger commuters. Poorer older people in this wider ring of towns and villages may find themselves the beneficiaries of increased house prices, but they may also find their adult children and grandchildren priced out, while older private renters will also face a squeeze.

Conversely, a decrease in urban congestion, improved air quality and reduced pressure on city centre housing may make urban retirement more attractive for those older people who have a choice.

Shared mobility impacts older workers

If the fall in private car ownership is made up in part by shared car use, we would expect to see a greater concentration of workspaces in urban areas or much larger out-of-town centres. It will not be feasible or affordable for individuals to share lifts or hail a paid vehicle to travel to smaller industrial estates or business parks, and employers in these kinds of places will either need to develop their own shared transport offer or relocate to bigger centres. For older workers who can afford to exercise choice, increased travel distances or the need to share transportation may lead to earlier exit from office-based employment.

With continued growth in ride-hailing, we can expect to see a different group of older workers becoming drivers for ride-hailing platforms. Conversely, if there is a significant shift from hailing to sharing, we would expect to see current older drivers losing work and income.

Shared mobility enables shared services

A growth in shared mobility may also enable new forms of shared services – most obviously in terms of public transport and Mobility-as-a-Service, but potentially in other areas too.

We are already seeing examples of closer integration between public transport, digital platforms and private transport, such as TfL's partnership with the Citymapper app, which enables pooling and hop-on-hop-off transit between buses and black cabs on key routes at peak times. Evidence suggests that older people are attracted to the idea of Mobility-as-a-Service, seeing how it could drive down travel costs and make it easier to plan and take journeys on public transport.⁷⁸ Older passengers often value the social component of public transport, regularly spending time in a shared space with others, and it is possible that shared / pooled vehicles could also offer this kind of mobile social space.

However, there are currently significant barriers to the development of true Mobility-as-a-Service, and regulatory action and infrastructure development by government will be needed, as well as private investment.

In England, people aged 65 and over qualify for free bus travel – which means that the government refunds the bus company the cost of their trip. This is a significant enabler of leisure and social

travel for many older people.⁷⁹ Including a subsidy across hired or pooled vehicles used as part of Mobility-as-a-Service for older people would significantly increase the costs to the public purse of transport concessions, but not providing such a discount would create a significant barrier to older people's uptake of these new forms of mobility.

In the absence of active government support for public and shared transport solutions, there is a risk that the decline in private car use leaves older people stranded, unable to meet their personal travel needs and increasingly isolated.

Shared vehicles don't only have to carry people from home to their destination. They could also enable services to come to older people or to community hubs, especially in rural areas. If sharing grows as a mode of getting around, we can expect to see a range of experiments in mobile banking, healthcare, shopping and other services and amenities.

There may be a particular opportunity for social care. With a high proportion of older (85+) and disabled people living in rural areas, the time and resources required for staff to travel between appointments is already a matter of serious concern for rural providers. Care teams could use shared mobility solutions, including smarter route planning and ride sharing using connected vehicles, ride hailing and/or more integrated public transport, to help manage this challenge in future.

The 'last ten yards' still matter

Finally, it is important to remember that the fundamental purpose of driving is to get somewhere that is not inside a car. The 'last ten yards' from kerb to door are an essential part of every journey, and for older people with mobility impairments these final steps may be the most challenging. This is a key reason why private cars are so attractive to older drivers – compared to public transport, the car maximises your chances of getting close to your destination, and a private car rather than a shared vehicle minimises your chances of being seen to need help.

We are already seeing ride-hailing services offer assistance to people with mobility issues, such as UberAssist and UberAccess. A recent US study, which gave older adults living with long-term conditions three months free travel with the Lyft ride-hailing

platform, found that they reported a reduction in social isolation and increased quality of life.⁸⁰ However, respondents also reported that cost would be a significant deterrent to continuing to use the platform after the study, highlighting the need for solutions that work for poorer older people and those who are digitally excluded.

To be truly inclusive, alternative mobility solutions, such as public, shared or integrated transport, will also need to address the 'last ten yards' issue. Similarly, in areas with shared rather than private charging infrastructure, it will be important to find ways for drivers of electric vehicles to get to their destination. This may be an area in which simple smart mobility devices come into their own, assisting people from kerb, bus stop or charging point to door.

The policy and social response to the future of driving in an ageing society

These possible futures, and their implications for driving and for our ageing society more widely, raise a series of opportunities and challenges for government and industry as well as drivers and communities to respond to.

Alternatives to driving

In future, most people will continue to drive for longer, deferring the negative impacts of unplanned driving cessation until later in life. However, there will be opportunities to reduce or even avoid these impacts altogether, if we can find ways for people to meet their mobility needs through alternative modes of transport, and to enable people to actively plan and choose to stop driving.

For this to happen, we need to make sure that alternatives are age-friendly – in particular, they will need to be attractive, accessible and affordable.

Given the importance of driving to people's sense of identity and autonomy, it is also clear that we will need action to support a shift away from the culture of the car. This will require a new framing of mobility, with stories and imagery promoting new modes of travel. It could also include behavioural tools and 'nudges', such as cost or activity monitors showing people the ongoing impact of car ownership in terms of upkeep or lack of physical activity, as well as the 'visible' cost of each journey, price comparison tools or 'shared first' default options in Mobility-as-a-Service planners.

With most new modes of travel highly dependent on smartphones / connected devices, there will also be a need to address digital exclusion, so that older people do not miss out.

The likely decline in private car ownership, alongside the shift to electric vehicles and subsequent reduction in urban air pollution, also create a significant opportunity to promote walking, cycling and other forms of active travel as an alternative to driving.

Barriers to inclusion

We predict that driving and car ownership will become relatively more expensive. Action will be needed to ensure that poorer people, especially older poorer people, do not lose out on mobility and become isolated and excluded – this could take the form of measures to reduce the costs of newer vehicles, and/or provide access to alternative transport modes.

We envisage that some degree of vehicle automation will increasingly be required to qualify for reduced insurance premiums and that, increasingly, data from automated vehicles may be shared with insurers and/or government. It will be vital that insurers work closely with government and vehicle manufacturers to consider how to ensure that older drivers, particularly those with limited resources, are enabled to continue to drive where they can and wish to do so. We will also need to ensure that drivers and car manufacturers are clear about who owns data from connected vehicles and how it can be used.

If, as in some of the possible futures we have explored, we see an increase in ride sharing, action will be needed to address the potential barriers to older people's access. Whether ride sharing takes the form of pooled vehicles, public transport and/or integrated mobility-as-a-service solutions, enabling people to use a range of private, shared and public travel modes more efficiently, digital exclusion will be a major challenge and older people could be cut off if these barriers are not addressed. There will also be a need to take conscious action to include people whose behaviours may not fit the social norm, including, for example, people with dementia.

Whether the future brings mainly private or mainly shared mobility, or a mix of both, it is clear that specific action will be needed to ensure that rural areas are not left behind. This will require deliberate action by Government, in the form of regulation and investment.

Finally, as new mobility solutions emerge, we will need continued consideration of how to address the challenges faced by people who are significantly older and/or living with long-term health conditions – in particular, the challenge of getting from kerb to door.

Recommendations

Action is needed across sectors to capitalise on the opportunities of future mobility and avoid the risks of worsening travel inequalities and increasing rural isolation.

- Central government will need to invest in public transport and rural infrastructure, including electric charging and vehicle connectivity. Government could fund some of this investment from charges / levies on developers of urban mobility infrastructure (analogous to the section 106 levy on housing developments) or private travel providers. Currently, investment in roads massively outstrips spending on alternative travel, and government should seek to realign its infrastructure priorities in the light of projected future trends in driving.
- The Government's Future of Mobility Challenge Fund investment should focus on the 'last ten yards' – stimulating innovation in new technology and business models to enable people to travel from kerb to door. Government should also support and promote voluntary and community-based solutions, which are likely to be more inclusive.
- Government should undertake research into the safety benefits of automation, so that any regulatory or industry action to require use of driver assistance technology is based on evidence. If this technology does make a significant difference, government should consider subsidising retrofitting in older vehicles (as it did for catalytic converters).
- Government and industry should work together to promote age-friendly, inclusive and accessible alternative forms of mobility. The government's primary role here would be to develop policies to encourage investment in new solutions and support more inclusive models (e.g. community transport), and to regulate against discrimination in shared travel.
- Government should also support action to encourage people to embrace alternative forms of mobility, and to support a shift away from the car – promoting new modes of travel, using behavioural tools and 'nudges' to encourage their uptake, and in particular addressing the practical, emotional and cultural issues around driving cessation for older people.

- Government should continue to subsidise the upfront costs of Electric Vehicles.
- Any central or local government investment in and support for Mobility-as-a-Service, or other shared transport solutions, should focus on accessibility and inclusion for older people, people on low incomes and non-drivers. As part of this, government will need to consider how to extend subsidies such as the free bus pass to new forms of shared mobility.
- Central and local government and businesses, especially service industries, should work together to explore new models of shared service provision utilising shared transport as a platform. Rural social care could be a productive area for initial experimentation.
- Central government should devolve greater regulatory powers to local authorities across the UK, so that they can take action to ensure that public transport, ride hailing / sharing, and other mobility services are inclusive.
- Local authorities and transport planners can promote shared mobility through infrastructure and traffic management, such as dedicated sharing lanes or parking spaces, congestion charging for private vehicles or banning single-driver cars from urban centres.
- Local authorities, urban and transport planners, developers and others involved in place-making should build for active travel and alternative modes of mobility, including walking, cycling, scooters and micro-vehicles, as well as connected public transport.
- Policy makers, public services and regulators at national and local level will need to ensure that transport alternatives are provided for rural areas, including public and shared transport services.
- Ensuring compliance with new automated safety measures is likely to require the same kind of long-term collective effort by insurers, manufacturers, regulators, police and road safety agencies, charities and others as we saw for seatbelt adoption. Work to build collaboration on these issues needs to start now.
- Insurance companies and manufacturers will need to find ways to manage the new risks created by software failure or security breaches, working with regulators and policy makers to develop new systems to manage safety, data security and liability. This

will include ensuring that drivers can control who has access to data from connected vehicles, and can make informed decisions about how it should be shared.

- The mobility sector as a whole (insurers, manufacturers, construction) will need to work with the IT and telecoms sector to find ways to protect connected vehicles and connected infrastructure from cyber-attack.
- The insurance industry will need to develop new solutions for shared use and/or ownership – for example, flexible micro-insurance to allow people to share the driving in a shared journey, procedures for allocating liability for an accident in a shared car, or agreements to share responsibility for maintenance or battery rental.

Conclusion

Our cars and the way we drive them are already changing and these changes will continue in future, with profound implications for how we live, work and play.

For many older people the car is a lifeline, and so it is vital that changes in how we drive are considered through the lens of our increased longevity as individuals and the ageing of our population.

The future will bring both opportunities and challenges for older drivers, and for mobility in an ageing society.

We need to manage the changes that are coming to make sure that we capitalise on the opportunities to support older people to stay mobile for longer, and minimise the potential for older drivers to be excluded.

In future we will increasingly:

- Drive for longer – supported by automation, more people will stay on the road for longer.
- Travel differently – with more ride sharing, enabled by digital technology and greater connectivity.
- Face different kinds of risk – with fewer accidents, and less air pollution, but new threats from cyber-attacks, and potential for some groups to face greater exclusion.

If we are not careful, we could see:

- Poorer older people missing out – due to the high costs of newer vehicles / technologies and difficulties in accessing insurance for people who do not have them.
- Rural areas left behind – as poor connectivity, lack of infrastructure and sparse population make newer models of mobility less viable in rural areas.
- People in poor health or with additional needs increasingly isolated – with people continuing to struggle with the last few yards between kerb and door.
- More people excluded from 'social' travel – especially those whose identities, impairments or personalities make them vulnerable to discrimination or less equipped for sharing.

- Digital 'have nots' left stranded – as transport solutions increasingly rely on the use of digital technology.

Action is needed by national and local government, manufacturers, insurers and others across the private, public and voluntary sectors to mitigate these risks.

It's important to note that each of these risks falls disproportionately on poorer older people, who are more likely to be isolated, to have poor health and to be digitally excluded. A deliberate focus on inclusion and equality will be needed.

Above all, it will be vital that **older adults are included in thinking through and managing the implications of changes to how we drive in future**. Older adults should be actively included in policy discussions around the future of mobility.

Annex: About this report

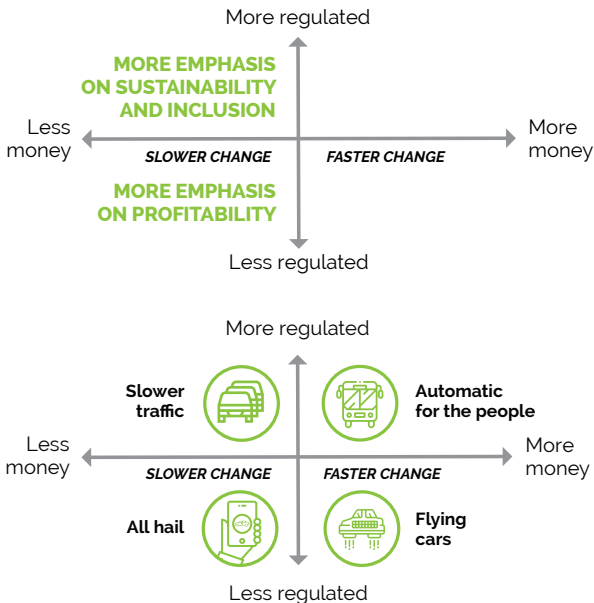
ILC undertook a programme of research during 2019 to explore the future of driving in an ageing society.

The research began with a review of academic and grey literature relating to future trends in driving and older drivers. The review identified three key trends driving the future of driving – electrification; the increase in digitally-enabled models; and increasing vehicle automation.

Our learning from the literature informed the development of four future scenarios which were explored in detail by a group of experts in mobility and ageing at a workshop held in October 2019. Attendees were drawn from across the voluntary sector, academia, industry and policy making.

The four scenarios considered in the workshop were developed by imaging how these trends would play out in environments of either very low or very high investment in innovation and development, and very low or very high levels of regulation, with reference to current and past trends in policy.

How automobile trends are expected to develop



Working with our experts we considered the implications of these futures on four key areas:

- Homes and the built environment.
- The economy – retail, work and leisure.
- Health.
- Social connection.

We then considered what action would be needed to maximise the opportunities for an ageing society in these scenarios and to minimise the challenges and risks.

The insights generated in this workshop were used to inform the analysis presented in this report. However, it is important to note that the views and recommendations set out here are those of ILC only and do not necessarily represent the views of participants in our workshop.

References

- ¹Mussetwhite, C. (2011) The importance of driving for older people and how the pain of driving cessation can be reduced. *Signpost: Journal of Dementia and Mental Health Care of Older People*, 15(3), 22-26.
- ²Automated and Electric Vehicles Act 2018
- ³See: <https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/industrial-strategy-the-grand-challenges#future-of-mobility>
- ⁴Mussetwhite, C. (2011) The importance of driving for older people and how the pain of driving cessation can be reduced. *Signpost: Journal of Dementia and Mental Health Care of Older People*, 15(3), 22-26. ; Weber, S., Porter, M. & Menev, V. (2010). Mobility in Older Adults: A Comprehensive Framework. *The Gerontologist*, 50(4), 443-450. doi: 10.1093/geront/gnq013; Mussetwhite, C. & Haddad, H. (2010). Mobility, accessibility and quality of later life. *Quality in Ageing and Older Adults*, 11(1), 25-37; Groessl, E., Kaplan, R., Rejeski, W., Katula, J., King, A. & Frisron, G. (2007). Health-related quality of life in older adults at risk for disability. *American Journal of Preventive Medicine*, 33, 214-218. doi: 10.1016/j.amepre.2007.04.031; Gardezi, F., Wilson, K. G., Man-Son-Hing, M., Marshall, S. C., Molnur, F. J., Dobbs, B. & Tuokko, H. 2006. Qualitative research on older drivers. *Clinical Gerontologist*, 31, 1, 5-22. doi: 10.1300/J018v31n01_02; Siren, A. & Hakamies-Blomqvist, L. (2005). Sense and sensibility: a narrative study of older women's car driving. *Transportation Research, Part F: Traffic Psychology and Behaviour*, 8, 213-28. doi: 10.1016/j.trf.2005.04.008; Ellaway, A., Macintyre, S., Hiscock, R. & Kearns, A. (2003). In the driving seat: psychosocial benefits from private motor vehicle transport compared to public transport. *Transportation Research Part F*, 6, 217-231. doi: 10.1016/S1536-8478(03)00027-5
- ⁵Mussetwhite, C. (2011) The importance of driving for older people and how the pain of driving cessation can be reduced. *Signpost: Journal of Dementia and Mental Health Care of Older People*, 15(3), 22-26.
- ⁶Mussetwhite, C. (2018) Older people's travel and mobility needs: a reflection of a hierarchical model 10 years on. *Quality in Ageing and Older Adults*, 19(2), 87-105. doi: 10.1108/QAOA-12-2017-0054
- ⁷Department for Transport (2018). Statistical data set: driving a licence holding and vehicle availability. Retrieved from: <https://www.gov.uk/government/statistical-data-sets/ntso2-driving-licence-holders>, accessed 08.01.20.
- ⁸Mussetwhite, C. (2011). Successfully giving up driving for older people. ILC-UK
- ⁹Future Lab. (2012, October, 18). Ford's 'Third Age' Suit. Retrieved from: <https://www.futurelab.net/blog/2012/10/fords-third-age-suit>; NBC News (2008). Aging suit' helps develop cars for older drivers. Retrieved from: <http://www.nbcnews.com/id/27200093/ns/business-autos/t/aging-suit-helps-develop-cars-older-drivers/>, accessed 21.8.19.
- ¹⁰'Car Keys. (2018). 10 Best Cars for older drivers. Retrieved from: <https://www.carkeys.co.uk/guides/10-best-cars-for-older-drivers>, accessed 26.8.19.
- ¹¹Bonder, B., & Dal Bello-Has, V. (2009). Functional performance in older adults. Philadelphia: F.A. Davis Co.
- ¹²Ralston, L. S., Bell, S. L., Mote, J. K., Rainey, T. B., Brayman, S., & Shotwell, M. (2001). Giving up the car keys: Perceptions of well elders and families. *Physical & Occupational Therapy in Geriatrics*, 19(4), 59-70; Fonda, S. J., Wallace, R. B., & Herzog, A. R. (2001). Changes in driving patterns and worsening depressive symptoms among older adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 56(6), S343-S351; Chihuri, S., Mielenz, T. J., DiMaggio, C. J., Betz, M. E., DiGuseppi, C., Jones, V. C., & Li, G. (2016). Driving cessation and health outcomes in older adults. *Journal of the American Geriatrics Society*, 64(12), 332-341; Ragland, D. R., Satariano, W. A., & MacLeod, K. E. (2005). Driving cessation and increased depressive symptoms. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, 60(3), 399-403
- ¹³Mussetwhite, C.B.A. (2019). Older people's mobility, new transport technologies and user-centred innovation. In B. Müller and G. Meyer (eds.) *Towards user-centric transport in Europe – Challenges, solutions and collaborations*. Lecture Notes Series, Switzerland: Springer, 87-103.
- ¹⁴Traverse, (2019). CAV public acceptability. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/837958/cav-public-acceptability-dialogue-engagement-report.pdf, accessed 08.01.20.
- ¹⁵Holley-Moore, G. and Creighton, H., 2015. The future of transport in an ageing society. Retrieved: https://www.ageuk.org.uk/globalassets/age-uk/documents/reports-and-publications/reports-and-briefings/active-communities/rb_june15_the_future_of_transport_in_an_ageing_society.pdf, accessed 08.01.20
- ¹⁶Liu, C., Tight, M., & Burrow, M. (2016) The unmet travel needs of the older population: a review of the literature. *Transport Reviews*, 37(4), 488-406. doi: 10.1080/01441647.2016.1252447.
- ¹⁷<https://electricvehiclesnews.com/Definition/description.htm>
- ¹⁸Next Green Car, see: <https://www.nextgreencar.com/electric-cars/>
- ¹⁹Carbon Brief, see: <https://www.carbonbrief.org/factcheck-how-electric-vehicles-help-to-tackle-climate-change>
- ²⁰Carbon Brief, see: <https://www.carbonbrief.org/rise-uk-electric-vehicles-national-grid-doubles-2040-forecast>
- ²¹BBC, 2019. Electric cars not attractive for most people in the UK. Retrieved: <https://www.bbc.co.uk/news/business-48342002> accessed 08.01.20.
- ²²House of Commons (2018, October, 16). Electric vehicles: driving the transition. Fourteenth Report of Session 2017-19. Retrieved from: <https://publications.parliament.uk/pa/cm201719/cmselect/cmbeis/383/383.pdf>.
- ²³Gov. UK. (2019). Low-emission vehicles eligible for a plug-in grant. Retrieved from: <https://www.gov.uk/plug-in-car-van-grants>, accessed 20.8.19.
- ²⁴House of Commons (2018, October, 16). Electric vehicles: driving the transition. Fourteenth Report of Session 2017-19. Retrieved from: <https://publications.parliament.uk/pa/cm201719/cmselect/cmbeis/383/383.pdf>
- ²⁵AA (2018) See: <https://www.theaa.com/about-us/newsroom/what-drivers-think-about-electric-vehicles>
- ²⁶Office for National Statistics (2018) 'Internet Users in the UK' Available at: <https://www.ons.gov.uk/businessindustryandtrade/itandinternetindustry/datasets/internetusers>
- ²⁷Uber (2019) 'Get in the driver's seat and get paid' Retrieved from: <https://www.uber.com/gb/en/about/>, accessed 2.8.19
- ²⁸Liu, C., Tight, M., & Burrow, M. (2018). Factors Preventing the Use of Alternative Transport Modes to the Car in Later Life. *Sustainability*, 10, 1-21. doi:10.3390/su10061982
- ²⁹Mussetwhite, C. (2018) Older people's travel and mobility needs: a reflection of a hierarchical model 10 years on. *Quality in Ageing and Older Adults*, 19(2), 87-105. doi: 10.1108/QAOA-12-2017-0054; Saxon, Ebert, and Sobhani (2019) Health impacts of unlimited access to networked transportation in older adults. *Journal of mHealth*. Retrieved from: <https://thejournalofmhealth.com/health-impacts-of-unlimited-access-to-networked-transportation-in-older-adults/access> <https://www.sciencedaily.com/releases/2019/08/190820141616.htm> accessed 08.01.20
- ³⁰Schrempff, J. (2019). Get a ride anywhere - New options for older adults. Retrieved from: <https://www.techenhancedlife.com/citizen-research/get-ride-anywhere-new-options-older-adults>, accessed 20.8.19.
- ³¹Schrempff, J. (2019). Get a ride anywhere - New options for older adults. Retrieved from: <https://www.techenhancedlife.com/citizen-research/get-ride-anywhere-new-options-older-adults>, accessed 20.8.19.
- ³²Chan, N., & Shaheen, S., (2012). Ridesharing in North America: past, present and future. *Transport Reviews*, 32(1), 93-112. doi: 10.1080/01441647.2011.621557
- ³³See: <https://www.nidirect.gov.uk/articles/car-sharing>
- ³⁴See: <https://www.dorsetcouncil.gov.uk/travel/public-transport/community-transport/communitytransport.aspx?ct=e9943faf-9148-4089-af1d-d5acd56f2970>; <https://liffshare.com/uk/community/dorset>
- ³⁵Ahern, A. & Hine, J. (2015). Accessibility of health services for aged people in rural Ireland. *International Journal of Sustainable Transport*, 9, 389-395; Shergold, I., Parkhurst, G., 2012. Transport-related social exclusion amongst older people in rural Southwest England and Wales. *Journal of Rural Studies*, 28, 412-421; Shergold, I., Parkhurst, G., Mussetwhite, C., 2012. Rural car dependence: an emerging barrier to community activity for older people. *Transport Planning and Technology*, 35, 69-85.
- ³⁶Murray, A. & Mussetwhite, C. (2019). Older people's experiences of informal support after giving up driving. *Research in Transportation Business & Management*, 100367. Available at: <https://www.sciencedirect.com/science/article/pii/S2210539519300343>
- ³⁷Murray, A. & Mussetwhite, C. (2019). Older people's experiences of informal support after giving up driving. *Research in Transportation Business & Management*, 100367. Available at: <https://www.sciencedirect.com/science/article/pii/S2210539519300343>.

- ³⁸Prieto, M., Baltas, G. & Stan, V. (2017). Car sharing adoption intention in urban areas: What are the key sociodemographic drivers?. *Transportation Research Part A: Policy and Practice*, 101, 218–227; Burkhardt, J. & Millard-Ball, A. (2006). "Who is attracted to carsharing?" *Transportation Research Record*, 1986, 98–105; Kopp, J., Gerike, R. & Axhausen, K. (2015). "Do sharing people behave differently? An empirical evaluation of the distinctive mobility patterns of free-floating car-sharing members." *Transportation*, 42(3), 449–469
- ³⁹Musselwhite, C.B.A. (2019). Older people's mobility, new transport technologies and user-centred innovation. In B. Müller and G. Meyer (eds.) *Towards user-centric transport in Europe – Challenges, solutions and collaborations*. Lecture Notes Series, Switzerland: Springer. 87–103
- ⁴⁰Catapult. (2016). *Mobility as a service: exploring the opportunity for mobility as a service in the UK*. Retrieved: <https://ts.catapult.org.uk/wp-content/uploads/2016/07/Mobility-as-a-Service-Exploring-the-Opportunity-for-MaaS-in-the-UK-Web.pdf> accessed 08.01.20
- ⁴¹Musselwhite, C.B.A. (2019). Older people's mobility, new transport technologies and user-centred innovation. In B. Müller and G. Meyer (eds.) *Towards user-centric transport in Europe – Challenges, solutions and collaborations*. Lecture Notes Series, Switzerland: Springer. 87–103
- ⁴²True Car (2018, March, 5). The 5 Levels of Autonomous Vehicles. Retrieved from: <https://www.truecar.com/blog/5-levels-autonomous-vehicles/>
- ⁴³Audi (2019). Audi piloted driving. Retrieved from: <https://media.audiusa.com/models/piloted-driving>, accessed 25.8.19
- ⁴⁴The Verge. (2019, April, 24). It's Elon Musk VS Everyone Else In The Race For Fully Driverless Cars. Retrieved from <https://www.theverge.com/2019/4/24/18512580/elon-musk-tesla-driverless-cars-lidar-simulation-waymo>
- ⁴⁵Ramkumar, M. (2019, August, 28). Autonomous Cars: Ford and Tesla Have Big Plans. Retrieved from: <https://articles2.marketrealist.com/2019/08/autonomous-cars-ford-tesla-have-big-plans/>
- ⁴⁶Li, S., Blythe, P., Guo, W. & Namdeo, A. (2019). Investigating the effects of age and disengagement in driving on driver's takeover control performance in highly automated vehicles. *Transportation Planning and Technology*, 42(5), 470–497. doi:10.1080/03081060.2019.1609221
- ⁴⁷Houser, K. (2019, July, 8). Elon Musk: I'll Take 'Massive Effort' To Create Safe Autopilot. Retrieved from: <https://futurism.com/the-byte/elon-musk-massive-effort-save-autopilot>
- ⁴⁸Murray, C. (2019, May, 17). Automakers Are Rethinking the Timetable for Fully Autonomous Cars. Retrieved from: <https://www.plasticstoday.com/electronics-test/automakers-are-rethinking-timetable-fully-autonomous-cars/9393798360804>
- ⁴⁹Euro NCAP (2018, October, 18). #TestingAutomation. Retrieved from: <https://www.euroncap.com/en/press-media/press-releases/testingautomation/>
- ⁵⁰Centre for Connected and Autonomous Vehicles, 2018
- ⁵¹Capoli, C. et al., 2017. Social and behavioural questions associated with Automated Vehicles. A Literature Review, London: Department for Transport; Clark, B., Parkhurst, G. & Ricci, M. (2016b). *Understanding the socioeconomic adoption scenarios for autonomous vehicles: A literature review*. University of the West of England, Bristol. Available at: <http://eprints.uwe.ac.uk/29134/1/Venturer-LitReview-5-1-ReportFinal.pdf>, accessed 20.8.19
- ⁵²Harper, C., Hendrickson, C., Mangones, S., Samaras, C. (2016). Estimating Potential Increases in Travel with Autonomous Vehicles for the Non-Driving, Elderly and People with Travel Restrictive Medical Conditions. *Transportation Research Part C: Emerging Technologies*, Volume 72, November 2016, Pages 1–9. <http://dx.doi.org/10.1016/j.trc.2016.09.003>
- ⁵³Musselwhite, C.B.A. (2019). Older people's mobility, new transport technologies and user-centred innovation. In B. Müller and G. Meyer (eds.) *Towards user-centric transport in Europe – Challenges, solutions and collaborations*. Lecture Notes Series, Switzerland: Springer. 87–103
- ⁵⁴<https://www.theccc.org.uk/publication/climate-change-is-the-uk-preparing-for-flooding-and-water-scarcity-3rd-progress-report-2012/>
- ⁵⁵<https://www.registrars.gov.uk/info/road-accidents-britain> based on analysis of DfT statistics available here <https://www.gov.uk/government/statistical-data-sets/ras50-contributory-factors>
- ⁵⁶https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/706517/older-car-drivers-factsheet.pdf
- ⁵⁷https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/448036/pedestrian-casualties-2013-data.pdf
- ⁵⁸See <https://www.wired.com/2015/07/hackers-remotely-kill-jeep-highway/>
- ⁵⁹Centre for Ageing Better (2018) *The digital age: new approaches to supporting people in later life* get online. Retrieved: <https://www.ageing-better.org.uk/sites/default/files/2018-06/The-digital-age.pdf> accessed 08.01.20
- ⁶⁰See: <https://about.bnef.com/blog/electric-transport-revolution-set-to-spread-rapidly-light-medium-commercial-vehicle-market/>
- ⁶¹The Rideshare Guy - 2019 Uber and Lyft Driver Survey accessed at <https://docs.google.com/document/d/4Ep8R9p4gQk6vZfwNm-XtHkMopIofz4EPBxkoQMvYgk/edit>
- ⁶²Centre for Ageing Better (2018) *The digital age: new approaches to supporting people in later life* get online. Retrieved: <https://www.ageing-better.org.uk/sites/default/files/2018-06/The-digital-age.pdf> accessed 08.01.20
- ⁶³Schrempf, J. (2019). Get a ride anywhere - New options for older adults. <https://www.techenhancedlife.com/citizen-research/get-ride-anywhere-new-options-older-adults>
- ⁶⁴<https://www.statista.com/statistics/682596/consumers-who-own-a-motor-vehicle-in-the-united-kingdom-uk-by-age/>
- ⁶⁵Barratt, T. (2019) Zero-emission driverless cars could 'revolutionise' mobility for older people. Retrieved: <https://airqualitynews.com/2019/06/14/zero-emission-driverless-cars-could-revolutionise-mobility-for-older-people/> accessed 08.08.20
- ⁶⁶Men's car usage declines from the age of -70, while women's begins to reduce in their mid-40s, with a dramatic shift from driving to being a passenger from 70+ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/823068/national-travel-survey-2018.pdf
- ⁶⁷Clean Green Cars. (2016, December 15). Are green cars suitable if you live in a rural area? Retrieved from: <https://www.cleangreencars.co.uk/green-car-news/are-green-cars-suitable-if-you-live-in-a-rural-area/>
- ⁶⁸https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/834585/reported-road-casualties-annual-report-2018.pdf
- ⁶⁹Musselwhite, C. (2011). Successfully giving up driving for older people. ILC-UK
- ⁷⁰<https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution>
- ⁷¹https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/795185/Review_of_interventions_to_improve_air_quality.pdf
- ⁷²Neale, C., Aspinall, P., Roe, J., Tilley, S., Mavros, P., Coyne, R., Thin, N., Bennett, G. & Ward Thompson, C. 2017. The Aging Urban Brain: Analyzing Outdoor Physical Activity Using the Emotiv Affectiv Suite in Older People', *Journal of Urban Health* doi:10.1007/s11524-017-0191-9
- ⁷³Williams, 2017
- ⁷⁴Musselwhite, C.B.A. (2019). Older people's mobility, new transport technologies and user-centred innovation. In B. Müller and G. Meyer (eds.) *Towards user-centric transport in Europe – Challenges, solutions and collaborations*. Lecture Notes Series, Switzerland: Springer. 87–103.
- ⁷⁵ONS (2018) Average commute and percentage travelling by car for the UK and constituent countries Accessed 25 November 2019, <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/>
- ⁷⁶Bäckström P., Sandow E and Westerlund O (2016). 'Commuting and timing of retirement'. *The Annals of Regional Science*, 56(1), pp.
- ⁷⁷Bohan, E. (2017). How self-driving cars will transform urban living for the better. Retrieved: <https://bigthink.com/how-self-driving-cars-will-transform-urban-living-for-the-better> accessed 08.01.20.
- ⁷⁸Musselwhite, C.B.A. (2019). Older people's mobility, new transport technologies and user-centred innovation. In B. Müller and G. Meyer (eds.) *Towards user-centric transport in Europe – Challenges, solutions and collaborations*. Lecture Notes Series, Switzerland: Springer. 87–103.
- ⁷⁹Andrews, G. (2011). *Just the Ticket? Exploring the Contribution of Free Bus Fares Policy to Quality of Later Life*. A thesis submitted in partial fulfilment of the requirements of the University of the West of England, Bristol, for the degree of Doctor of Philosophy.125-152adhoocs/008986averagecommuteandpercentagetravellingbycarfortheukandconstituentcountries
- ⁸⁰Saxon, Ebert, and Sobhani (2019) Health impacts of unlimited access to networked transportation in older adults. *Journal of mHealth*. Retrieved from: <https://thejournalofmhealth.com/health-impacts-of-unlimited-access-to-networked-transportation-in-older-adults/> accessed 08.01.20.
- ⁸¹<https://www.sciencedaily.com/releases/2019/08/190820141616.htm> accessed 08.01.20.



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