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Review of the UK passenger road transport network

Future of Mobility: Evidence Review

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Review of the UK passenger road transport network

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This document is not a statement of government policy.

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Executive summary

Context

Department for Transport statistics indicate that the total road length, vehicle miles, licensed car numbers, new private vehicle registrations and household access to a car/van were higher in 2016 than at any previous time (Department for Transport, 2017f). This report reviews trends in demand for and provision of road transport in the UK. Data are drawn from several sources, including the National Travel Survey, the Census, and the London Travel Demand Survey. Interfaces between transport demand and provision are explored, and new transport data sources are highlighted to demonstrate how further insights may be gained.

Demanders of transport

Our analysis includes *personal travel* by car/van drivers, car/van passengers, and taxi passengers. As there is a lack of data on emerging shared mobility modes in travel survey data, we have used taxi passengers and car passengers as the closest proxy. Since 1997, there has been a 10% decline in trip rates and distances for car drivers. In the same period, there has been a 15% decline in trip rates and distances for car passengers. Taxi/minicab trips have declined by 3% since 1997, but there is some preliminary evidence of an increase since 2010. In contrast, annual trip distances by taxi have increased by 22% since 1997. For context, over the same period, the average number of trips by all modes has decreased by 7%.

Gender and age

On average, males drive more, and are more likely to be driving when travelling by car. Females travel less distance by all modes and are more likely to travel as a car passenger than males. Distance travelled as a car driver rises steadily from the age at which people can start driving and peaks in age group 50-59, after which it reduces with increasing age. Taxi use is consistent across genders, and peaks for the age group 21-29. Since the mid-1990s there has been a decline in car use among young adults, which is evident both in the proportion of young drivers holding a driving licence and in the number of annual miles driven.

Geography

Use of private cars varies significantly around the UK. Car trip rates and annual travel distances in London are about half of those in other regions. People in rural areas travel further by car (as both drivers and passengers), even though the total number of trips is roughly similar for different residence areas. Taxi use varies in different regions but is less common in rural areas. Time series data for rural-urban classifications suggest that travel behaviours in these different area types are relatively stable. People in rural villages travel approximately twice the distance of those in urban conurbations per year, which reflects greater distances between places of residence and the location of goods and services.

Car access

People without car access take fewer trips and travel less distance by all modes, however this excludes taxis. People without a car take approximately four times as many taxi trips per year (29) as people who live in households with access to a car (7). It is unclear whether access to a car through a shared mobility scheme would lead to the same travel behaviour as having access to a car in a person's household.

Car occupancy

Car occupancy varies significantly for car trips of different purposes; average rates are around 2 people for school and holiday trips, between 1.6-1.7 for shopping and leisure trips and only 1.2 for commuting and business trips. The data indicate that people are more likely to share trips for leisure. These figures are indicative of barriers and other practical factors that limit sharing for commuting car trips.

Travel to work

Between 2001 and 2011, the proportion of commuters travelling 10 km or over increased from 32.3% to 35.8%. The majority of 16 to 74-year olds in employment travelled to work by driving a car (54.5% in 2011) and a further 5% travelled to work as a car passenger. While the proportion of people driving to work decreased by approximately 1.2%, the overall growth in numbers working meant that there was an increase of 1.4 million people driving to work (Office for National Statistics, 2015a). Car travel to work is less common for people who live in city centre areas, particularly in London boroughs. Of the 30 local authority districts with the lowest proportion of people driving to work, only four are not in London (Isles of Scilly, Cambridge, Oxford, and Brighton and Hove). Travel to Work Areas also indicate that an increasing proportion of workers are commuting longer distances. We also find that commuting distances as a passenger are shorter than as a car driver; people in the 25-34 age group tend to travel longer to access a workplace than those in other age groups; and workers with higher qualifications tend to travel further to get to work.

Providers of transport

Private transport

The number of passenger kilometres travelled by road passenger transport in the UK has increased by approximately 350% in the last 60 years. The most significant changes in private car availability among British households took place in the period between 1950 and 2000, with the proportion of car-owning households increasing from 14% in 1951 to 74% in 2002, coinciding with an overall decline in vehicle acquisition costs. Before the widespread adoption of motorised modes of travel, more than 14.7 billion miles were travelled on bicycles in 1949. This has decreased to 3.45 billion miles travelled by bicycle in 2016.

Public transport

As of 2017, local buses accounted for 50% of all public transport journeys in Great Britain, which constitutes a significant decrease from the 74% figure recorded in 1992. A consistent downward trend has been observed across all countries since

2013, with increased congestion, car ownership, modal shift, reduction in local authority support and the emergence of online shopping recognised as contributing factors.

Taxis and shared mobility

In addition to taxis and traditional minicab services offered by Private Hire Vehicles (PHVs), new mobility modes through cars owned by third parties take the form of ride sourcing, ride sharing and car sharing. The number of licenced taxi vehicles in England and Wales increased by 19% from 2005 to 2017. In the same period, PHV registrations increased by 68%, with most gains observed since 2013, which was the year that several ride-sourcing platforms were introduced in the UK market. Where recorded, the average vehicle age upon licensing was found to be 3.6 years for taxis and 4.4 years for PHVs.

Ride sourcing

Ride sourcing describes the for-profit services provided by transportation network companies (TNCs) whereby ride sourcing operators pair potential passengers with PHV drivers via a digital platform (using GPS on a smartphone based app). The number of PHVs (87,409) and PHV drivers (117,712) in London have increased by 39% and 50% since 2015, respectively, while the number of taxi drivers has remained stable (24,487) (Transport for London, 2017). Across England and Wales, PHVs have increased from approximately 171,000 in 2015 to 210,000 in 2017, while the number of licensed taxis has remained steady at approximately 81,000. In 2017 there were approximately 8.353 million ride-sourcing platform users, and the number of users is expected to reach 11.325 million by 2020.

Ride sharing

Ride sharing refers to journeys where two or more people share a car and travel together towards a common destination. There are currently six digital ride-sharing platforms in the UK. There is a lack of data and reports that quantify usage patterns and volumes of the UK ridesharing sector.

Car sharing

Car-sharing schemes give members access to vehicles in return for annual membership and usage fees. In London, the number of car club members increased by 20% to 186,000 between 2014/15 and 2015/16, and 34.5 million miles were travelled in car club cars in 2015/16.

Bicycle sharing

As of 2017, over 10.7 million bicycle-sharing trips per annum took place in the UK, by over 450,000 regular and casual users. A total of 16 bicycle-sharing schemes were in operation, with 1,164 docking stations and 17,354 bicycles. As of January 2018, eight local authorities in the UK were known to be actively considering deploying new schemes in the near future. Dock-less bike-sharing schemes have enjoyed widespread adoption throughout Asia, and several such schemes are currently active in the UK, mostly operating in close collaboration with local authorities. Analysis of trip data from the first 7 years of operation of the

Barclays/Santander cycle hire scheme in London indicates that there is on average a 50.8% difference in the number of trips that occur in the busiest (usually July) and quietest (usually December) months of the year.

Provider/demander interfaces

The Department for Transport identified a weakening relationship between gross domestic product and car travel, and a disconnection between population growth and car use in urban areas, where the availability of other transport modes and reduced average ages contributed to a reduction in car use. There are several factors that will affect the future of demand and provision of road transport; these include peak car, the travel behaviour of young adults, shared mobility, vehicle automation, and mobility as a service.

Data for taxi use in London does not yet reflect the well-publicised rise in Transportation Network Companies (TNCs). However, occupancy for taxi trips is higher, indicating a greater tendency to share taxi trips, and taxi trips tend to be point-to-point. Taxi trips tend to be longer than car trips, but shorter in duration than public transport. As new shared mobility modes emerge, travellers may prefer to use them for direct services, rather than for multi-stage trips, which implies that local authorities should be proactive in integrating these services with existing public transport networks to limit further congestion on roads.

There is significant opportunity to utilise new data sources at the interface of road travel demand and provision. Among the examples discussed are: how mobile phone data can be used to understand travel behaviour at higher temporal and spatial resolutions, how data can be used for dynamic route planning, to inform the integration of emerging transport technologies, and to enable peer-to-peer sharing.

Conclusions and recommendations

Our review of data characterising demanders and providers of road transport in the UK indicates that there is significant stability in general trends and that existing travel survey data indicate that new shared modes of transport are making inroads only in particular geographical areas. The new shared modes are poorly captured by existing survey questions, and there is a significant opportunity to utilise new data sources to improve understanding of how these modes may emerge, and therefore inform the evolution of road travel in the UK.

We make the following recommendations:

1. Review existing forecasts of road travel demand in the UK and conduct side-by-side comparisons under a range of different scenarios.
2. Incorporate more categories of road travel into existing travel surveys to account for new modes of travel.
3. Evaluate new sources of data and explore the potential to use machine-learning techniques to leverage the various forms of data collected and support government efforts to track travel demand and direct future infrastructure investment.

Contents

1 Introduction

Context

Statistics from the Department for Transport (DfT) indicate that 2016 was a record-breaking year for car travel in the UK, with total road length, vehicle miles, licensed cars, new private vehicle registrations and household access to a car/van all being higher than ever (Department for Transport, 2017f).

As of 2016, there is a total of 246,510 miles of road in Great Britain (GB), consisting of 2,268 miles of motorways, 29,090 miles of A roads and 215,152 miles of minor roads. Car travel is the most common mode of transport in GB; it accounted for 62% of all trips, 78% of all passenger miles travelled and 253 billion vehicle miles in 2016. Over 30.9 million vehicles are licensed for use on GB roads and there were 2,418,000 new private car registrations in 2016 in GB. In England, there were 32.4 million full UK driving licence holders, and 77% of households had access to a car/van in 2016.

Private car ownership – that is owning or leasing a vehicle for private use within households – is currently the primary means of accessing cars. However, a range of alternative models has emerged in recent years, largely facilitated by advances in information and communication technologies (ICT), which have brought the private road transport system into a state of flux, particularly in urban areas (Morton et al., 2017). In the UK, 83% of the population live in urban areas. This has increased from 78% in 1960 (World Bank, 2018; Department for Environment and Rural Affairs, 2018).

A small number of forecasts pertaining to the future of the private road transport activity are currently in the public domain and are summarised in Table 1 (approximate figures). The most prominent forecasts are from the DfT using the National Transport Model. At the time of writing, these had last been updated in 2015 to account for a broad set of uncertainties, and currently include car ownership and trip rates in addition to income growth and fuel prices (Department for Transport 2015a).

As shown in Table 1, DfT analysis indicates that, across all of the envisaged scenarios, car traffic is forecast to range between 355 billion and 480 billion vehicle kilometres in 2040, an increase of 4-40% from 2010. The car fleet is also forecast to increase from 24 to 31-35 million. The main reason for the forecasted increase in traffic levels is population growth, exacerbated by rising incomes and falling costs. Collectively, these are expected by the DfT to contribute towards an increase in the proportion of trips and the distance per person travelled by car.

Other forecasts of the UK transport system include the UK Infrastructure Transitions Research Consortium's National Infrastructure Systems Model (NISMOD) (Hall et al., 2017), and the UK Transport Carbon Model (UKTCM) (Brand et al., 2012; Brand et al., 2013; Brand et al., 2017), summarised in Table 1. The UKCTM forecasts of vehicle-km and fleet sizes in 2040 are above the range of forecasts for the DfT scenarios. An evaluation of differing methodologies and prediction of road traffic forecast models is a significant research gap. Furthermore, transport planning and policy making could have a significant effect on the future of transport, via the provision of infrastructure and the promotion of alternative vehicles or transport modes (Hickman and Banister, 2007; Lyons and Davidson, 2016).

Table 1: Comparison of different estimates and forecasts for the private road transport system in 2010 and 2040, respectively.

Year	Source	Vehicle km (billions)	Passenger km (billions)	Car fleet (millions)	Car ownership per person†	New car sales (millions)
2010	DfT (2015a)	340		24	0.38–0.55‡	
	NISMOD (Hall et al., 2017)		630			
	UKTCM (Brand et al., 2017)			30		
	UKTCM (Brand et al., 2013)					2.4
	UKTCM (Brand et al., 2012)	408*				
2040	DfT (2015)	355–480‡		31–35‡	0.43–0.62‡	
	NISMOD (Hall et al., 2017)		650–950‡			
	UKTCM (Brand et al., 2017)			44**		
	UKTCM (Brand et al., 2013)					3.4***
	UKTCM (Brand et al., 2012)	490**				3.4**

† Lower and higher values represent London and South West regions respectively
‡ Range of values represents results from different scenarios
* Interpolated between 2007 and 2015
** Interpolated between 2030 and 2050 forecast
*** Interpolated between 2020 and 2050 forecast

Structure of report

Section 2 focuses on demanders of road transport and reviews available travel survey and Census data, Section 3 focuses on different providers of road transport mobility services, Section 4 focuses on emerging trends at the interfaces between providers and demanders, and Section 5 summarises the conclusions and areas for further research.

2 Demanders of road transport

Our analysis includes personal travel by car/van drivers, car/van passengers, and taxi passengers. Conventional public transport modes (for example, bus or train) are considered out of the scope of personal road transport. There is a lack of data on emerging shared mobility modes in National Travel Survey data so we have used taxi passengers and car passengers as the closest proxy. Due to the aggregation of trips by car and van in travel survey statistics, these are combined and are referred to as car travel unless explicitly mentioned.

Data sources

Travel survey data was compiled from the 2016 National Travel Survey (Department for Transport, 2017c), 2011 Census data (Nomis - Office for National Statistics, 2013), and the 2016 London Travel Demand Survey (Transport for London, 2016a). Given that the National Travel Survey coverage changed from sampling residents of all Great Britain to residents of England only in 2013, many of the presented data trends are for England.

National Travel Survey

The 2016 National Travel Survey (NTS) (Department for Transport, 2017c) is the latest in a series of UK household surveys dating from the mid-1960s and conducted annually from 1988. The survey is designed to track long-term development of trends in personal travel and care must be taken when drawing conclusions from short-term changes. NTS data is collected via two main methods. Firstly, face-to-face interviews are carried out with all members of the household to collect personal and household characteristics, along with information on all of the vehicles to which they have access. Secondly, each household member is then asked to record details of all their trips over a seven-day period in a travel diary, allowing travel patterns to be linked with individual characteristics. The NTS covers travel by people in all age groups, including children.

For the 2016 NTS, 6,656 households in England participated fully in the survey by providing information via interview and completing a seven-day travel diary. In addition to the publicly available data online, an additional data request was made to the NTS statistics team via the Government Office for Science.

The subject of the NTS is personal travel (Department for Transport, 2016). This is travel for private purposes or for work or education, provided the main reason for the trip is for the traveller himself or herself to reach the destination. The NTS covers only private households within England and excludes people not living in households, such as students in halls of residence and tourists. Trips made in the course of work are included, provided that the purpose of the trip is for the traveller to reach a destination. Travel to deliver goods, or to convey a vehicle or passengers (for example, as a bus driver or taxi driver), is not covered. Travel for a leisure purpose is normally included. However, trips which are themselves a form of recreation are not.

A household consists of one or more people who have the sampled address as their only or main residence and who either share at least one main meal a day or share the living accommodation. Individuals are characterised by their age, sex, economic status, region, access to a car, and settlement type in the form of an urban/rural indicator. The term 'car' and 'car/van' is used for all three- or four-wheeled vehicles with a car body type, and also light vans, 4x4 vehicles, minibuses, dormobiles and motorcaravans. Such vehicles are regarded as household cars if they are either owned by a member of the household, or available for the private use of household members.

The '*main driver*' of a household car is the household member that drives the furthest in that car in the course of a year. Households with two or more cars are likely to have two or more main drivers, one for each car. '*Other drivers*' are people in car-owning households who have a full driving licence to drive a car but are not main drivers of a household car. '*Non-drivers*' are all other people in car-owning households. They include children below driving age and adults with provisional driving licences.

A rural-urban classification is used to distinguish residents of rural and urban areas. The classification defines areas as rural if they fall outside of settlements with more than 10,000 resident population. At its most detailed the rural-urban classification assigns areas to one of six rural or four urban settlement types. Urban areas are the connected built up areas identified by Ordnance Survey mapping that have resident populations above 10,000 people (2011 Census). Rural areas are those areas that are not urban, that is consisting of settlements below 10,000 people or are open countryside.

Census

The Census takes place every ten years to estimate the population of all people and households in England and Wales. It is the only survey that includes the entire population, covers everyone at the same time and asks the same core questions everywhere. The information the Census provides allows central and local government, health authorities and many other organisations to target their resources more effectively and to plan housing, education, health and transport services for years to come. The latest Census was held on Sunday 27 March 2011.

The Census includes questions on the method of travel to work and the location of home and workplace, which can then be related to other characteristics of the respondents, including geography and demographics (Office for National Statistics, 2013). Data on the Census data relating to the method of travel to work was obtained from Nomis (Nomis - Office for National Statistics, 2013).

Travel to work areas (TTWAs) are a geography created to reflect self-contained labour market areas in which most people both live and work, and are produced by Newcastle University for the Office for National Statistics using the Census data on travel to work (Office for National Statistics, 2016). A self-contained labour market area is one in which all commuting occurs within the boundary of that area and the main criteria for defining TTWAs are that at least 75% of the area's resident workforce work in the area and at least 75% of the people who work in the area also live in the area. The resulting TTWAs are not fixed in size and are not constrained by administrative boundaries. The size and number of TTWAs is indicative of commuting distances; fewer, larger TTWAs would indicate longer commuting distances. As the definition of TTWAs has remained consistent from between the 2001 and 2011 censuses, they are useful for revealing UK-wide trends.

The standard TTWAs represent approximate self-contained labour market areas for the working population as a whole. However, alternative TTWAs have been developed to highlight commuting patterns for different subgroups of the working population. The method used to produce the 2011 TTWAs was applied to origin and destination data for subgroups of working people with different population characteristics in the 2011 Census, to create alternative TTWAs by age group, employment type, method of travel to work and highest level of qualification. In other words, a set of TTWAs has been created for each of the subgroups. For example, the 25 to 34 age group TTWAs are calculated only from that subgroup of the population (Office for National Statistics 2016).

London Travel Demand Survey

The London Travel Demand Survey annually interviews 8,000 random households in London and the surrounding area (Transport for London, 2016a). The survey uses three questionnaires to collect:

1. household demographic information;
2. individual demographic and travel-related information such as working status, frequency of use of transport modes, driving licenses and public transport tickets; and
3. trip sheets to record all trips on a designated travel day, capturing trip purposes, mode choice, start and end times, and locations of trip origins and destinations.

Car travel per person

Trends

Trends in the average number of trips and distance travelled by as a car driver, car passenger, taxi are shown in Figure 1. Since 1997, there has been a 10% decline in trip rates and distances for car drivers. In the same period, there has been a 15%

decline in trip rates and distances for car passengers. Taxi/minicab trips have overall declined by 3% since 1997, but there is some preliminary evidence of an increase since 2010. Between 1997 (1995/97) and 2000 (1998/00) there was a 31% increase in taxi/minicab distance travelled. Despite a decreasing trend since then, the overall distance travelled is still 22% higher than in 1997. However, sample size for taxis is smaller and therefore the trends cannot be interpreted to be conclusive. For context, over the same period, the average number of trips by all modes of transport has decreased by 7%.

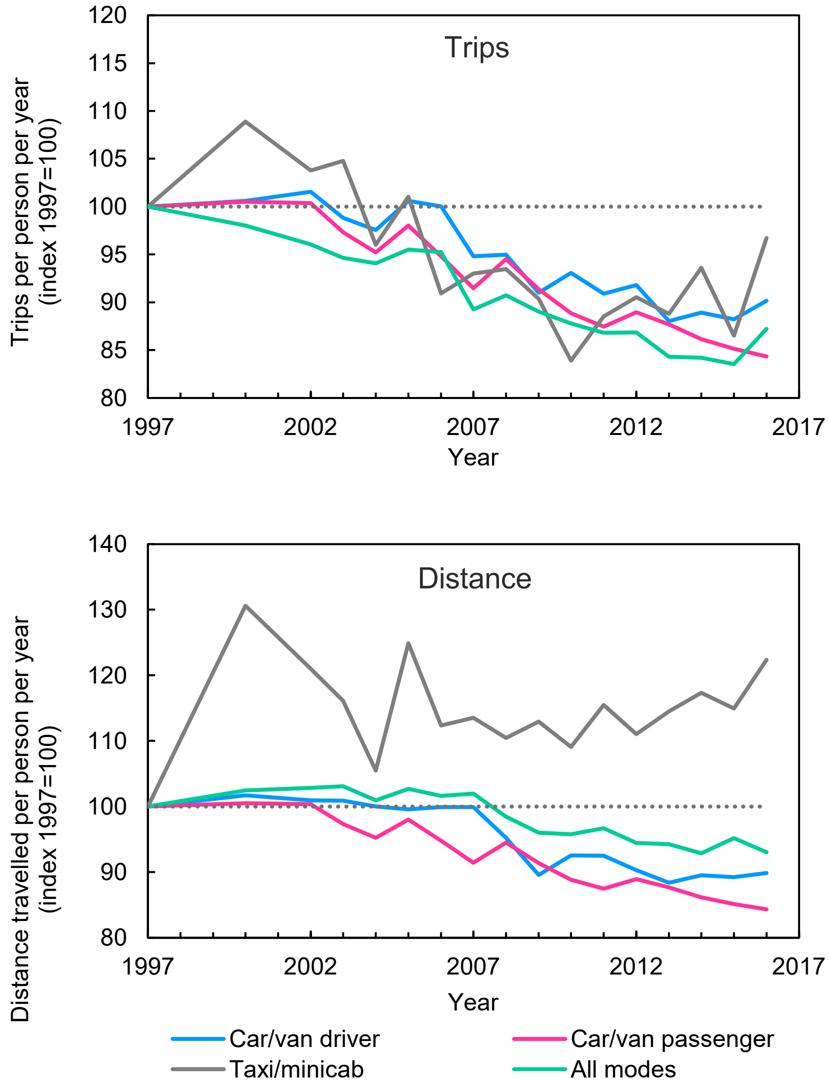


Figure 1: Average number of trips and distance travelled per person per year by different car use in England, indexed to 1997 (Table NTS0303, NTS0305).

Life stage and gender

Figure 2 shows the distance travelled by different car modes and all modes of transport for different ages and genders. Overall, males drive more, and are more likely to drive when travelling by car. Females travel less distance by all modes and are more likely to travel as a car passenger than males. Distance travelled as a car driver rises steadily from the age at which people can start driving and peaks in age group 50-59, after which it reduces with increasing age. Taxi use is consistent across males and females; however, it peaks for the age group 21-29.

Older drivers

By 2040, nearly one in seven people is projected to be over the age of 75 (Government Office for Science, 2016). Around the same time, one in 12 of the population will be over 80 (Office for National Statistics, 2015b). The percentage of people aged over 70 who have a driving licence increased from 38% in 1995/97 to 58% in 2012, and this this is forecast to continue to increase to ~70% in 2030 (Mitchell, 2013). People who are aged 70+ in 2040 will be used to driving and will be in work for longer, so there may be an increase in the activity of older drivers in the private road transport system (Musselwhite et al., 2015; Shergold et al., 2015).

Staying connected to communities and social networks is associated with positive mental and physical health (Musselwhite et al., 2015). Technologies, such as driver assistance and vehicle automation, may help to improve the safety of the private road transport system for older drivers. However, how older drivers accept, adopt and make choices regarding these technologies requires further research. Recent studies suggest that older drivers may resist the adoption of autonomous and shared vehicles (Abraham et al., 2017; Haboucha et al., 2017). A high level of adoption of these technologies may increase mobility by car of the growing number of older people, significantly increasing private road traffic in 2040 (Harper et al., 2016).

Young drivers

Since the mid-1990s there has been a decline in car use amongst young adults, which is evident both in terms of the proportion of young people holding a driving licence (Figure 3) and in the number of annual miles driven. There is a clear dependence on place of residence; young adults living in London are significantly less likely to hold a full UK driving licence than those in other urban areas. Those who live in rural areas are most likely to hold a driving licence. The main determining factor in annual mileage is whether the young adult drives themselves to work (Berrington and Mikolai, 2014). Surveys indicate a number of reasons why British young adults are not acquiring driving licences. These include the financial costs (learning, insurance and purchase): a higher personal income is related to a greater likelihood of holding a licence (Le Vine and Polak, 2014).

Implications for future private car activity are that increases in educational enrolment, unemployment, the proportion of young adults living in the parental home, and stagnating incomes for this demographic, may all be associated with declining in car use amongst young adults. Conversely, future increases in the level of education, female employment, and young adult incomes may be associated with an increase in licence-holding and car use (Berrington and Mikolai, 2014; Le Vine and Polak, 2014). Further research is required to understand the interaction of these potential trends, but the evidence also suggests there are many policy levers that could be used to promote or deter car use amongst young adults.

Furthermore, recent evidence suggests that young adults (aged 16-21) in the UK do not have a cultural affection for car ownership, but rather see it as another mode of transport that facilitates access to work and sociability (Green et al., 2017). This indicates that car use amongst young adults may be determined by a rational comparison between cars and other modes of transport. Similar patterns of reducing numbers of young adults obtaining driving licences are also occurring in other parts of the world (Delbosc, 2017).

A recent report to the DfT provides an in-depth analysis of the travel behaviour of young adults and the implications for future travel demand in the UK (Chatterjee et al., 2018).

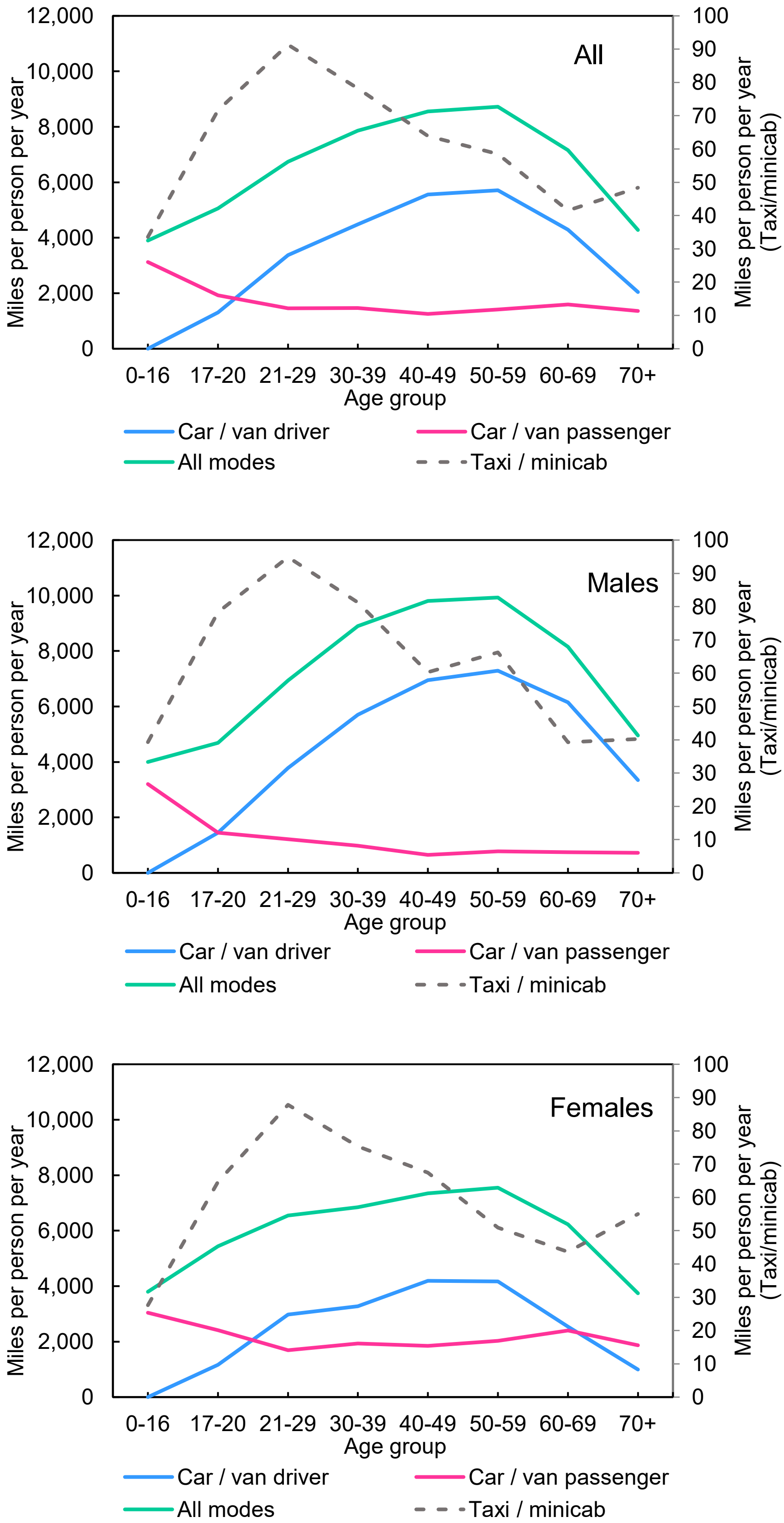


Figure 2: Distance travelled by car, by age group and by gender in England, 2016 (Table NTS0605).

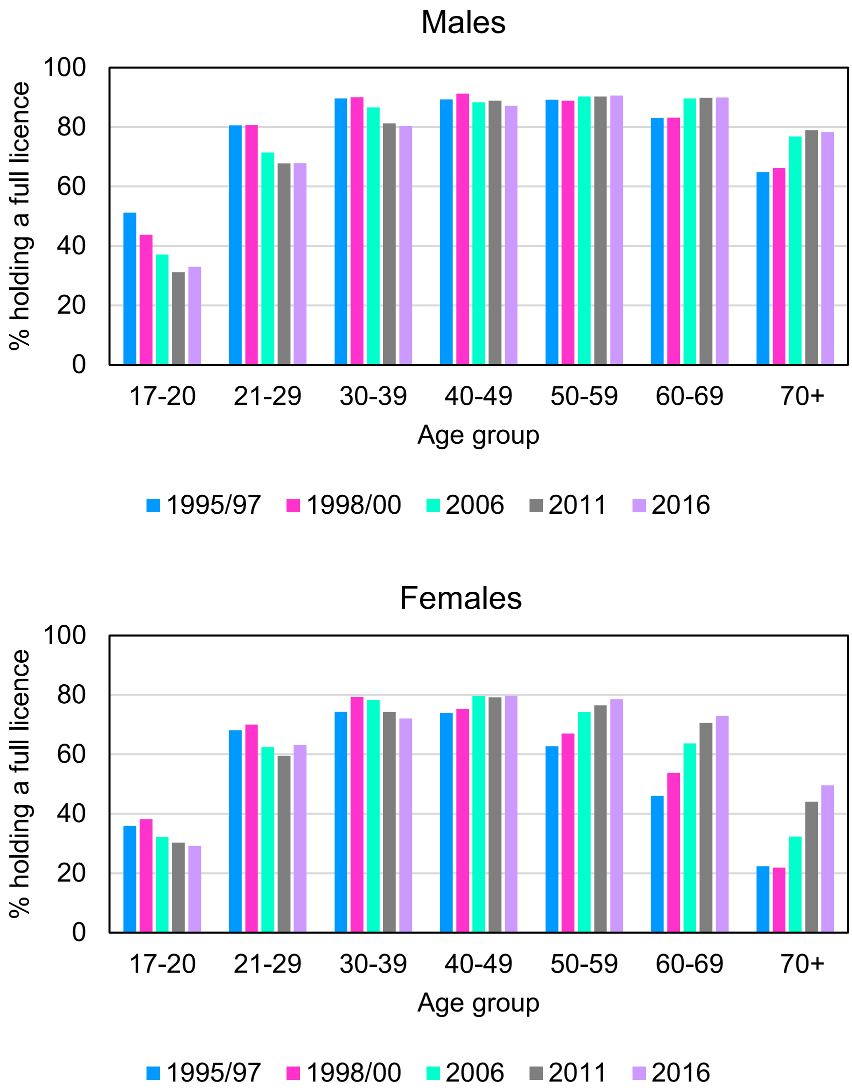


Figure 3: Percentage of people holding a full driving licence in England (Table NTS0201).

Geography

Use of the private car varies significantly with location. Table 2 and Table 3 show the number of trips and distance travelled by car modes in different regions and area types (rural-urban classification) in England in 2015/16. Car trip rates and annual distances in London are about half of what they are in other regions. It is also clear that people in rural areas travel more by car (trips and distances), as a driver and passenger, even though the total number of trips is roughly similar for different regions of residence. Taxi use varies in different regions, with the highest level of use found in the North East, North West, Yorkshire and Humber and the West Midlands. Taxi travel is less common in rural areas.

Figure 4 and Figure 5 show time series of trips and distance travelled for rural-urban classifications by different car modes and for all modes of transport as context. While there is a gradual decline in the number of trips and distance travelled across all areas (consistent with the discussion above), the data suggests that travel behaviours in these different area types is relatively stable.

Car use differs with the level of urbanity; the number of trips and distance travelled by car drivers and car passengers are highest for the most rural areas. Conversely, the number of taxi trips are highest in urban areas.

Urbanites make ~10% less trips by all modes than those living in other areas, however the number of trips per person by all modes in different areas is relatively consistent. A difference is observed in the distance travelled by people living in different areas – those in rural villages travel approximately twice the distance of those in urban conurbations per year. This reflects the greater distances between places of residence and the location of goods and services (such as education and work).

Table 2: Trips per person per year by car modes in different regions and rural-urban classifications, England 2015/16 (Table NTS9903).

	Trips per person per year			
Region of residence:	**Car / van driver**	**Car / van passenger**	**Taxi / minicab**	**All modes**
North East	373	191	16	902
North West	410	221	17	962
Yorkshire and The Humber	421	221	13	972
East Midlands	432	236	8	1,002
West Midlands	408	224	15	918
East of England	428	219	7	949
London	189	105	7	792
South East	442	219	7	965
South West	432	226	6	998
England excluding London	422	221	11	961
England	385	203	10	934
Rural-Urban Classification of residence				
Urban Conurbation	308	175	12	878
Urban City and Town	412	216	11	966
Rural Town and Fringe	455	225	6	985
Rural Village, Hamlet and Isolated Dwelling	542	244	4	984
All areas	385	203	10	934

Table 3: Distance travelled per person per year by car modes in different regions and rural-urban classifications, England 2015/16 (Table NTS9904).

	Distance (miles) per person per year			
Region of residence	**Car / van driver**	**Car / van passenger**	**Taxi / minicab**	**All modes**
North East	3,038	1,711	65	6,082
North West	3,155	1,789	70	6,266
Yorkshire and The Humber	3,373	2,025	57	6,635
East Midlands	3,815	2,109	47	6,970
West Midlands	3,255	1,900	79	6,072
East of England	3,958	2,043	49	7,582
London	1,394	941	61	4,555
South East	4,076	2,058	49	7,644
South West	3,988	2,363	30	7,713
England excluding London	3,636	2,012	56	6,957
England	3,278	1,841	56	6,574
Rural-Urban Classification of residence				
Urban Conurbation	2,210	1,372	67	5,219
Urban City and Town	3,482	1,917	53	6,745
Rural Town and Fringe	4,749	2,476	47	8,589
Rural Village, Hamlet and Isolated Dwelling	5,861	3,064	36	10,159
All areas	3,278	1,841	56	6,574

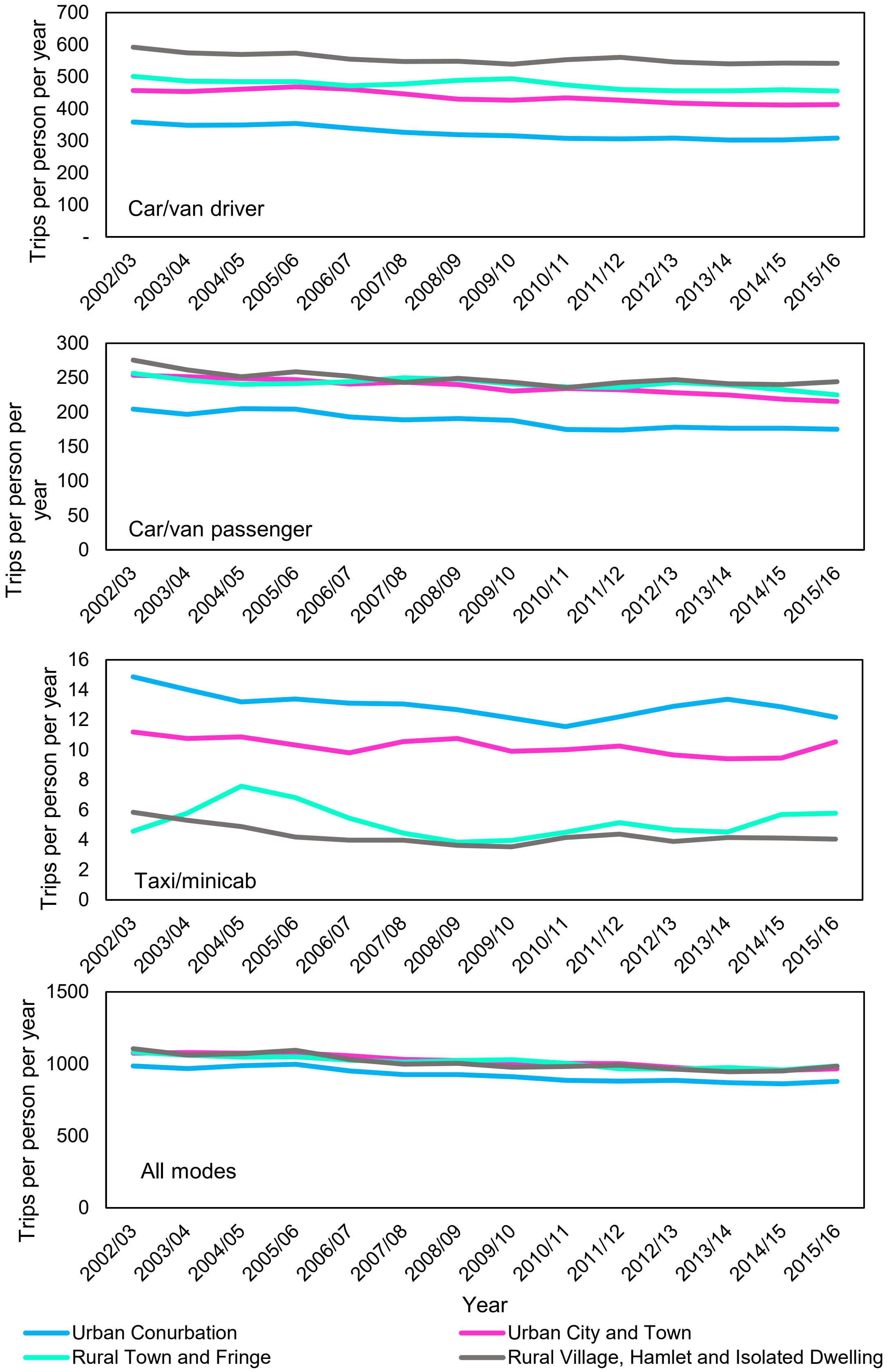


Figure 4: Number of trips per person per year by area type in England, 2002-2016 (Table NTS9903 special request).

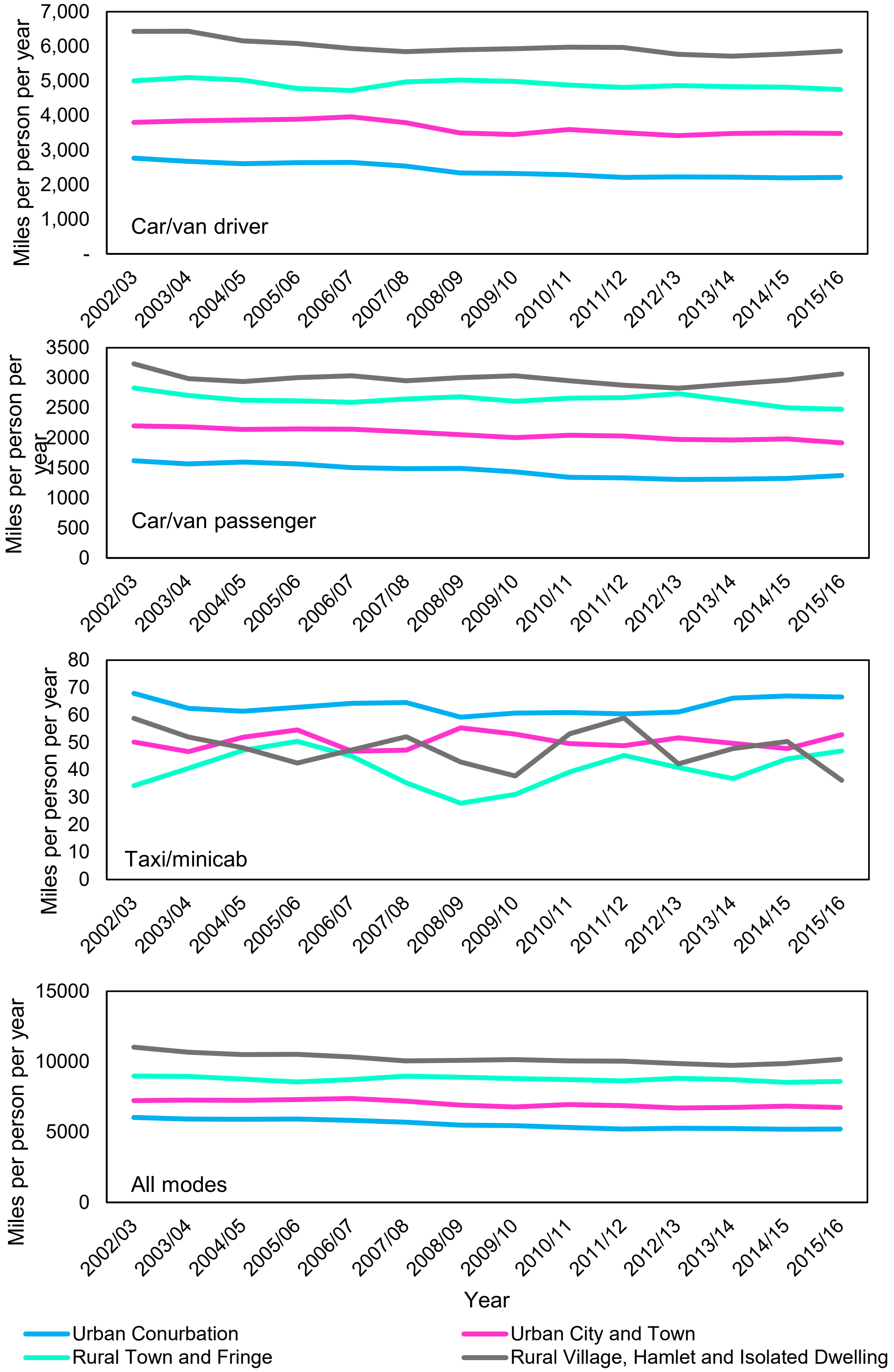


Figure 5: Distance travelled per person per year by area type in England, 2002-2016 (Table NTS9904 special request).

Car access

Access to a car is also a key determinant of car travel behaviour, as shown in Table 4. People without access to a car take fewer trips and travel less distance, by car and by all modes overall. People without a car also take approximately four times as many taxi trips per year (29) as people who live in households with access to a car (7). However, in terms of the other form of sharing captured by the survey data, namely as a passenger in a car, people living in households with a car take approximately 2.5 times more trips as a car passenger (226) than people without car access (90). People without car access take approximately three times more trips as a car passenger (90) than by taxi (29). These differences are greater in terms of distance travelled, indicating that car passenger trips are longer than taxi trips on average.

It is unclear whether access to a car through a shared mobility scheme would lead to the same travel behaviour as having access to a car in a person's household.

Table 4: Trips and distance travelled per person per year by car modes and personal car access for 2015 and 2016 (Table NTS0702).

		People in households with a car / van				
Trips per person per year by car modes	**People in households without a car / van**	**Main driver**	**Other driver**	**Non-driver**	**All**	**All persons**
Car / van driver	7	789	263	3	471	389
Car / van passenger	90	93	247	441	226	202
Taxi / minicab	29	5	8	9	7	11
All modes	702	1,135	903	829	1,008	954
Distance (miles) per person per year by car mode						
Car / van driver	51	6,745	1,821	36	3,981	3,289
Car / van passenger	793	1,220	2,507	3,155	2,004	1,790
Taxi / minicab	113	46	61	44	47	58
All modes	2,836	9,169	6,686	4,313	7,282	6,499

Trip purpose

Figure 6 shows the proportions of trips for different purposes for different rural-urban area classifications in England. The greatest proportion of trips are shopping trips (18-20%), followed by commuting trips (13-17%), personal business trips (10-11%), and visiting friends at their home (8-10%).

London is an anomaly in that commuting trips account for the greatest proportion of trips (20%), followed by shopping trips (17%).

Figure 7 shows that commuting trips account for the greatest proportion of distance travelled (15-23%), followed by visits to friends at their home (13-15%), holiday trips (12-14%), and shopping trips (10-14%).

In London, commuting trips account for a greater proportion of distance travelled (26%), than in any other region. Furthermore, in contrast to total distance travelled, which decreases with urbanity, the reverse is true for the proportion of distance travelled for commuting purposes, which is higher for urban areas than rural areas.

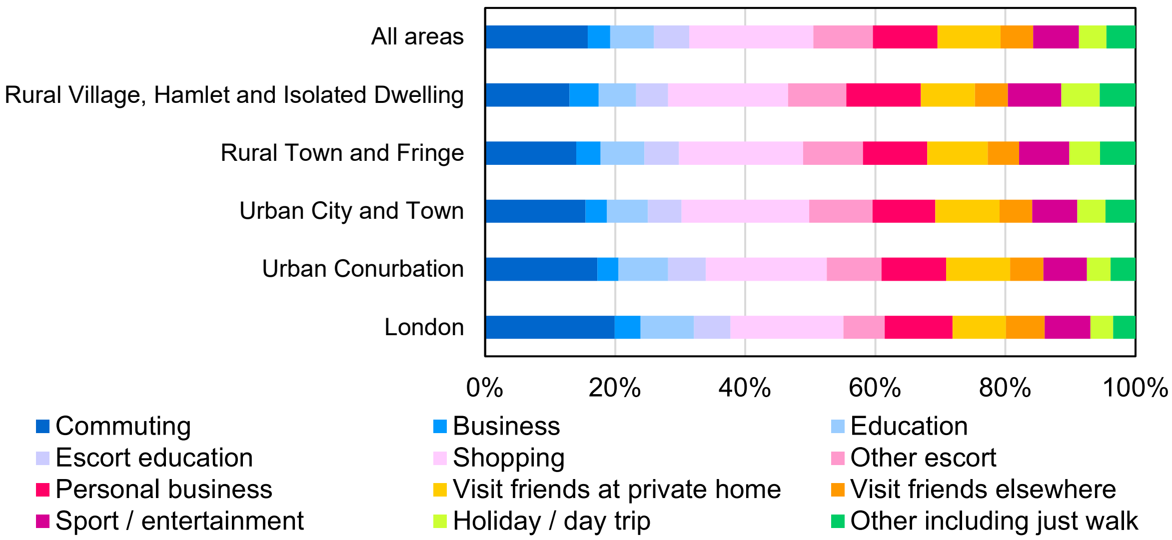


Figure 6: Trip purpose share by rural-urban classification in England, 2014/15 (Table NTS9904).

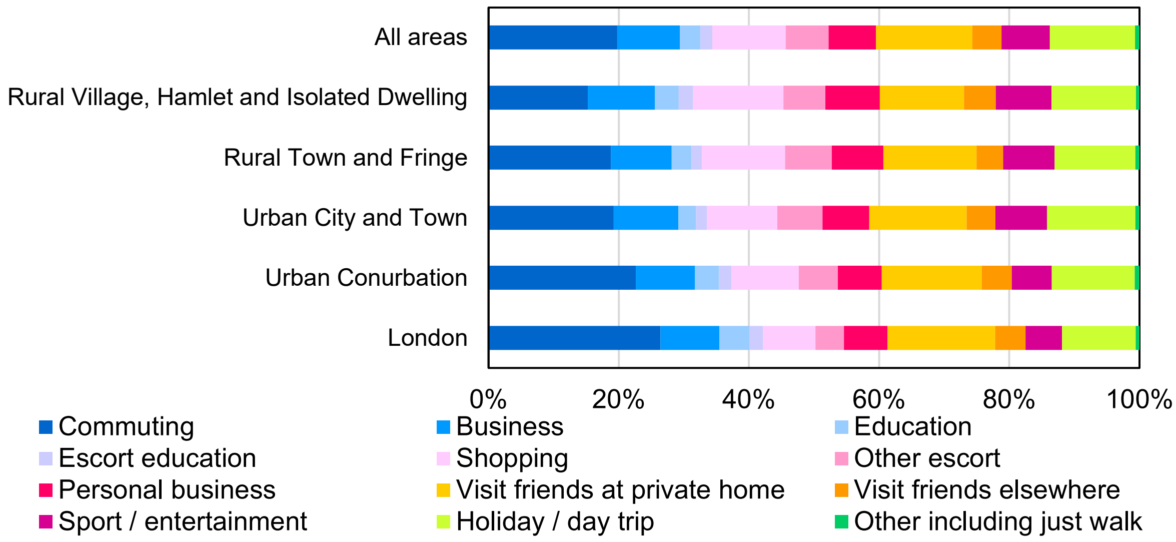


Figure 7: Trip purpose share by distance travelled and rural-urban classification in England, 2014/15 (Table NTS9904).

Car occupancy

Car occupancy varies significantly for car trips of different purposes, as shown in Table 5. Average car occupancy is around 2 for education (journeys to and from school) and holiday trips, around 1.6-1.7 for shopping and leisure trips, but only 1.2 for commuting and business trips.

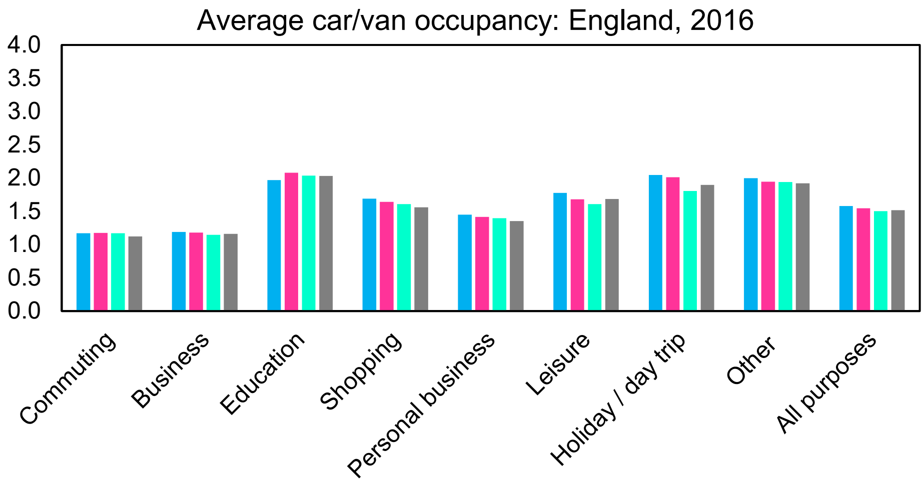
This indicates that people are more likely to share trips for leisure. However, it also indicates that there are barriers or practical factors that limit sharing for commuting car trips.

The higher occupancy for leisure trips is reflected in the NTS data on trip rates by purpose and main mode (NTS0409 and NTS0410), which show that the most common purpose for trips as a car passenger is leisure. These data also show that leisure is the most common purpose of taxi/minicab trips.

Table 5: Car/van occupancy by trip purpose in England in 2016 (NTS0906).

Trip purpose	Average car/van occupancy	Single occupancy rate (%)
Commuting	1.2	86
Business	1.2	87
Education	2.0	37
Shopping	1.6	52
Personal business	1.4	69
Leisure	1.7	55
Holiday / day trip	2.0	40
Other including just walk	2.0	36
All purposes	1.5	62

Figure 8 shows the average car occupancy for car and taxi trips by trip purpose in England by different area classification. In general, occupancy for taxi trips is greater (1.5-4) than for car trips (1-2), indicating that people have a greater tendency to share taxi trips. The highest average occupancy is for taxi trips for education purposes in rural areas.



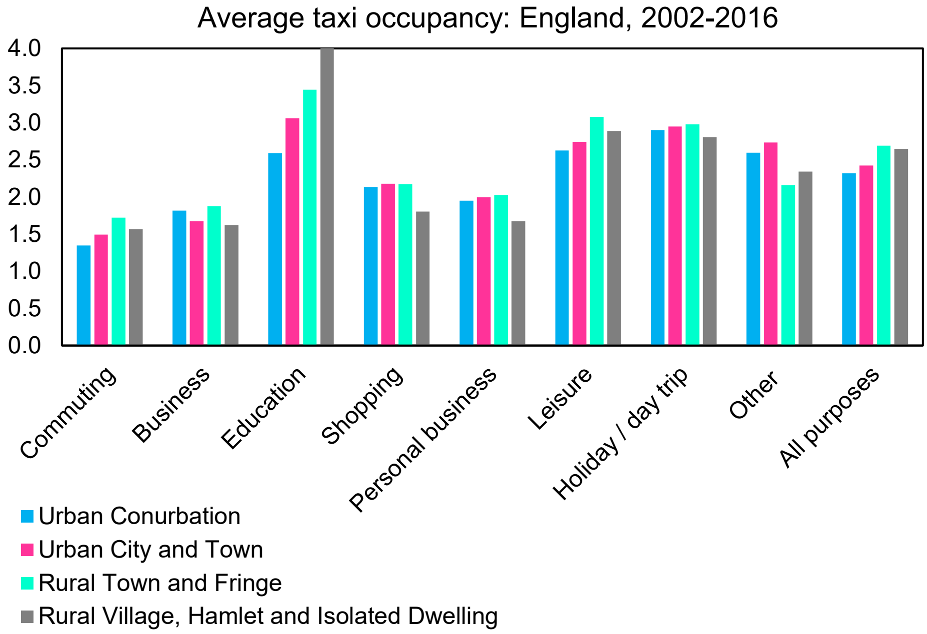


Figure 8: Average car occupancy for car/van trips in England, 2016; and average taxi occupancy in England, 2002-2016 (Table NTS0906 special request).

Travel to work

Method of travel to work

Census data provide further insight into the mode of choice for commuting trips around the country. Method of travel to work is the mode of transport used to cover the longest part, by distance, of a journey to work in the week before the Census day.

Between 2001 and 2011, commuting distances increased, as shown in Figure 9. The proportion of commuters travelling 10km or more increased from 32.3% to 35.8%. This trend is linked to the main mode of transport to work, which is shown in Figure 10. In 2001 and 2011, the majority of 16- to 74-year-olds in employment travelled to work by driving a car or van (55.2% in 2001, 54.5% in 2011). A further 6.3% and 5% travelled to work as a passenger in a car or van in 2001 and 2011, respectively. The second most reported method of travel to work was by foot (10%), whilst the third was travel by bus, minibus or coach (7%). While the proportion of people driving to work decreased by ~1.2%, the overall growth in the number of people working meant that there was an increase of 1.4 million people driving to work (Office for National Statistics, 2015a). Between 2001 and 2011, the proportion of people working from home, commuting by train, and commuting by underground/metro/light rail increased by 12%, 22% and 27%, respectively, albeit from low bases.

Figure 11 shows that the main difference in mode choice in different areas is the proportion of people using public transport (including buses, trains and underground trains/light rail/trams) versus cars. In London, 50% of people aged 16 to 74 who were in employment were primarily using public transport to travel to work, compared with 31% travelling by car, motorcycle or taxi. Outside London, the proportion of workers mainly using public transport ranged from 6% in the South West to 13% in the North East, with the percentage using cars, motorcycles or taxis ranging from 67% in the South East to 75% in Wales.

Although the South West had the lowest percentage of journeys to work by public transport, it had the highest percentage of workers travelling on foot or using a bicycle (17%), together with the highest percentage of people working from home (7%). In other areas the percentage using foot or bicycle varied from 12% in the West Midlands to 14% in Yorkshire and the Humber.

The method of travel to work is shown with greater geographical resolution in Figure 12, which aggregates the 2011 Census responses to local authority districts (LADs) and reveals the geographical variation in the proportion of people who drive to work and who are driven to work as a car passenger. Car travel to work is less common for people who live in city centre areas, particularly in London boroughs. Of the 30 LADs with the lowest proportion of people driving to work, only four are not in London (Isles of Scilly, Cambridge, Oxford and Brighton and Hove). These data are shown in Table 6.

The LADs with the highest percentage of workers who are driven to work as a car passenger are Boston (11.55%), Corby (11.13%) and Merthyr Tydfil (10.65%), as shown in Table 7. It has not been possible to discern clear similarities between these areas in terms of demographics and economic characteristics. A more detailed study of these areas would be required to reveal the reasons for the relatively high car sharing.

There is a positive correlation between the percentage of people who drive to work and the percentage of people who are driven to work (Figure 13). However, other factors are also likely to influence the proportion of people that use a carpool to travel to work in a given area.

Figure 9: Commuting distances in the UK in 2001 and 2011 (ONS, QS701EW).

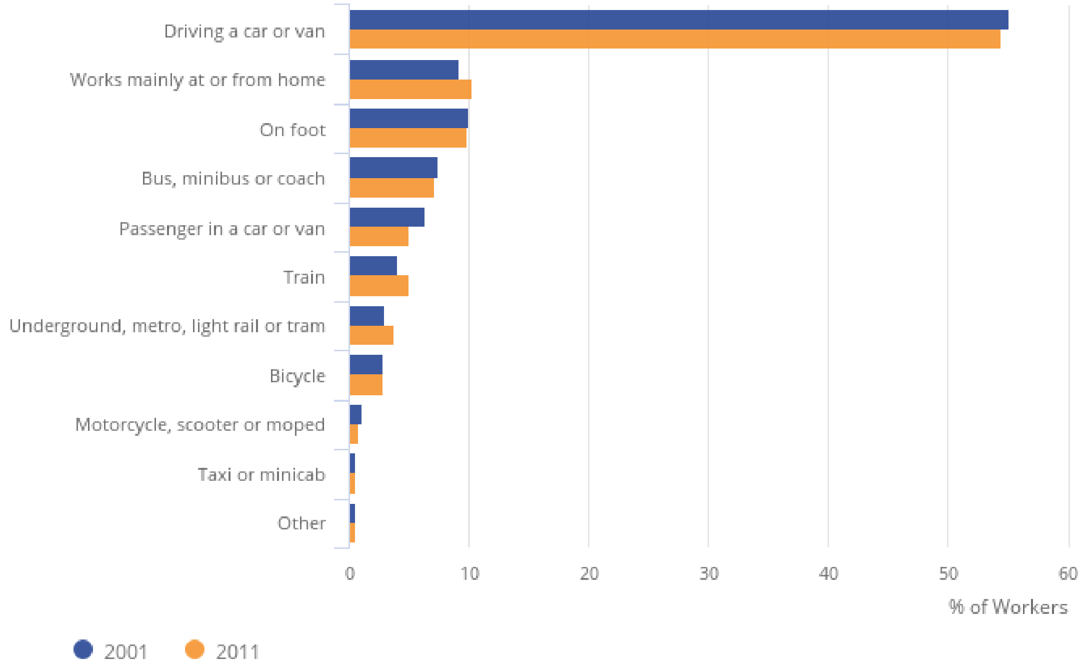


Figure 10: Method of travel to work in 2001 and 2011 (ONS, QS701EW).

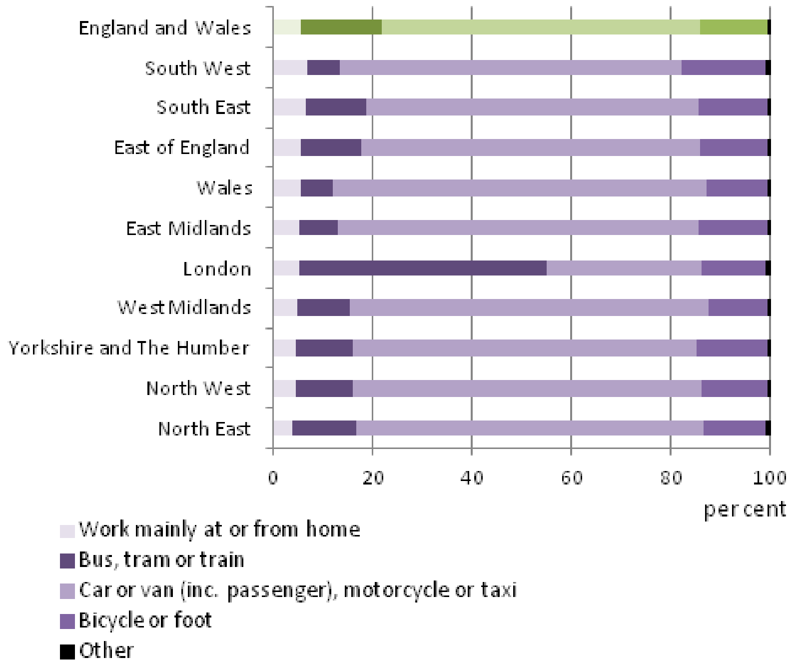


Figure 11: Method of travel to work by region in 2011 (ONS, QS701EW).

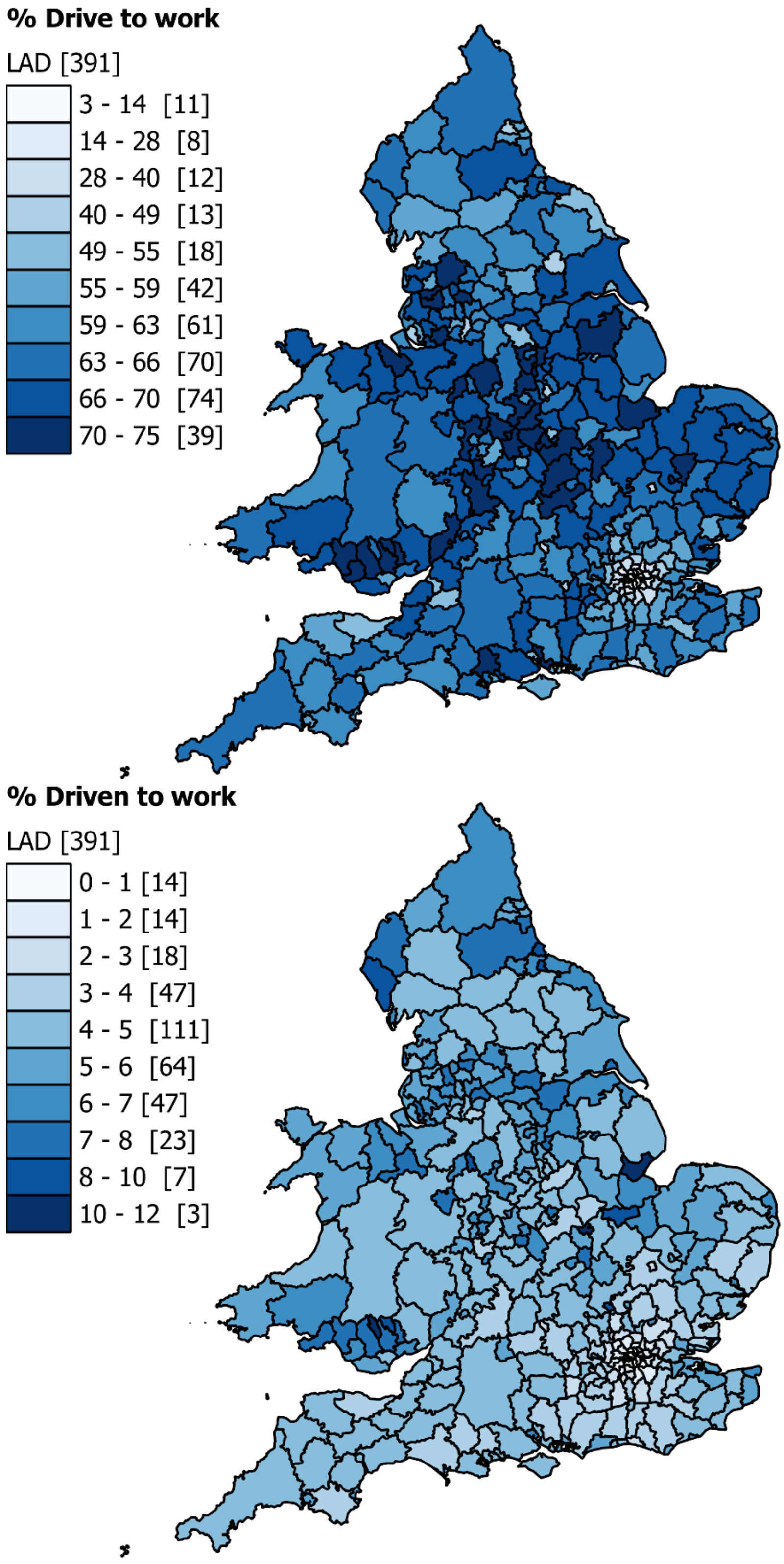


Figure 12: Method of travel to work for different Local Authority Districts in England, 2011 (ONS, QS701EW)[1].

[1] Classes determined using Natural Breaks (Jenks). Numbers in square brackets indicate the number of LADs in each class

Table 6: Percentage of workers who drive to work and are driven to work in different local authority districts in England and Wales, ranked by lowest percentage of people driving to work.

	Local authority district	% of workers who drive to work	% of workers who are driven to work
1	City of London	3.05	0.25
2	Islington	9.22	0.67
3	Westminster	9.44	0.78
4	Camden	10.01	0.73
5	Tower Hamlets	11.18	0.86
6	Hackney	11.29	0.77
7	Hammersmith and Fulham	12.05	0.71
8	Lambeth	12.32	0.70
9	Southwark	12.39	0.80
10	Kensington and Chelsea	12.77	1.01
11	Wandsworth	14.40	0.73
12	Haringey	18.52	1.09
13	Newham	20.36	1.55
14	Lewisham	21.86	1.32
15	Isles of Scilly	22.12	2.06
16	Merton	27.46	1.63
17	Brent	27.61	1.98
18	Greenwich	27.72	1.92
19	Waltham Forest	28.45	1.88
20	Cambridge	31.65	2.81
21	Richmond upon Thames	32.53	1.35
22	Ealing	33.36	1.96
23	Oxford	34.00	3.22

24	Barnet	36.46	2.11
25	Croydon	36.75	2.35
26	Brighton and Hove	37.22	3.49
27	Redbridge	37.63	2.33
28	Kingston upon Thames	38.08	2.17
29	Barking and Dagenham	38.24	2.85
30	Hounslow	39.91	2.42

Table 7: Percentage of workers who drive to work and are driven to work in different local authority districts in England and Wales, ranked by highest percentage of people driven to work.

	Local authority district	% of workers who drive to work	% of workers who are driven to work
1	Boston	62.95	11.55
2	Corby	64.72	11.13
3	Merthyr Tydfil	65.77	10.65
4	Blaenau Gwent	72.12	10.06
5	Copeland	65.94	9.56
6	Middlesbrough	59.60	8.70
7	Peterborough	60.31	8.68
8	Stoke-on-Trent	65.60	8.67
9	Luton	57.66	8.54
10	Hartlepool	63.21	8.51
11	Blackburn with Darwen	63.75	8.32
12	Wrexham	69.31	8.30
13	Rhondda, Cynon, Taff	70.51	8.21
14	Leicester	51.76	8.06
15	Telford and Wrekin	69.98	8.03

16	Burnley	64.39	8.03
17	Coventry	59.42	7.98
18	Caerphilly	71.60	7.91
19	Kingston upon Hull, City of	53.20	7.90
20	Mansfield	69.36	7.88
21	Sunderland	60.87	7.87
22	Neath Port Talbot	72.65	7.82
23	County Durham	67.67	7.77
24	Torfaen	72.53	7.76
25	Knowsley	58.92	7.72
26	Wakefield	65.95	7.67
27	Doncaster	64.68	7.63
28	Blackpool	56.54	7.60
29	Allerdale	63.66	7.57
30	Lincoln	54.82	7.57

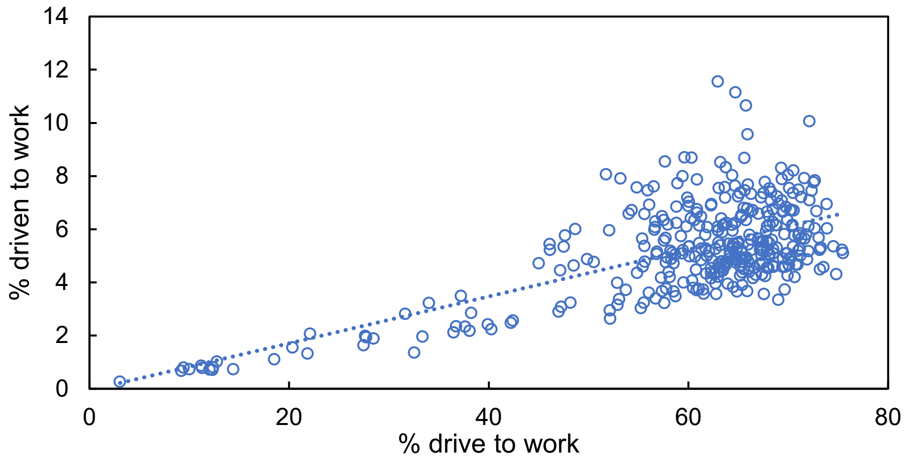


Figure 13: Correlation plot between the percentage of people who drive to work and the percentage of people who are driven to work in different local authority districts in England and Wales.

Travel to work areas

As described above, TTWAs are a geography created to reflect self-contained labour market areas in which most people both live and work. TTWAs are not fixed in size and are not constrained by administrative boundaries. The size and number of

TTWAs are indicative of commuting distances; fewer, larger TTWAs would indicate longer commuting distances.

There is significant variability in the size of TTWAs across the UK, indicating significant differences in commuting distances. There has been a reduction in the number of TTWAs over time: in 1991 there were 308 TTWAs covering the UK; in 2001 TTWAs there were 243 TTWAs; and there was a further reduction to 228 TTWAs in 2011. This reduction indicates that an increasing proportion of workers are commuting longer distances to travel to work. The ONS suggested that this trend could be due to a number of factors, as follows:

- sustained increase in car use;
- fewer jobs in manufacturing and mining, where local working was common;
- diffused job opportunities (such as employers de-centralising to city edges);
- more jobs at professional/managerial levels with higher pay levels, allowing more costly travel;
- more households with two earners who often cannot live near both workplaces;
- more complex working patterns (such as people working part of the week at home).

These findings are consistent with the commuting distances recorded by the Census, which show that the proportion of commuters travelling 10 km or more has increased from 32.3% to 35.8%.

Alternative TTWAs have been developed by the ONS to highlight different commuting patterns for different subgroups of the working population and are discussed below.

TTWA - mode of travel

Applying the TTWA methodology to different mode choices reveals that commuting distances are correlated with the mode of travel. For travel to work by bus, there are 184 TTWAs, for all car users there are 131 TTWAs, for car passengers there are 225 TTWAs and there are 16 TTWAs for train passengers. These are shown in Figure 14.

This clearly indicates that commuting trips as a car passenger tend to be much shorter than commuting trips as a car driver, indicating that car sharing is more likely for more local commuting trips.

The low number of TTWAs for train travel indicates that rail commuters travel significantly further to get to work on average than car drivers.

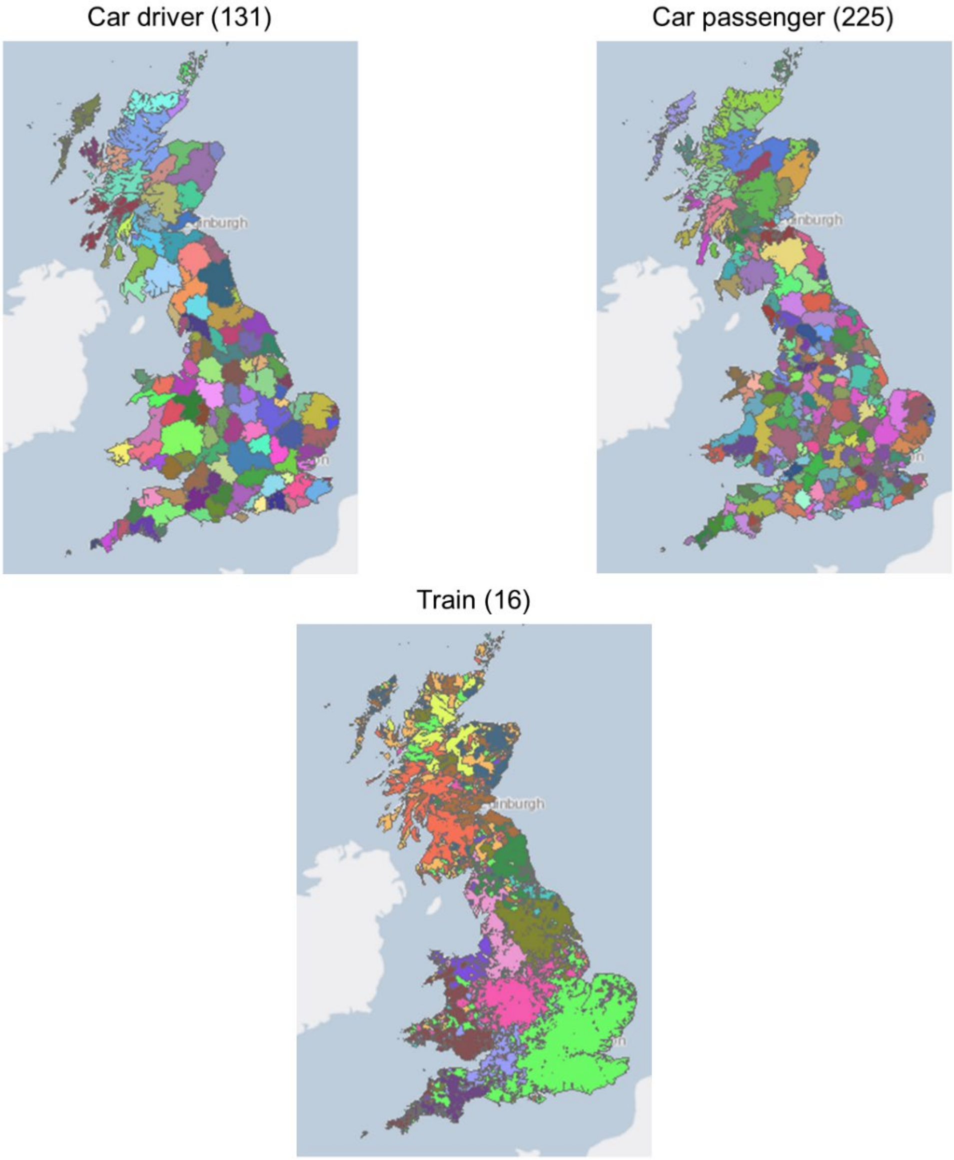


Figure 14: TTWAs for different commuting mode choice (number of TTWAs)[2].

[2] Colours are illustrative to highlight boundaries

TTWA - age

While the data from the NTS showed that annual car travel distances increase with age up to the 50-59 age group, the TTWAs reveal that people in the 25-34 age group tend to travel longer distances to get to work (163 TTWAs). Commuting distances decrease with age. There are 184 TTWAs for people aged 35-49, 249 for people aged 50-64, and 264 for the 65-74 age group.

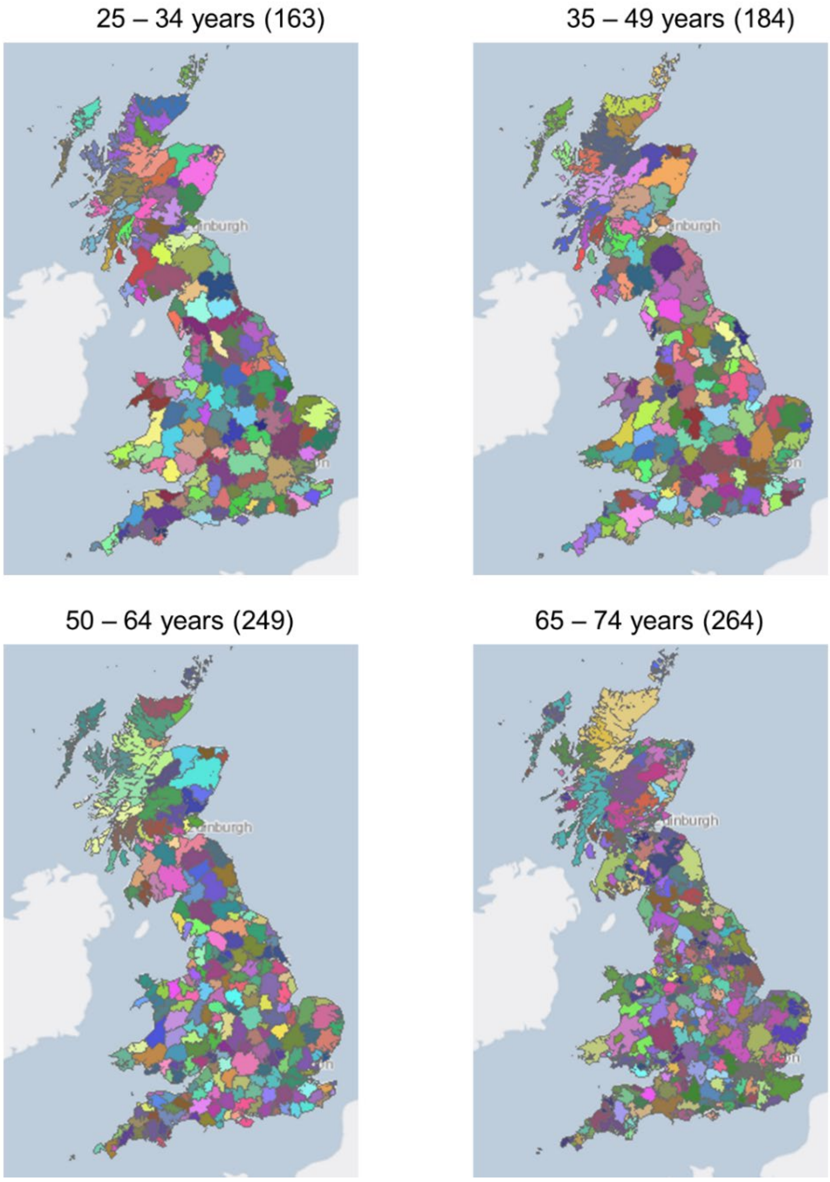


Figure 15: TTWAs for different age groups (number of TTWAs).

TTWA - qualifications

Another factor affecting commuting distances is the level of qualifications. The TTWAs for different levels of qualifications are shown in Figure 16. Workers with higher qualifications tend to travel further to get to work (262 TTWAs) than those with medium level of qualifications (304 TTWAs) or low qualifications (416 TTWAs).

Low qualifications (416) High qualifications (262)

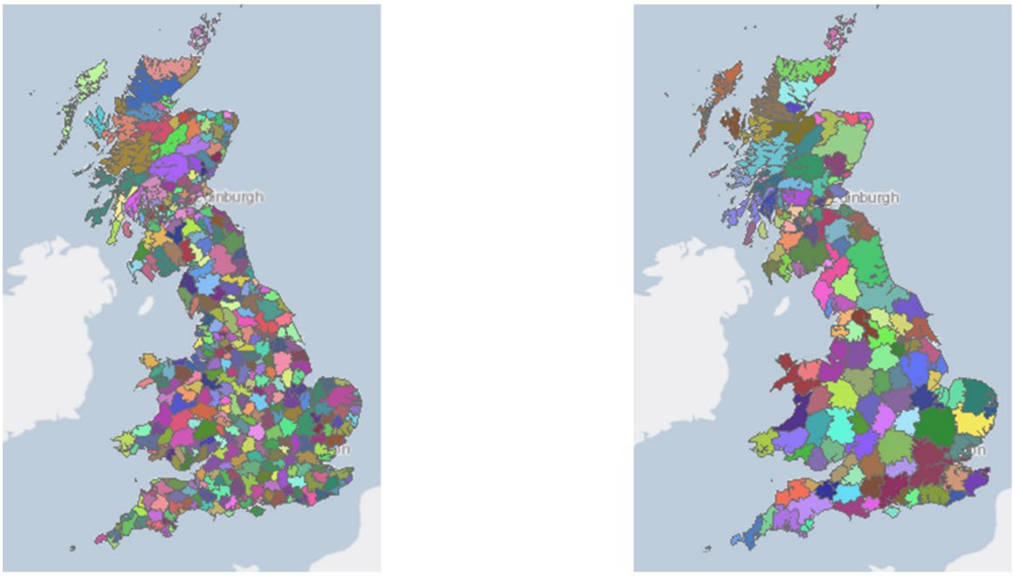


Figure 16: TTWAs for low and high qualification levels (number of TTWAs).

3 Providers of road transport

In the 60 years for which DfT data has been made available, the volume of road passenger transport in the UK has increased by approximately 350%, when expressed in passenger kilometres. Over this period, the proportion of road transport volumes that took place on buses and coaches (road public transport) has decreased from an initial 51% in 1952 to 5% in 2016. Conversely, the proportion of road transport volumes by car, van and taxi increased from 32% to 94% over the same period.

The purpose of this chapter is to present and discuss trends in the various forms of road transport that are available to travellers in the UK. Beyond modes of private road transport (car, bicycle, walking), we also consider public transport and shared mobility in its various forms, as present in the UK in 2018.

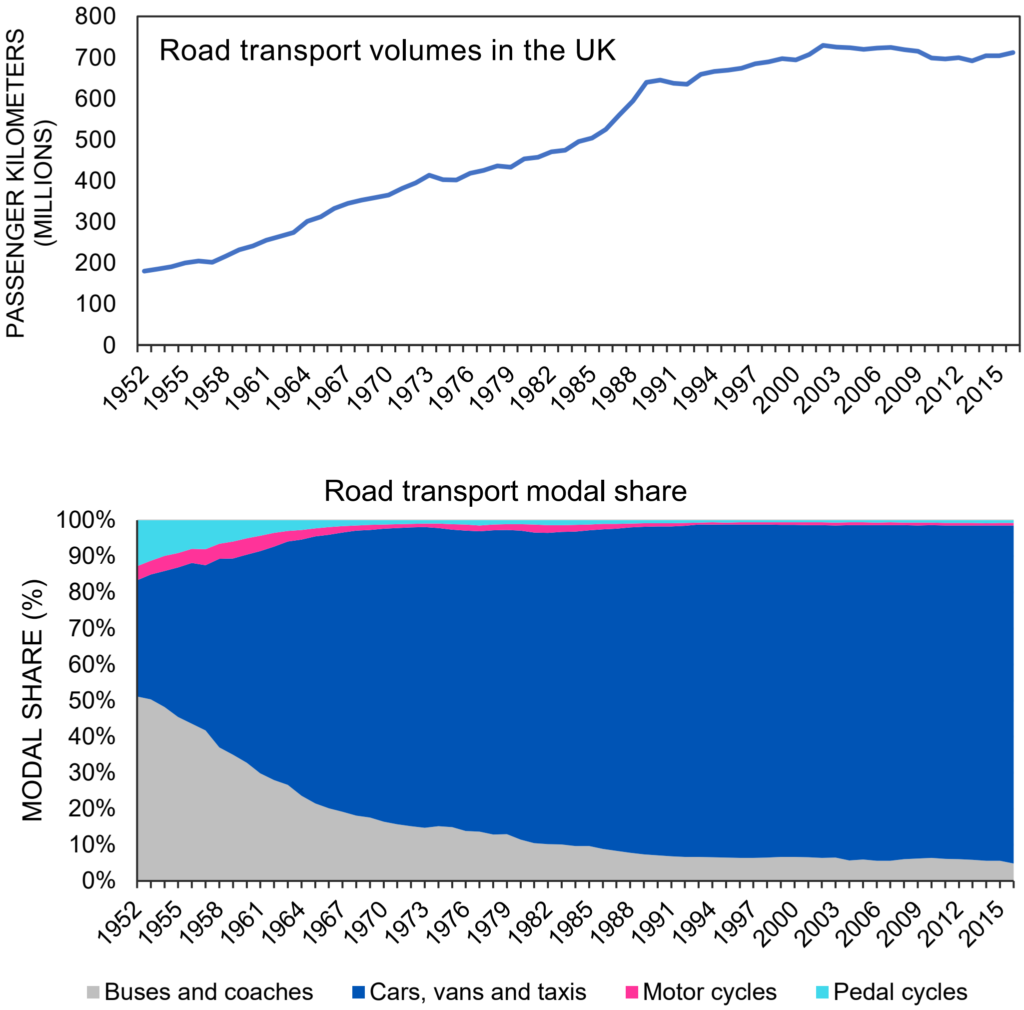


Figure 17: Road Transport in the UK. Volumes and modal shares (DfT, Table TSGB0101).

Private transport

Private vehicles

Since their introduction at the beginning of the 20th century, motor vehicles have become an increasingly popular mode of road transport. The most significant variations in private car availability among British households (see Figure 18) took place in the period between 1950 and 2000, with the proportion of households owning a car increasing from 14% in 1951 to 74% in 2002 (Department for Transport, 2017b).

Over this period, and in accordance with surveys by the DfT and the Office of National Statistics, we have observed an overall decline in vehicle acquisition costs and an increase in the cost of petrol and oil. A minor increase has been recorded since this period, with 77% of households classed as car-owning in 2016. The proportion of households with access to exactly one car is 43%, a figure that has remained approximately steady since the 1971 Census.

The proportion of households with access to two cars or more has consistently increased throughout the surveyed period, beginning with 1% in 1951 and reaching 34% in 2016. This has coincided with an overall increase in the number of females in the UK in possession of a driving licence, which has also increased the expected average number of drivers per household.

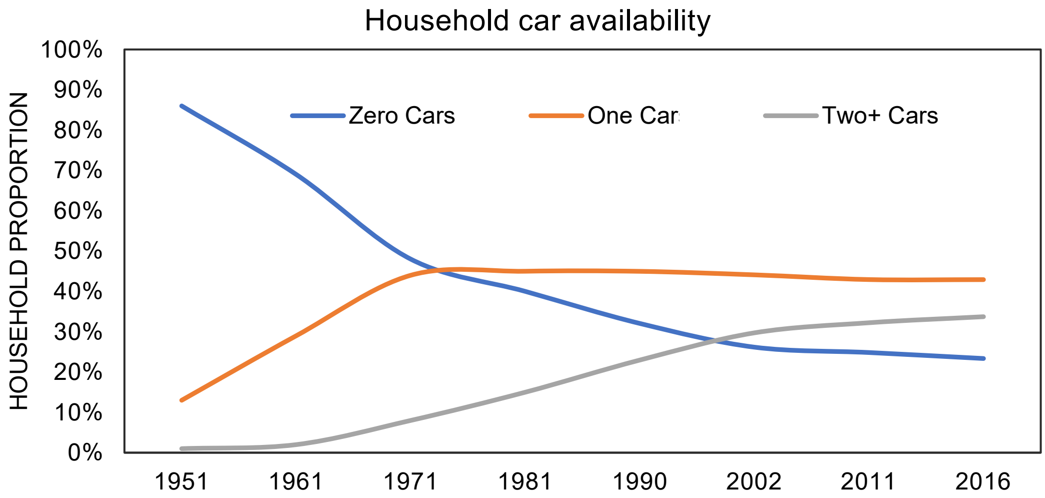


Figure 18: Household car availability (DfT, Dataset NTS02).

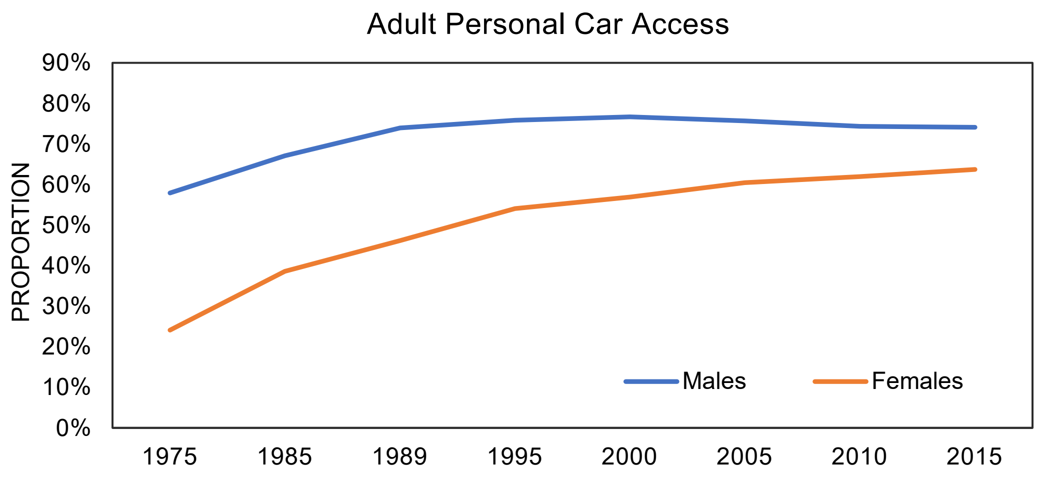


Figure 19: Adult personal car access in England, by gender (DfT, Table NTS0206).

The age of licensed car fleet in the UK has seen a few minor fluctuations over the past decade (Figure 20), starting with an average age of 7 years in 1994, reaching an initial peak of 7.3 around 1997, only to drop to 6.9 around 2005. The average age reached a maximum of 8.1 years in 2014 and has remained steady in the following years. Although these patterns are primarily attributed to fluctuations in the number of new car registrations in each year (which can be linked to the state of the economy), further analysis is required to assess the influence of increasing safety standards and emissions reduction initiatives. It should be noted that these figures would include leased vehicles, which are not separately considered by the Office of National Statistics and DfT surveys that were used for this report.

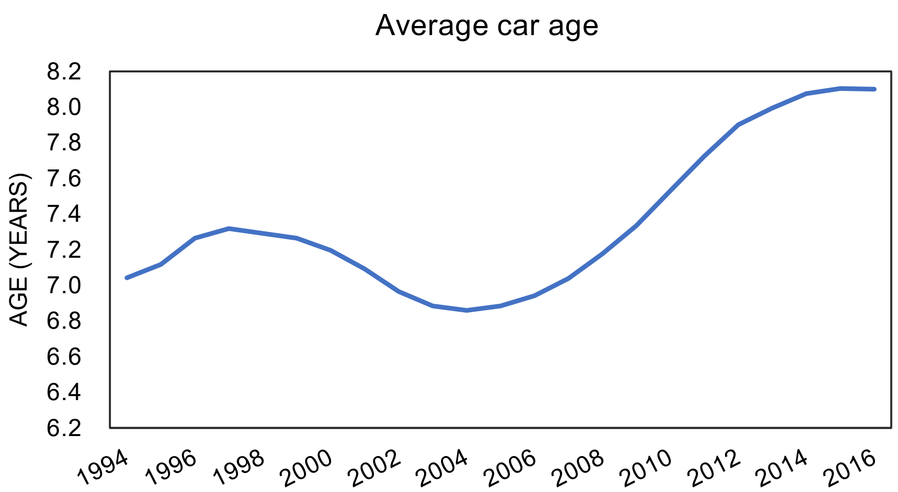


Figure 20: Average car age in the UK.

Private bicycles

Before the widespread adoption of motorised modes of travel, cycling was a particularly popular form of travel, with over 14.7 billion miles travelled on cycles in 1949 (Department for Transport, 2017d), compared with 3.45 billion miles travelled in 2016. Nevertheless, changing cultural attitudes and increased investment in cycling infrastructure and training have facilitated a continuous year-on-year growth in cycling use since 2008.

In addition to private cycle ownership, recent years have seen the introduction of cycle sharing schemes in several UK cities. Such schemes, which are examined separately later in this section, provide a valuable source of data on cycling patterns and usage demographics that could be partially used for modelling private cycling use.

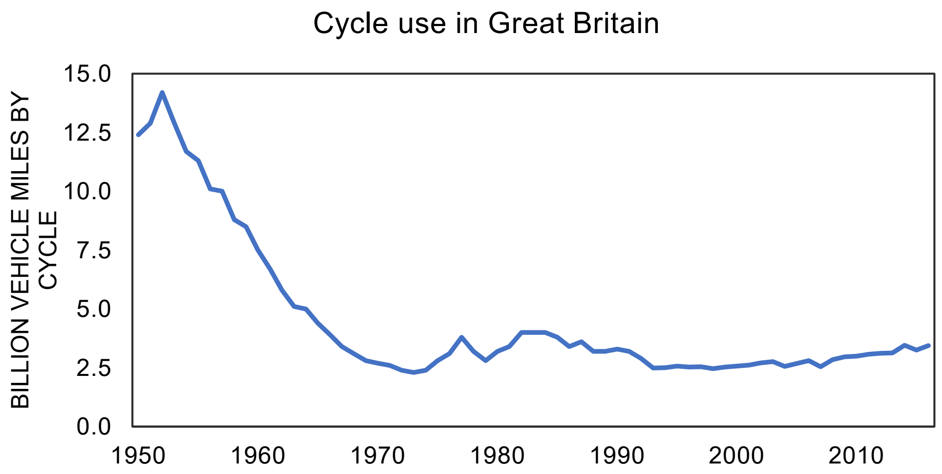


Figure 21: Pedal cycle traffic (miles) in Great Britain (DfT, Table TRA04).

There are significant variations in cycling use patterns over the course of the year, presumably attributed to seasonal variations in weather and, daylight. The impact of such variations on London cycling patterns can be discerned in the data collected using automated cycle counters in London by Transport for London. Data in the NTS indicate that the increase in cycle usage can be attributed to increases in distance travelled (+37% since 2002) rather than the number of trips (which have seen a decrease of 19% in the same period).

The increase in cycle use has been more pronounced in specific urban areas. In London, the number of average daily cycle journeys has increased by 63% percent in the decade leading up to 2015 (Transport for London, 2016b). At the same time, an increasing disparity between the number of male and female cyclists has been recorded in London over the years, with the number of trips recorded for male cyclists 2.7 times greater than for females.

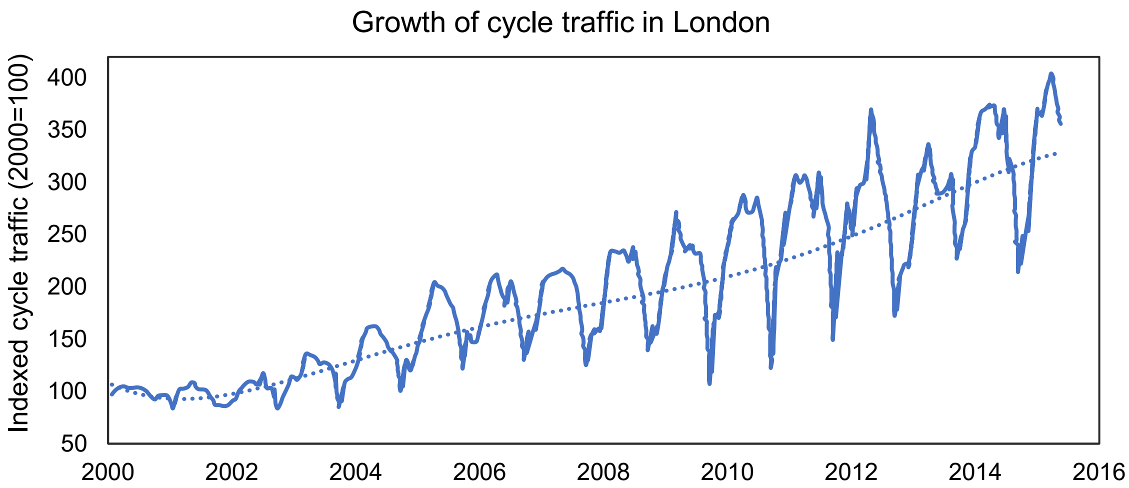


Figure 22: Detected cycle trips in the London strategic road network throughout the year. Adapted from Transport for London, 2015b.

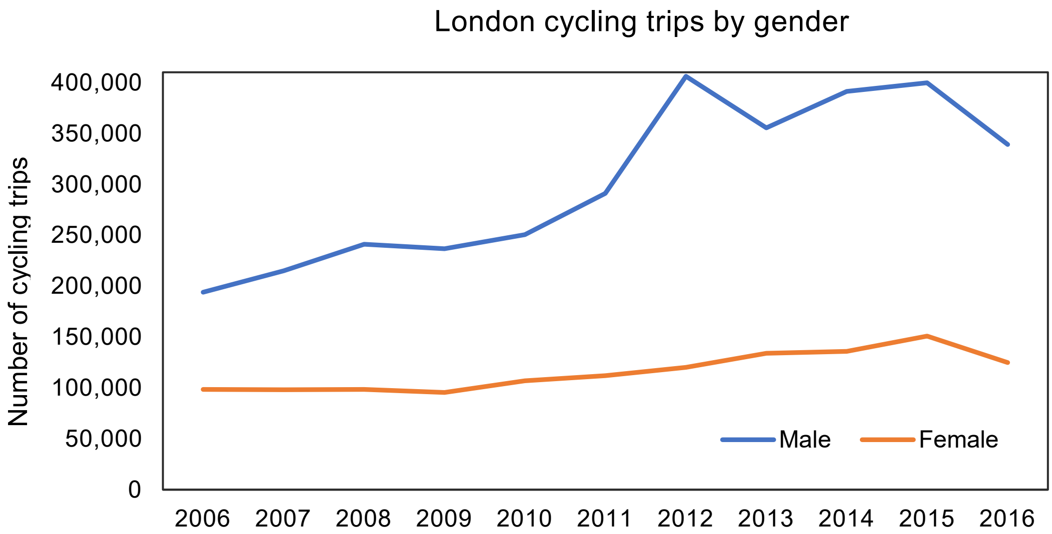


Figure 23: Recorded cycling trips in London, by gender (Transport for London, 2016b).

Walking

Walking can be a sole mode of transport for individual trips, especially in urban environments, or it can constitute a component of a longer, multimodal journey. Over the course of NTS exercises in the last 50 years, data were collected for walking trips that exceeded a distance of one mile. Data about short walks (defined as those lasting less than 20 minutes) were first collected by the NTS in 2016. As a result, it might be difficult to make direct comparisons with historical datasets. Indeed, the latest NTS report specifically points out that short walks have been excluded from most historical discussions.

Data for England from the NTS indicate that the average number of walking trips and walking miles per person have decreased in the period between 2002 and 2016. At the same time, the number of trips in London that consisted solely of walking increased by 9.3% between 2008 and 2014. Further increases in the number of journeys in London have been attributed to increased adoption of public transport as a mode of travel that facilitates or encourages walking trips.

A degree of variation in walking frequencies can be observed across the population, with people aged between 17 and 20 being more likely to undertake frequent walks (three or more times per week, with a duration of more than 20 minutes). Approximately 45% of people over 70 walk for more than 20 minutes less than once per year.

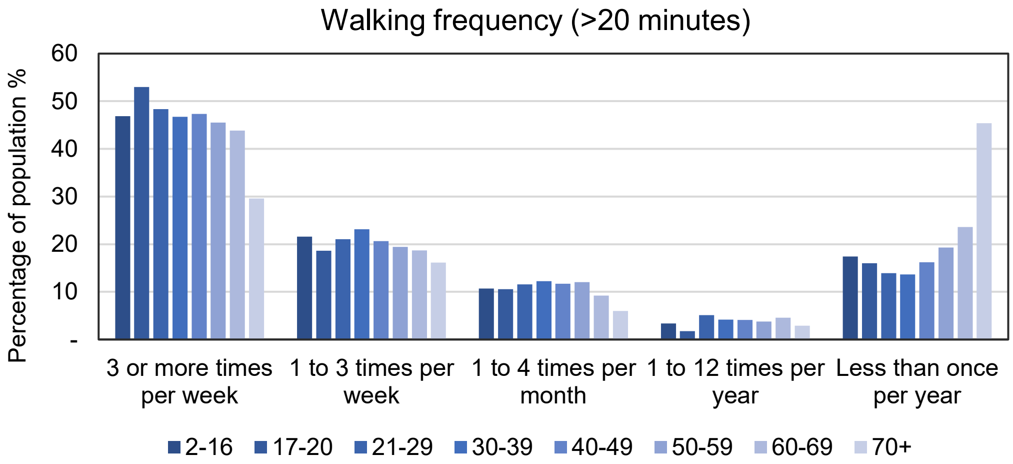


Figure 24: Personal walking patterns in England by age group (NTS).

Public transport

Mass transit has been instrumental in allowing cities to absorb population growth by providing efficient links between increasingly distant housing and employment districts. It is, however, not a panacea for all urban mobility requirements. Certain population groups still prefer private cars, and in regions with sparse transit coverage, cars are the only realistic option. As an example, in London, despite incremental increases in public transport provision and use over the last 20 years, cars are still the most significant transport mode. However, car travel is decreasing and there are variations across different boroughs as discussed in Section 2. In some areas of London, public transport accounts for less than 20% of all travel, with over 45% trips made by car (Transport for London, 2016b).

As of 2017, local buses accounted for 50% of all public transport journeys in Great Britain (Department for Transport, 2017a), which constitutes a significant decrease from the 74% figure recorded in 1992. This change is attributed to an overall increase in use of the national rail network. A consistent downward trend in bus use has been observed across all countries since 2013, with increased congestion, car ownership, modal shift, reduction in local authority support and the emergence of online shopping recognised as contributing factors.

NTS data on the age of buses used for public transport indicate an average figure of 7.6 years for Great Britain, which has remained relatively consistent over the past decade. It should be noted that the age of the Welsh fleet used to be significantly higher, but it has achieved parity with national figures over the past two years. Conversely, the London bus fleet has aged over the past decade but remains well below the national average as of 2017 (Department for Transport, 2017g).

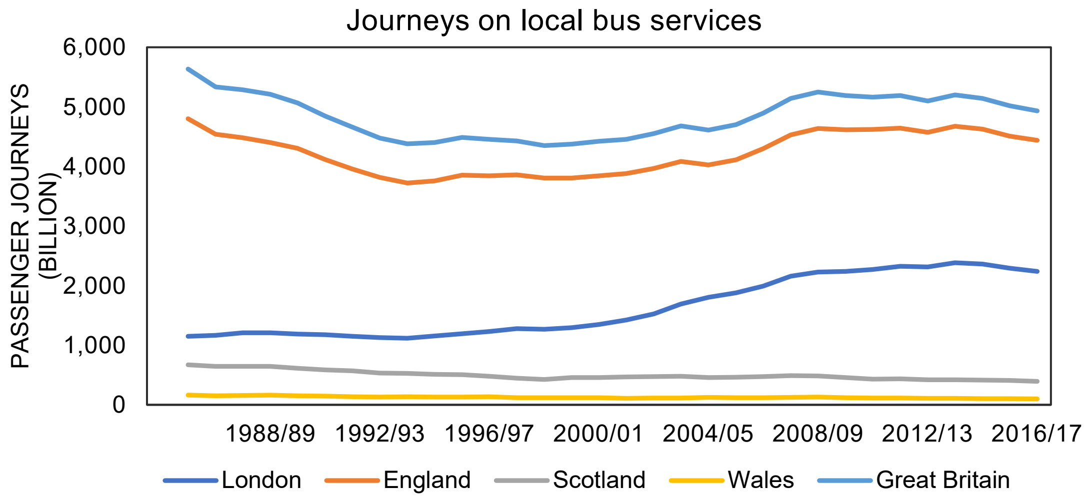


Figure 25: Local bus usage patterns in different regions of the UK (DfT, Table BUS06)

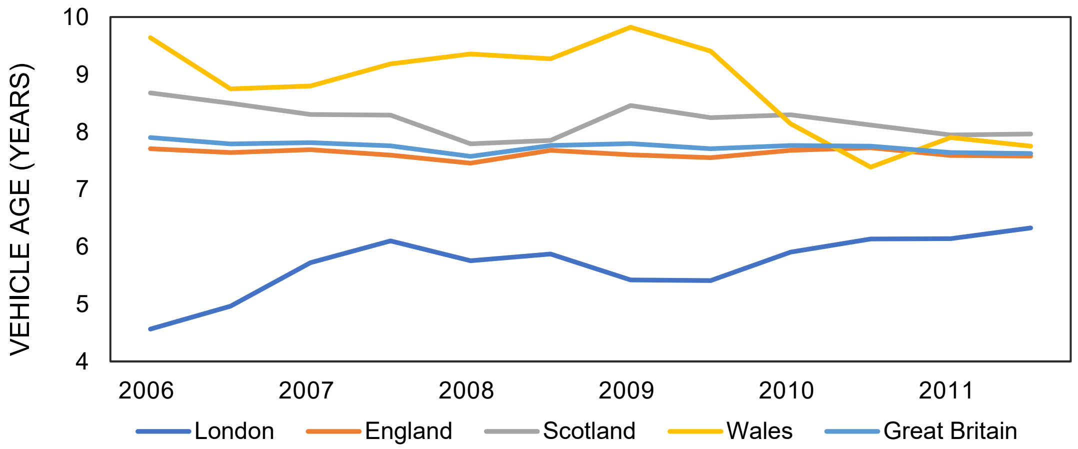


Figure 26: Average bus age in different regions of the UK (DfT, Table BUS06).

Taxis and shared mobility

As of 2018, there is no universally agreed terminology to distinguish between the various forms of mobility that rely on passenger cars owned by third parties. For the purposes of this study, in addition to taxis and traditional minicab services offered by private hire vehicles (PHVs), we adopt the terms ride sourcing, ride sharing and car sharing. Under this category, we shall also include cycle sharing schemes, which are increasingly popular in large cities around the world (and have proven highly successful in London).

Taxis

Even though regulatory regimes vary across the UK, the key consistent distinction between taxis and private hire vehicles is that the former can be hailed on the street and are available for immediate hire. Taxi drivers in the UK have usually undergone a standardised qualification process, which in London also includes an extensive geographic knowledge training regime ("the knowledge"). In many UK regions, only specific vehicle models are eligible for registration as licensed taxis, often with further requirements on vehicle age.

PHVs have existed in various forms over the past century, and in contrast to taxis, they must be pre-booked and cannot use taxi ranks. Before 2013, the vast majority of PHV drivers provided their services independently or through small-to-medium minicab companies. Figures from the DfT (Department for Transport, 2017e) indicate that the number of licensed taxi vehicles in England and Wales has increased by 19% in the period between 2005 and 2017. At the same time, PHV registrations have increased by a significant 68%, with most gains observed since 2013, which was the year that several ride-sourcing platforms were introduced in the UK market.

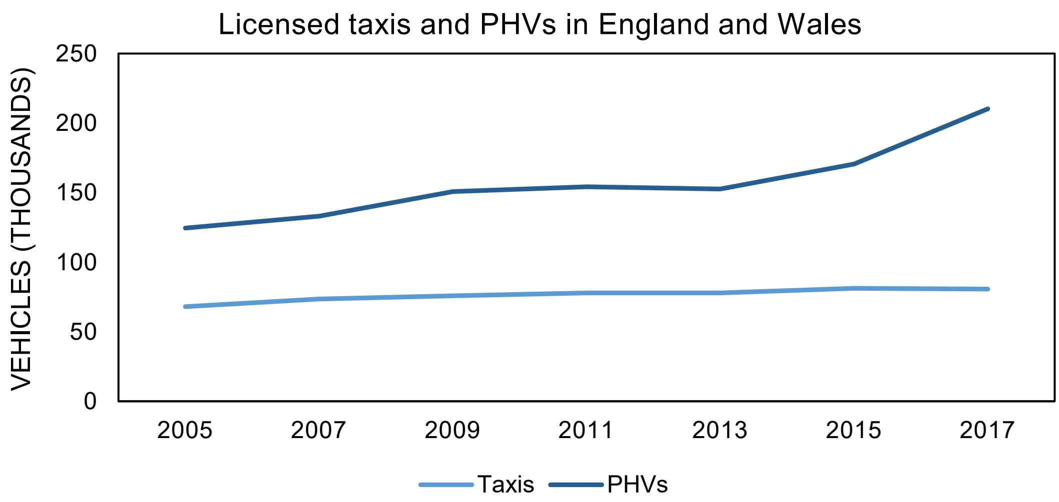


Figure 27: Licensed taxi and PHV numbers in England and Wales (Department for Transport, 2017e).

Data on the age of licensed taxis and PHVs in the United Kingdom were not readily available from DfT or any relevant trade bodies. However, the DfT's taxi statistics survey (Department for Transport, 2017e) provides an overview of licensing policies throughout licensing authorities in England and Wales. Of the 312 distinct licensing authorities, 65% imposed age limits for taxis, and 63% for PHVs. Where recorded, the average vehicle age limit upon licensing was 3.6 years for taxis and 4.4 years for PHVs.

Ride-sourcing platforms

The term ride sourcing refers to the for-profit services provided through transportation network companies (TNCs), such as Uber or Addison Lee. Such services alleviate the need for street-hailing as they connect drivers and passengers using smartphone applications. As a result, they can provide services similar to those of conventional taxis, with similar levels of convenience, and often at a lower cost. In the UK, vehicles that provide such services are required to hold a PHV licence. TNCs in the UK and beyond have enjoyed wide market adoption wherever they operate but are feared to shift users away from more efficient modes of transit and to cause an increase in the number of private vehicles in areas of public transport.

Both the NTS and the DfT's taxi statistics survey (Department for Transport, 2017e) track trip patterns, vehicle numbers and driver registrations for taxis and PHV vehicles. However, they do not distinguish adequately between taxis and PHVs, nor between PHVs that operate independently, through minicab companies or TNC platforms.

Nevertheless, it is possible to discern a distinctive increase in PHV registration numbers since 2013. This increase coincides with the introduction of popular TNC platforms. According to TfL, the number of PHVs (87,409) and PHV drivers (117,712) in London have increased by 39% and 50% since 2015, respectively, while the number of taxi drivers (24,487) has remained stable (Transport for London, 2017). Across England and Wales, the number of PHVs has increased from approximately 171,000 in 2015 to 210,000 in 2017, while the number of licensed taxis has remained steady at approximately 81,000.

As part of its annual Digital Market Outlook survey, business intelligence company Statista indicates that in 2017 there were approximately 8.353 million ride-sourcing platform users, with the number of users expected to reach 11.325 million by 2020 (Statista, 2018). In addition to the ride-sourcing platforms that are the focus of this section, this figure includes app-based taxi reservation platforms, and peer-to-peer ride-sharing schemes (which are discussed in the following section). However, this analysis does not seem to have directly considered travel preferences, but rather estimated user numbers through surveys and mobile app market share analysis.

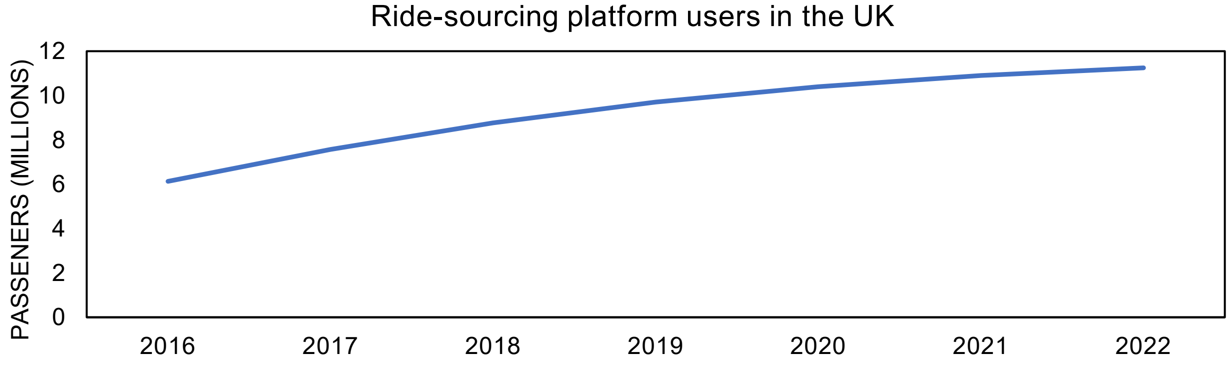


Figure 28: Licensed taxi and PHV numbers in England and Wales (Statista, 2018)

Ride sharing

Ride sharing refers to journeys where two or more people share a car and travel together towards a common destination. The key objective of car sharing is to share a vehicle and the cost of the trip. This differs from ride sourcing (as defined earlier), where the riders are in control of trip origins and initiate the trip (through a digital platform), and the driver provides a for-profit service. Other terms used for ride sharing include "2+ car sharing" (Steer Davies Gleave, 2016b), peer-to-peer carpooling or lift-sharing. At this point it should be noted that several ride-sharing platforms (for example, Uber and Gett) offer hybrid services that combine ride-sharing and ride-sourcing features, where geographically compatible trips initiated by independent travellers are combined and served by a for-profit driver.

In contrast to ride sourcing, drivers or vehicles participating in ride-sharing schemes do not need to hold PHV licenses as of 2018. There currently exist six digital ride-sharing platforms in the UK. Two of these (BlaBlaCar and GoCarShare) target individual travellers, while four (Carbon Heroes, Liftshare, Jambusters and Carshare Online) cater to individuals and employers alike (to facilitate carpooling among employees of the same company). We have not been able to identify any reports that quantify usage patterns and volumes of the UK ride-sharing sector, although we believe that it would be technically feasible to perform a preliminary analysis on trips advertised and requested in many of the aforementioned platforms.

Car sharing

Members of car-sharing schemes (otherwise referred to car clubs) have access to vehicles in return for a joining or annual membership fee in addition to usage fees, levied by time or distance. As of January 2018, there exist at least 48 distinct car-sharing schemes in the UK (Carplus, 2018b). These can be distinguished in terms of ownership/scale (commercial versus community-run) and allowed trip-types (flexible versus return-trips).

The majority of car-sharing schemes currently use a return-trip structure, where drivers are required to return cars to their originally designated parking space and would be charged regardless of car idle time between the two legs of the journey. Flexible car sharing schemes (one-way car clubs) charge users only for the duration of the actual journey, as long as the vehicle is parked within a designated service area. Fuel and insurance costs are typically included in the pricing scheme.

Because of the flexibility that they offer to customers, one-way car sharing schemes tend to have a higher frequency of usage per customer than round-trip car sharing (Le Vine and Polak, 2017). In London, the number of car club members increased by 20% to 186,000 between 2014/15 and 2015/16 and 34.5 million miles were travelled in car club cars in 2015/16 (Steer Davies Gleave, 2016b).

The average hire duration for round-trip schemes in London is 7 hours and 12 minutes, as opposed to an average duration of 36 minutes for flexible clubs (Steer Davies Gleave, 2017). An earlier study covering clubs throughout England and Wales (Steer Davies Gleave, 2016a) provides an average hire duration of 6.9 hours for return-trip clubs but does not provide a figure for flexible schemes.

Car-sharing scheme fleets comprise cars with a lower average age, significantly lower emissions outputs and higher safety standards than the average UK passenger vehicle fleet (Steer Davies Gleave, 2017).

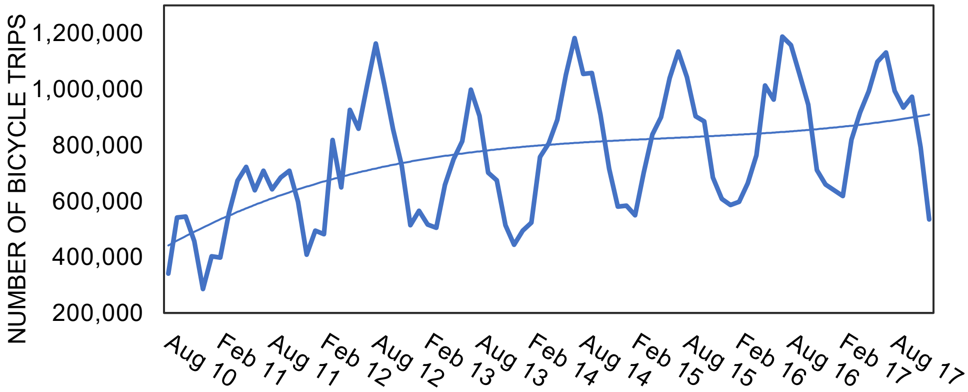
Bicycle sharing

Bicycle sharing schemes have existed in various forms over the last 50 years. Starting with simple free-to-all initiatives, more advanced systems soon appeared that used coin-deposits or card- or key-access technologies. The latter approach proved to lead to more sustainable and even profitable systems, which were soon supplemented by internet-enabled electronic terminals that are used in the schemes found in most large cities around the world (Angeloudis et al., 2014).

The first scheme to introduce a modern bicycle sharing platform to a large audience was Vélib' in Paris. This was soon followed by many other similar schemes around the world, including the Barclays cycle hire scheme in London (later rebranded as Santander Cycles as a result of changes to the sponsoring arrangements). As of 2017, over 10.7 million bicycle-sharing trips per annum took place in the UK, by over 450,000 regular and casual users. A total of 16 schemes, were in operation, with 1,164 docking stations and 17,354 bicycles. Of those, the Santander Cycles scheme was by far the largest, with approximately 13,600 bicycles, 839 stations and approximately 10.4 million trips per annum recorded in 2017 (Transport for London, 2015a), . As of April 2018, ten local authorities in the UK were known to be actively considering deploying new schemes in the near future (Carplus, 2018c).

Dock-less bike-sharing schemes have enjoyed widespread adoption throughout Asia. Despite being more flexible operationally, their lack of docking allows for arbitrary numbers of bicycles to be directed to specific parts of the areas that they operate. Uncontrolled scheme growth, has resulted in the emergence of “shared bike congestion” in many Chinese cities (The Guardian, 2017; China Daily, 2017). Several such schemes are currently active in the UK (for example, oBike, ofo, Urbo, YoBike), mostly operating in close collaboration with local authorities (Carplus, 2018a).

As is to be expected with other modes of active travel, significant seasonal variations can be observed in the use of such schemes. Analysis of trip data from the first seven years of operation of the Barclays/Santander cycle hire scheme in London indicates that there is on average a 50.8% difference in the number of trips that occur in the busiest (usually July) and quietest (usually December) months of the year. Seasonal variations are also observed in journey durations, with average journey times in the least busy months just 65% of those in the busiest months.



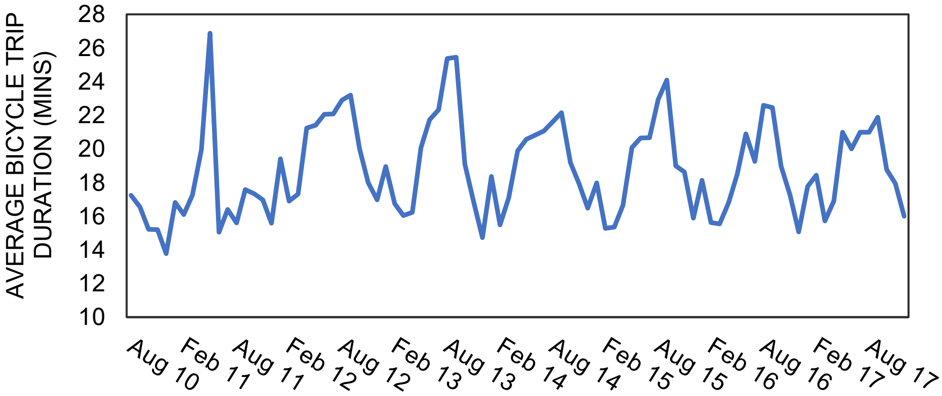


Figure 29: Monthly bicycle trips and average trip duration for the Barclays/Santander cycle hire scheme in London (Transport for London, 2015a).

Provider-demander interfaces

In a 2015 report, the DfT presented an analysis of the drivers for change in road traffic (Department for Transport, 2015b). It identified a weakening relationship between gross domestic product and traffic, and a disconnection between population growth and car use in urban areas, where the availability of other transport modes and reduced average ages contributed to a reduction in car use. Historically, increased driving costs (such as fuel and parking) were associated with slower traffic growth in urban areas. However, the increasing adoption of low-emission and fuel-efficient vehicles is expected to weaken the effects of future fuel price increases. Attitudes to driving and the environment seem to have a weak effect on car travel even amongst pro-environmental individuals, except for young urban dwellers.

The DfT identified several other drivers for the future of road travel in the UK. While there is evidence that *communication technologies* (for example, telecommuting) can reduce the need to travel and the resulting number of trips, this is more likely amongst higher income groups, with longer term impacts being highly uncertain. *Market saturation* refers to levelling-off of ownership rates, trip rates and distances travelled per person by car. However, these could be offset by population growth. *Network effects* and constrained road capacity mean that further growth in road travel is limited by increased congestion, making car travel relatively less attractive in comparison to other modes (Department for Transport, 2015b). Other drivers identified by the DfT include car sharing and the interaction with land-use (for example, employment and housing developments). These effects were evaluated to be highly uncertain, with the impacts of shared mobility options limited to dense urban areas (Department for Transport, 2015b).

The deployment of connected and autonomous vehicles (CAVs) is another highly uncertain and potentially disruptive development for road transport. CAVs are expected to deliver societal benefits, including reductions in traffic congestion and vehicle-related emissions. Shared-use vehicles and automation are expected to significantly reduce the cost of mobility and provide mobility services to segments of the population for whom other public transport modes are not economically viable. Furthermore, CAV deployment could also work in conjunction with existing transport service providers, taking on the first or last part of their journeys (first- and last-mile trips). Further benefits for users are predicted to come from improved road transport safety. However, reducing the cost of road transport could also increase demand, if not actively managed (Stocker and Shaheen, 2017; Wadud et al., 2016; Harper et al., 2016).

Peak car

Car travel per person in the UK (and several other OECD countries) has plateaued in the last two decades and has not increased in line with forecasts. Some of the proposed drivers for this trend include (Stapleton et al., 2017):

- increasing income inequality and worsening economic situation of young people (Klein and Smart, 2017);

- increased uptake of higher education amongst young people, thereby delaying car ownership (Department for Transport, 2015b);
- changing age structure of the population, with a growing proportion of older people who drive less (Goodwin, 2012);
- relative increases in non-fuel costs of car ownership, for example, parking and insurance (Le Vine and Jones, 2012; Department for Transport, 2015b);
- an approachment towards saturation levels of car ownership and driving licences (Delbosc, 2017);
- changes in company car taxation reducing subsidised car travel (Le Vine et al., 2013);
- replacement of car use by electronic communication combined with the growth of e-commerce, home working and online shopping (Metz, 2013);
- changing preferences regarding ownership and use of cars relative to other goods and services (McDonald, 2015);
- growing trends of urbanisation (Headicar, 2013);
- increased congestion, especially on urban roads (Department for Transport, 2015b);
- modal shifts encouraged by improvements to public transport, cycling and walking infrastructure (Department for Transport, 2015b; Goodwin, 2012);
- declining marginal utility of increasing average trip length as a result of increasing accessibility and choice of services: this describes how the incremental benefits (utility) of driving a further distance to access a service, for example to a supermarket that is further away, decreases if those services can already be accessed at a closer destination, for example, a local supermarket (Metz, 2013);
- levelling off of door-to-door car speeds coupled with stable travel time budgets, which means that car travellers are no longer able to travel further in the same amount of time (Metz, 2013); and
- the high rate of net immigration in the 2000s, coupled with lower propensity to drive amongst immigrant communities (Headicar, 2013).

Using an econometric approach and aggregate data for car travel in Great Britain over the period 1970-2012, Stapleton et al. (2017) proposed that the most important factors are as follows:

- Income: a 1% increase in income was associated with a 0.55% increase in vehicle kilometres.
- Urbanisation: a 1% increase in the proportion of the GB population living in the five largest cities was associated with a 1.7% decrease in the distance travelled.
- Fuel cost: a 1% increase in fuel cost per kilometre was associated with a 0.26% decrease in vehicle kilometres.

The use of aggregate data, which may obscure trends in different groups of the population, and spatial variability is common to many previous econometric studies (Stapleton et al., 2017). In the following section, we introduce potential opportunities with new datasets.

The travel behaviour of young adults could have a significant impact on “peak car” and the future of road travel in the UK (Chatterjee et al., 2018). There may be a sustained change in travel behaviour, as the generation born in the 1980s and 1990s, who are accustomed to lower car use than previous generations, hold onto these behaviours as they get older. The lower rates of car travel may also be replicated in successive generations, such that lower car use becomes the new norm. There is a great deal of uncertainty in forecasting the future travel behaviour of young adults and it is likely to be influenced by varying combinations of the following factors:

- changes in the structure of the labour market and security of employment;
- urbanisation and land use;
- housing availability, location and tenure;
- career expectations; and
- demographic and taxation factors that affect how wealth moves between generations.

Further, such social change is also likely to be affected by the interaction of all of the above factors with:

- household formation;
- marriage and parenthood; and
- the specific ways in which new technologies are adopted by different groups (Chatterjee et al., 2018).

Shared mobility

The average car in the UK spends 96% of the time parked (Bates and Leibling, 2012). Shared mobility is the shared use of a vehicle that enables users to have short-term access to car travel on an “as-needed” basis and includes services such as car sharing, bike sharing, on-demand ride services, ride sharing, micro-transit and courier services (Stocker and Shaheen, 2017).

The evidence for the impact of these shared mobility schemes is still limited, but there is emerging evidence of highly diverse effects on car use. A US study has found that the availability of car sharing schemes can reduce car ownership, by suppressing vehicle purchases among some members, and overall distance travelled by car (reduction of 6-16%). However, the scale of the impact is dependent on the user, the city and other environmental factors such as the availability of other modes of transport (Shaheen et al., 2016). Evidence for London also suggests car club membership leads to lower levels of car ownership and reduced travel distance by car (reduction of 730-840 miles per year per member) and also that vehicle occupancy is higher for car-club trips (around 2.5), compared with the national average (1.6) (Steer Davies Gleave, 2016b). More early evidence from London suggests that income level is a significant factor in determining the effects of car clubs; people on moderate incomes are more likely to reduce car ownership than those on high incomes. There is evidence that non-car-owning households use the car club for carrying cargo, which is one of the reasons for car dependence identified in a recent study (Le Vine and Polak, 2017). Further research is required to understand how car clubs affect behaviour through life-course events (for example, marriage and children) and as the services evolve (for example, price levels and service coverage), in different environments (for example, parking availability and public transport provision), and across different users and trip activities.

Evidence for the impact of ride sourcing and ride sharing on travel behaviour is insufficient. One US study of ride sourcing users in San Francisco found that, if ride sourcing were unavailable, 39% would have taken a taxi, 33% would use bus or rail, and 6% would drive their own car. In other words, ride sourcing trips were taking trips away from both taxis and public transport modes. However, there is little evidence for the effect of ride sourcing on generating trips that otherwise would not have happened or on overall car use, even though ride sourcing allows users to drive less themselves (Rayle et al., 2016).

The impact on future car use remains highly uncertain, but shared mobility is an area where policymakers can have significant impacts, given that car sharing schemes require public sector agreements for parking spaces, and ride sourcing of PHVs requires approval from a licensing authority (Le Vine and Polak, 2017).

Automation

Connected and autonomous vehicles (CAVs) are vehicles used to move passengers or freight with some level of connectivity to other vehicles and to infrastructure, and automation that assists or replaces human control. CAVs are already used in controlled environments (for example, the Docklands Light Railway in London), and many people in the automotive industry are predicting a revolution in passenger transport that will be unlocked by automation. CAVs are expected to bring benefits in the areas of safety, increased road capacity and accessibility, and to reduce the environmental impact of road transport (KPMG, 2015).

Advanced CAV technology development began in 1977 in Japan, and today more than 30 companies around the world are developing CAV technology, including most vehicle manufacturers. Most vehicle manufacturers that have announced plans for CAVs already offer or plan to soon release vehicles with some automated features. Eleven companies claim that they will have highly automated vehicles by 2020. Separate agencies are predicting that all cars will be CAVs by 2035, others that CAVs will make up 75% of car sales by 2035, while another is predicting 9% of sales in 2035 and 90% of sales in 2055. Predictions among experts indicate that fully automated vehicles are 20 to 30 years away (Stocker and Shaheen, 2017; Flaig, 2017). KPMG have produced forecasts for production of CAVs to 2030 which indicate 100% penetration of connected vehicles, and a 25% penetration of Level 4/5 (fully automated) autonomous vehicles (KPMG, 2015).

Historically, improvements in road capacity have not improved average vehicle speeds or congestion as more road space attracts more drivers (Graham et al., 2014). The impact of CAVs on traveller behaviour is also highly uncertain and complex. Increases in road capacity as a result of CAVs may induce car travel, as with previous efforts. Furthermore, since CAVs enable their occupants to do something with their time, people may be willing to spend more time travelling (Van den Berg and Verhoef, 2016). Both of these aspects may indirectly reduce the cost of car travel, which could induce more people to travel, and travel significantly further by car (Wadud et al., 2016; Harper et al., 2016).

A synergy could exist between vehicle automation, shared mobility and electrification, as follows: higher vehicle utilisation through automation of shared vehicles would make electric vehicles more cost competitive and mitigate the environmental consequences of more car travel (Offer, 2015).

A report for the RAC Foundation (Johnson, 2017) highlighted a number of significant uncertainties about the readiness of the road infrastructure, training and testing of new drivers, interactions between CAVs and other road users, the safety of vulnerable road users, and CAV parking and breakdowns.

There is little evidence about the impact of different CAV strategies on the condition of road infrastructure, its maintenance, renewal and configuration requirements, and road signage/marking requirements. Examples from aviation and rail sectors indicate that more advanced infrastructure requires higher costs of maintenance.

The majority of studies conclude that governments need to make planning decisions that will affect the speed at which CAVs are adopted, whether they interact with shared mobility and electrification, and the infrastructure cost.

Mobility as a Service

Mobility as a Service (MaaS) is defined as “the integration of various forms of transport services into a single mobility service accessible on demand” (MaaS Alliance, 2018). As a term, MaaS is frequently used in the fields of mass transit and transportation, with recent studies indicating that there is a sharp divide between private car users and public transport users. However, MaaS proponents propose that, by transitioning to a system where all forms of transport are offered on a single platform, the boundary could be softened. Mobile phone applications such as Google Maps or CityMapper already collate many modes of transport in a single platform and, if this is extended comprehensively to include modes such as car sharing and taxi services, transportation could be optimised to a higher degree.

With the advent of autonomous vehicles, the distinction between private vehicles, taxis and TNCs will likely fade, with (autonomous) cars eventually expected to operate as an extension to public transport.

As a concept of travel, demand responsive transit (DRT) is squarely positioned between mass transit and modern ride sharing. Pooled taxi services to significant transport terminals (for example, AirportBus) can also be considered as a light form of DRT. Accessibility-oriented schemes have operated in several cities for decades, mainly in the form of door-to-door services for people with disabilities (for example, TfL Dial-a-Ride). The reliance on human drivers and conventional vehicle types precluded the provision of cost-effective DRT systems that could deliver capacity, safety and efficiency levels required for consideration as a mode of public transport. Furthermore, and especially in the case of accessibility-oriented DRT schemes, they require the presence and operation of yet another fleet of vehicles that parallels functions provided by the mainstream public transport system.

Insights from taxi use in London

The London Traveller Demand Survey (LTDS) provides insight into how users of taxis interface with the taxi/private hire service providers. Figure 30 shows the time series of taxi trips per person between 2005/06 and 2015/16. People in Inner London take approximately twice as many taxi trips as people in Outer London. Between 2005/06 and 2014/15, the taxi trip rate was in the range of 0.04-0.05 trips per day. However the latest year of the survey indicates that the taxi trip rate has increased to a new high of 0.06 trips per week. This data runs somewhat contrary to the anecdotal narrative of the rise of private hire vehicles and new mobility services such as Uber. However, it must be noted that the LTDS does not currently specify new mobility services as a separate mode. Similar trends are seen in the taxi mode share in Figure 31.

Figure 30: Taxi trips per person per day in different regions of London, London Travel Demand Survey (Transport for London, 2016a).

Figure 31: Trips by taxi as a proportion of all trips (Taxi mode share) in different regions of London, London Travel Demand Survey (Transport for London, 2016a).

In Section 2, we observed that the occupancy for taxi trips tends to be higher (1.5-4 people) than for car trips (1-2), indicating that people have a greater tendency to share taxi trips. The LTDS provides further insight in terms of the number of stages per trip and the average duration of taxi trips compared to other modes. The following analysis highlights that, while the average occupancy for taxis indicates a propensity towards sharing, taxis are similar to private cars use in terms of direct routes and average trip durations.

The number of stages per trip quantifies whether a mode is used to travel directly from the trip origin to trip destination (stages/trip = 1) or if there is more than one mode of travel and a transfer between modes (stages/trip > 1). The stages/trip ratios for car drivers, car passengers, taxis and the Underground are shown in Figure 33. It is evident that taxis are used in much the same way as private cars and facilitate direct travel from origin to destination: the stages per trip for taxis is approximately 1.14 in Inner and Greater London, compared to 1.04 for car trips. In contrast, trips by public transport are often made up of multiple stages, with a stage/trip ratio of 1.71.

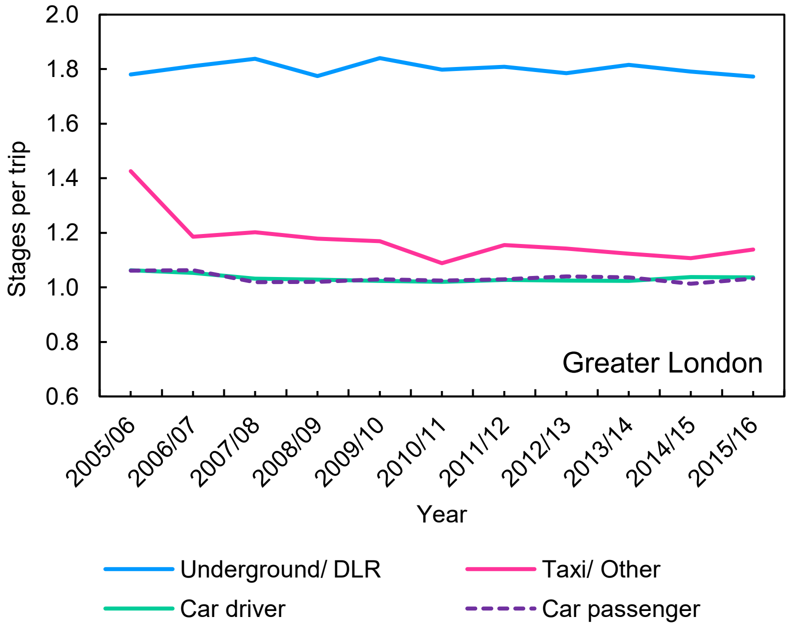


Figure 32: Stages per trip for different transport modes in Greater London, London Travel Demand Survey (Transport for London, 2016a).

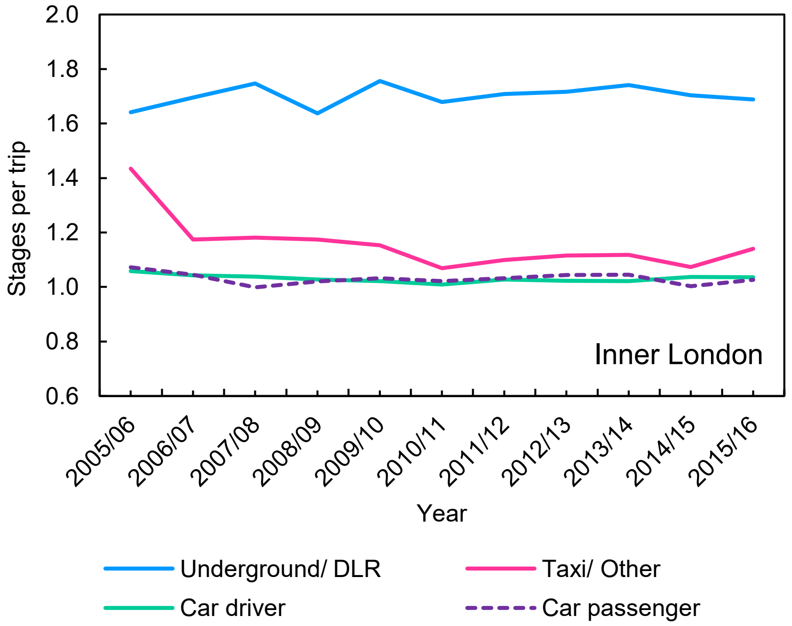


Figure 33: Stages per trip for different transport modes in Inner London, London Travel Demand Survey (Transport for London, 2016a).

Average trip durations for the same four modes in Greater London are shown in Figure 34. This indicates that, while taxi trips (32 minutes) tend to be longer than car trips (25 minutes), they are not as long as trips by the Underground (50 minutes) or bus (38 minutes).

The stability in all the time series data presented from the LTDS indicates that it may not be capturing the well-publicised rise in new mobility services. As new shared mobility modes emerge, travellers may prefer to use them for direct services, rather than for multi-stage trips, which implies that local authorities should be proactive in integrating these services with existing public transport networks to limit further congestion on roads.

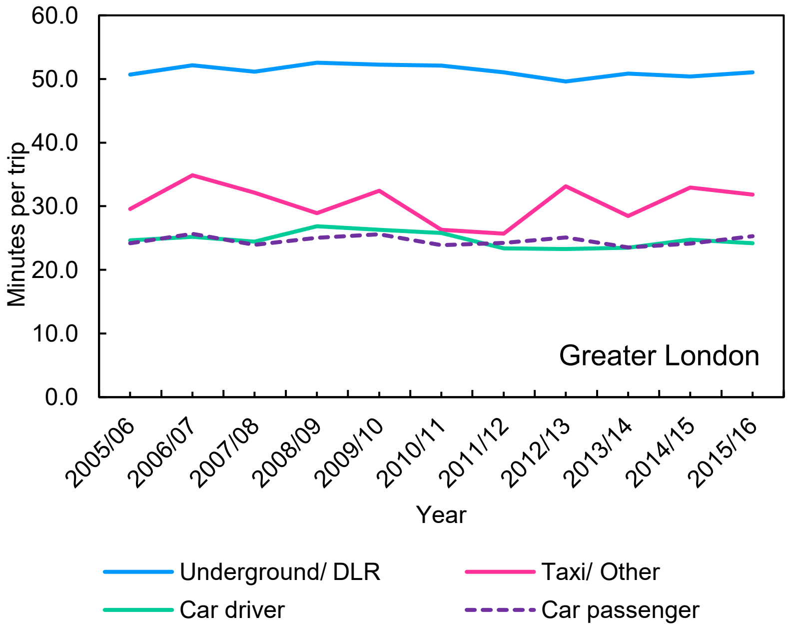


Figure 34: Average trip duration by mode in Greater London, London Travel Demand Survey (Transport for London 2016a).

Data opportunities

Emerging data sources provide the opportunity to better match transport supply to demand and will enable the development of intelligent mobility. The Transport Systems Catapult conducted an extensive review of emerging transport data sources in 2015 (Transport Systems Catapult, 2015). In this section we highlight a small subset of opportunities provided by new transport data sources.

Mobile phone data

There is a significant potential for using mobile phone data to reveal traveller behaviour, and we understand that the primary mobile service providers are involved in projects where their data is being used to manage transport infrastructure. The opportunity presented by the data is discussed with a brief example provided to us by Telefonica/O2.

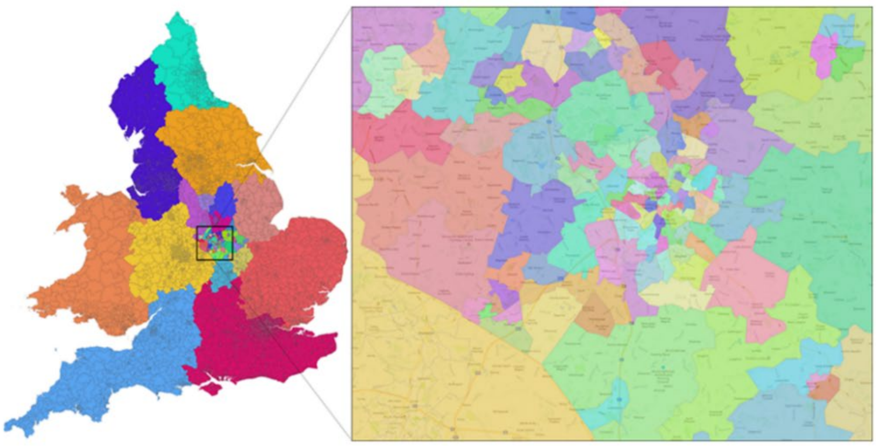
Mobile phones generate 'events' as they communicate with the mobile network. Active events include connection events (for example, when a user turns their phone on or off), call events (such as making or receiving a phone call), and text events (making or receiving a text message). Passive events include when a user moves to a different location and their phone connects to another mobile network transceiver, and time-based events which occur when there are no other events for a prolonged period. Each event has an associated timestamp and location of the mobile network transceiver. Processing this event data can reveal ‘dwells’, when a user is stationary, and ‘journeys’, which are classified as the period between two dwells.

An example, shown schematically in Figure 35, shows how road users passing through a specific road junction in Leicester can be tracked in terms of their origin and destination, trip purpose (work, other), and direction of travel (inbound, outbound), and whether the trip is home-based (originating or ending at their home address). All users’ data is anonymised and aggregated up to specified zones. The accuracy of the positioning data (approximately 200 meters in cities) is high enough to extract route choice and journey times.

The potential of this type of data is to provide detailed travel patterns with very high spatial and temporal resolution. Telefonica/O2 collect around 6 billion events per day from over 25 million unique users. Given the ubiquity of mobile phones, it is unlikely to be biased in the same way that smartphone app data can be biased by a higher proportion of younger users. However, each telecoms provider will capture only a segment of the market, and mode choice and trip purpose are inferred. It can also be combined with the information of account holders to provide further contextual, demographic information.

Specified road junction

Specified origin and destination zones



from_zone	to_zone	hbw_outbound	hbw_inbound	hbo_outbound	hbo_inbound	nhb
(origin)	(destination)					
1	130		0	3	7	12
1	126		1	4	6	7
1	55		0	3	16	4
1	124					0
1	138	0	5	27	48	79
1	70	6	14	45	37	50
1	5	2	19	10	21	12

Figure 35: Example of the use of mobile phone location data to extract the origin and destination zones of trips through a specific road junction in Leicester.

Notes. The sample matrix shows the counts of journeys between each origin-destination zone.

hbw = home-based work trip, hbo = home-based other trip, nhb = non-home-based.

Sample data and example provided by Telefonica/O2. Colours denote zones mobile data captured.

Planning for emerging transport technologies

Travel patterns differ significantly in different cities, as discussed in Section 2. With new emergent modes of autonomous and shared mobility, it will be necessary for city authorities and transport planners to take active roles in ensuring that new mobility services satisfy unmet needs and improve social welfare.

Combining a number of different transport data sources, including travel patterns from mobile phone data, INRIX quantified how certain cities would be more or less suited to fleets of shared autonomous electric vehicles suited for short intra-city trips (INRIX, 2017). They conducted their analysis for different cities in the US, and for different zones within cities. An important parameter in their quantitative scoring metric was the density of trips (trips per square metre) that remained within that zone.

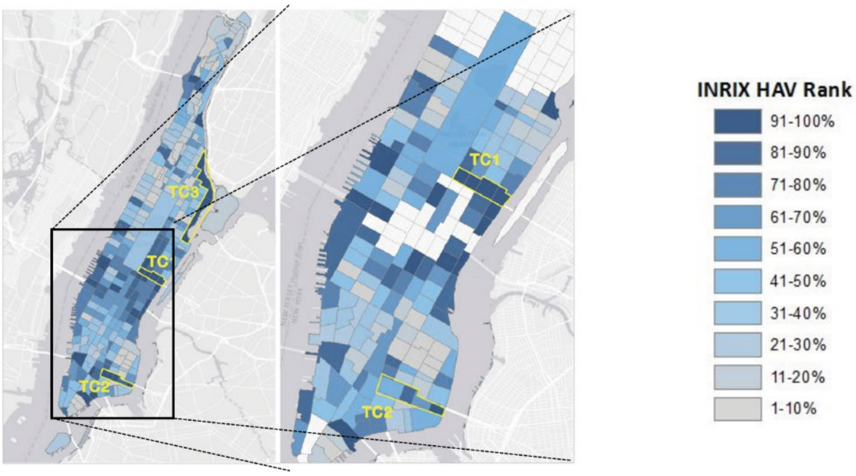


Figure 36: Example of using transport data to quantify the suitability of different areas for highly autonomous vehicles (HAVs). Adapted from INRIX Research (INRIX, 2017).

Intermodal route planning

Dynamic management of trips, route and mode choice could maximise the utilisation of the transport system as a whole and help to reduce journey times. This concept would require the integration of multiple different datasets from across the transport system, including:

- public transport schedules
- real-time traffic conditions
- road closures
- parking availability
- weather
- events.

INRIX and BMW have implemented this concept of 'intermodal navigation' in the BMW i3 and i8 vehicles. Drivers are alerted to faster alternative modes of transport if major delays occur along their routes. The driver can then select an alternative mode of transport and is provided with navigation to the nearest connection in time for the next departure. Such a system would also be compatible with floating car-sharing schemes.

Peer-to-peer sharing

Vehicle telematics data are used by car insurance companies to monitor driving behaviour, to accurately calculate premiums, and to reward or penalise "good" and "bad" driving behaviours. Accelerometer and GPS data can be collected using a dedicated device or a smartphone installed in the vehicle to monitor how safely the driver is driving. Through the use of such vehicle telematics data, it would also be possible to reveal travel patterns for drivers to complement travel survey data.

Peer-to-peer platforms for car sharing offer people the option of hiring out a car that they own, or borrowing a car for a short visit or local journey, which could increase vehicle utilisation. A significant barrier to peer-to-peer car sharing has been the question of how to correctly price the insurance of the new driver. With vehicle telematics tracking, insurance companies can build profiles of drivers and therefore enable drivers to drive other cars using one insurance account.

This idea is being developed by The Floow, a Sheffield-based telematics company, who are proposing to use telematics to analyse and rate driving behaviour to enhance the level of detail available about potential borrowers. For example, a borrower who has a history of a safe driving style would be higher rated, providing greater reassurance to the vehicle lender when considering whether to authorise a particular loan request. The smartphone-based app platform would also be able to integrate insurance provision, ensuring relevant legal requirements were met for the duration of the transaction.

Conclusions and recommendations

Our review of data to characterise demanders and providers of road transport in the UK indicates that travel surveys do not specifically capture trends related to new shared modes of transport. There is significant stability in the recorded general trends of personal travel, and while personal trip rates and distances travelled by car are showing signs of declining, growth in the overall population is expected to drive aggregate levels of car travel. Our analysis suggests that new shared modes of transport (such as ride sourcing and ride sharing) are making significant inroads only in particular geographical areas, primarily in London. The new shared modes are poorly captured by existing survey questions, and there is a significant opportunity to use new data sources to improve understanding of how these modes may emerge, and therefore to inform the evolution of road travel in the UK.

Recommendation 1 – Forecasts

There have been several surveys on the future of road travel demand in the UK, including a major DfT review on the forecasts and change drivers, completed in 2014. However, significant developments in new mobility services, vehicle ownership models, low-emissions vehicle technologies and prospects of vehicle automation have occurred since the last review. There are many significant interactions between road transport and other sectors of the economy, for example, fuel duty receipts, that will be affected by the range of forecasts.

Action: Review existing forecasts of road travel demand in the UK and conduct side-by-side comparisons under a range of different scenarios.

Target: Government Office for Science; DfT.

Recommendation 2 – Travel surveys

Existing travel surveys poorly capture new shared modes of transport, which are distinct from traditional taxi and PHV travel. Questionnaires and methodologies should be adapted to distinguish between taxi, traditional PHVs, ride sourcing TNCs, ride sharing, and car sharing.

Action: Incorporate more categories of road travel into existing travel surveys to account for new modes of travel.

Target: National Travel Survey; Census; London Travel Demand Survey.

Recommendation 3 – New data to characterise road travel

Travel surveys including the National Travel Survey, Census and London Travel Demand Survey provide an invaluable resource for tracking trends in travel demand and behaviours. However, there is a significant latency inherent in the process due to the effort required to collect survey responses and process data, which prevents this data from being able to reveal rapidly evolving emergent trends. New sources of travel data, such as mobile phone movements, vehicle telematics, app use and data from mobility service providers could be used to reveal changes in travel patterns and preferences at higher temporal and spatial resolutions. Furthermore, there has been little work on data synthesis from the diverse data sources that are available, which could benefit from recent advances in statistical science and machine learning. These analyses could be aimed at:

- quantifying the use of ride sourcing, ride sharing and car sharing services;
- understanding transport needs and their variation in time and space, which could help planners to integrate new mobility services with existing public transport services;
- providing dynamic inter-modal routing services that would help travellers to choose the most efficient routes and quickly react to disruptions; and
- promoting peer-to-peer sharing services that could lead to further growth in shared mobility and the sharing economy, by building individual traveller profiles and linking to vehicle insurance schemes.

Action: Evaluate new sources of data and explore the potential to use machine-learning techniques to leverage the various forms of data collected and support government efforts to track travel demand and direct future infrastructure investment.

Target: Government Office for Science; DfT; Department for Business, Energy and Industrial Strategy.

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