Inclusive mobility in the West Midlands: Understanding declining bus patronage by senior residents from smart card data

Key findings

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I. The study

This ESRC-funded research project 'Inclusive mobility in the West Midlands: Understanding declining bus patronage by senior residents from smart card data' investigated the changing bus patronage of senior residents in West Midlands Combined Authority (WMCA). Since 2009, the region has experienced a dramatic decline in bus patronage. Understanding these trends is an urgent priority for local authorities and transport providers, as unmet mobility needs can reinforce social disadvantage among potentially vulnerable groups, such as elderly residents.

The ESRC funded this work as a pilot project demonstrating the use of new and emerging forms of data for policy. We analysed boarding patterns by 396,413 anonymised passenger accounts registered under the English National Concessionary Travel Scheme (ENCTS) over the period November 2010 to August 2016. In order to better understand the decline in bus patronage, we undertook the following analytical steps:

- Estimation of bus patronage from smartcard transactions,
- Classification of passengers by their boarding patterns into six groups,
- Estimation of the geographic distribution of different passenger groups and
- Description of demographic and neighbourhood context of passenger groups.

In addition, we analysed data on the wider regional trends related to demographics and changing eligibility to ENCTS.

II. Findings

1. The impact of eligibility restriction

Residents are entitled to free bus and tram travel in the West Midlands when they reach the female state pension age. The state pension age for women was 60 in 2010, and has increased at various points annually to reach 63 in 2016. This restriction in eligibility reduced the number of eligible residents by 10%. But the smartcard data analysis records a decline in boardings by 25% during the same time period.

2. Six groups and three waves of receding patronage

We use a technique known as Sequence Analysis to unpack this overall trend. We only include those residents who were eligible throughout the entire time period, i.e. those who were 66 years or older in 2016. Between 2010 and 2016, the population of this cohort shrank by 20%, while boardings declined by 30%. Against this trend, the earlier years showed a relative increase of boarding rates, which suggests significant heterogeneities in this group.

We identify six groups of passengers based on their boarding profiles 2010-2016:

1. **Rarely Seen Passengers (55%)**. About one in four of these passengers never used the bus, and the remaining passengers rarely made more than four boardings a month.

2. **Irregular Passengers (14%)**. Per month, 60% of passengers boarded the bus up to four times, but the proportion of passengers not boarding at all doubled in 2016.
3. **Regularly Seen Passengers (8%)**. On average, about half of the passengers make at least two to three trips per week. The incidence of non-boardings increases from three to 25% in 2016.
4. **Withdrawing Passengers (7%)**. Initially regularly seen passengers steadily withdrew from using the bus from early 2012. In August 2016, three in four did not use the bus any more.
5. **Withdrawing Passengers - Post 2014 (5%).** A second wave of receding patronage can be observed by initially frequent passengers. This wave started in 2014, with the sharpest decline observed between 2015 and 2016.
6. **Daily Passengers (12%)**. On average, passengers of this group board at least daily. Yet, an increase in cardholders who do not board could be observed in 2016.

Based on these patterns, we distinguish three waves of receding patronage: first, a gradual wave beginning in 2012, represented by group 4; second, sharper decline in patronage, represented by group 5; and third, abrupt withdrawal from the bus system from 2016, found in the remaining groups.

3. Marked social and geographic differences

Rarely Seen Passengers (1) are more often male and are concentrated in peripheral parts of the metropolitan region with less population density, higher car ownership and more affluence. *Irregular Passengers (2)* tend to live in suburban parts of the region, such as Solihull and King's Health and the suburbs of Coventry. *Regularly Seen Passengers (3)* often live in Coventry. Women are overrepresented in the latter two groups.

The two types of *Withdrawing Passengers (4, 5)* are often 81 years or older. While group 4 is concentrated in central Birmingham, passengers of group 5 often live in more deprived and ethnically diverse western and some eastern parts of Birmingham. Similarly, *Daily Passengers (6)* tend to live in central Birmingham to the west, often in neighbourhoods with a higher proportion of non-white population, lower car ownership and lower income at older age. Areas with high concentrations of groups 5 and 6 are served by the West Midlands Metro.

4. Residents indicating social disadvantage reduce their patronage more often

The socio-demographic and geographical context suggests that the first two waves are potentially related to immobility in old age, while the second wave also occurs in a context with stronger signs of social disadvantage. In the third wave, it is the group of *Daily Passengers* who indicate social disadvantage. Considering that these latter two clusters comprise 60% of all boardings, the overall trend of receding patronage strongly reflects a tendency by which passengers whose socio-spatial context suggests greater vulnerability to

public transport captivity and social exclusion appear to leave the public transport system more than other passengers.

III. Policy domains and future research

The findings of the study generated hypotheses as to the potential causes, which can be grouped in to a social, health-related, and structural domain.

Social

- Greater poverty among pensioners leads to fewer out-of-home activities.
- Online shopping replaces out-of-home trips.
- Senior residents, particularly women, have greater access to the car.

Health

- Earlier onset of mobility-limiting disability or ill-health among vulnerable groups and increasing health inequalities.

Structural

- Emergence of new ride-sharing and e-hailing modes attracts demand away from buses.
- The recent extension of the West Midlands Metro may have led to the substitution of some bus boardings.

Increasing poverty among pensioners may be inferred from receding patronage in more deprived neighbourhoods, also as it coincides with the recent, ascertained increase of pensioner poverty in the United Kingdom (see Joseph Rowntree Foundation 2017, www.jrf.org.uk/report/uk-poverty-2017). Greater poverty may further lead to earlier onset of ill health and mobility-limiting disability, which would again be reflected in receding patronage. Greater access to cars by women may also be plausible reason, but the evidence suggests that this may not be a major factor in explaining the receding patronage. Neither do our findings contradict the remaining hypotheses on online shopping and new transport modes. We could not find evidence that changes in bus schedules and levels of service are associated with lower patronage.

In the context of this pilot project, carried out to demonstrate the use of smartcard data for policy, these conclusions are preliminary and intended as starting points for larger, follow up inquiries. These enquiries may generate more certain insights into current trends in inclusive mobility in the West Midlands Combined Authority and beyond.

Detailed results

1. The impact of eligibility restriction

Up to 2010, all passengers of age 60 or more were eligible to the concessionary scheme. Since then, the eligibility age has been gradually increased in line with the female state pension age. As a result, the eligible population in the WMCA has decreased by 10% [Table 1]. Annual boardings estimated from smartcard transaction have dropped by more than 25% during the same time period.

Table 1. *Expected and actual boardings of (a) eligible residents and (b) the population cohorts of age 66 or more in 2016.*

	2010	2011	2012	2013	2014	2015	2016
(a) eligible population							
average eligibility age	60.0	60.5	61.0	61.5	62.0	62.5	63
eligible residents	551,000	542,486	533,576	524,137	515,689	506,028	496,795
residents (indexed 2011)	101.6	100.0	98.4	96.6	95.1	93.3	91.6
boardings (indexed 2011)*	-	100.0	99.4	98.2	100.1	90.1	74.5
(b) resident cohort of age 66 or more in 2016							
minimum age in cohort	60	61	62	63	64	65	66
residents	551,000	529,189	507,257	485,013	464,096	441,798	420,303
residents (indexed 2011)	104.2	100.0	95.9	91.7	87.7	83.4	79.5
boardings (indexed 2011)*	-	100.0	97.2	93.8	93.3	83.3	69.6

* Boardings figures in early 2010 are incomplete, as the smartcards were rolled throughout that year. Hence the 2010 values are not shown.

Viewing only passengers that were eligible throughout the entire time period, i.e. those that were 66 years or older in 2016, we perceive a similar 10%-gap between the number of residents in that age group and the number of boardings. But during the earlier years, boarding counts remained stable, which indicates that there has been a relative increase in boarding rates with a sharp drop after 2014.

A more detailed analysis of the relationship between changing eligibility and access to the bus networks is provided in a separate document on the website (https://www.cdrc.ac.uk/research/healthymobility/).

2. Six groups and three waves of receding patronage

We find six groups of passengers who are marked by different boarding patterns throughout the study period [Figure 1]. Detailed boarding, geographical and socio-demographic characteristic for each group are provided below. *Rarely Seen Passengers* are by far the most common passengers with a proportion of 55%. This group is followed by *Irregular Passengers* with 14%. A proportion of 12% may be considered *Daily Passengers*. *Withdrawing Passengers* are smaller with 7% and 5% each. But due to their higher usage of the bus system, changes in these groups affect boarding patterns more significantly than any other group.

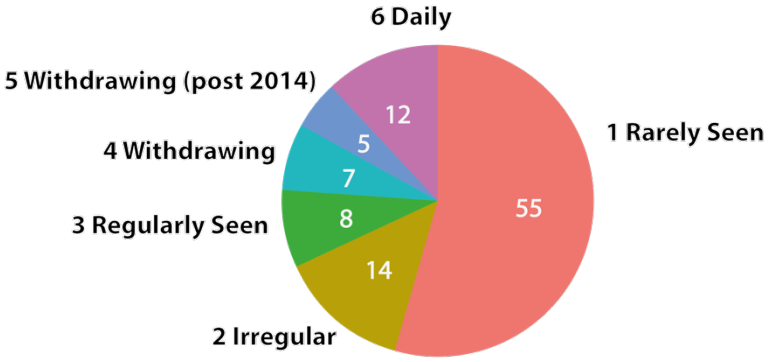


Figure 1. *Distribution of clusters.*

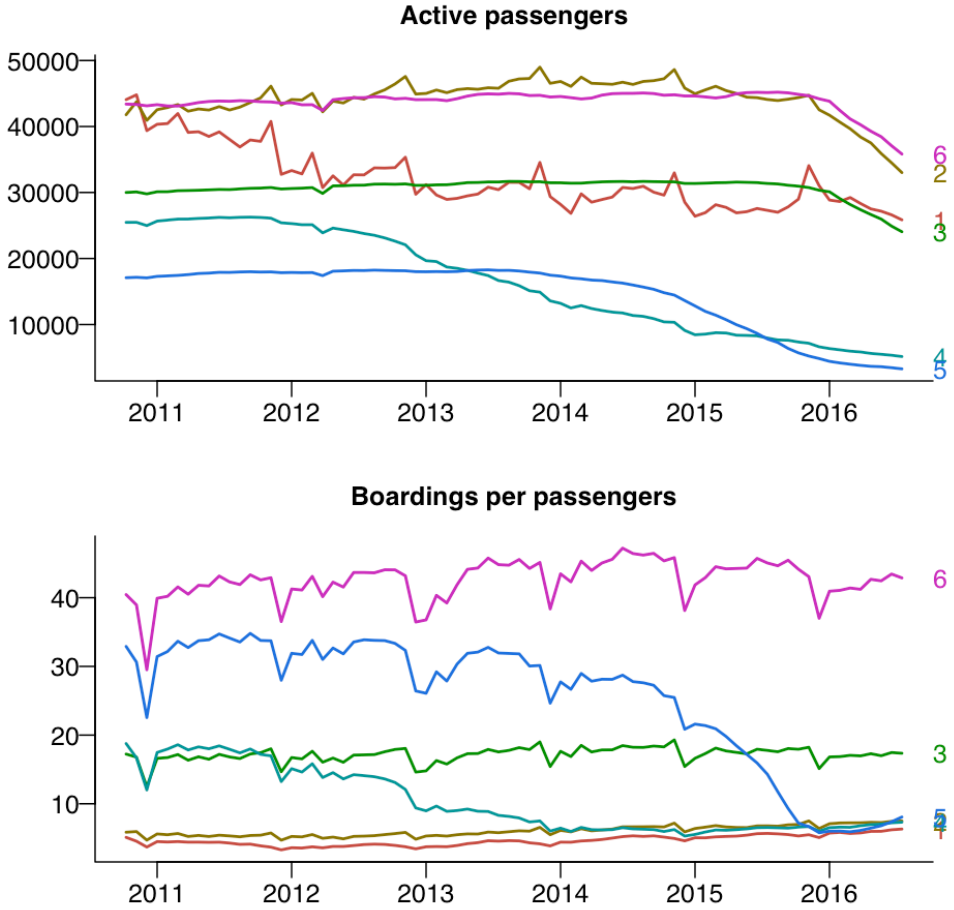


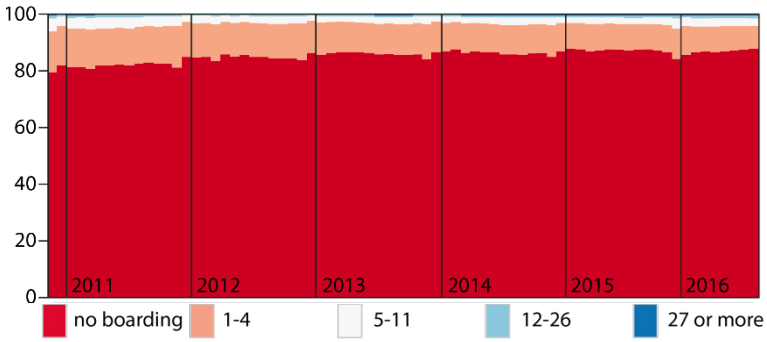
Figure 1. *The groups' frequency and patronage.*

The number of active passengers, i.e. those who board at least once in an episode, has remained stable in groups 2, 3 and 6 until 2016. Gradual decrease in patronage occurs in group 4 and a sharp decrease each in group 1 (2011-2012) and group 5 (post 2014). In 2016, the patronage in groups 2, 3 and 6 dropped by approximately 20%, in cluster 1 by 30%. At the same time, average boarding rates remained stable, which suggests that passengers of this type withdraw from bus use completely. There is, however, a slight increase in boarding rates in groups with lower patronage (1, 2) by 20%. Groups 4 and 5 reveal both a consistent decrease in patronage alongside reduced boarding rates.

3. The profiles and their social and geographic contexts

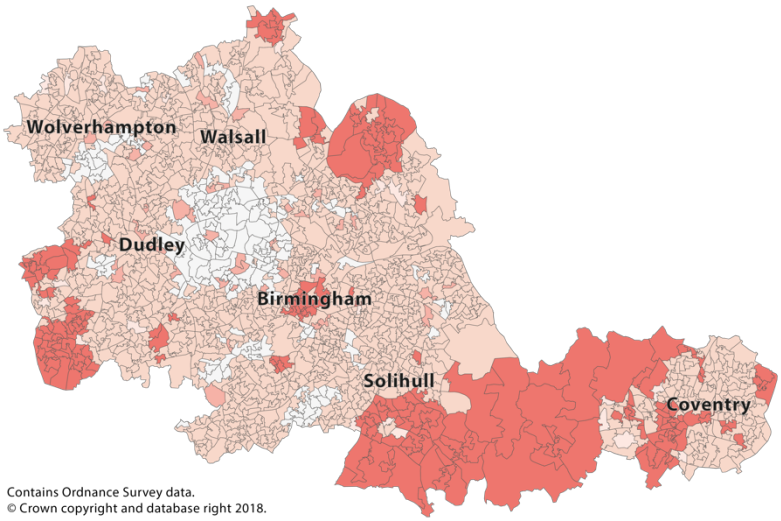
Group 1 – Rarely Seen Passengers (55%)

Patronage profile



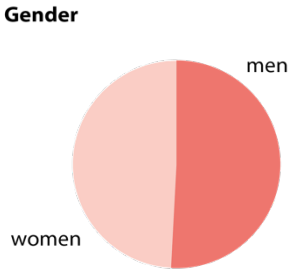
Bus boardings are rare, and about 25% of these passengers have never used the bus throughout the entire study period. Some passengers sporadically board regularly but are subsequently not seen on the system for longer time periods. Overall patronage declined initially up to 2012, and then remained stable with increasing boardings per passengers after 2016.

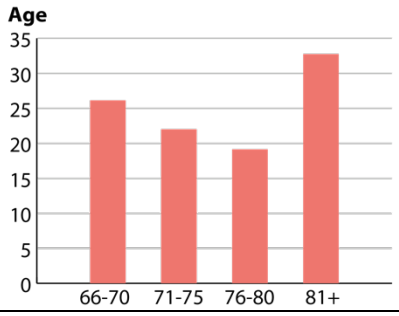
Geographic concentration



- Higher concentrations in more peripheral and less urban parts of the West Midlands Combined Authority
- Another concentration in the centre of Birmingham

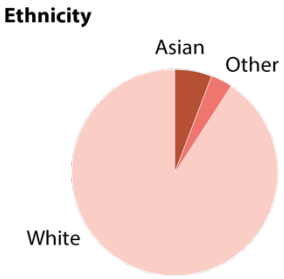
Demographics

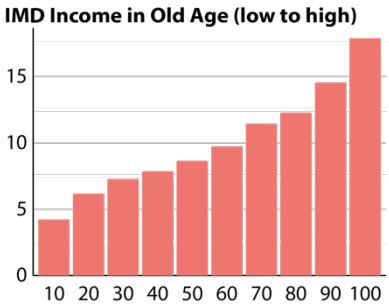




- Men are overrepresented in this cluster with 51%, considering that the share of men is 43% in this age group.
- One third of these passengers were 81 or older in 2016, another 26% between 66 and 70.

Neighbourhood context

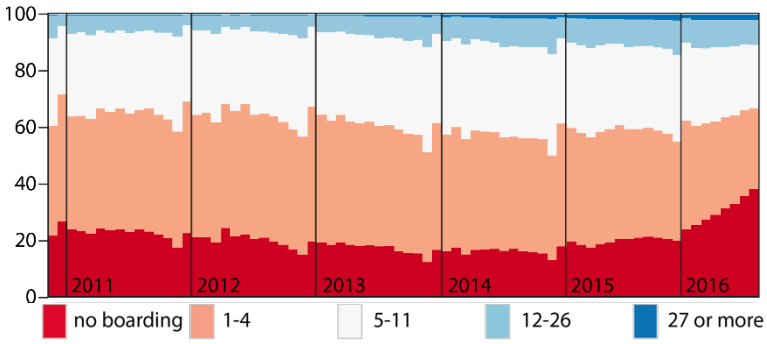




- Passengers of this group live in neighbourhoods where, on average, 91% of residents classify themselves as ‘white’
- They tend to live in more affluent areas of the West Midlands Combined Authority

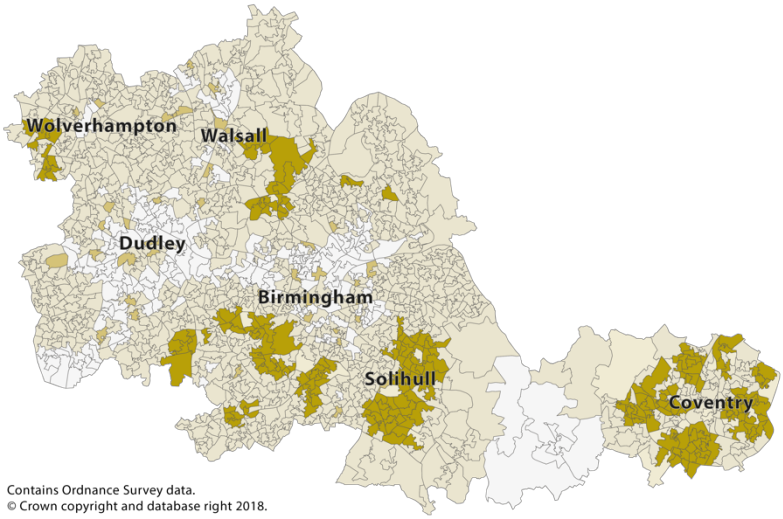
Group 2 – Irregular Passengers (14%)

Patronage profile



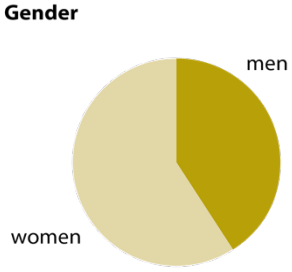
These passengers use the bus system throughout the study period, making on average one to two boardings per week. But the incidence of passengers making no boarding at all doubled in 2016 from 20 to 40%.

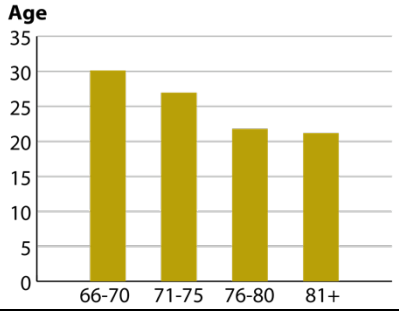
Geographic concentration



- Higher concentrations in suburban parts West Midlands Combined Authority
- Suburban areas adjacent to Coventry and Wolverhampton
- Concentrations in southwestern suburbs of Birmingham and Solihull

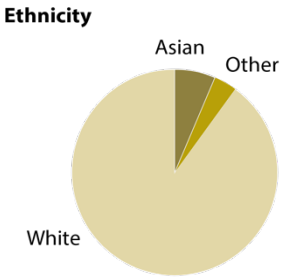
Demographics

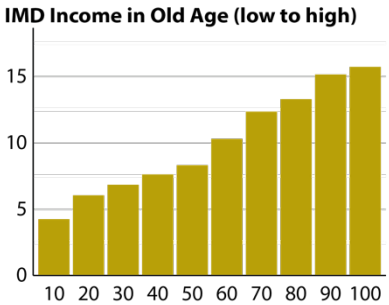




- Women are slightly overrepresented with a share of 59% compared to the demographically expected proportion of 56%.
- Passengers tend to be younger in comparison. Nearly 80% are 80 years or younger.

Neighbourhood context

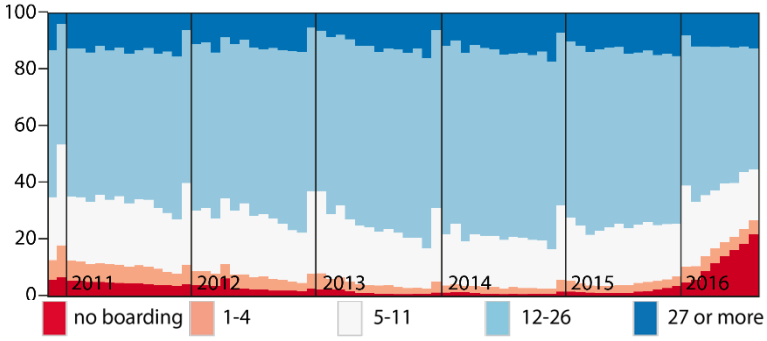




- Passengers of this group live in neighbourhoods where, on average, 90% of residents classify themselves as 'white'
- They tend to live in more affluent areas of the West Midlands Combined Authority

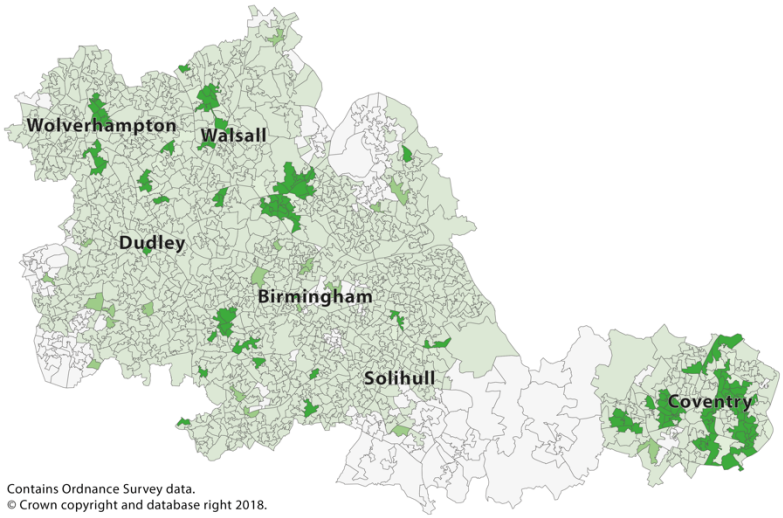
Group 3 – Regularly Seen Passengers (8%)

Patronage profile



For most of the study period, about half of the passengers make between one and two dozen boardings per four-week episode. On average, this translates into at least two to three trips per week. But from 2016, the share of passengers not boarding at from 3 to 25%.

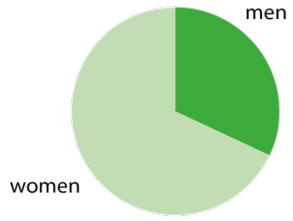
Geographic concentration



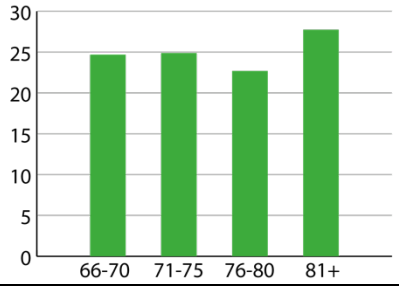
- Higher concentrations in neighbourhood surrounding Coventry
- Some weaker concentrations in Wolverhamption and Hamstead
- Otherwise even spread throughout the region except less populated areas

Demographics

Gender



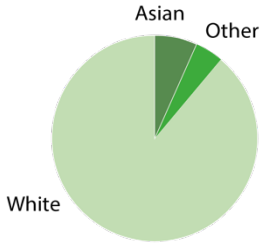
Age



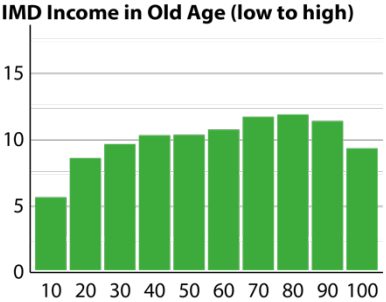
- Women constitute the majority of these passengers with a proportion of 68%.
- Passengers have an even age profile, all age groups are approximately equally represented.

Neighbourhood context

Ethnicity



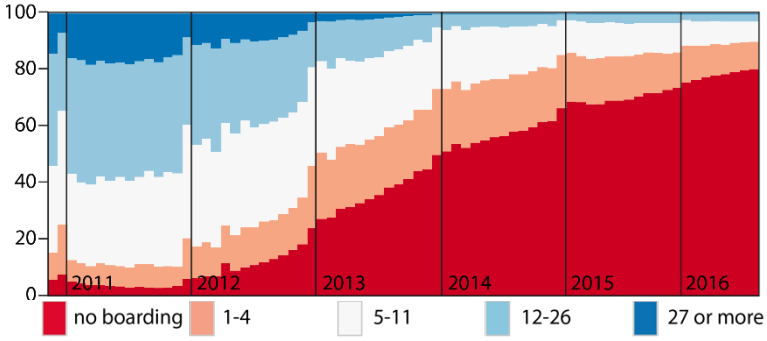
IMD Income in Old Age (low to high)



- Passengers of this group live in neighbourhoods where, on average, 89% of residents classify themselves as ‘white’
- They tend to live in a medium to upper range of neighbourhoods in terms of income in old age.

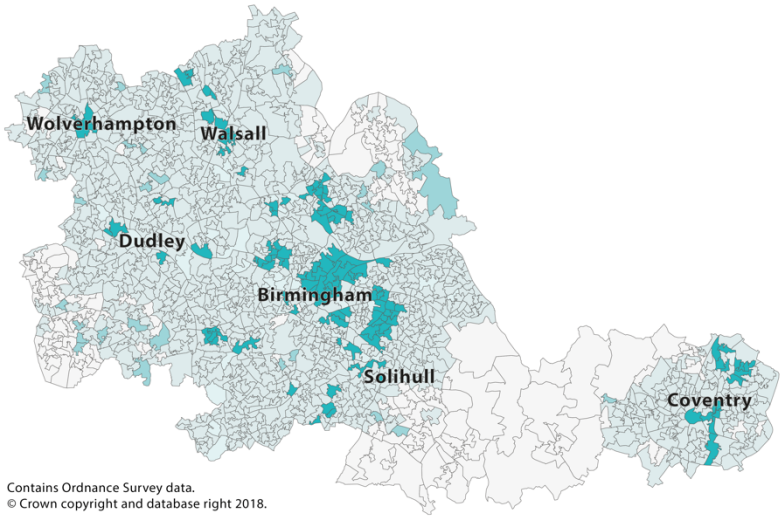
Group 4 – Withdrawing Passengers (7%)

Patronage profile



While in 2011, these passengers could be described as regularly seen, a gradual withdrawal began in early 2012 which remained steady since. In August 2016, three in four would not use the bus any more, and continuous usage with more than 26 boardings per episode disappeared entirely.

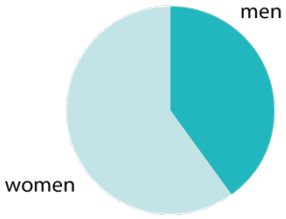
Geographic concentration



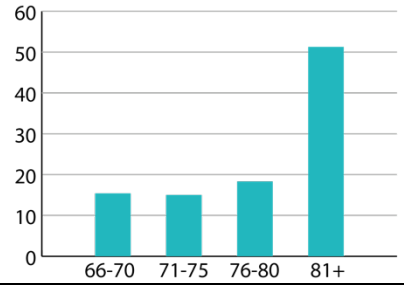
- Higher concentrations in north western, central Birmingham neighbourhoods
- Other hotspots include the centres of Wolverhamption, Walsall and Coventry
- Some surban locations in eastern Birmingham and northern and southern Coventry

Demographics

Gender



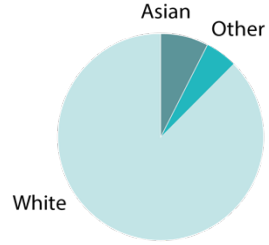
Age



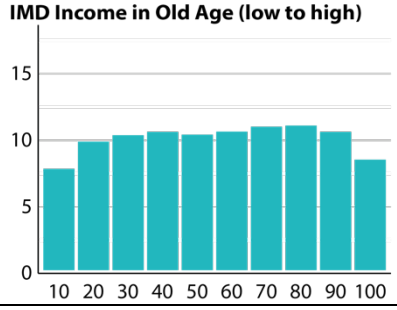
- A majority of 60% of passengers are women.
- A majority of 51% are 81 years or older. The remaining age groups are represented equally by well below 20% of passengers

Neighbourhood context

Ethnicity



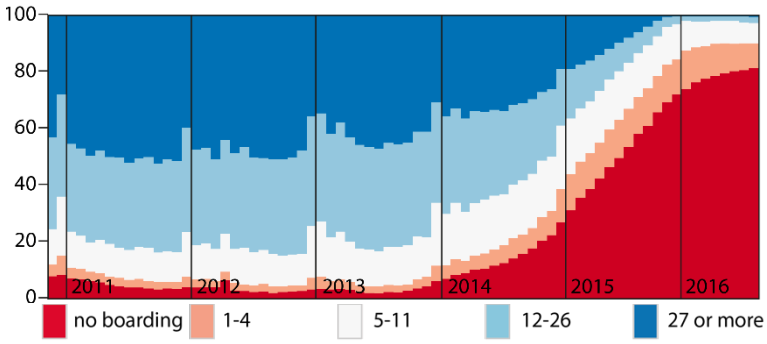
IMD Income in Old Age (low to high)



- Passengers of this group live in neighbourhoods where, on average, 87% of residents classify themselves as ‘white’
- They tend to live in a medium range of neighbourhoods in terms of income in old age.

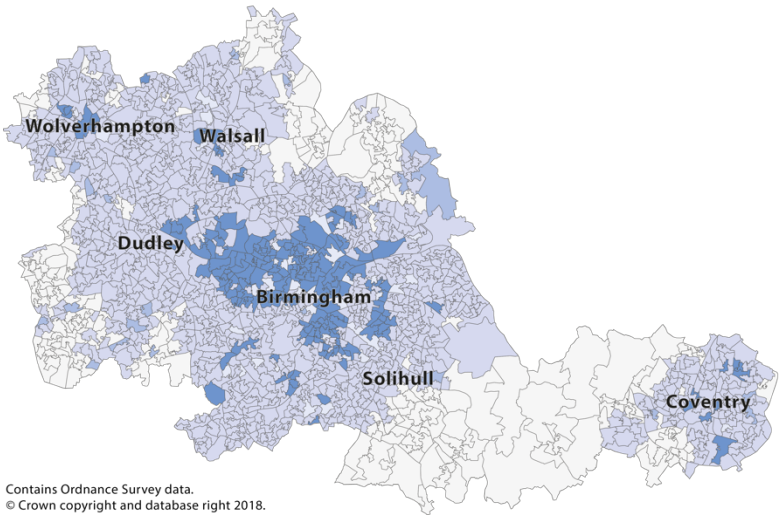
Group 5 – Withdrawing Passengers Post 2014 (5%)

Patronage profile



Passengers reduce their use of the bus system after 2014. In 2011, nearly 80% use the bus several times per week if not daily. In 2016, 80% have abandoned the bus, with the sharpest decline between 2015 and 2016.

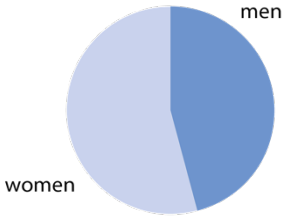
Geographic concentration



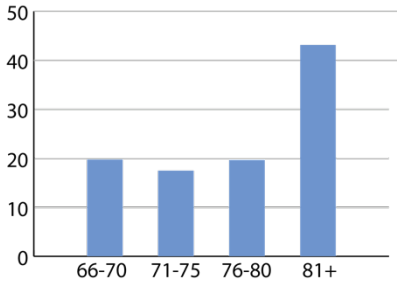
- A main spatial cluster of these passengers is located a highly populated area between Birmingham, West Bromwich and Dudley.
- Other, less pronounced concentrations can be found in Wolverhamption and Walsall and south eastern suburbs of Birmingham

Demographics

Gender



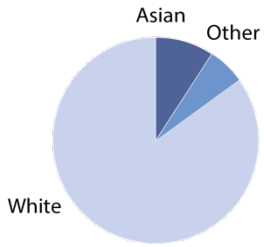
Age



- Women and men are equally represented in this cluster with 54% and 46% respectively.
- Passengers of age 81 years or older are overrepresented in this group with 43%. The remaining age groups are represented equally by approximately 20% of passengers.

Neighbourhood context

Ethnicity



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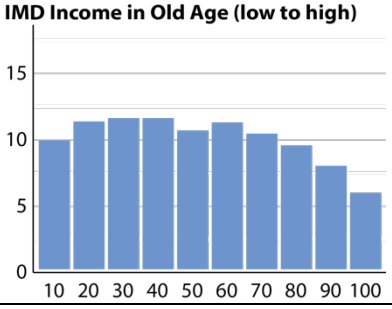
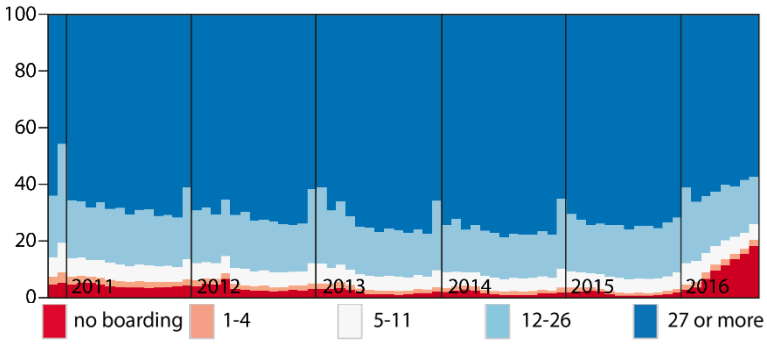


- Passengers of this group live in neighbourhoods where, on average, 85% of residents classify themselves as ‘white’
- They tend to live in more deprived neighbourhoods in terms of income in old age.

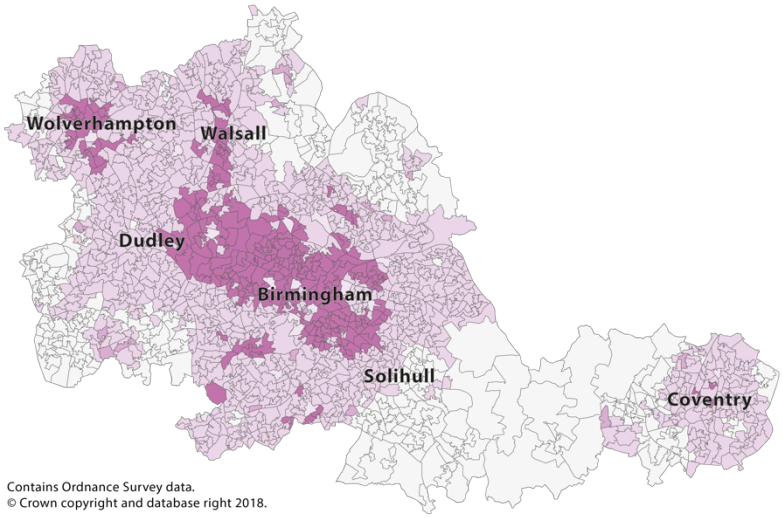
Group 6 – Daily Users (12%)

Patronage profile



These passengers use the bus on a daily basis. Episodes with no boardings are rare. Yet, even here, an increase in cardholders with no boardings can be observed in 2016. Passengers with high boarding rates appear to abruptly switch to no boardings at all. Consequently, overall boardings decrease noticeably.

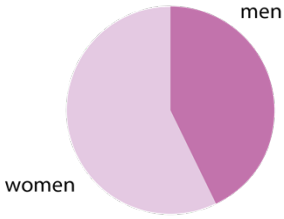
Geographic concentration



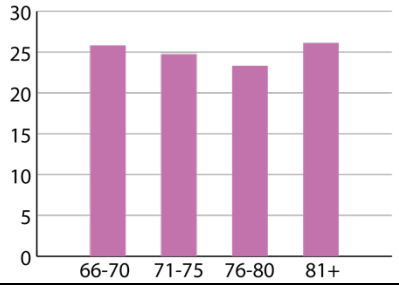
- Passengers in this group are overwhelmingly concentrated in the urban corridor between Birmingham, Dudley and Walsall, coninciding with the catchment area of the West Midlands Metro.
- Another concentration can be found in Wolverhampton.

Demographics

Gender



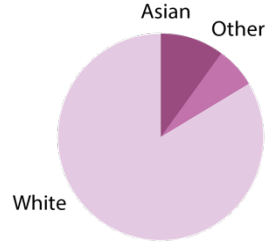
Age



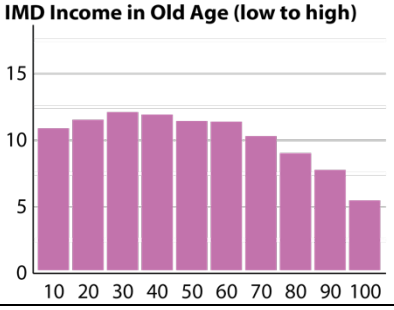
- Women and men are proportinately represented with 57% and 43% respectively.
- Passengers of all age groups are equally represented in this group.

Neighbourhood context

Ethnicity



IMD Income in Old Age (low to high)



- Passengers of this group live in neighbourhoods where, on average, 84% of residents classify themselves as ‘white’
- They tend to live in more deprived neighbourhoods in terms of income in old age.

4. Residents indicating social disadvantage reduce their patronage more often

In conclusion, the analysis of patronage profiles alongside geographic and social context suggests that later boarding declines occur by passengers who are likely more vulnerable to social exclusion. If this hypothesis can be further substantiated, the receding patronage may be caused by social and economic forces rather than structural ones observed on the transport sector. Nevertheless, external data on social and demographic trends suggest that declining boardings may also be attributed to other factors.

- Rise in online shopping trends among residents of age 65 or more [ONS 2018a]
- Rise in pensioner poverty in the UK, especially among single male pensioners [JRF 2017]
- Stable, regional mortality rates [ONS 2018b], although this trend may mask social inequalities in health
- Sharp increase in patronage of the West Midlands Metro by 29% since its extension [DfT 2017]
- Introduction of the e-hailing services UBER and GetTaxi in early 2015.

Further analysis of the smartcard transactions and related data within a larger project might generate more insights with respect to the significance of these trends. So far, the results of our pilot project provide starting points for future focussed investigations to understand current ENCTS patronage and issues of inclusive mobility in the West Midlands Combined Authority.

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