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Sociodemographic and spatial disaggregation of e-commerce channel use in the grocery market in Great Britain

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ABSTRACT

The UK Grocery e-commerce industry is amongst the most developed in the world with an estimated value of £11.4Billion in 2018. Assisted by technological developments, the market has experienced dramatic growth over the past two decades. Grocery retailers have invested in online infrastructure and home delivery networks. As a result, consumers have a range of options which enable them to shop interchangeably between in-store and online channels. The proliferation of new grocery shopping channels such as home delivery or 'click and collect' (collect in store or collection from a non-store collection point), coupled with changing consumer behaviour, provides new challenges for retailers in understanding consumer dynamics in this market. This paper explores consumer behaviour and preferences for e-commerce in the grocery retail industry in Great Britain (GB) using a survey of 19,033 respondents from the major market research company YouGov. Respondents were asked a range of questions around uptake and channel usage in the grocery e-commerce sector. The survey presents a novel opportunity to analyse self-reported consumer behaviour in GB, with survey responses attached to key sociodemographic and locational information. We find that sociodemographics are an important driver of groceries e-commerce usage and channel choice, with females, more affluent households and those in the 25–44 age group most likely to use home delivery, corroborating previous research. Contrasting previous research, we also find statistically significant evidence of relatively high values of home delivery use among over-55s. Whilst overall usage is lower, we find a particular affinity to collection facilities among males and skilled manual workers. Spatially, we find evidence of both the innovation-diffusion theory and the efficiency theory at both a national and local authority district level, using a brief case study of Yorkshire and the Humber. These insights can support grocery retailers as they further develop costly localised infrastructure to support e-commerce. It could also assist retailers in understanding the localised drivers of channel choice as they seek to shift demand from home delivery (with high costs faced by the retailer in relation to the 'last mile') to click and collect (in which the customer faces the costs associated with the last mile).

1. Grocery e-commerce

The grocery e-commerce industry in the UK was worth £11.4Billion in 2018 and is amongst the most developed in the world. Kantar World Panel (2018) report that grocery e-commerce sales account for 7.2% of all fast-moving consumer goods (FMCG) sales in the UK, behind market leader South Korea (19.7%) and fast growing Asian markets such as China (9.5%) and Taiwan (8%) (Batty, 2018). The Institute of Grocery Distribution (IGD) forecasts the grocery e-commerce sector in the UK to grow from £11.4Billion in 2018 to £17.3Billion by 2023 (IGD, 2018). Further market research highlights the UK as having a higher groceries e-commerce order frequency than any other country, with an estimated average of 15.4 online grocery transactions per household per year (Rigby, 2017).

The proliferation of new retail channels such as home delivery and click and collect facilities has resulted in a more complex set of omni-channel interactions between consumers and retailers, with consumers making use of a full range of channels for their grocery shopping (Elms et al., 2016). These complex interactions between consumers and multiple retail channels pose new operational and strategic challenges and opportunities for retailers. Verhoef et al. (2015) argue that giving consumers' freedom to use channels interchangeably makes it difficult to

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understand or predict these consumer purchasing behaviours. Paramount for retailers in tackling this problem is an understanding of who their consumers are, which channel(s) they are likely to use, and where they live. Through the analysis of under-exploited consumer survey data, this research addresses the following research questions;

1. To what extent do different sociodemographic groups self-report engagement with groceries e-commerce?
2. How does grocery e-commerce engagement among different sociodemographic groups differ by e-commerce channel?
3. To what extent is there a geography to e-commerce use? Is this geography mediated by the location of the physical grocery infrastructure?

2. Infrastructure, demographics and the geography of e-commerce use

2.1. E-commerce and its infrastructure

Understanding and predicting consumer demand and channel usage is a challenge for retailers. Birkin et al. (2017) highlight the complexity of contemporary distribution where meeting and understanding customer needs in an omnichannel context is more difficult than ever before. The emergence of internet technologies and increased competition in the grocery industry contributed to major retailers developing online grocery operations (Doherty et al., 2006). The introduction of new online retail channels (home delivery and click and collect services) gives consumers more opportunity to buy products when, where and how they want (Hubner et al., 2016). Brynolfsson et al., 2013 argue that the omnichannel market place can break down existing barriers to purchase for consumers, particularly in terms of physical distance/accessibility and brand image.

Gocery home delivery is well established in GB following its introduction in the late 1990s (Lee, 1997), and is now the modal grocery e-commerce service. By the year 2000, Tesco operated an online grocery service to serve a large proportion of GB with a home delivery network (Clark and Ping Chang, 2014). It was often suggested that consumers would be reluctant to use e-commerce services in the grocery industry – as they could not see or touch the products (Hackney et al. 2006). However, subsequent investment by retailers in home delivery distribution networks and services, led to rapid expansion in this channel, and by 2013, all major grocery retailers in GB were offering a comprehensive home delivery service (Armstrong, 2016).

Whilst potentially benefitting the consumer, online grocery operations create logistical challenges for retailers in the management of resources and the operation of complex and costly infrastructure associated with order fulfilment. In the UK, most grocery retailers utilised store-based online order picking, packing and despatch in order to facilitate rapid expansion into this sector across a number of localities that are proximate to the end consumer. However, store base order fulfilment may be inefficient (customer-facing stores are not designed for efficiently of order assembly), thus limiting capacity and reducing customer satisfaction (Hubner et al., 2016). Some retailers (especially online-only grocers such as Ocado) have introduced specific 'online distribution centres' (or 'dark stores') to service online orders, with these most suited to urban areas with higher order volumes (Hubner et al., 2016 Eriksson et al., 2019).

Whether order fulfilment takes place in store or within a 'dark store', retailers are faced with considerable costs associated with 'the last mile' delivery to the consumers' home. The last mile often accounts for over 50% of the supply chain costs of order fulfilment (Hubner et al., 2016; Aspray et al., 2013), with consumers typically unwilling to face the full costs associated with delivery (Fernie and McKinnon, 2009). The attended delivery model applied in UK groceries (customer at home to receive the order during a narrow and defined timeslot) often results in considerable inefficiencies with complex and costly last mile vehicle routing and order sequencing required in order to maximise customer satisfaction (Brown and Guiffrida, 2014). Alternative delivery models such as unattended delivery (the dominant mode in Switzerland) or drive through collection points (the most prevalent mode of online groceries in France) may afford retailers greater logistical efficiency and reduced costs associated with the last mile (Hubner et al., 2016), whilst also freeing consumers from restrictive time-slots during which they need to be available to accept deliveries and affording them free delivery options (Buldeo Rai et al., 2019).

In part a response to costs associated with the last mile, and in an attempt to reflect changing consumer behaviours, UK grocers introduced store collection points (Beck and Rygl, 2015; Zissis et al., 2018; Davies et al., 2019). Retailers often offer multiple online services in an attempt to increase market share without affecting profitability (Zissis et al., 2018). They also exist to increase market presence in geographically competitive locations and compete with the offer of online retailers, allowing consumers to shop whenever and wherever they want (Vyt et al., 2017). Following the success of the model in the French market, ASDA launched same day 'click and collect' facilities in the UK in 2014 (Sillitoe, 2014). All UK grocers with a physical store presence, alongside pure play retailer Ocado, offer a collect in store service. This approach may make more efficient use of existing store based infrastructure and transfer the costs associated with the last mile back onto the consumer.

Many retailers also offer collection from collection points in non-store locations, often targeting commuters, highlighting the importance of collection points to non-residential populations (Nguyen et al., 2017). Collection lockers located in non-store locations (such as at transport interchanges, workplaces and at popular leisure venues) have been very successful for non-food goods, yet the uptake for groceries has more mixed success, (for example, Tesco and Sainsbury's previously provided groceries from a select group of tube stations in London but withdrew in 2015 amid claims that they weren't used as extensively as hoped – and primarily by local residents rather than targeted rail commuters (Haslett, 2015)), highlighting the different consumer behaviours in the grocery sector and the unique interactions between supply and demand. In particular it highlights the need for retailers to understand the more nuanced usage of e-commerce channels to ensure that investment in costly non-store based collection infrastructure targets new consumers rather than encourage channel substitution away from more cost-effective store-based collection facilities.

Early research into e-commerce usage focused on the geography of the internet (Zook, 2000, Warf, 2010). The growth of e-commerce services was often associated with investment and penetration of broadband infrastructure (Rouibah et al., 2009). In early 2019, the whole of the UK has access to basic broadband facilities (minimum speed 2Mbps) with 95% of households having access to superfast broadband connections (speeds of 24Mbps+) (Gov.UK, 2019). As access to the internet increasingly fails to disaggregate consumers, other demographic and geographic factors are found to play key roles in e-commerce uptake. Whilst physical infrastructure and geography is of minor importance to certain types of e-commerce, such as digital music downloads, grocery e-commerce remains constrained by physical factors: specifically, the retailers must provide the complex infrastructure to meet the demand. This includes labour intensive in store or warehouse based order picking and packing alongside locally-based fleets of delivery vehicles (see Hubner et al., 2016). Understanding the influence of factors such as demographics and geodemographics that drive demand for e-services is crucial.

2.2. Demographics

In academic research, there has often been a focus on consumer demographics and e-shopping frequency, and purchase behaviour has been found to differ between demographic groups. In a UK context this is highlighted by the Internet User Classification (IUC) which captures

internet use and engagement (including e-groceries shopping) at a neighbourhood level, recognising the impact of local sociodemographics including age, income, employment status and education on e-engagement (Alexiou, 2018).

Gender plays an important role in driving observed e-shopping behaviours (Ren and Kwan, 2009). Mortimer et al. (2016) find females most likely to engage with e-commerce with a higher online shopping frequency than males across a number of retail sectors. Conversely, in a study in the Netherlands, Weltevreden (2007) found females to be more likely to be physical store shoppers or online searchers whereas males were likely to be frequent e-shoppers. Further research in this area is needed. A challenge taken up by this paper.

Many UK/GB based studies have had a focus on the age of grocery e-commerce shoppers. Clarke et al. (2015) present analysis from the Acxiom Research Option Poll, finding 25–44 year olds to be the most active group with one third of respondents regularly engaging with e-commerce services. Conversely, over 65's were the least frequent online shoppers, with just 1 in 10 respondents reporting regular e-commerce use. This pattern of low use amongst older age groups and highest use among younger – but not the youngest – adult age groups is replicated in the findings of many studies. Mortimer et al. (2016) find more frequent use among younger age groups and the 55–64 and 65+ age groups have been found to exhibit the lowest online purchase frequency (Statistica, 2018). This pattern has been confirmed in market research, with consumers within the 25–34 and 35–44 age bands using e-commerce services regularly (Mintel, 2017).

Turning to income/affluence, Lubris (2018) finds income levels and disposable income to be a key consideration in purchase decisions. Clarke et al. (2015) find wealthy households are ten times more likely to order online compared to lower income households, whilst Davies et al. (2018) note that consumers drawn from more affluent socio-economic groups exhibit higher usage of store-based e-groceries collection points. Additionally, Mintel (2017) find greater disposable income to be associated with e-commerce shopping for groceries. Linked to affluence, Weltevreden (2007) found that more educated respondents were more likely to be e-commerce shoppers. Finally, despite finding statistically insignificant associations between both age/gender and e-commerce frequency, Soopramiem and Robertson (2007) find consumers with higher income levels are more likely to buy online. These factors all vary over space, generating a complex underlying Geography to potential e-commerce uptake and channel choice.

2.3. Geography, geodemographics and the physical store landscape

As noted by Beckers et al. (2018), spatial components to e-commerce uptake have been increasingly tested/theorised in academic research, starting with the work of Anderson et al. (2003), which formulated two competing schools of thought on the geographical spread of e-commerce. First, the innovation-diffusion theory in which e-commerce would first be an urban phenomenon driven by technology in centres of innovation, which would subsequently diffuse to areas that are more rural. Support for the innovation-diffusion theory has been found in a number of studies across different national contexts, with Cao et al. (2013) noting that consumers in urban areas exhibited higher volumes of e-commerce transactions than their rural counterparts) (see also Clarke et al., 2015; Zhou and Wang, 2014). Second, the efficiency theory states that propensity to shop online will be higher in rural areas where access to physical stores is lower and online uptake improves accessibility for the consumer, as identified in a number of studies in a variety of international context at different spatial scales (e.g. Farag et al., 2006; Ren and Kwan, 2009; Nguyen et al., 2017). Further, Beckers et al. (2018) also note that some studies have found evidence of both theories occurring concurrently (e.g. Kiby-Hawkins et al., 2018; Motte-Baumvol et al., 2017), demonstrating the complex Geography to e-commerce uptake.

As noted earlier, grocery e-commerce is constrained by geographical factors. Much of the theorising of the relationship between demographics, geography and e-commerce sales was agnostic to these factors. One of these issues is the provision of physical stores with a primary function to serve in-store shoppers. For a review of a number of studies on the association between store access and e-commerce uptake see Weltevreden (2007). Using loyalty card data from a major grocery retailer, Kiby-Hawkins et al., 2018 explored the link between grocery e-commerce market share, geodemographics and store provision, all of which are linked factors in retail geography, and find areas of:

1. High online share and high store provision. This may be driven by affluence and possibly linked to retailer preference.
2. High on-line share and low store provision, driven by restricted accessibility to food stores.
3. Low on-line share and high store provision, which may reflect low uptake driven by geodemographic characteristics and good access to physical stores.
4. Low on-line share and low store provision. Linked to retailer preference and the 'food desert' debate (see Clarke et al., 2002; Wrigley, 2002 for more on food deserts).

Kiby-Hawkins et al., 2018 present findings which may in part support the innovation-diffusion theory with many of those areas identified as 'High on-line share and high store provision' are found in major urban areas, whist those with 'High on-line share and low store provision' exhibited characteristics associated with the efficiency theory. Whilst Kiby-Hawkins et al., 2018 consider overall propensity to shop online for groceries, they don't investigate channel usage, for example there may be evidence that higher on-line market share in areas with high store provision may be driven by click and collect, versus greater use of home delivery in areas with comparatively poor store provision. They also acknowledge that retailer preference may play a role as higher social classes have an affinity with the partner retailer in their study.

In contrast to Kiby-Hawkins et al., 2018, we have access to self-reported consumer grocery shopping behaviours across the whole grocery market and with a clear distinction between home delivery and click and collect channels. Using this data, we investigate the demographic and locational variations in e-commerce usage, specifically considering channel choice and testing the complex competing or complimentary theories of efficiency and innovation, before a local focus on the Yorkshire and the Humber region of the UK. We use this case studies to investigate the role of physical access to e-commerce infrastructure.

The structure of the paper is as follows. Section 3 details the data and methodology. Thereafter, sections 4 and 5 present findings and discussion on variations in e-commerce use by sociodemographic group and by geography. Finally, section 6 offers conclusions and further research avenues.

3. Data and methodology

3.1. Survey data

YouGov, a leading market research company who conduct internet panel surveys, provided the data used in this paper. YouGov maintain a 1

Table 1
E-commerce channel frequency questions.

Questions	Possible responses
How frequently do you order groceries online for home delivery? How frequently do you order groceries online for collection in-store? How frequently do you order online for collection at a [non store] collection point?	Regularly Occasionally Rarely/Never

Table 2
Survey population by gender (rounded).

Gender	Survey sample (19,033 respondents)	National comparison
Male	47%	47%
Female	53%	53%

Table 3
Survey population by age band (rounded).

Age band	Survey Sample (19,033)	National comparison
18–24	6%	12%
25–34	13%	17%
35–44	15%	18%
45–54	18%	18%
55+	48%	36%

Table 4
Survey population by social grade and the national breakdown (rounded).

Social Grade	Survey sample (16,832)	National comparison
A	18%	4%
B	24%	23%
C1	25%	28%
C2	14%	20%
D	8%	15%
E	10%	10%

million strong panel and draw a sub-sample which is representative of British adults, emphasising quality of sampling over quantity of respondents (YouGov, 2019). The data was supplied as part of an agreement with the Consumer Data Research Centre (CDRC), an Economic and Social Research Council (ESRC) investment.

Across a number of different surveys YouGov collected data related to grocery shopping behaviours from a total of up to 19,033 respondents between 2015 and 2016. Within this paper, we analyse three questions relating to e-commerce shopping frequency across different grocery channels. Responses are aggregated on a 3-category scale (based on respondent's self-identifying use without being given guidance by the survey company), as shown in Table 1, and subsequently analysed using Mosaic plots including statistical significance testing.

We group rarely/never because demand planning is generally focused on weekly or monthly revenue forecasting, relying on regular or semi-regular patronage. The survey company provided pre-aggregated responses by gender, age and social class band as well as by Local Authority District (LAD) geography. GB comprises 379 LAD's and they are the key unit of local government at which council's deliver local services and administer government legislation (ONS, 2018). The nature of these data allows for analysis of varying channel preferences and behaviours by consumer sociodemographic groups, namely gender (Table 2), age (Table 3), and social class (Table 4). Sample sizes in each group differ (since these questions were asked across multiple surveys with differing response rates) and statistical significance testing is used to identify robust findings. The National Readership Survey (NRS) social grade system is adopted, as described in Table 5. The following tables provide a national comparison based on the makeup of Great Britain at the most recent Census of Population and housing, conducted in 2011, for comparison.

Greater disaggregation of the over-55 group would be preferable although is limited by the pre-aggregated data. This is a diverse age cohort likely comprising a spectrum of people from late career, time-poor, cash-rich professionals through to the time-rich but potentially cash poor retired persons, and the pre-aggregation somewhat limits the interpretation of results for older aged persons. Social grade E would preferably be further disaggregated with respondent types varying from students to the retired. Careful consideration of conclusions drawn is necessary for this group.

Furthermore, responses were pre-aggregated by a sub-national geography, at the Local Authority District Level (LAD) in GB (19,033 respondents). The YouGov survey averages 645 respondents per LAD (mean), with the spatial distribution and proportion of the population by

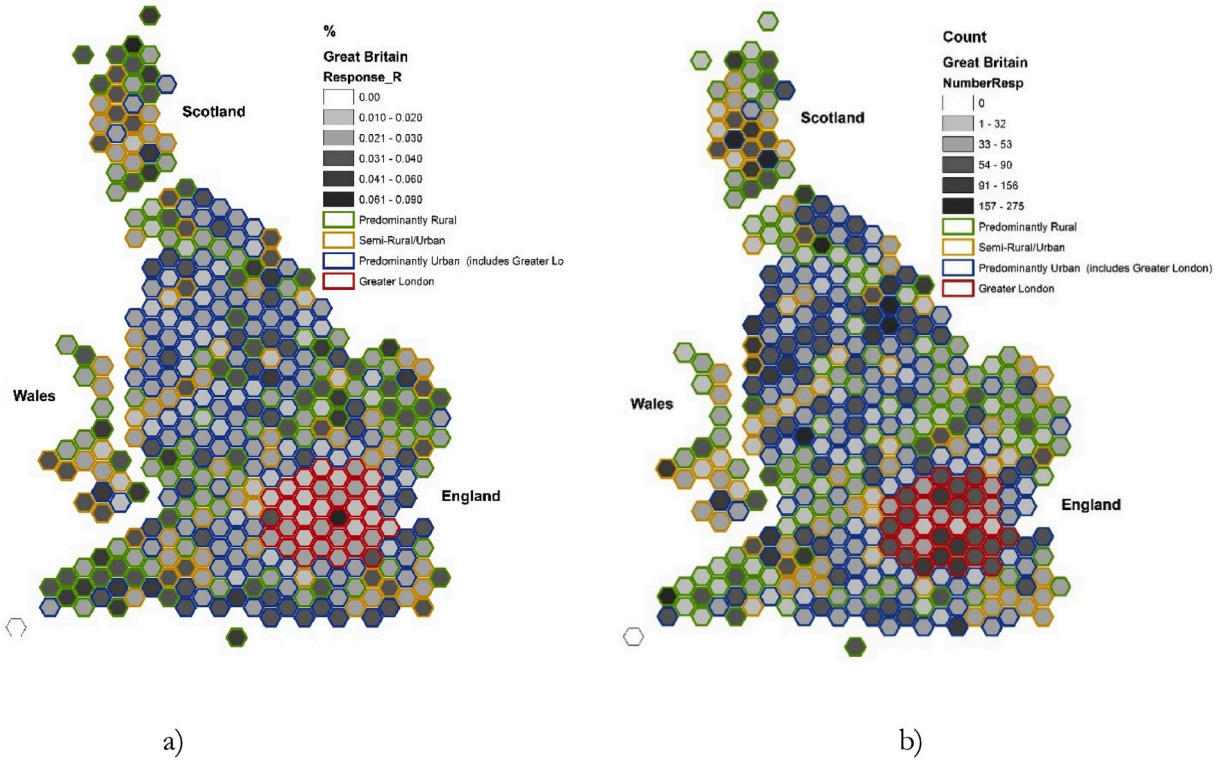


Fig. 1. a) Count of survey respondents and b) % of total population at the LAD level in GB.

LAD shown in Fig. 1. Fig. 1 also provides a broad urban-rural classification of LADs, supporting our discussion in section 5, in which we look at the competing schools of thought on the geography of e-commerce adoption.

The hexagon representation equalises LAD size to reduce the visual dominance of more rural areas. Blank spaces between England and Scotland, and England and Wales, simplify interpretation of the spatial distribution.

3.2. Grocery stores

To construct the retail landscape, the XY coordinates of stores were obtained from the retail consultancy firm Geolytix (Retail Points, version 12, October 2018). They publish open source data on grocery store locations in GB in which stores are classified by size using the Competition and Markets Authority (CMA) classification of stores, as shown in Table 6.

4. Results by sociodemographic group

4.1. All survey respondents

Table 7 shows variation in use of the three different e-commerce channels across all survey respondents.

The most popular e-commerce grocery channel is home delivery with 13.04% regular and 11.08% occasional users, dwarfing the use of collection channels. These results suggest that consumers substitute home delivery for in-store shopping, with a high percentage of regular users and a lower proportion of occasional users. For collection channels, we see the opposite, suggesting that these infrequently used channels are primarily used in conjunction with other channels. Within each channel, variation by different sociodemographic groups also exists.

We find that home delivery is the dominant e-commerce channel. Whereas 'click and collect' facilities are a relatively recent innovation in the industry, most major retailers have extensive home delivery networks (Hubner et al., 2016). Previous literature and market research suggests that e-commerce users are more likely to be in the younger – but not the youngest - age groups (Mortimer et al., 2016; Mintell, 2017; Statistica, 2018), female and in higher social grade/affluence groups (Lubris, 2018). Younger age groups are generally more technologically connected and wealthier groups have more disposable income, both of which influence grocery e-commerce uptake. Demographically, our results generally concur with previous findings. Overall, we find females are more likely to be e-commerce users than males, the younger but not youngest age groups are the most likely age groups and higher social grades are more likely than lower social grades. We also find differences by channel type, as discussed further below.

Table 5
Social grade descriptions.

Social Grade	Description
A	Higher managerial, administrative and professional
B	Intermediate managerial, administrative and professional
C1	Supervisory, clerical and junior managerial, administrative and professional
C2	Skilled manual workers
D	Semi-skilled and unskilled manual workers
E	State pensioners, casual and lowest grade workers, students, unemployed with state benefits.

Table 6
CMA store classification.

Store Classification	Size (ft^2)	Store Type
A	Less than 3,013 ft^2	Convenience
B	3,013–15,069 ft^2	Mid-sized
C	15,069 to 30,138 ft^2	Large Supermarket
D	30,138 ft^2 +	Hypermarket

4.2. Gender

Mosaic plots in Figs. 2–4 show use of the three channels by gender breakdown. Mosaic plots show (Friendly, 1994):

- Relative sample size in each group by width of each rectangle
- Proportion of each group giving each response by length of each bar
- Greater or fewer people than expected persons giving each response by either dashed outline (fewer) or full outline (more)
- Significance of the greater or fewer by colour - dark red/dark blue at the 0.001 level ($>\pm4$) and light red/light blue at the 0.05 level ($>\pm2$), based on standardised residual of a Pearson's chi-squared test (χ^2).

Female respondents exhibited a more regular use of home delivery, a highly statistically significant result. Females also exhibit a greater collection in store frequency than males, whilst this is reversed in relation to collection at a collection point. Collection channels have higher occasional use than regular use. This possibly suggests they are adopted occasionally by consumers seeking one-off convenience in the shopping process rather than as a regular substitute for in store or home delivery channels. Whereas females are more regular home delivery users (by around 25%), male respondents in our study were substantially more likely to be collection point users (around 300% more likely). However, the only statistical significant finding is that females are more frequent occasional collection in store users than expected and males are less frequent occasional collection in store users than expected.

4.3. Age

Figs. 5–7 show use of the three channels by age breakdown. More regular and occasional use of home delivery than expected and less regular and occasional use of collection facilities than expected is evident among the over-55s, both of which are highly significant. Less regular home delivery use than expected is evident among the younger age groups when compared to the over-55s with the lowest levels observed for 18–24 year olds in a highly significant result. The 18–24 age group stands out as the only group with a higher proportion of occasional home delivery users than regular home delivery users, a highly statistically significant finding. The second highest home delivery use occurs for 34–44 year olds although the result is less statistically significant, possibly denoting worthiness in further investigation.

This group (along with 25–34 year olds) also have a higher than expected use of both types of collection facilities, with highly statistically significant χ^2 values whereas lower than expected use of collection facilities as identified among both 18–24 year olds and 45-44 year olds, although results did not reach acceptable levels of statistical significance. A particularly interesting finding in collection point use is that the 18–24 and 45–54 age groups were more likely to be regular than occasional collection point users if they use this channel. Both 18–24 year olds and 45–54 year olds may have fewer commitments than other

Table 7
E-commerce use by channel.

Channel	Used regularly (%)	Used occasionally (%)	Used rarely/never (%)
Home delivery	13.04	11.18	75.78
Collection in Store	0.92	2.85	96.23
Collection Point	0.37	0.98	98.65

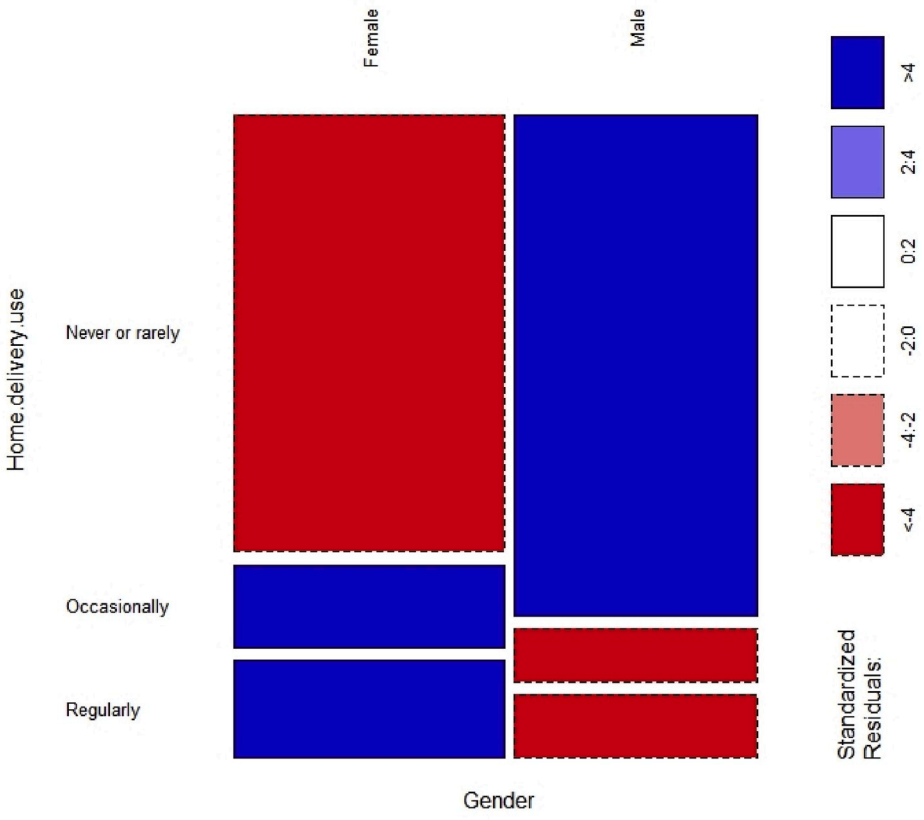


Fig. 2. Home delivery use by gender (19,033 respondents).

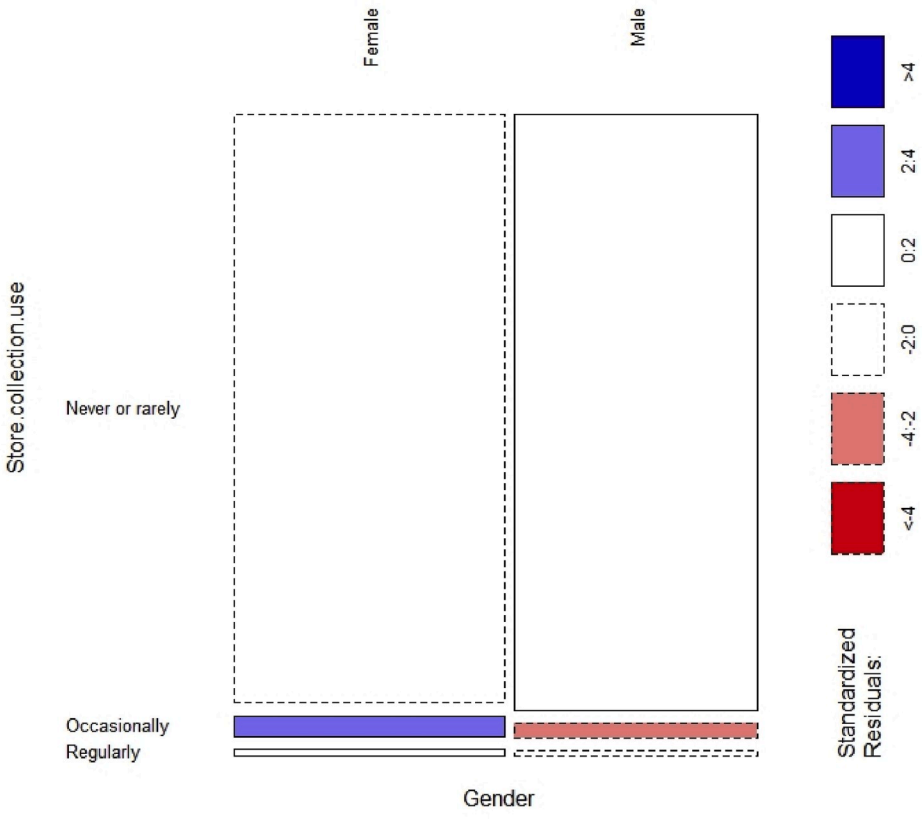


Fig. 3. Store collection use by gender (19,033 respondents).

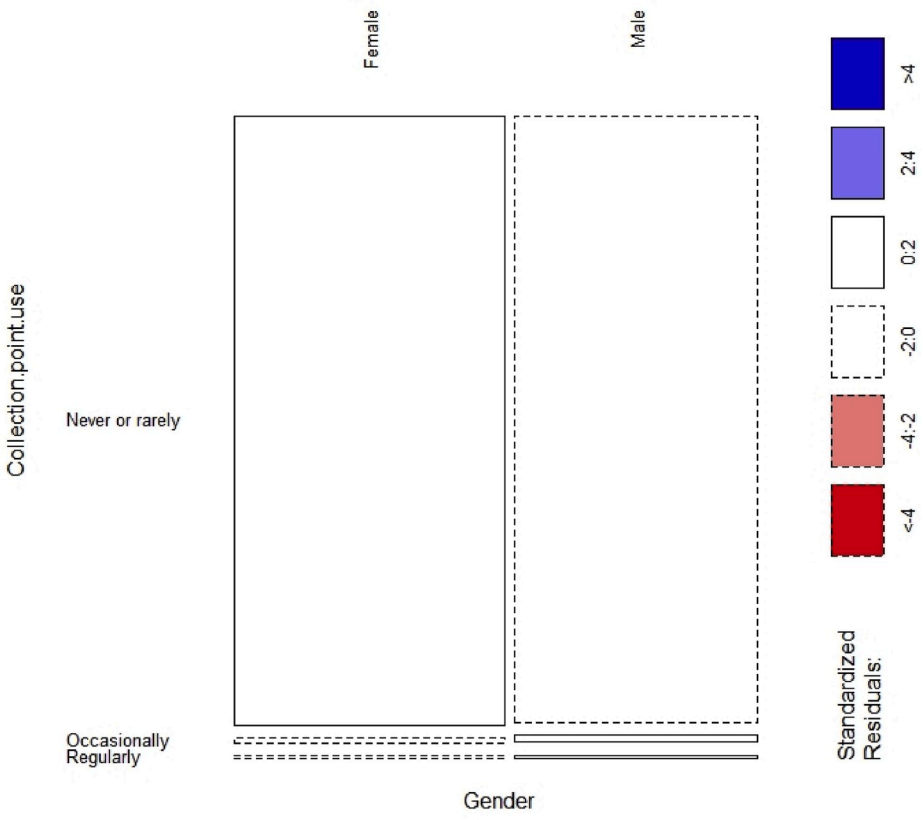


Fig. 4. Collection point use by gender (19,033 respondents).

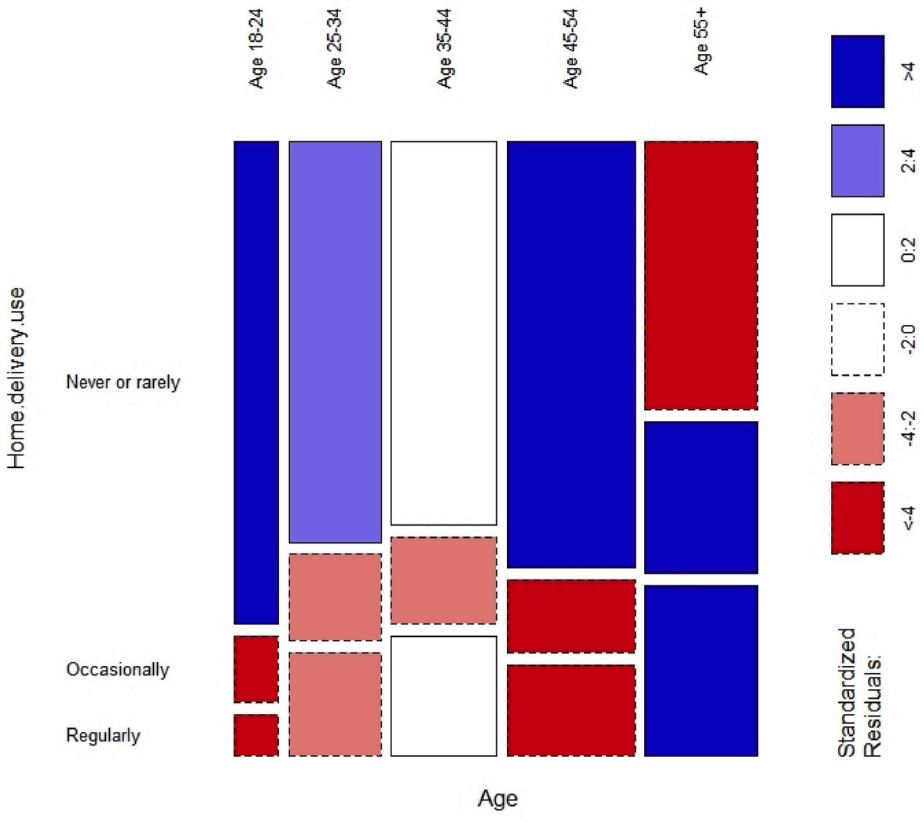


Fig. 5. Home delivery use by age (19,033 respondents).

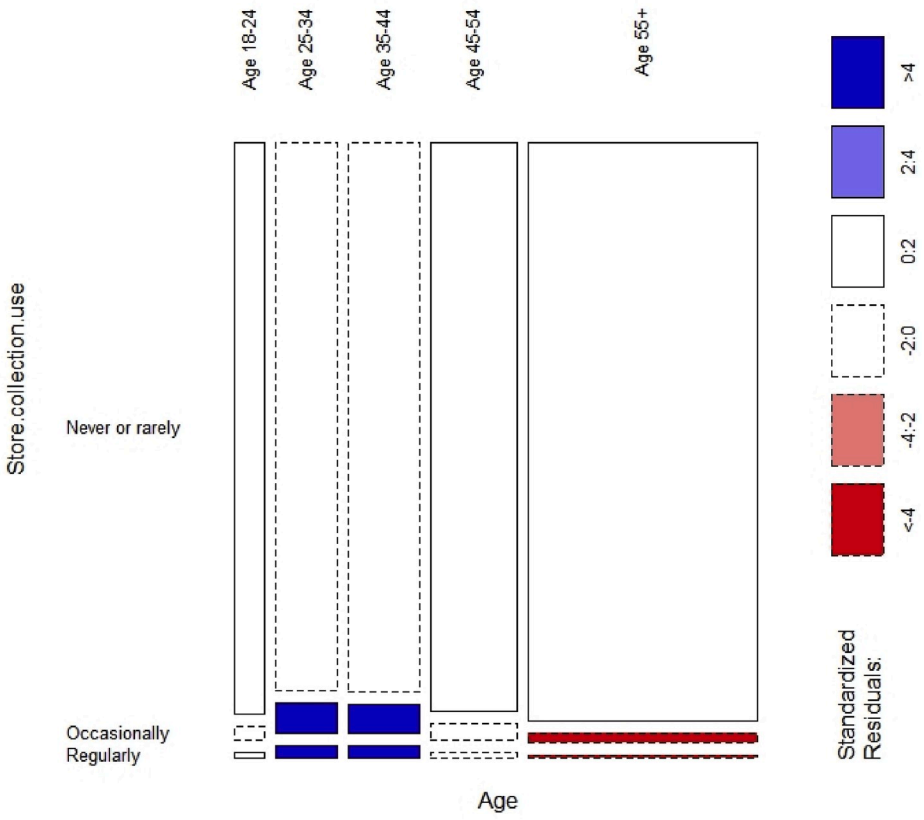


Fig. 6. Store collection use by age (19,033 respondents).

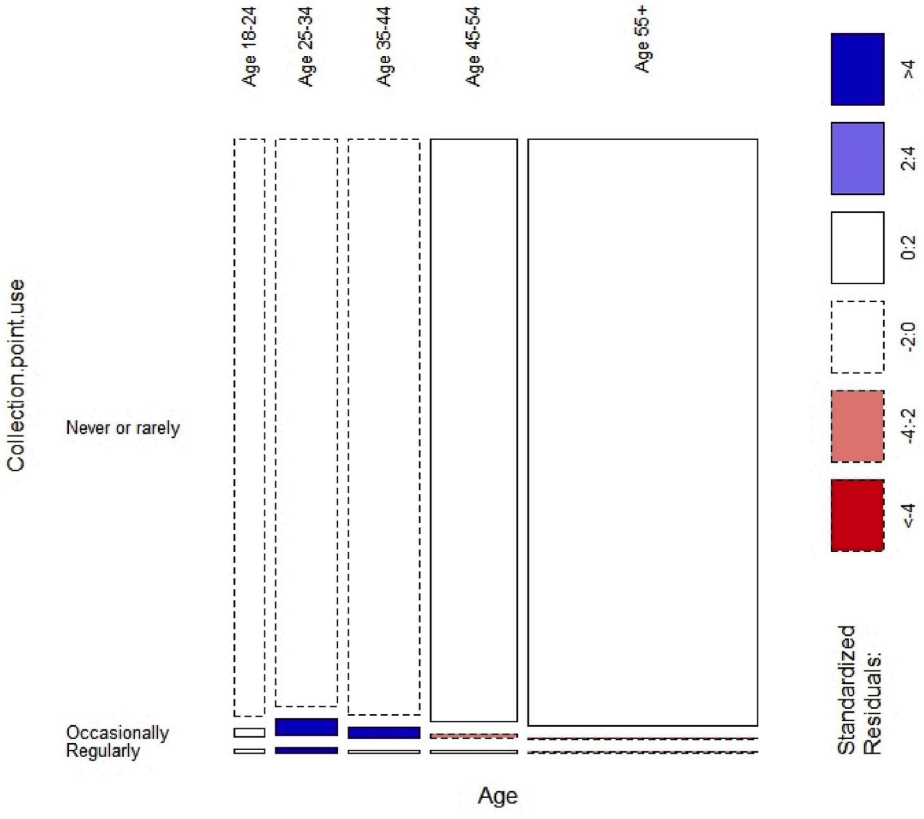


Fig. 7. Collection point use by age (19,033 respondents).

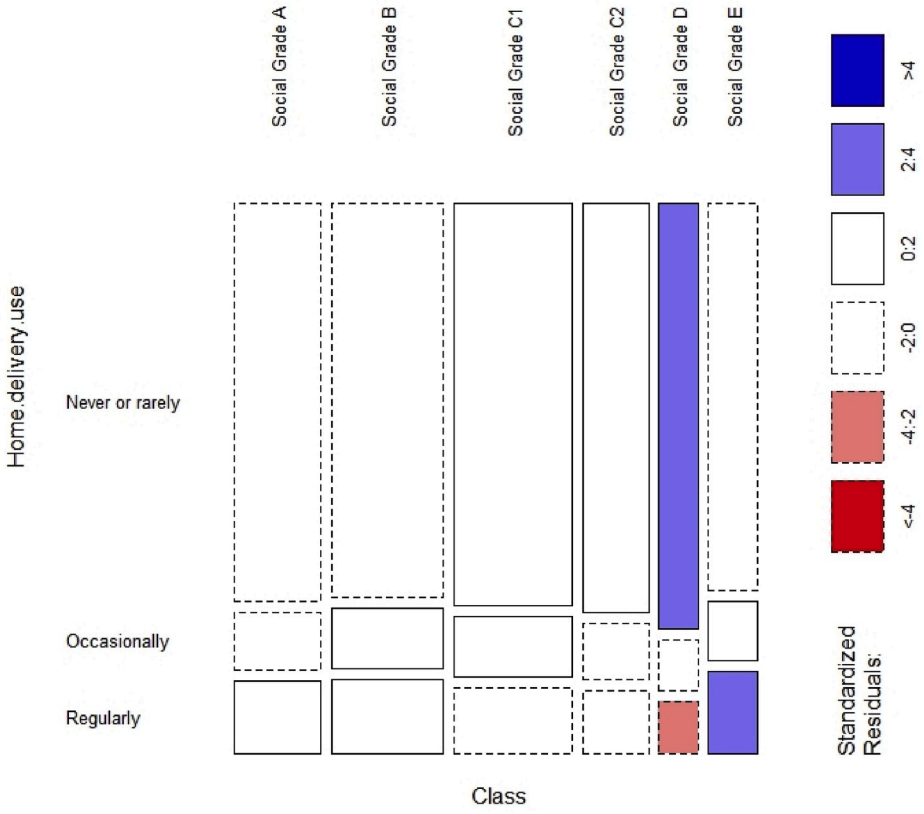


Fig. 8. Home delivery use by social class (16,832 respondents).

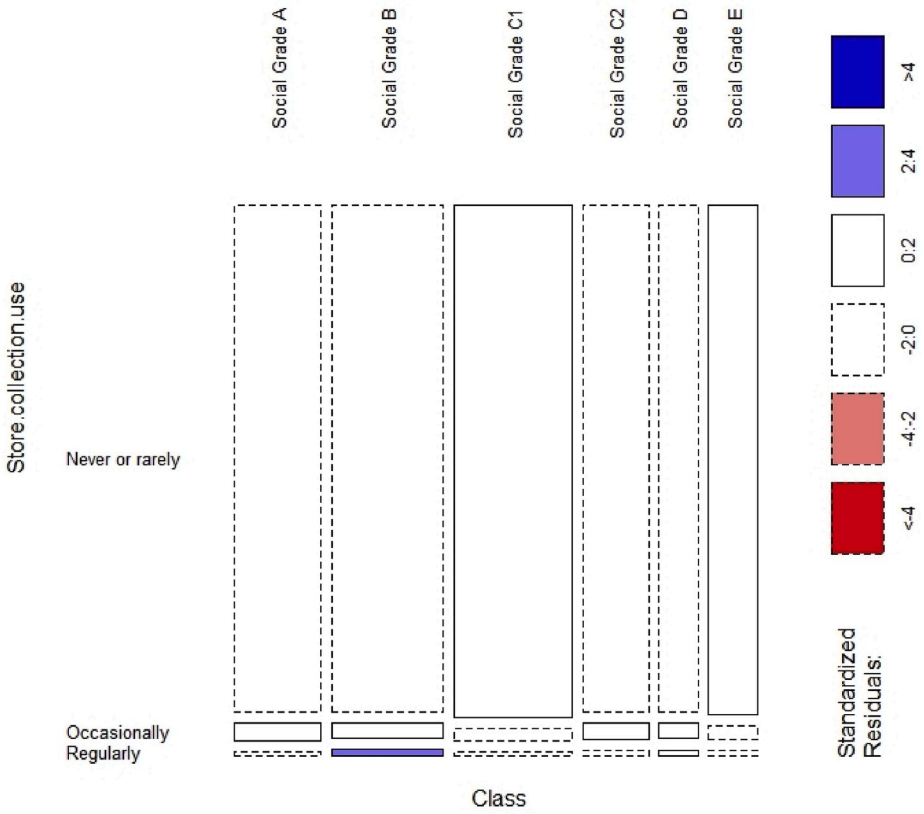


Fig. 9. Store collection use by social class (16,832 respondents).

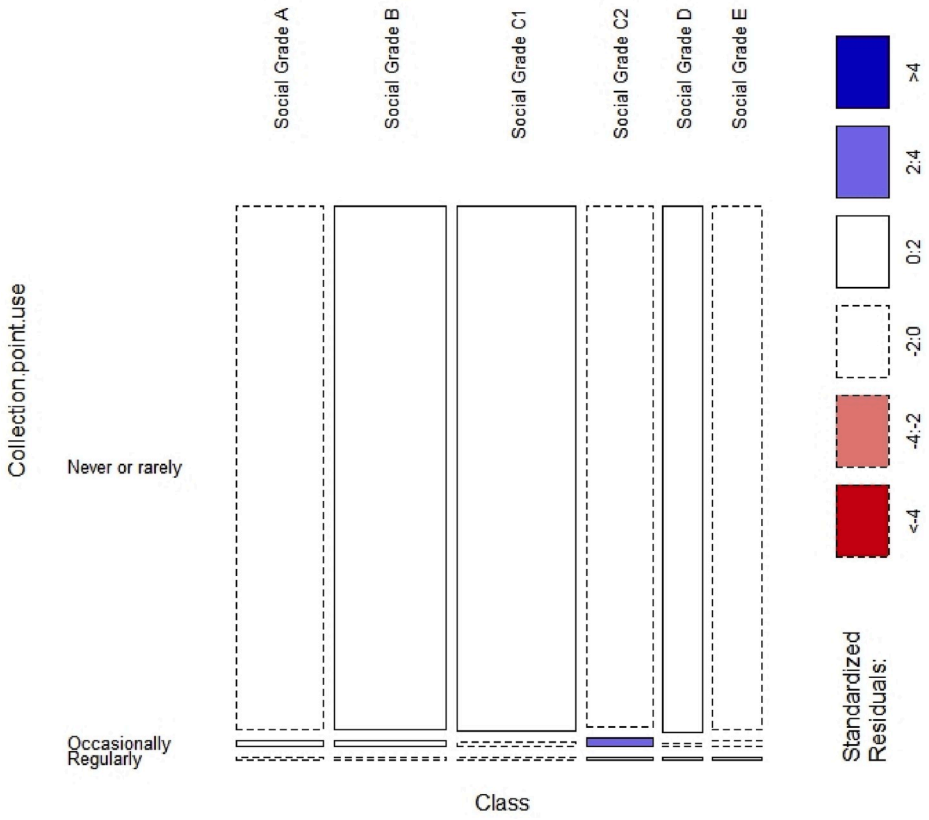


Fig. 10. Collection point use by social class (16,832 respondents).

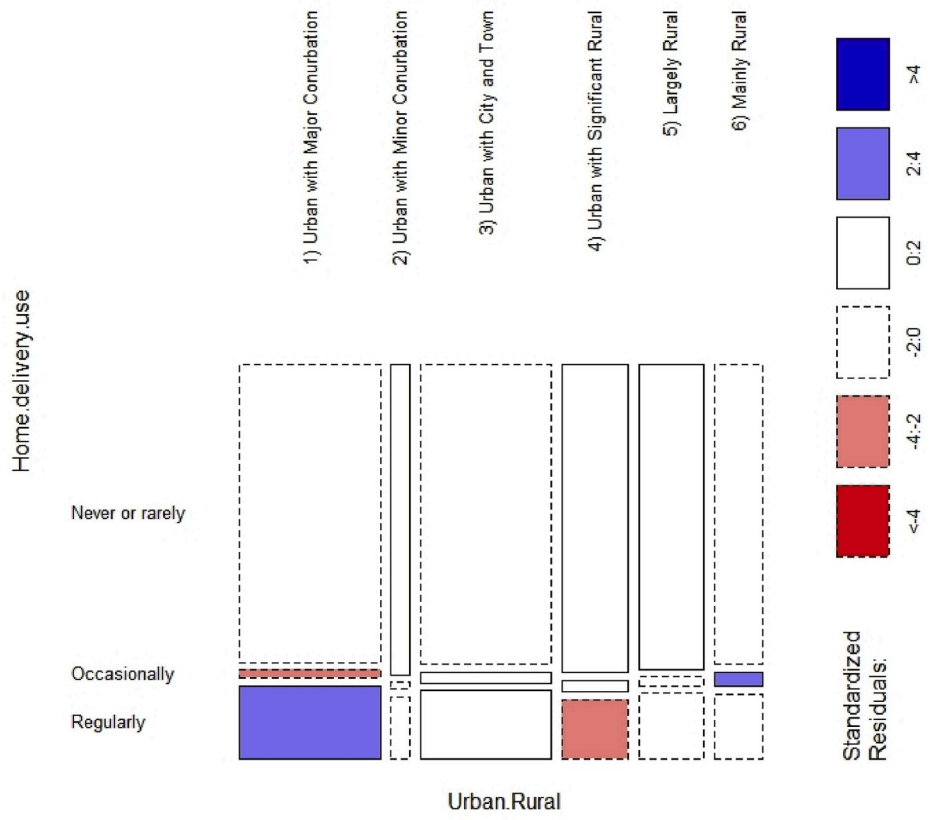


Fig. 11. Home delivery use by rural urban geography (12,246 respondents).

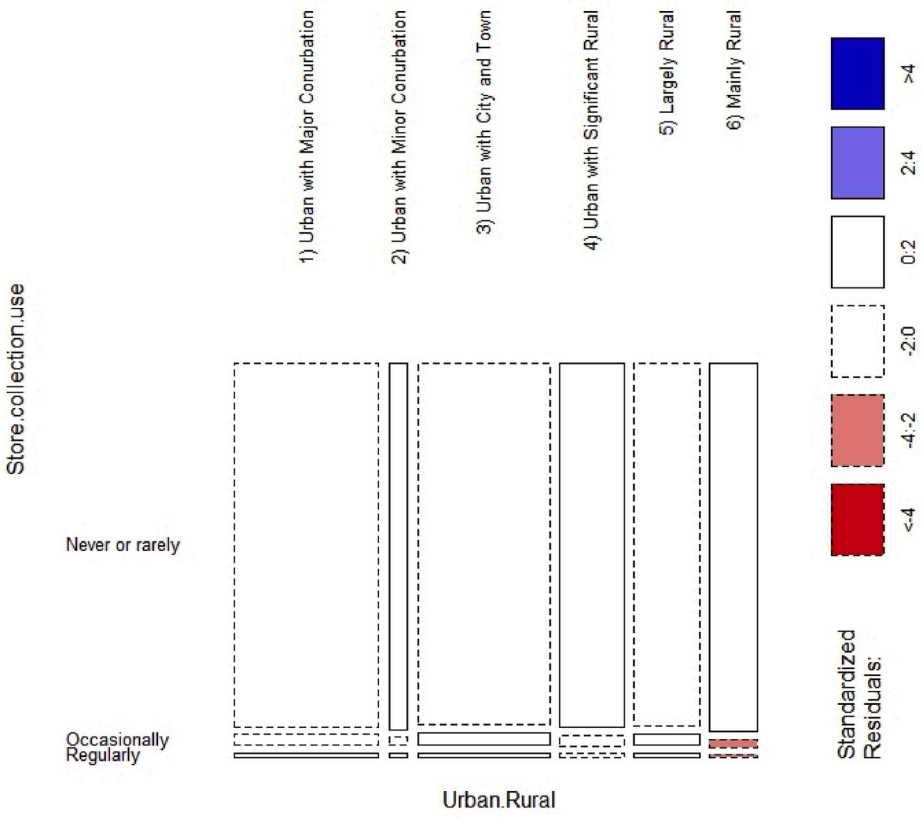


Fig. 12. Store collection use by rural urban geography (12,246 respondents).

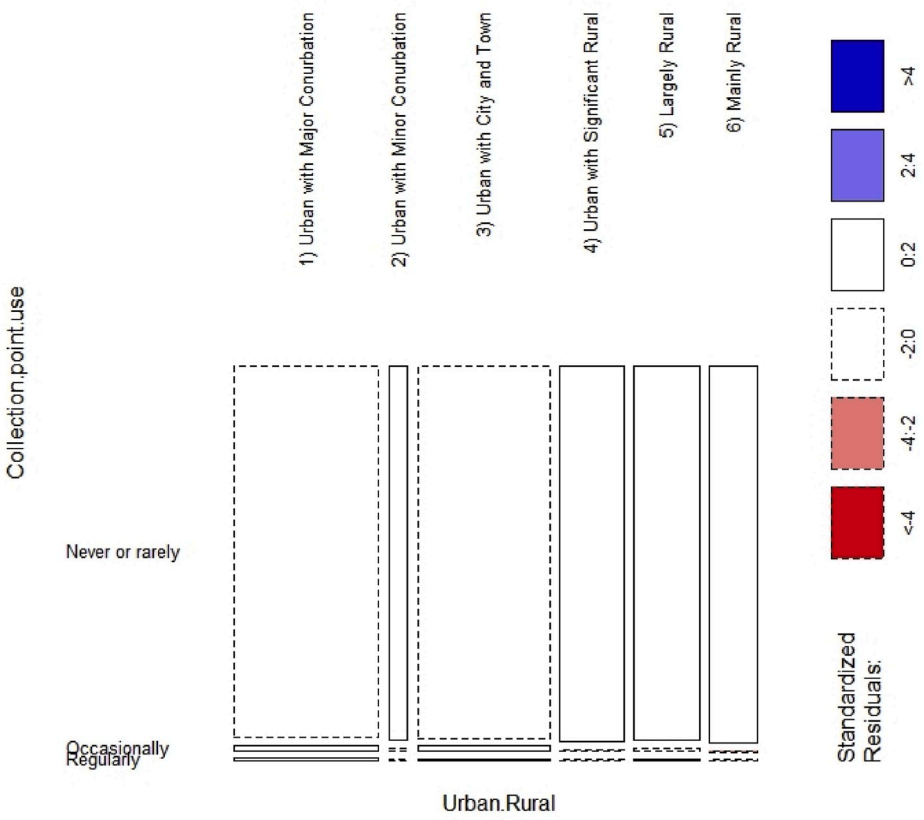


Fig. 13. Collection point use by rural urban geography (12,246 respondents).

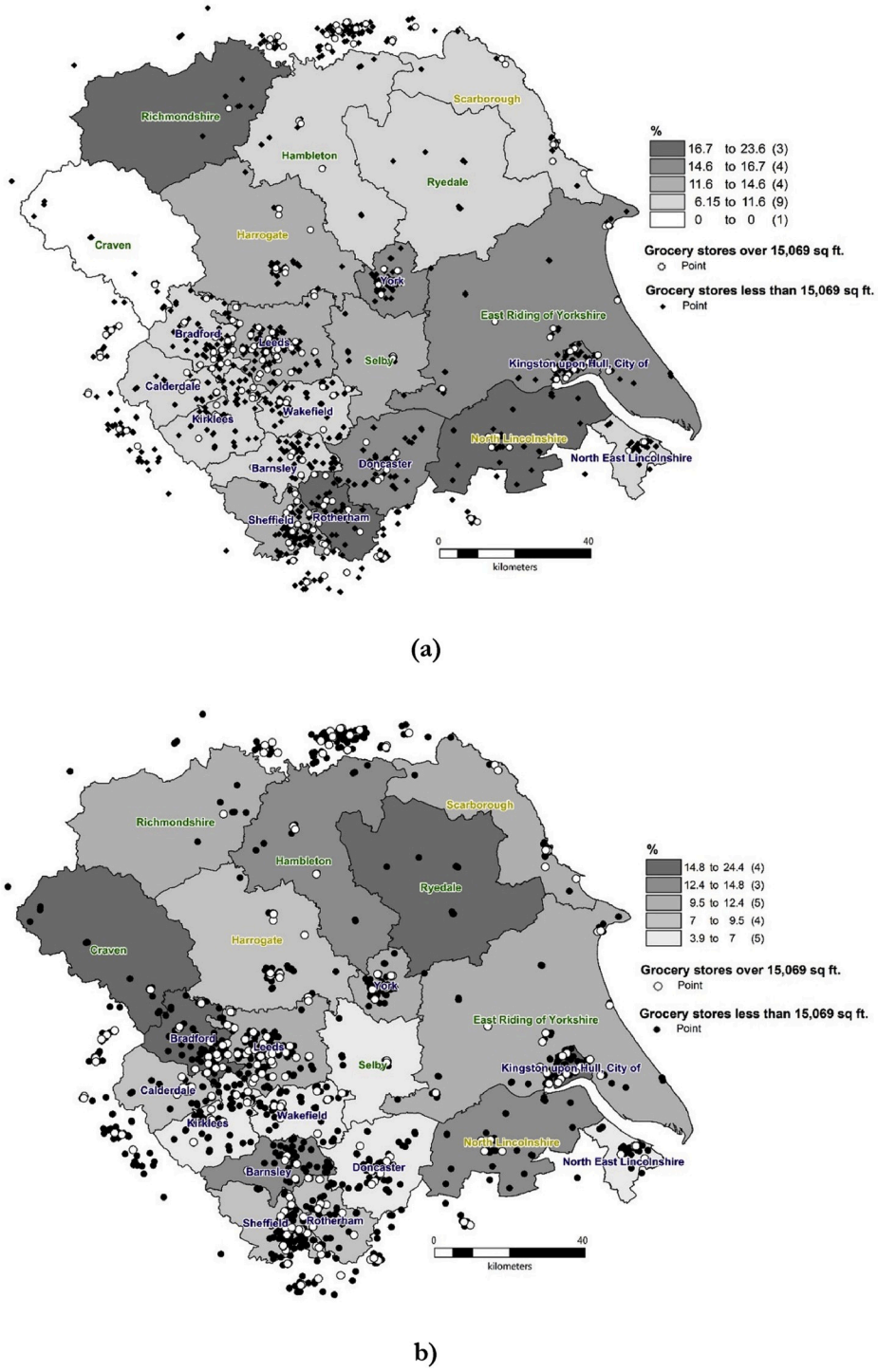


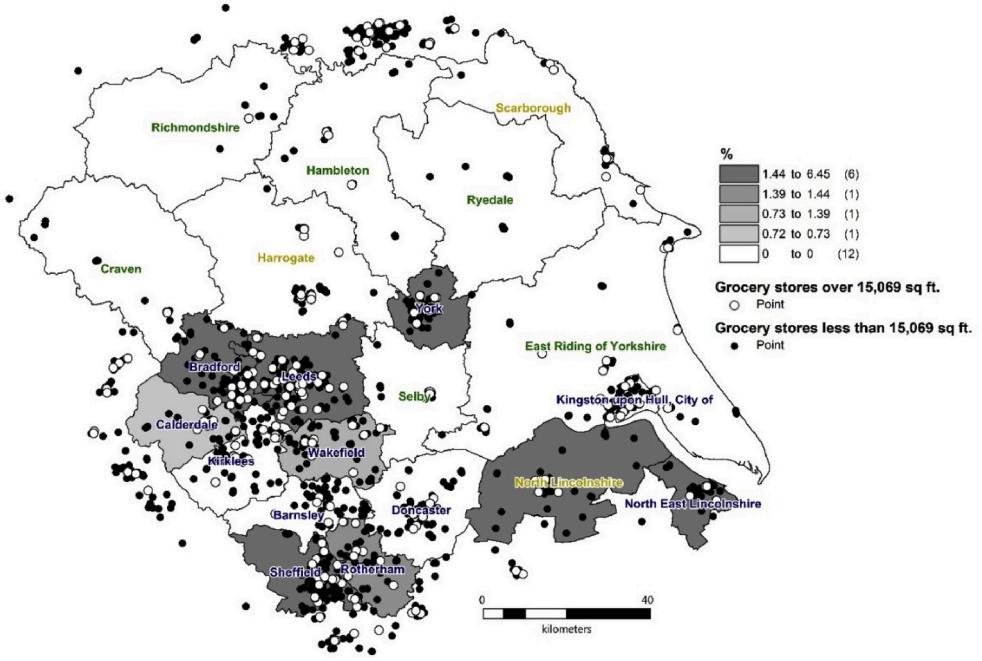
Fig. 14. a) Regular and b) Occasional home delivery users in Yorkshire and the Humber.

age groups (especially in relation to childcare) and have the ability to be flexible, whilst still being in more technologically active age groups. They may also have less routine so rather than book a delivery slot that requires them to be at home at a set time, they could use collection points at their convenience.

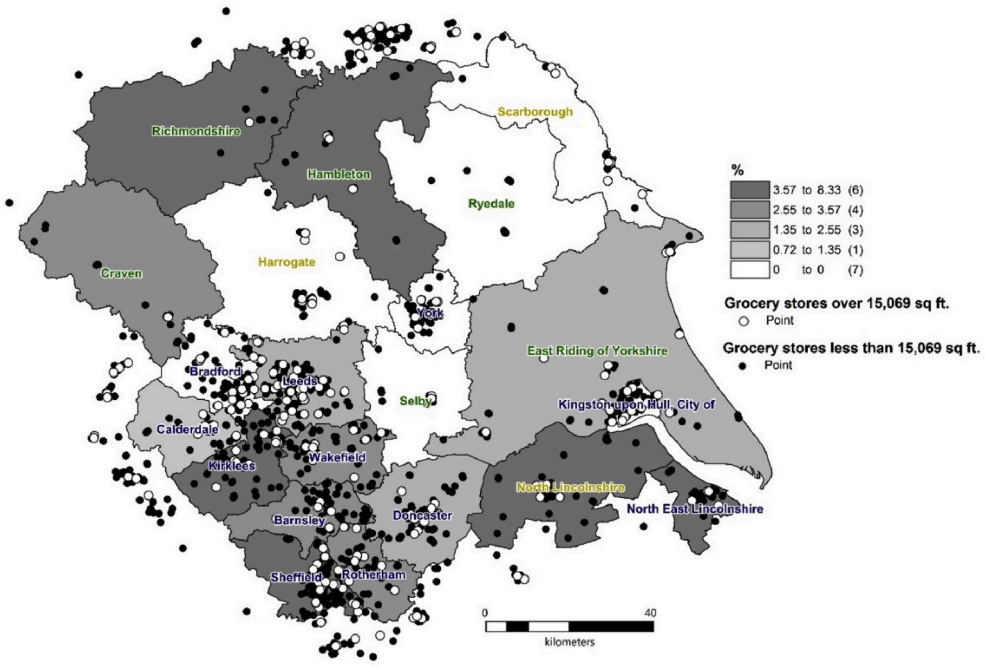
4.4. Social class

Figs. 8–10 show use of the three channels by social class breakdown. Results show fewer instances of statistical significance when broken down by this type of sociodemographic category. There is an observed social gradient of home delivery use with more regular and occasional use among higher social grades. The lower social grade D exhibits less regular than expected uptake, a result which is significant at the 0.05 level. This social gradient is not observed for either collection facility uptake. However, social grade B are more regular than expected e-commerce users compared to other groups, a highly statistically significant finding.

The most striking group of click and collect users are C2 respondents, who have a higher than expected use compared to other groups use. This group comprises skilled manual workers who are likely to be male - a group found to have an affinity with click and collect - and who are



(a)



b)

Fig. 15. a) Regular and b) Occasional collection in-store users in Yorkshire and the Humber.

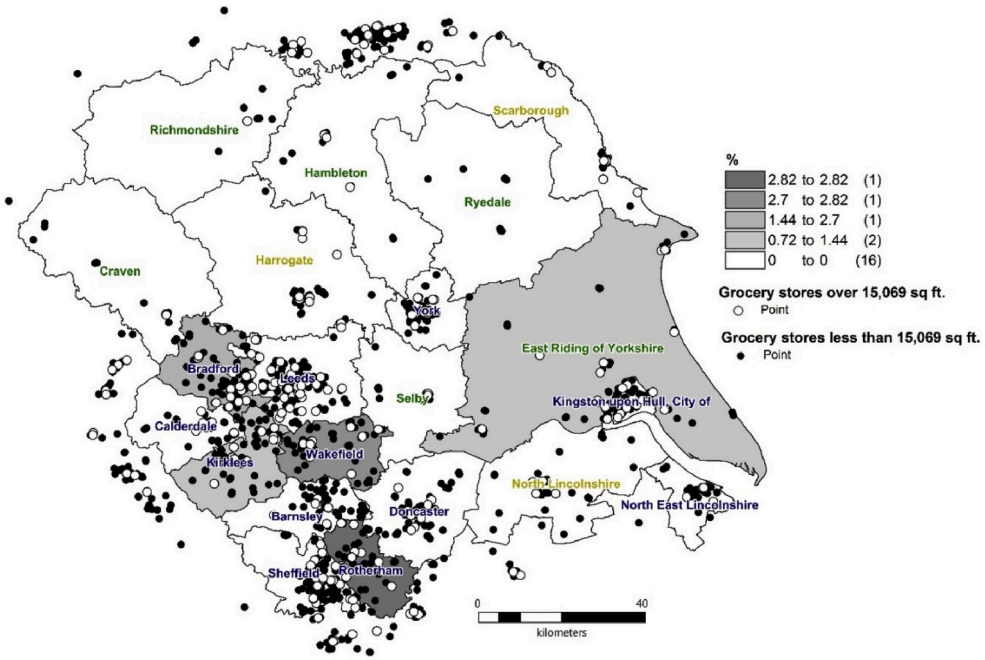
likely to travel to work by car, the primary mode of travel for this service. They are possibly more likely than other groups to have flexibility over working hours and patterns (e.g. self-employed tradespeople).

Next, we look at the geography of e-commerce use, by channel, in GB.

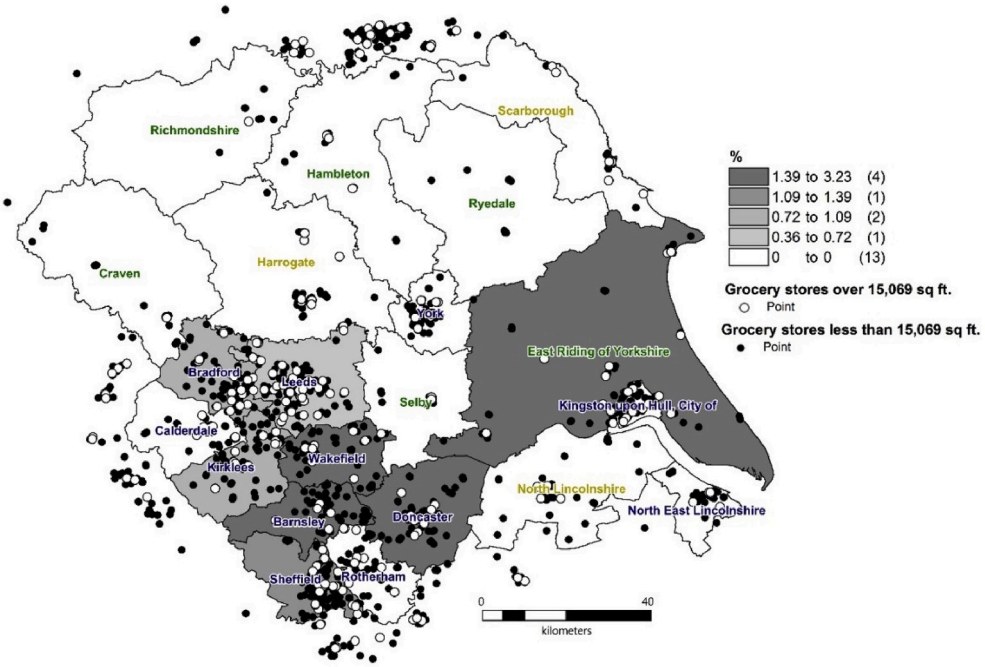
5. Results by geography

5.1. Rural-urban classification

Figs. 11–13 break down use of the three e-commerce channels by the



a)



b)

Fig. 16. a) Regular and b) Occasional collection at collection point users in Yorkshire and the Humber.

classification using the 2011 Rural-Urban Classification of Local Authorities in England (DEFRA, 2014). This is in effect a test of the varying theories of the competing schools of thought on the spread of e-commerce adoption. Here we focus on England because each country has a different classification and England contains the majority of respondents (12,246 respondents – 64.3%).

The mainly rural group has slightly higher than expected overall adoption of e-commerce across the different channels. In home delivery, there is little evidence of an overall urban rural gradient in usage. However, there is evidence of statistically significant greater than expected regular use among respondents in major urban areas and statistically significant greater than expected occasional use among mainly

rural respondents.

For the store collection channel, there is slightly more evidence of an urban rural gradient among regular adopters, although a lack of statistical significance other than for fewer than expected regular and occasional users among respondents residing in mainly rural areas. In collection point use, some evidence of an urban to rural gradient exists although the number of overall users is very small. Statistically significant (0.05) fewer than expected occasional and regular users among mainly rural residents, possibly suggesting this technology driven channel is less common in rural areas.

Overall, the results find some evidence for both innovation diffusion theory and efficiency whereby the latter is e-commerce is improving accessibility by adding to the options available in areas more likely to have limited provision. In finding some evidence for both theories, we corroborate the findings of Kiby-Hawkins et al., 2018 and Motte--Baumvol et al. (2017).

Along with general rural and urban factors, physical grocery infrastructure plays a role in the geography of e-commerce uptake. Sections 5.2 focuses in on the Yorkshire and the Humber study region, investigating the role of the physical grocery landscape within the urban-rural divide.

5.2. Regional picture: Yorkshire and the humber

Yorkshire and the Humber is a former government office region in the north of England with an estimated population of 5.3 million in an area of around 15,000 km^2 (ONS, 2018). It is a diverse region with areas of urban, suburban and rural geography. Large metropolitan cities to the west and south such as Leeds and Sheffield and their associated suburbs share a region with more affluent smaller cities/large towns such as Harrogate and York and less affluent smaller cities/towns such as Hull and Barnsley. There is also considerable rural land use in the north and east of the region, characterised by relatively poor access to retail services. Yorkshire and the Humber thus provides an excellent example in which to investigate further the impact of urban-rural geographies and physical store provision on self-reported e-commerce uptake. The analysis in this section is largely illustrative because the pre-aggregated location of respondents by LAD limits our ability to draw conclusions on the impact of the physical landscape on e-commerce use at the micro level, as we are cannot calculate the actual access any given survey respondent has to grocery opportunities.

Figs. 14–16 show e-commerce use by channel in Yorkshire and the Humber - response counts vary from 17 to 275 in LADs, with the full list of sample size in each shown in appendix tables A1. All maps have the physical grocery landscape overlaid. Larger stores of a greater floorspace have the capacity for e-commerce services and are the traditional venue for weekly, large-basket shopping trips, typically substituted for e-commerce purchases, as consumers need to reach a minimum spend limit to justify delivery (OneSpace, 2018). White circles on the maps indicate larger stores with a theoretical capacity for home delivery/collect in store whereas small black dots indicate smaller stores, which contribute to available opportunities, but are unlikely to provide e-commerce infrastructure. Convenience stores are not plotted, since these are not a destination for a main food shop and have no grocery e-commerce infrastructure. Stores and collection facilities falling outside our study area are shown as these may form an important part of the retail supply side available to consumers within outlying parts of the study area. LAD names (e.g. Leeds) have been colour coded based on the rural-urban classification. Blue is urban, yellow is semi-rural, and green is rural.

In Yorkshire and the Humber, we find evidence supporting both innovation-diffusion theory and the efficiency theory. Rural areas are high users of home delivery and occasional click-and-collect users (e.g. Hambleton, Richmondshire). Potential evidence for innovation-diffusion theory is also observed, with collect in-store users being generally concentrated in more urban areas to the south and south west of the region. Kiby-Hawkins et al., 2018 observed varying relationships between physical store provision and e-commerce use. They noted areas of high online share and high store provision but speculated that the affluence of the customers of their partner retailer may be driving this pattern. We find evidence that this relationship holds true across all consumer types, including those from less affluent locations, particularly in Rotherham to the south of the study area. Leeds, an urban local authority in Yorkshire and the Humber shows evidence of low online share and high store provision, as also noted by Kiby-Hawkins et al., 2018. The overall pattern of collection from a collection point is mixed. This may be driven by infrastructure that is difficult to measure in Yorkshire and the Humber due to a lack of available data.

6. Conclusions

With considerable growth in order volumes and value forecast (IGD, 2018), the UK e-groceries market is an important part of grocers growth strategies and a key battleground between retailers. Kor (2019) recognises the transformative effect on the UK groceries e-commerce sector that the unsuccessful Asda/Sainsbury's merger could have offered, enabling the merged entity to enjoy considerable economies of scale and efficiencies in home delivery and collection point operations at the local level. Whilst that merger didn't take place, the Competition and Markets Authority investigation into the proposed merger revealed the competitive nature of retailers' online groceries operations at a localised level. It highlights the need for spatial and location-specific decision making regarding the efficient and cost-effective organisation of the e-commerce network, which has long been recognised as fundamentally important to the development of grocery e-commerce services (Anderson et al., 2003).

On the demand side, online groceries can offer considerable time, convenience and cost-saving benefits, yet it has not been universally adopted by consumers. Over a third of UK consumers are reported to have no intention of shopping online for groceries or have tried and abandoned e-groceries (Harris et al., 2017). In a competitive market where consumers are free to shop interchangeably between channels and may exhibit a 'stop/start' pattern of e-commerce uptake (switching between online and in-store groceries shopping) (Harris et al., 2017), retailers thus face considerable pressures in understanding and controlling consumer demand on a channel-by-channel basis (Verhoef et al., 2015).

The major contribution of this study is in the analysis of the different groceries e-commerce channel users, stepping beyond the focus on the home delivery channel in e-commerce analysis. We find home delivery is the dominant groceries e-commerce channel, proving popular as a regular channel for many consumers. We find statistically significant evidence of higher use of home delivery among females and the affluent and the 25–44 age group, in keeping with the established literature. We also find significant evidence of higher use of home deliveries for the 55+ age group, a novel finding in comparison to previous studies. Whilst collection point usage is far less popular than home delivery and typically used to complement other channels, we find evidence that certain consumer groups (by age and social grade) are more likely to self-report regular collection point usage, most likely driven by the convenience that this channel offers in relation to their lifestyle and personal mobility patterns. We suggest that further work is needed, ideally using retailer data, to explore consumer loyalty and order frequency in relation to collection points and to understand how this channel is used in combination with in-store and home delivery channels.

In keeping with previous studies (Beckers et al., 2018; Kiby-Hawkins et al., 2018; Motte-Baumvol et al., 2017) we find statistically significant evidence of both the innovation-diffusion theory and the efficiency theory, with these findings holding true in our localised case study of Yorkshire and the Humber. In support of the latter, we find rural consumers stand out as adopters of e-commerce across all channels, especially home delivery. For collection facilities, we also find urban

consumers have comparatively high use, in support of the innovation-diffusion theory. We also find some evidence of the impact of the location of the physical grocery landscape and e-commerce, finding similar patterns to Kiby-Hawkins et al., 2018 despite being a study covering a wider number of retailers.

We recognise the limitations of the study. We use data generated from an online panel survey. As noted in the methodology, YouGov maintain a 1 million strong panel and draw a sub-sample which is representative of British adults, easing concerns over the representativeness of this type of survey. Furthermore, we test for statistical significance to assess robustness of the relationships found. Pre-aggregated survey respondents limit us to single demographic categories where cross tabulations would have been more favourable. The meaning of the responses (e.g. regularly) is also open to interpretation. We would have given more clarity on this had we commissioned the survey. Moreover, the identification of location of respondents by LAD limits our ability to draw conclusions on the impact of the physical landscape on e-commerce use at the micro level. Future opportunities for research emerge with more precise small-area geolocation of survey respondents enabling a more in depth analysis of the impact of competing physical store opportunities on grocery e-commerce use, with a multilevel modelling framework potentially offering fruitful analysis. Nevertheless, these data enable us to draw previously un-researched insights into channel usage, disaggregated by consumer type and area-based characteristics which could afford considerable benefits to retailers.

Our findings are in keeping with Wollenburg, 2018 assertion that as many as 90% of online grocery orders in the UK are fulfilled by home delivery. They report that retailers are increasingly attempting to shift costs associated with the last mile onto consumers by boosting the share of collection point usage relative to home delivery. Similarly, Davies et al (2018) recognise that diversification of e-groceries order fulfilment via growth of collection point options is an important part of UK grocers' e-commerce growth strategies. As outlined by Hubner et al. (2016), retailers have to make complex investment decisions logistics to facilitate store and warehouse based e-groceries order fulfilment, accounting for picking and packing capacity and efficiency alongside logistical costs associated with the last mile. The insights that we offer into self-reported channel usage at a local level are thus essential to enable retailers to further develop these networks in an efficient and sustainable manner.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jretconser.2020.102076.

Appendix

Table A1
Number of respondents by LAD in Yorkshire and the Humber

Local Authority	Respondents
Barnsley	62
Bradford	139
Calderdale	65
Craven	20
Doncaster	72
East Riding of Yorkshire	139
Hambleton	28
Harrogate	55
Kingston upon Hull	74
Kirklees	138
Leeds	275
North East Lincolnshire	51
North Lincolnshire	31
Richmondshire	17
Rotherham	71
Ryedale	27
Scarborough	42
Selby	21
Sheffield	183
Wakefield	74
York	93

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