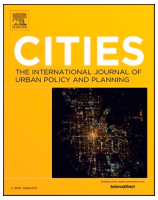
Cities 130 (2022) 103872

Contents lists available at ScienceDirect

Cities

journal homepage: www.elsevier.com/locate/cities



Perceived accessibility of employment sites by jobseekers and the potential relevance of employer-subsidised demand responsive transport to enhance the commute

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ARTICLE INFO

Keywords:
Employment
Job-seekers
Demand responsive transport
Travel
Shared-ride
Commute

ABSTRACT

The constraints placed by the transport options available to job-seekers are key factors for the accessibility of employment locations and therefore social inclusion. The present paper investigates the importance of these constraints and the potential appeal of an employer-subsidised Demand Responsive Transport (DRT) service to job-seekers at risk of social exclusion. Mainly quantitative questionnaire data were obtained from a survey (n = 254) of jobseekers attending three 'Jobcentre Plus' government agency offices in Bristol (UK) during September 2017. The offices, which integrate the provision of social security benefits with support to secure work, were in inner-city, intermediate, and peripheral locations. Comparative spatial analysis was conducted both within and between the locations. The respondents emerged as having high public transport dependence for the commute, and transport-related perceived barriers emerged as second in importance only to 'qualifications and skills' and were reported as having inhibited attendance at job interviews and jobs. The preferences identified from the literature for finding work near home or in the city centre was confirmed. Reaching employment locations on the periphery of the city was particularly problematic. Job-seekers interviewed at the intermediate location reported the widest geographical scope of search. Logistic regression modelling confirmed the perceived options for public-transport commuters were somewhat different. Gender and the type of work sought also influenced spatial perceptions. Respondents were more willing to share the commute with 'people they knew', and strongly supported the concept of employer-subsidised DRT, with some statistically significant gender differences in attractiveness regarding the specific nature of the service offer. It is concluded that employer-subsidised DRT services would be most appropriate for remote sites, in situations in which the labour force is likely to be drawn from areas hard to connect with public transport, and where car use is either low, or being reduced by car use restraint policies. Future research into the context of real-world applications is required to examine whether benefits to employers, including staff recruitment and retention, would be sufficient to justify employer subsidies.

1. Introduction

It was nearly two decades ago that the UK Government's Social Exclusion Unit (2003) argued that employers should be more cognisant of, and responsive to, the importance of transport issues in citizens finding and keeping work. Since then, recognition of the importance has grown amongst policy makers and researchers, but practical progress to enhance transport access to employment has been limited (Lucas, 2012.)

A number of factors influence the search for work. Economic models consider the jobseeker's perception of what his or her services are worth, and the wages offered, together with prevailing levels of unemployment (Lippman & McCall, 1976; McFadyen & Thomas, 1997). Job search characteristics are also identified as varying according to a range of socio-demographic, psychological, and practical factors such as ethnicity (Fieldhouse, 1999), deprivation of neighbourhood (Clark and Whiteman, 1983, in Hanson & Pratt, 1991), and particularly gender

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https://doi.org/10.1016/j.cities.2022.103872
Received 22 April 2021; Received in revised form 22 February 2022; Accepted 6 July 2022

(Hanson & Pratt, 1991). Spatial and transport considerations are further perceptual and practical factors within this complex set which affect job searches and subsequent employment (Green et al., 2005; Social Exclusion Unit, 2003).

Transport services that are accessible to all have been argued to be important for equity within society (Hine & Mitchell, 2001). The UN Special Rapporteur on extreme poverty and human rights has labelled the failure to provide such services as 'incompatible with human rights requirements' (Alston, 2019, cited in Alston et al., 2021, p. 35). In this context, Demand Responsive Transport (DRT) services have been posited as a way to supplement traditional public transport at particular times and places, and hence could provide enhanced access to peripheral employment locations (Crisp et al., 2018). However, such services tend to be complex to arrange and expensive to operate and a research and policy gap exists around how to deliver such services in a way that is effective in enabling labour force participation and efficient to the funder. The present paper therefore presents a study of the perceived accessibility of employment sites by job-seekers, combined with an analysis of whether providing an employer-subsidised DRT (esDRT) service could address jobseekers' concerns about the limited accessibility of employment sites by public transport. The work took place in the urban area of Bristol, UK, where the authors had a specific funded collaborative research opportunity.

Following a review of the literature, the methodology, based on a survey of employment office attendees, is outlined. The subsequent analysis and findings respond to three specific research questions concerning the importance of transport for job seekers, spatial analysis of where respondents would be willing to work, and the attitudes towards a potential DRT service. The conclusions consider some implications and discussion for the application of the service.

2. Literature review of factors influencing the accessibility of employment opportunities

During the post-war period in the industrialised democracies a number of factors have encouraged the location or relocation of commercial activity at the periphery of urban areas, including land use policies, the high relative accessibility offered by peripheral and orbital roads, and relative land values (Crisp et al., 2018). The distribution of residences has also reduced in density and undergone suburbanisation. Hence, commutes have tended to become longer, and citizens without access to private motor transport have often experienced reduced accessibility to employment sites.

The consequences of limited accessibility can be intensified by perceptions, for instance of impractical commutes by public transport (ibid. p.2), and can particularly affect job *seekers*, with some employers reluctant to offer jobs to individuals who would have difficult commutes (p.38). Nonetheless, significant transport investment has been undertaken in the post-war era without much consideration of the social and distributional consequences of inequalities of accessibility (Clifton & Lucas, 2004). Indeed, Pilegaard and Fosgerau (2008) suggested that the inclusion of labour-market imperfections in cost-benefit analyses of transport schemes would substantially alter their prioritisations. However, whilst changes to econometric methods might correct this failing in the future, for much of the existing urban realm accessibility can only be enhanced by 'retro-fitting'. Here, one such option is the provision of flexible, inclusive transport services to overcome spatiotemporal gaps in traditional public transport networks.

As noted in the introduction, the job search is a complex activity, but transport and travel impinge on it in a number of ways. First, the individual's past travel experience will influence his or her knowledge of the locale, and perceptions of accessibility by different modes of transport. Quinn (1986) argues that job vacancies in unfamiliar areas may fail to register interest. Unfamiliar areas are often non-central neighbourhoods, on the far side of the city to the place of residence. Quinn also found that almost 75 % of journeys to job interviews were to districts familiar to the interviewee (districts covering substantially <75 % of the city area) and that the existence, and knowledge, of bus routes played an important role. One of the mechanisms leading to reliance on personal experience may partly arise from difficulties in accessing information about vacancies (Patacchini & Zenou, 2005), although the rise of the internet may have eroded this effect since 2005.

Given that most employment is associated with a daily commute between residence and workplace then distance, sometimes expressed as journey time, is a key spatial factor in job searches, with the perceived relevance of jobs decreasing sharply the further away they are from the seeker's residence. McQuaid and Lindsay (2002) identified that, in the UK at least, <5 % of job seekers would only look in their immediate neighbourhood. However, Manning and Petrongolo (2017) confirmed the presence of distance effects at the intra-city level; on modelling job search behavior in England and Wales they found that in the case of two jobs being offered, one of which was local and the other 5 km distant, there was only a 20 % chance that the job seeker would choose the further option, suggesting a high 'cost of distance' (Op. Cit., p.5). This supports Bonhomme and Jolivet's finding cited in Manning & Petrongolo, 2017) that European workers were willing to have substantially smaller salaries in order to have reduced commute distances. This may be related to associations between longer commutes and impingements on aspects of subjective well-being, particularly leisure time satisfaction (Clark et al., 2019).

The time job-seekers would be willing to spend commuting has been found to be invariant with the number of bus services available, the availability of private transport, and the accessibility of employment sites (McQuaid et al., 2001), suggesting those constraints are seen as relatively fixed, and not mutable by scarce supply of jobs. However, this does not mean that job-seekers set a high barrier for what is an acceptable, or at least an accepted, commute: Crisp et al. (2018) found residents of deprived neighbourhoods were not only willing to undertake lengthy commutes, sometimes of up to 90 minutes in each direction, but some had done so in the past. Considering jobseekers in general, McQuaid and Lindsay (2002) found that 40 % would be willing to commute more than one hour for a full-time job.

Although central business districts (CBD) still tend to have the largest concentration of jobs, and this seems salient (Green et al., 2005, report young people being aware of this fact), trends for decentralisation and its impacts have been observed and studied particularly, but not exclusively, in North America and Europe (Ozus et al., 2012; Zhao et al., 2011). The causes of decentralisation are various and can be combined with the emergence of concentrations of employment outside the CBD, as a result of the agglomeration of interdependent businesses (Anas et al., 1998, cited in Gobillon et al., 2007), changes in workforce residential locations e.g., from city centre to suburb (Steinnes, 1977, cited in Gobillon et al., 2007) and land prices (Gobillon et al., 2007). Sometimes greater residence-workplace separation has arisen through intentional planning policies for decentralisation, such as the strategy adopted in Brisbane, Australia (Burke et al., 2010). Whilst decentralisation has been associated with some positive outcomes in particular domains, including the reduction of public transport over-crowding, air and noise pollution in the CBD, and congestion (Hall 1972, cited in Burke et al., 2010; Ozus et al., 2012), for employment decentralisation has been identified as disadvantaging those with limited mobility (Kain, 1992, cited in Garcia-López & Muñiz, 2010), posing challenges for the efficient provision of public transport (and thus encouraging car use), and leading to further dispersal of residential locations, leading to consumption of undeveloped land (Garcia-López & Muñiz, 2010). However, decentralisation does not automatically imply longer average commutes and additional travel burdens or barriers. Much depends on whether the planning of residential and employment locations is integrated and managed. For example, in the more interventionist planning context of China, decentralisation of jobs to suburban sub-centres has been found to hold the potential to reduce the need for long commutes, and to increase suitable matches between places of residence and employment in Beijing, China

(Zhao et al., 2011).

Gender differences have emerged in the acceptability of decentralisation trends, with women showing greater preferences for working in CBDs. Women on average have been found to generally undertake shorter commutes than men (Hanson & Pratt, 1991; Shearmur, 2006), particularly when accessing 'female-dominated' jobs, (Hanson & Pratt, 1991). (Note that the types of 'female-dominated jobs may be important here: 81% of these were non-skilled non-manual roles, (receptionist or cashiers for example) or skilled non-manual (such as nurse), and only 10.5% were in professional or managerial occupations (p.235)). However, a study drawing on Canadian Census data found that, relative to men, women were willing to travel disproportionately far to CBDs for employment compared to non-CBD locations (Shearmur, 2006). Shearmur hypothesises CBDs may be more attractive to women due, in part, by being settings in which it is easier to transcend gender barriers (citing Villeneuve and Rose, 1988), and 'agglomeration or milieu effects' (p.355). Occupation type was controlled for, and thus was eliminated as an explanation for the preference.

What is clear, however, across these spatial trends and social distinctions is that the effects of distance to, and concentration of, job opportunities are mediated by the transport mode(s) available to the jobseeker, with considerable inequalities existing between individuals and social groups, particularly for those on low-incomes. Crisp et al. (2018) demonstrate a wide range of constraints: some workers achieve commutes through lift sharing, but such arrangements can be complicated to orchestrate. Walking and cycling are also inexpensive but have a limited range or high time cost. Crisp et al. interviewed one man who could not commute on foot due to arthritis and report another commuter walking seven miles to attend early shifts, suggesting obvious extreme time costs. These limitations meant that very few of the low-income workers/job seekers Crisp et al. interviewed commuted via these modes. Sparse schedules or networks can also limit the relevance of public transport particularly to low-paid workers undertaking shifts outside of the 'nine-to-five' norm (Alston et al., 2021; Crisp et al., 2018) particularly where necessary interchanges impose disproportionate time penalties or walk legs, or there are reliability or affordability concerns. A journey with a within-mode interchange or using multimodal services may require separate fares. Avoiding long walk-legs may require paid parking at a station or using a taxi to reach the transit stop.

In the USA, car ownership has been found to be strongly associated with the chance of finding employment (Cervero et al., 2002). Similarly, Shen (1998) found automobility (as opposed to public transport use) to be more important for job accessibility than residential location. For low-income neighbourhoods in the UK, Bastiaanssen et al. (2019), drawing on public transport timetables and micro-datasets of employment, report a causal relationship between accessibility to jobs by public transport and probability of employment. Proximity to stops and stations can be important for public transport's relevance (Quinn, 1986). The likelihood of individuals receiving state financial aid and finding employment (whilst controlling for car use) has been found to be higher where the individual lives within walking distance of bus stops or rail stations (Cervero et al., 2002). Shen (1998) confirmed that public transport users living near to public transport benefit from higher accessibility than those living further away. Related to the importance of proximity, ethnicity effects have been identified in the USA: the benefit of public transport improvements for Latino and Black communities, who had inferior access to employment, was found to be limited by low-density sprawl or the services not stopping near enough to where needed (Holzer et al., 2003). Indeed, transport opportunities have been shown in some cases to be more important than spatial constraints. Shen (1998) suggested that workers living near to the CBD had better accessibility to employment than suburban dwellers, but the advantage of living near the CBD was less important in accessibility terms than being able to commute by car. In their analysis of access to early morning shifts at the major employment site of Manchester Airport (UK), Crisp et al. (2018) found that public transport commutes often took up to five times longer than car commutes. Moreover, temporal factors can also interact with the level of public transport fares (which are often more salient than the total cost of car use): short-length shift work can be perceived as offering negligible financial benefit by public transport users after wages and fares are considered (Ricci, 2016).

Given the slow rate of change in the built environment which limits the possibility to influence commute-lengths, initiatives to promote inclusive access to employment and reduce the environmental impacts of commuting tend to emphasise public transport solutions. For example, employers in the UK are encouraged to implement workplace-based travel plans intended amongst other things to improve access to job sites by non-car modes (Bartle & Chatterjee, 2019). However, if traditional modes leave temporal and spatial gaps in transport provision, these gaps contribute to transport-related exclusion to employment. Some of these gaps may be filled through DRT, which can be used in two ways: a) to extend service provision into times and places not currently served, but doing so on a flexible basis, or b) by addressing the so-called 'first/last mile' (FLM) barrier by providing a 'feeder' service to established public transport systems. Employment inclusion can be particularly facilitated by utilising whole-journey ticketing and serving peripheral employment areas (Crisp et al., 2018, p.51). Speed is an important factor allowing FLM services to increase accessibility to jobs by public transport for low-income residents (Boarnet et al., 2017), as a higher overall journey speed extends the labour market isochrone. In the USA, the use of faster FLM modes achieved greater increase in job accessibility by public transport than increasing the frequency of the 'main leg' service. It was concluded (Op. Cit., p.308) that on-demand ride-sharing services could be particularly suited to reducing FLM connection times.

However, the problem of achieving financial viability away from the highest-density urban areas is significant, and illustrated well by the case of Kutsuplus, which was a ridesharing mini-bus service which attempted to serve a wide area within Helsinki. The service, through providing rides from any origin to any location in Helsinki, often experienced near-empty vehicles due to the limited number of passengers with compatible journey characteristics. It proved too expensive to run and was decommissioned (Sulopuisto, 2016). This is a specific instance of demand responsive services, (aiming to supply an alternative to car ownership), often being 'resource intensive' (Brake et al. 2007, cited in Davison et al., 2014, p.48). Financially viability (profitability in the case of businesses) is both important and particularly challenging for shared-ride DRT ventures in general (Calvert et al., 2019).

The concept of DRT considered in the present paper invokes an esDRT service concept secured through stakeholder partnerships: services in spatiotemporal niches which provide trips to selected employment sites, and potentially offered as part of a job package for would-be employees. Features of the 'business model' which address employers interests include the assumption that revenues derive from both from fares paid by individual passengers and from employers partnering in the provision of a service and that services are tailored in their operational characteristics to particular employers' needs. Hence, improved access specifically to their employment sites is offered, so enhancing recruitment and employee retention, but at a lower cost than procuring an exclusive service and more efficiently than a traditional service. Indeed, the service is distinct from a traditional 'works bus', as each vehicle trip is not (necessarily) limited to providing a service to one employer only. It has similarities with other extant or extinct services, including Uber's 'Smart Routes' (Gray, 2015), although that approach used a fixed route, and UberPOOL, which identifies passengers making similar journeys and allocates them to the same vehicle (Watanabe et al., 2016), but is 'geofenced' and sometimes time-limited to areas identified as offering sufficient density of demand with respect to available vehicles. Whilst esDRT is also spatiotemporally constrained, it differs from UberPOOL in its targeting of particular groups of employees travelling between residential origins in a defined area to specific employment sites, proximately located to each other. Hence, like UberPOOL, the

service seeks a financially viable service niche by placing spatial and temporal constraints on demand but differs from it by seeking viability through placing further constraints linked to the employee-employer-employment site nexus. A 'travel club' approach to services, where passengers are registered members, can benefit a DRT business model through encouraging loyalty (Enoch et al., 2004).

Whilst identifying a financially viable business model has been the primary constraint on more widespread application of DRT, further difficulties with achieving a successful shared-ride on-demand service should be noted. These include discomfort around sharing vehicles with strangers (Nguyen, 2013, which has presumably become heightened since the COVID-19 Pandemic), and the time costs of both putting necessary technology in place, and developing relationships with stakeholders, such as employers (Calvert et al., 2019).

Hence, a summary of the key findings of the review is that:

- access to transport can be a particular barrier to employment for those expecting to enter low-wage jobs and/or without access to a car,
- those barriers were particularly high in the cases that the supply of jobs is oriented towards peripheral car-dependent locations or there are residential neighbourhoods poorly served by public transport,
- traditional alternatives to the car have shown considerable shortcomings in addressing the access constraints to date, and
- DRT applications to date have also tended to suffer from problems, particularly in terms of financial viability.

Therefore, the research set out to consider whether a new type of 'partnership' DRT would be seen as a relevant solution by people engaging with the social security benefits system who were seeking work, and therefore who were at increased risk of experiencing labour market exclusion on mobility grounds. To understand these perspectives, it would first be necessary to research the context of their job-searching in terms of spatial, transport and other constraints.

3. Local context, survey method and sample characteristics

The authors were part of a consortium research project involving private and public partners which researched and piloted DRT solutions in Bristol. The research reported in the present paper was undertaken in part to inform trials of an esDRT service for the Avonmouth port area on the western periphery of the city (see Fig. 1). Avonmouth hosts a significant and growing source of a range of employment types, especially warehouse and distribution-based businesses (Bristol City Council, 2019). In 2019 distribution centres occupied approaching 500,000m^2 in the area, with a further 185,000m^2 for logistics companies planned in the near future (Bristol City Council, 2019, p.48) There are residential areas nearby which are one source of potential skilled and unskilled labour, but some of these proximate areas are segregated by a trunk motorway and agricultural land. They perform poorly against measures of socioeconomic disadvantage (for example, Lawrence Weston South has, since 2015, moved into the 10 % most deprived category of 'Lower Super Output Areas' (a spatial subdivision of census data) in England and Wales, Bristol City Council, 2021.) Not everyone in these areas can afford a car, and public transport access to the employment sites is poor. The Bristol Transport Strategy in 2019 noted that, partly due to shift patterns, public transport access to Avonmouth workplaces was 'often not realistic', that 'the only realistic access is by car' and that 'innovation is required to address the accessibility issues' (Bristol City Council, 2019, p.48). For some Avonmouth employers obtaining sufficient labour has thus proved difficult.

Data were collected from 254 respondents visiting three Bristol 'Jobcentre Plus' (JCP) offices (in the districts of Easton, Shirehampton and Horfield) on twelve days during September 2017. JCP is a government agency with a network of offices which integrate the management of social security benefits with support for unemployed people to find jobs, in line with national policy to maximise labour market participation and minimise the share of government expenditure spent on benefits. Virtually all JCP visitors on the data collection days were approached by researchers to take part in the survey, with a particular focus on those attending a meeting with a JCP 'coach'. The JCP staff encouraged clients to participate in the survey. A few people visiting the centres for other reasons, relating to out-of-work benefits for example, also completed surveys. The sample represents roughly 10 % of all those registered at those three JCP offices around the time of survey. The sample size precluded some analyses requiring disaggregation, into age group or desired occupation, for example. The three JCP locations were chosen to represent different degrees of peripherality from the city centre and specifically to include the Avonmouth area. Respondents completed a paper questionnaire, assisted if required by a member of the research team. Some accepted assistance due to poor English skills, or poor eyesight. Fig. 1 shows the JCP locations and the home location of respondents, based on postcode.

Data were collected on the respondents' job search criteria, including preferred job types and locations. Seven-point Likert scales were applied to survey commute mode, perceived access constraints, travel costs and ease of movement. Socio-demographic data and information about factors which might limit the chances of a respondent being offered, or keeping, a job, were also collected. Finally, opinions were sought on a suggested esDRT commuter service. Respondents also had an opportunity to provide free-text responses; 41 were received. These were categorised into themes, such as 'complaints about public transport'. Each theme contained no more than ten comments so there was little value in further disaggregation.

The survey sample comprised 52 % men; a share somewhat higher than the 43 % representation amongst the Bristol region's unemployed residents (this figure is derived from unemployment statistics and is estimated, due to small sample size, see Office for National Statistics, 2019). Respondents were drawn fairly evenly across the working age groups. The age profile of the sample was similar to that of unemployed people in the region from Office for National Statistics (2019) data. Most survey respondents (77 %) selected one of the 'white' ethnicity categories; similar to the 78 % of those unemployed in the UK during July–September 2017 who were white (Office for National Statistics, 2021). Evidence from the national Census of 2011 suggests different levels of car availability are associated with ethnicity (Nomis, 2022). Residents of Bristol with ethnicity other than white were more likely to be in a household with no car or van available (33 % were in such households) than white individuals (20 %). However, this figure does not relate to job seekers specifically.

Fig. 2 summarises the type of work being sought by gender. A higher proportion of female respondents were seeking retail, office, and particularly social/health care work. A higher share of male respondents were looking for unskilled, skilled trades or professional/managerial work.

4. Analysis and findings

4.1. Research question 1: what is the relative importance of transport as a barrier to those seeking employment in Bristol, and in which ways does it act as a barrier?

A range of potential factors which might constrain successful access to employment were presented to respondents. The cost of public transport stood out amongst these as important, second only to relevant skills and qualifications (see Fig. 3[1]). Qualitative comments relating to bus services in Bristol also identified perceived insufficiency of routes and frequency, and unreliability, as problems. For example, one

[1] In Figs. 3–5 the degrees of agreement and disagreement have been combined for clarity of presentation.

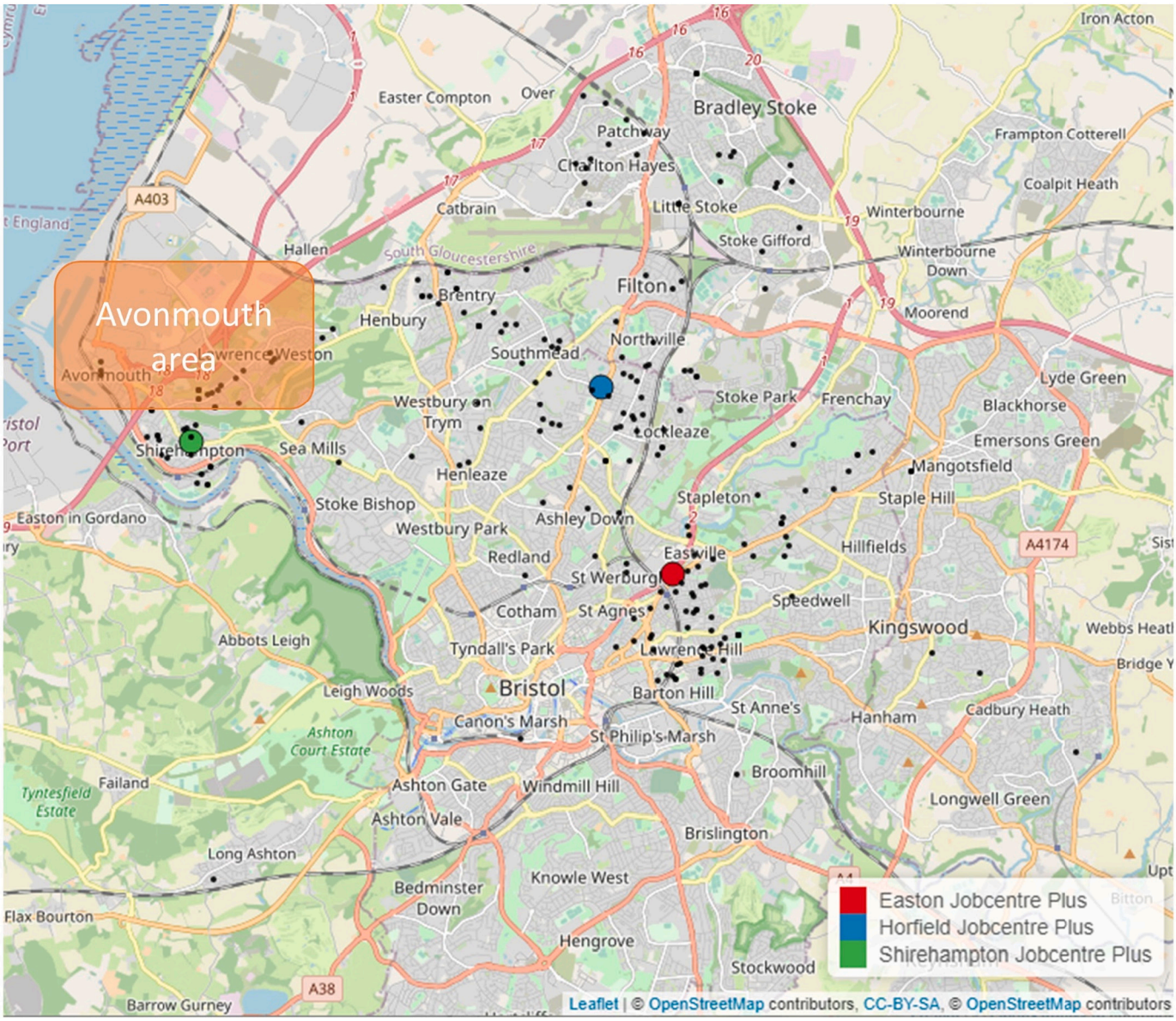

Fig. 1. Jobcentre location and respondents' home location based on postcode.

respondent reported: 'It would have taken me 50-60 mins to walk to my last job but due to lack of direct bus route it would take close to 2 hours by bus.'

More detailed quantitative exploration of the inhibitory effects of transport (Fig. 4) revealed that transport factors had led to 19 % of respondents having left a job, and 26 % having missed a job interview. A minimum level of health is required to utilise most public transport, and those without a sufficient health status were even more likely to have missed an interview (40 % of those in this situation.) As noted in the literature review, gender differences in job search and commuting have been identified in the past. Differences were thus tested for in our dataset, but not found, in relation to missing an interview or leaving a job for transport reasons (missed an interview: $\chi^2 = 1.637$, $p = 0.201$; left a job: $\chi^2 = 1.123$, $p = 0.289$).

Despite perceptions of high costs and other shortcomings, public transport remained important for the JCP attendees overall: almost two-thirds of respondents agreed (to any extent) that they would normally use it to commute (Fig. 5); a proportion far higher than the 11 % for Bristol as a whole recorded in the 2011 Census. Women respondents were significantly ($\chi^2 = 3.928$, $p = 0.047$) more likely to commute by public transport (71 % compared to 59 % for men; a slightly lower ratio than the 1.3 women per man for bus passengers nationally, DfT, 2017). Women may partly be more public transport dependent due to less willingness or ability to use some alternatives. For example, only 16 % would cycle up to 10 km to work compared to 35 % of men ($\chi^2 = 10.132$, $p = 0.001$). As would be expected, the data suggest that the more strongly that respondents agreed that they would normally commute by public transport, the less likely they were to have access to a car for work (although sample sizes for these subcategories were too small to test for significance).

In contrast to the shortcomings of public transport, car ownership was commonly perceived to improve job opportunities. This was illustrated by almost half (47 %) agreeing that the jobs they were applying for needed them to have a car. Over half (53 %) agreed that travelling by car would enable them to have more than one job. This is a reminder that some types of employment have become more fragmented, involving flexible contracts with limited or no guaranteed hours of work per week. Hence, the findings were consistent with the claim by Cervero et al. (2002) that car ownership is strongly beneficial for obtaining employment. Of the 115 people who agreed that the jobs that they were

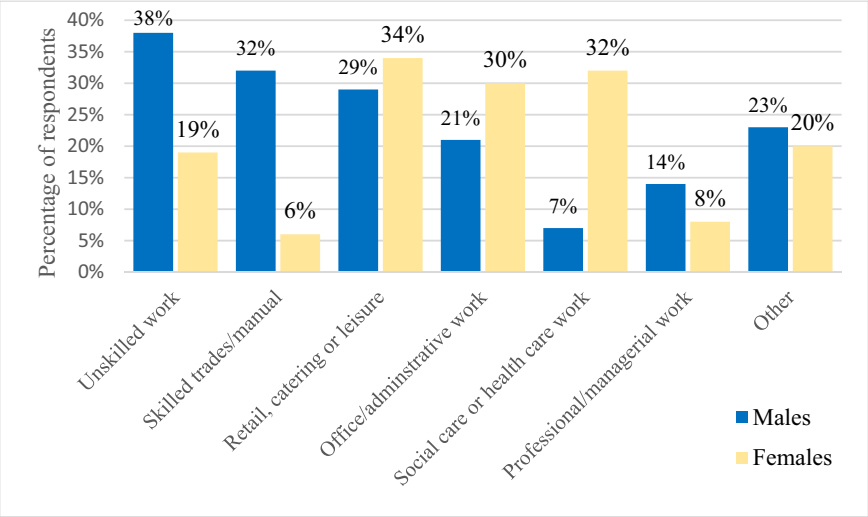

Fig. 2. Type of work being sought by gender (Multiple criteria could be selected).

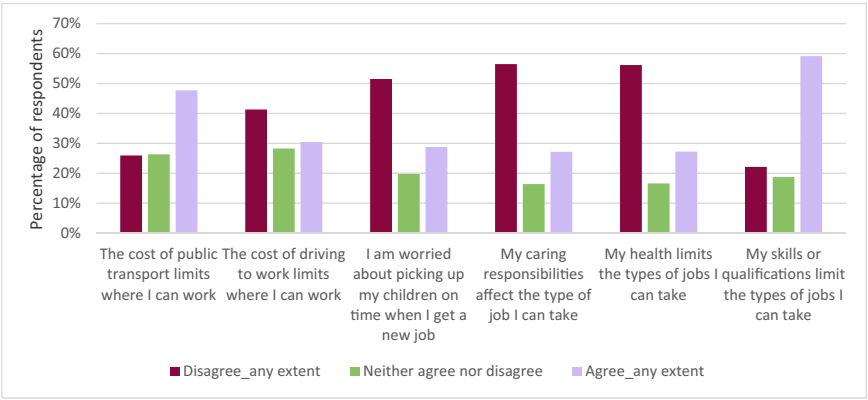

Fig. 3. Perceived constraints on accessing employment.

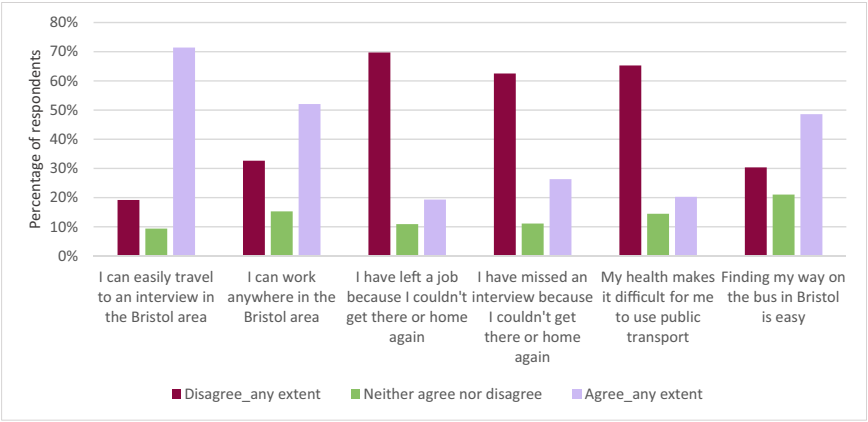

Fig. 4. Influence of mobility on availability for work.

applying for needed a car, only 59 % stated that they had access to a car for travelling to work. It could not be established, given the data collected, whether the jobs themselves required access to a car as a condition of appointment, or whether the location and/or working hours necessitated a car in the respondent's opinion. It is likely that both of these factors influenced the responses. One respondent for instance considered that: 'Many job ads ask for a driving license but actually mean 'you must own a car."

Car use, whilst advantageous for employment, was not an option for most respondents: whilst 47 % had a driving license, only a third had access to a car for commuting. Data from the 2011 Census showed that 45 % of commuters resident in the Easton area travelled by car, as did

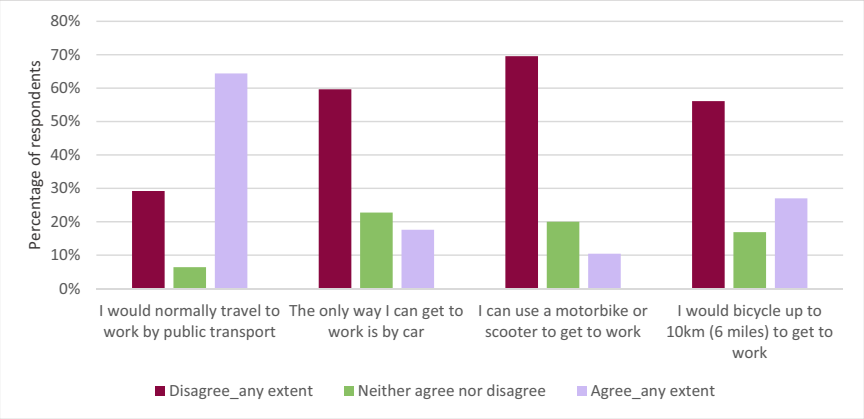

Fig. 5. Perceived availability of commuting modes.

60 % of those in the Horfield area and 69 % of those in the Shirehampton area (Office for National Statistics, 2013). Job seekers then had notably lower access to a car for commuting than employed people. Whilst some qualitative responses supported quantitative findings by emphasising the convenience and perceived reliability of car use compared to public transport, others commented on negative features of car use, including environmental and financial costs, and the difficulty of parking in the city centre.

4.2. Research question 2: how do different residential location types affect the spatial scope of job searches, including for those who are, or are not, dependent on public transport?

Respondents were asked if they thought they could work anywhere within the Bristol area. Those who thought they could work anywhere were less likely to 'normally use public transport' to commute (57 %) than those who thought they could not work anywhere (71 %). This difference was not statistically significant when using a significance level of 0.05 ($\chi^2 = 2.804$, $p = 0.094$). There was, however, a statistically significant difference ($\chi^2 = 11.67$, $p < 0.001$) between car access for people who thought they could work anywhere in Bristol (43 %) and those who thought they could not work anywhere (20 %). To investigate the spatial distribution of their job searches, respondents were asked if they would be willing to work in six specific areas of Bristol. These six areas are shown in Fig. 6. Two of the areas contained JCP offices surveyed in this research. The third JCP (Horfield) lies close to the Southmead and Filton employment areas, so all respondents were offered a selection of nearby and more distant areas.

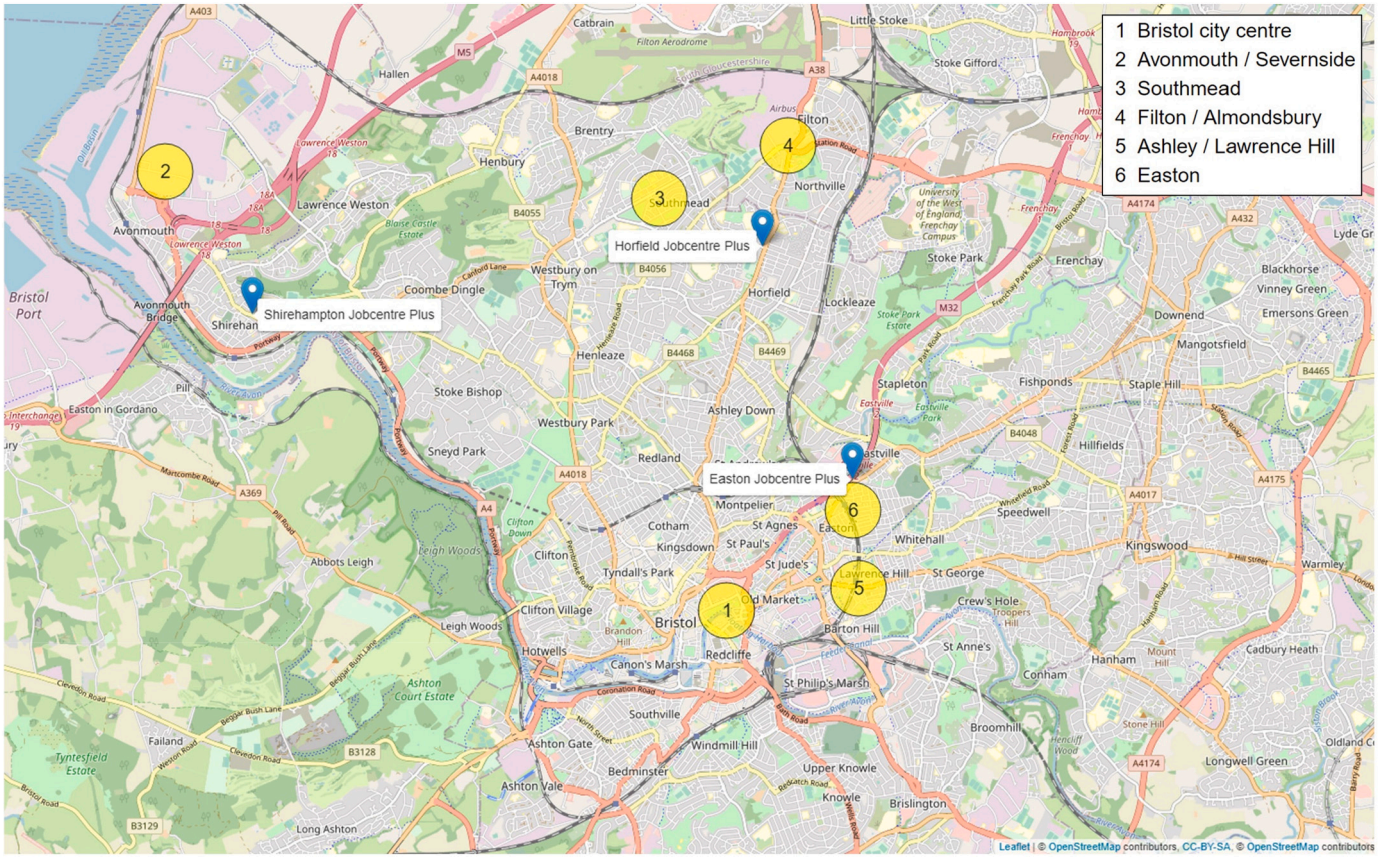

Fig. 6. Six areas suggested to respondents for notional job searching.

In accordance with previous evidence (Green et al., 2005; Shen, 1998) the city centre was found to be a particularly attractive place to work (see Fig. 7), regardless of which JCP the participant visited, although with distance decay apparent (Easton is closest, followed by Horfield and then Shirehampton). Employment close to the JCP in which the survey was completed was also popular (in most cases respondents would have attended the JCP nearest home). Thus, more respondents in the Easton Jobcentre Plus offices than in the other Jobcentres were likely to consider working in Easton and the adjoining Ashley/Lawrence Hill area. Similarly, those answering in Horfield were more likely to consider working in the proximate Southmead and Filton/Almondsbury areas and those answering in Shirehampton were more likely than others to consider working in nearby Avonmouth/Severnside.

These findings support Manning and Petrongolo's (2017, p.5) claim that job seekers attribute a 'high cost to distance'. In the case of Bristol, the data partly accord with McQuaid and Lindsay's (2002) suggestion that most job seekers will search for jobs beyond their own neighbourhood, as the city centre was attractive for all three groups. However, the distance decay in attractiveness observed over a distance of a few miles did not accord with Crisp et al.'s (2018) finding that 'most' of their interviewees would consider commutes of more than an hour.

Using postcode-of-residence data provided by respondents, average distances were estimated to the six work destinations. Respondents were then disaggregated by whether they would/would not work there, and whether they tended to depend on public transport. Average distances for these subgroups were then calculated. These distances were 'crow fly', and so shorter than the actual trips would be.

As reported in Table 1, respondents with expected commute mode other than public transport were overall willing to accept longer-distance commutes to the six locations than public transport users. The difference between the two groups was negligible for travel to the city centre but up to 48 % further for the 'non-public transport' group in respect of suburban locations.

Respondents in Horfield, a suburb intermediate between centre and periphery, and in Easton, an inner-city suburb, showed overall greater consideration for working in other locations, indicating broader perceptual horizons. In particular, Horfield respondents' ratings were never in third place, showing the broadest spatial scope, although overall Easton respondents showed the highest acceptance of locations, albeit across a more restricted spatial scope. Hence, Quinn's (1986) findings about perceptions and the importance of familiarity with potential work areas contribute to explaining these findings, alongside practical accessibility considerations.

In contrast, those with the most peripheral home locations, (Shirehampton respondents) were least likely to consider working in areas that were neither in the city centre nor immediately adjacent to the home area. Some asymmetry could also be observed with the respondents from the Easton JCP, who were twice as willing to travel out to the most peripheral Avonmouth/Severnside areas than Shirehampton JCP respondents were to travel to Easton. Given that the practical constraints for these reciprocal journeys can assumed to be similar, this finding may be explained by differences in perceived accessibility or opportunity.

However, despite this difference, respondents from the two JCPs that were remote from Avonmouth-Severnside would mostly not include the area in their searches. Reasons given for this by respondents picked up on issues identified in the literature review: that poor public transport was a limiting factor, one respondent highlighted a long walk from train station to employment sites, and another reported it would be difficult to arrive for an early morning shift. The authors had heard of late arrivals to jobs in Avonmouth resulting in dismissal, or simply that, in the context of 'flexible' contracts, the work for the day had already been assigned, meaning travel expenses had been incurred for no wage gained.

To explore the factors influencing whether respondents would look for work in each area, six binomial logistic regression models were generated, a separate model for each of the potential workplace destinations in Fig. 7. The dependent variable in each model was a binary variable, where '1' denoted that the respondent was likely, very likely or extremely likely to consider working in that area and '0' denoted any other response. The seven independent variables were binary variables indicating gender, typical public transport commuters, availability of a car for commuting, seeking unskilled work, seeking office work, seeking professional work, and also a continuous variable containing the Haversine distance between the respondent's home postcode and the centre of the proposed area of work.

The independent variables were selected based on their availability in the data, and subject matter knowledge. Chi square tests identified relationships between the six job-type variables and indicated which should be included in the models. Variance inflation factors were calculated for each independent variable in each model to assess multicollinearity. The variance inflation factors ranged from 1 to 1.6 and therefore there was not considered to be excessive multicollinearity. Gender was included as a binary variable as there were insufficient data to include a third category.

Whilst 229 respondents with sufficient data led to an equivalent of over 28 responses per parameter (eight including the intercept), the sample size was relatively small and separation of data into a training and testing set was not feasible. The modelling therefore did not produce predictive models but indicated the potential statistical significance of the independent variables. The variables included in the models were not able to explain a large amount of the variability observed in the data. Needs relating to household members, presence of specific bus routes and/or familiarity with locales, for example, could be factors unobserved by the model. Table 1 contains the odds ratios estimated in the six models generated to model factors affecting the likelihood of working in each of the six areas of Bristol, with the McFadden's R^2 values shown in

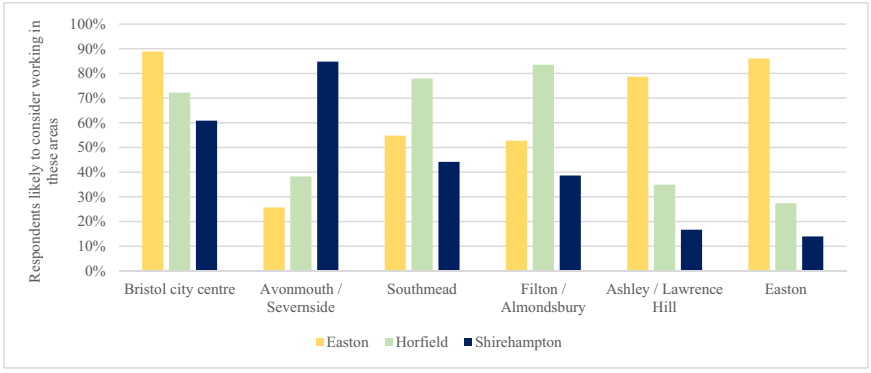

Fig. 7. Likelihood of considering working in different areas of Bristol.

Table 1
Odds ratios for all six models of likelihood of seeking work in an area.

Variable	Ref group	Bristol city centre	Avonmouth/ Severnside	Southmead	Filton/ Almondsbury	Ashley/Lawrence Hill	Easton
Distance to area (kms)	N/A	0.74***	0.72***	0.79***	0.81**	0.73***	0.69***
I would normally travel to work by public transport	Disagree	0.44*	1.78	1.34	2.51*	1.17	1.22
Do you have access to a car for travelling to work?	Yes	1.02	1.38	1.13	1.83	2.17	1.33
Gender	Male	1.81	1.47	1.10	1.33	2.60**	2.21*
Unskilled work	Yes	1.16	1.36	0.94	1.37	1.27	1.23
Office/administrative work	Yes	4.40**	1.68	1.84	2.11*	1.38	1.43
Professional/managerial work	Yes	6.14*	2.36	2.10	1.26	1.12	1.35
McFadden's R^2		0.167	0.183	0.066	0.115	0.186	0.191

Where:
*** means $p < 0.001$.
** means $0.001 \leq p < 0.01$.
* means $0.01 \leq p < 0.05$.

final row. It should be noted that McFadden (1977, p35) stated that values between 0.2 and 0.4 represent an "excellent fit" for this measure. The particularly low values for the Southmead and Filton models should be remembered when interpreting findings. The *p*-values are provided in Table 2.

The distance variable has an odds ratio below 1 in each of the models, which is as expected due to the decay of desirability with distance. The public transport variable was statistically significant in two models only. People who would normally commute by public transport were less likely to be looking for work in Filton and more likely to be looking for work in the city centre. The variable indicating access to a car was retained in the model as it appears to have a slightly different effect than the public transport variable, but it was not statistically significant in any of the models. It should be noted that there is a fairly strong relationship between the car access variable and the public transport commute variable. This means that the variable relating to public transport commuting will also be capturing some of the effects of car access in the model and it should be interpreted accordingly.

Considering gender, men were more likely than women to be looking for work in Ashley / Lawrence Hill and in Easton, presumably due to the perceived suitability of jobs available in the area. The type of work being sought influenced where respondents would consider working, as people looking for office or professional work were more likely to be looking in Bristol city centre and people looking for office work were also more likely to be looking for jobs in Filton.

4.3. Research question 3: do job seekers perceive that the offer of an esDRT service could influence their job-seeking, and which factors and features would enhance its attractiveness?

As attributions towards a DRT service would be expected to reflect at least in part attitudes to existing shared services, notably bus services, prior to discussing the specific esDRT concept, the survey examined agreement with five statements relating to sharing a vehicle for

Table 3
Perceptions and preferences in relation to shared vehicles.

	Survey statement	Overall agreement with statement	Female	Male	Chi Squared test by gender: Test statistic	P-value
1	I feel safe travelling on public transport	65 %	58 %	72 %	4.912	0.027*
2	I prefer to get a lift with friends or family to work than go on public transport	39 %	41 %	36 %	0.573	0.449
3	I prefer travelling to work on my own	52 %	47 %	55 %	1.424	0.233
4	I am happy travelling to work together with other people I know	68 %	73 %	64 %	2.492	0.114
5	I am happy travelling to work together with other people I don't know	43 %	42 %	44 %	0.065	0.798

Where:
* means $0.01 \leq p < 0.05$.

Table 2
P values for all six models of likelihood of seeking work in an area.

Variable	Ref group	Bristol City Centre	Avonmouth/ Severnside	Southmead	Filton/ Almondsbury	Ashley/Lawrence Hill	Easton
(Intercept)	N/A	<0.001	0.011	0.014	0.474	0.524	0.288
Distance to area (kms)	N/A	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
I would normally travel to work by public transport	Disagree	0.049	0.158	0.418	0.015	0.692	0.623
Do you have access to a car for travelling to work?	Yes	0.963	0.425	0.733	0.114	0.055	0.486
Gender	Male	0.087	0.232	0.743	0.345	0.003	0.016
Unskilled work	Yes	0.703	0.403	0.836	0.349	0.511	0.567
Office/administrative work	Yes	0.002	0.150	0.074	0.034	0.377	0.330
Professional/managerial work	Yes	0.021	0.073	0.137	0.639	0.827	0.556

commuting (Table 3). Two-thirds felt safe on public transport, but half preferred travelling to work alone and there was greater willingness to share with familiar, rather than unfamiliar travellers. On testing for gender differences just one statistically significant result emerged, regarding perceived personal safety on public transport, with a lower percentage of women feeling safe. This may partly explain the stronger preference amongst women for commuting with people they knew. Given that the basis of the esDRT is a somewhat closed social group, limited to those travelling to specific employers, these findings offered some support that the concept could be more attractive than fully public transport.

Attitudes towards an esDRT service were then examined. The notional service was given the marketing identity of 'Buzz' in the survey and posited as a possible enhancement for commuting. Participants were informed that it would be reserved for employees of participating employers, provided in clean and comfortable vehicles, and shared only with co-workers. Boarding and alighting points would be within a particular service area, which might be near home or close to another facility such as a railway station. However, specific details on fares and routes were not given because these would be very specific to the eventual partnership arrangement with a particular employer, or group of employers, in a particular location, who might choose to subsidise or fund the service in full. Instead, respondents were informed that *"Some employers offer access to a dedicated shared transport service…to help you get to and from work more easily."* This was intended to give the sense that it would be affordable, but not necessarily free. Given that the respondents were job seekers, not employees, it was not possible to ask a question to solicit whether DRT would actually be used in the context of a specific workplace relevant to each respondent.

The attitudinal statements proffered covered the overarching attractiveness and accessibility benefits of DRT, the trip decision-making conditions which would support DRT being seen as a solution, economic and social factors which would encourage use (Table 4). All statements attracted at least 50 % support, but higher levels of acceptance emerged if the service was presented as essential (no other options available) or if it was confirmed as fitting with the notional working schedule. These 'when' and 'where' factors appear more important than recommendations from colleagues or the opportunity to travel with colleagues.

Responses from women were consistently more favourable to Buzz than those from men, possibly reflecting a preference for sharing with known others, as reported above. However, these differences were only statistically significant in respect of four statements: women were more willing to accept payment by salary deduction, to use the service in return for a reward, or if it was not possible to park a car, and if colleagues who live near to them were also travelling. The largest difference related to parking constraints, with nearly two-thirds of women recognising Buzz as an alternative in these circumstances, but less than half of men.

5. Discussion and conclusion

Considering the fit of the paper's findings with the existing literature, accessibility and transport were confirmed as important perceptual and practical factors to entering the labour market amongst job-seekers engaging with the social security system, and therefore at heightened risk of social exclusion. Indeed, these spatial constraints were second only to skills and qualifications as a barrier to entering employment (and that this latter barrier was foremost stands as an important reminder that transport is a 'derived demand' and that transport factors only become relevant as a constraint if suitable work is available).

The spatial analyses undertaken confirmed, in part, McQuaid and Lindsay's (2002) findings that job-seekers do search outside their local residential areas. For many of the participants of the study the default area of search was the environs of the immediate residence, plus the city centre. However, a distinct finding of this research is that respondents at the Horfield JCP, located in an intermediate suburb had the broadest search horizons, which provides some contrast with Shen (1998), who found that those living near the CBD are best placed for seeking work. This finding would need further research to be fully understood, but at least in part it is explained by Horfield being at an intermediate point on a key radial transport corridor with very frequent bus services.

Indeed, public transport remains important for job seeking in Bristol, and this is despite the caveats raised in the literature about its limitations (Holzer et al., 2003; Quinn, 1986). This is likely also true for other cities of a similar size, with similar transport system characteristics, and with substantial peripheral employment clusters. Nonetheless, whilst some respondents did consider working outside the city centre or locations proximate to their residences, public transport and a 'high cost of distance' (Manning & Petrongolo, 2017, p.5) seemed to limit the extent of these aspirations. Hence, the constraints and limitations of relying on the traditional public transport network of city centre-oriented routes emerged, along with the growing advantage of car access in a 'precariat' labour market of fragmented employment. Indeed, half of respondents acknowledged the jobs they were applying for were 'car-dependent'. The gap between current public transport use and possible future car use may partly be explained by intentions to acquire cars, and those with cars choosing to use public transport, for example, for jobs in the city centre with parking constraints. However, the findings are also consistent with job seekers feeling compelled to find work in locations to which they have not identified a means of long-run viable access. The risks that the employee seeks alternative employment, or loses the job through poor punctuality and attendance, are likely to be heightened in a situation where only a poorly-fitting commute solution exists.

Alongside the importance of spatial specifics, temporal constraints were confirmed as highly relevant considerations. It is important to emphasise that an apparently comprehensive network map of public transport routes may appear limited once low frequency is combined

Table 4
Attitudes towards esDRT concept by gender.

					Chi Squared test by gender:	
	Survey statement	Overall agreement with statement	Female	Male	Test statistic	P-value
1	I am more likely to choose a job if the employer has Buzz available	52 %	55 %	50 %	0.699	0.403
2	I would use Buzz if it took me to a job I couldn't get to any other way	75 %	78 %	74 %	0.497	0.481
3	Buzz needs to fit with work shifts/h for me to use it	74 %	78 %	71 %	1.580	0.209
4	I am happy with the idea that payment goes direct from my wages/salary	50 %	59 %	42 %	7.228	0.007**
5	Buzz could give me access to more job opportunities	63 %	69 %	59 %	2.978	0.084
6	I would use Buzz if I could collect shopping vouchers or points each time I used it	50 %	60 %	41 %	8.643	0.003**
7	I would use Buzz if I couldn't park my car at work	51 %	64 %	41 %	12.161	<0.001***
8	Recommendations from friends or colleagues would encourage me to use Buzz	60 %	64 %	57 %	1.182	0.277
9	Travelling with colleagues who live in my area would encourage me to use Buzz	58 %	66 %	53 %	3.939	0.047*

Where:
*** means $p < 0.001$.
** means $0.001 \leq p < 0.01$.
* means $0.01 \leq p < 0.05$.

with compulsory start times. If an interchange is required to reach a peripheral location, then public transport-dependence becomes a significant deterrence to taking a job, and if an employee is allocated to the nightshift, public transport may be non-existent.

In this context, the research extended the general finding from the literature review that DRT may constitute a solution for connecting public transport-dependent job seekers (Crisp et al., 2018). It has demonstrated that a targeted esDRT solution to address spatiotemporal gaps was seen as relevant by people engaging with the social security benefits system who were seeking work, and therefore at increased risk of experiencing labour-market exclusion on mobility grounds. As well as being relevant for social policy, the findings are relevant for the economy and employers, as labour shortages and high staff turnover, such as seen in Bristol's Avonmouth area, are costly and disruptive for employers. Features of a future esDRT could include advanced routing software to dynamically adapt routes over a period of weeks according to emerging demand. Indeed, in some cases the financial benefits to businesses of effective staff recruitment, retention, and wellbeing may exceed the costs of esDRT. By focusing on specific employment sites, esDRT can be concentrated on specific times of day and therefore support specific shift patterns. Employers can choose to absorb part or all of the cost, with various recovery models for the user contribution, including the deduction of the fare for trips made direct from the salary. Where national taxation regimes allow, recovery can be from gross rather than net salary (for example, in the UK, through the 'salary sacrifice' procedure). Alongside enhancing the accessibility of the site, other potential benefits for the employer include reducing the need to provide parking for employee vehicles and reducing traffic around the locality of the site. Further research on operating examples would be necessary to test the financial viability of such a proposition in practice.

From a travel behavioural perspective there was some support for the concept that commuters are more likely to choose a service if sharing with others with which they have some affiliation, such as being co-workers, but the service seems, in the context of a hypothetical survey, to have been evaluated as 'just another transport option', as there was more modest support for the 'club' aspects of the scheme (receiving points for participating, or paying for use via the payroll) which might promote the social context of participating and reduce the costs to the user. And from the sustainable mobility perspective, the contingency of the DRT being seen as relevant if car parking would be difficult underlines the importance overall mobility management at employment sites (Bartle & Chatterjee, 2017).

The gender difference in the attractiveness may reflect the higher representation of women amongst public transport users and higher attachment to personal modes of transport (cars, powered two-wheelers and cycles) on the part of males. The stronger interest amongst women is of relevance to transport planners and employers, as it suggests that sites employing a high proportion of women might be particularly suitable for early deployments, in order to build up the acceptance profile of the services across a city. Otherwise, contexts in which the service is likely to be particularly relevant are where there is a moderate density of demand from residential suburbs to peripheral employment sites, where those sites are not (and cannot easily be) served well by traditional public transport. As well as serving residences directly, connections with existing public transport hubs to provide the FLM function could add to viability.

The most important limitations of the study are, first, that the survey of attitudes towards esDRT referred to a generic, notional scheme, and there was no opportunity to undertake a quantitative survey of users and non-users of an actual service, and second, that the sample size precluded disaggregation of the analyses beyond gender. Nonetheless, the study has implications for employers and public agencies who might wish to develop esDRT services as part of labour market policies or employment packages, thus making jobs explicitly feasible for public transport-dependent searchers who might otherwise be excluded. Indeed, such services appear to have most relevance where there are peripheral employment sites, inadequate public transport systems for dealing with that peripherality, and workforces who are unable, or unwilling, to own private cars, or their use is being discouraged as a matter of policy.

CRediT authorship contribution statement

Tom Calvert: Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing. **Fiona Crawford:** Methodology, Formal analysis, Data curation, Writing – review & editing, Visualization. **Graham Parkhurst:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Supervision, Project administration, Funding acquisition. **John Parkin:** Conceptualization, Methodology, Formal analysis, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Note: the order of authors given above is the finalised order for this paper.

Acknowledgements

The research reported in the paper was supported by the Innovate UK-funded consortium project 'Mobility on Demand Laboratory Environment' [grant number 53652-404182], with further exploitation under Centre for Connected and Autonomous Vehicles and Innovate UK-funded grant 'MultiCAV' [project reference number 104276]. The authors are grateful for the advice and facilitation provided by the consortium's lead partner Esoterix Systems, a developer of innovative, flexible transport services. The authors also thank Dr. Ian Shergold and Dr. Juliet Jain for the part they played in data collection.

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