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Abstract
This paper investigates the importance of non-work travel to the growing population of telecommuters and the implications of this for sustainable travel patterns. Previous research has identified a link between increased online access to work and reduced proximity between residential and workplace locations. These studies raise concerns that as more people split their work activities between home and external workplace, whilst living in more dispersed locations, more unsustainable transport impacts will be generated, including higher vehicle mileage, car dependency, and less physical activity. This paper counters that the implications of telecommuting and other flexible working practices for sustainable travel behaviours may be more dependent upon the number and type of non-work journeys and the accessibility of amenities for these purposes rather than on the distance to the workplace for less frequent commuting journeys. Using the National Travel Survey for England, the travel behaviours of those who identify themselves not as home workers but as working from home at least once a week are compared to other working adults by measuring and modelling the number and purpose of trips within a week's travel diary, independent of distance or mode. Telecommuters record fewer commute trips, more trips for other purposes, and the marginal utility of additional non-work trips to telecommuters is greater than for many other socio-economic characteristics. Thus, addressing the accessibility of non-work destinations proactively through local planning has the potential to optimise the sustainability benefits of telecommuting.

Key Words
Telecommuters; journey purpose; National Travel Survey; accessibility; travel diary

Introduction
Accessibility is a key concept within transport planning that is applied to quantify the level of time, cost, or distance penalties that permit or limit interactions between people, goods, activities, and opportunities dependent upon the transport systems and networks available (Reggianni et al., 2011). It is also dependent upon the spatial and temporal constraints or flexibilities attached to both individuals and opportunities (Miller, 2005; van Wee et al., 2013). Information and Communication Technologies (ICT) likewise provide access to activities, permit social interactions, and enable the purchase of goods, resulting in choices between travel and online access becoming ever more flexible, and even interchangeable (Lyons, 2015). The increasing access to work and work tasks at home on a regular or occasional basis via telecommuting is a primary example of this flexibility. Work is still an 'anchor point' for those in employment, a constraint requiring 'non-discretionary' commute trips within a concentrated timescale around which other daily travel is organised (Le Vine et al., 2017; Miller, 2005). Yet when people choose to telecommute regularly despite the presence of an external workplace or places, they are reducing, if not eliminating, the number of such journeys they need to make. This in turn affects the number, distance, and environmental impact of both the remaining commuting journeys and the total trips taken by the individual, household, or local population (Choo et al., 2005; Gubins et al., 2017; Zhu, 2013).

The concept of space-time geography helps to explain this phenomena, as telecommuting reduces the spatial and temporal constraints on an individual's availability to undertake activities at different locations within a given timeframe (Hägerstrand, 1970; Miller, 2005; Wang et al., 2018). Telecommuters have more control over where and when they perform work tasks, and, at the very least, the travel time they save on days when they telecommute can be spent working or performing other activities, making them more available to be in various locations during the working day.

Indeed, research in China and the United States has concluded that telecommuters tend to make more trips for other purposes and that the demand for non-work activities may influence their choice to telecommute in the first place (Asgari and Jin, 2017; Loo and Wang, 2018; van Wee et al., 2013).

This paper builds on such literature by exploring the behavioural variation in out-of-home activity participation, in this case in England, by measuring and modelling the frequency of trips for different purposes by those who self-identify as regular telecommuters. It also considers the relative importance to travel behaviour patterns of the space-time flexibility enabled by telecommuting compared to other types of work flexibility and socio-demographic characteristics. The empirical analysis uses the National Travel Survey (NTS), which includes both a week's travel diary with records of all trips taken for different purposes during that week, plus an interview component for the same participants that includes a question on how frequently individuals work from home. Previous activity-based studies such as that using household survey data in New York by Asgari and Jin (2017) tend to measure only one or two journey purposes or categorise out-of-home and online activities into 'mandatory', 'maintenance', and 'discretionary'. This methodology may enable an understanding of behavioural patterns, but offers little insight into the level of travel demand for different purposes, and thus the implications for accessibility and sustainability, so this study reviews 11 separate journey purposes.

Purpose is considered independently of distance or mode to better understand first whether individuals appear to have trip budgets as well as 'travel time budgets' (Mokhtarian and Chen, 2004), and secondly the implications of changing working patterns and distributions of non-work journeys for the provision of sustainable access from residential areas to the various land uses relevant to the 11 journey purposes. This reflection on land use and local amenities is topical in the English context, as recent policy has emphasised housing numbers over other planning matters including accessibility, which has in turn raised concerns about the sustainability of new development and long-term land use patterns (Averley et al., 2016; Transport for New Homes, 2018). Thus, our study aims to contribute to the debate by approaching the growing trend of telecommuting as an opportunity to investigate the relative frequency and importance of non-work journey purposes. This in turn might better inform policies on the integration of land use, transport and online accessibility, which are key determinants of the distance and impact of travel on sustainability.

Telecommuting in Context

Telecommuting can be categorised in different ways according to the type of employment: employees, self-employed, full-time, part-time; the definition of where it occurs: home or 'nearer home' than the usual workplace; the frequency; and the intensity: full-days, part-days, or overtime (Allen et al., 2015; Bailey and Kurland, 2002; Haddad et al., 2009; Felstead, 2012). However, in transport research, the definition refers to the direct replacement of commute journeys with remote participation, usually using ICT from home; and investigation has focused on the potential of telecommuting to reduce vehicle miles and impacts in order to contribute to the sustainable transport agenda (Cairns et al., 2004; Choo et al., 2005; White et al., 2007). And yet, a number of studies from the United States and Europe show this assumption is flawed. Telecommuters tend to have longer commute distances and durations on the days they do commute, and telecommuting households have longer total one-way commute distances (de Vos et al., 2018; Peters et al., 2004; Singh et al., 2013; Zhu, 2013). Furthermore, telecommuters make more business and non-work trips and fewer high-efficiency linked trips, raising concerns that increased online access may have a neutral or unsustainable impact on total trips and distance travelled, particularly if telecommuters

tend to live in more suburban, perhaps car-dependent areas (de Abreu e Silva and Melo, 2018; Gubins et al., 2017; Wang and Law, 2007).

Whilst there is some evidence that telecommuters are concentrated in suburban areas (Ellen and Hempstead, 2002), given the availability of other modes of transport, these commuters are not necessarily car-dependent. For example, since frequent telecommuters, who make up 8% of the working population in England, are twice as likely as non-telecommuters to travel by heavy rail when they do commute, then some of those travelling longer distances are not increasing vehicle mileage (Department for Transport, 2017, own calculation). It may be that any link between telecommuting and rail commuting is more related to the socio-economic characteristics telecommuters and rail commuters share, but it is still notable that working from home and commuting by rail are the only two 'modes' of accessing work which are increasing in England outside London, whilst 'multi-modality' more generally appears to be decreasing (Headicar and Stokes, 2016; Heinen and Mattioli, 2017; Le Vine et al., 2017). Therefore, the possibility that the two complement each other suggests that telecommuting and living further from the workplace does not necessarily have to be an unsustainable trend.

Furthermore, accessibility is as much a product of the density and distribution of work and other opportunities, as it is of the transport networks or absolute measures of distance (Noulas et al., 2012). If we move on from the sustainability of 'excess commuting' or commuting further than the optimum as derived from utility-based accessibility models, the sustainability of non-work journeys becomes a key policy implication (Ma and Banister, 2006). Indeed, both long commutes and the growing importance of non-work travel relative to commuting may affect not only the propensity to telecommute, but also the search for a residential location that better balances travel requirements with different lifestyles, land uses, or attitudes about travel (Aditjandra et al., 2011; Hu and He, 2016; Melia et al., 2018). Modelling such behavioural feedback and interaction is complex, and the measures of accessibility and choice are often limited by the data available (Lavieri et al., 2018; van Wee et al., 2013). Still, there are studies from the USA to China that indicate not only that telecommuters make more non-work trips, but also that those living in areas with greater densities of local, non-work destinations or by commercial /retail centres, are more likely to telecommute (Andreev et al., 2010; Loo and Wang, 2018; Singh et al., 2013). Furthermore, where people live in high density areas, trip-chaining and complex 'tours' are likely to involve travelling shorter distances (Chen and Akar, 2017). Therefore, understanding the demand for work flexibility and access to amenities could enable a better land-use planning response to people's needs (Banister, 2008; Kwan et al., 2007). That applies to both people whose work and lifestyles are already flexible and fragmented in time and/or space, and also those who aspire to work from home one to two days per week (Headicar and Stokes, 2016).

The stated desire not for daily home-working, but rather for regular, weekly telecommuting, suggests considerable suppressed demand, particularly among women and part-time workers, who are less likely to be given the opportunity by their employers, but are more likely to say they want that flexibility, perhaps due to additional care-giving responsibilities (Headicar and Stokes, 2016; Lavieri et al., 2018; Singh et al., 2013). Meanwhile, the ongoing development of ICT and the growth of the knowledge economy with its autonomous, task-based work culture is swelling the ranks of the professional, better educated, more internet-savvy sectors of the population who are more likely to telecommute (Felstead and Henseke, 2017; Headicar and Stokes, 2016; Peters et al., 2004; Singh et al., 2013). Therefore, as telecommuting and other flexible working patterns spread to different populations, it is increasingly important to understand how the frequency of travel for non-work purposes varies between regular telecommuters and those who more rarely or never telecommute.

Thus, the empirical analysis below aims to confirm whether telecommuters have similar trip budgets despite making fewer commute journeys; which non-commute journeys become significantly more important within trip budgeting for those with spatial and temporal flexibility; and the relative influence of telecommuting status compared to other key socio-economic and demographic characteristics on the frequency of certain types of trips, e.g. for escorting dependents.

Materials and Methods

The main data source used in this paper is the *National Travel Survey: 2002-2016* (NTS), administered annually to approximately 16,000 individuals in 7,000 households selected through random sampling of households within postcode sectors that are stratified to acquire a regionally representative sample according to 30 NUTS2 areas and census-based urban/rural classifications (Department for Transport, 2017, *National Travel Survey 2016 Technical report*). Although the survey has a history which dates back over 50 years, there are regularly minor changes to the questionnaire, and occasionally more major reviews and alterations to data collection. Since 2013, the survey has only sampled households in England, so data from the other British nations from earlier surveys was excluded from this analysis. In 2016, there was a major change to the recording of short walks in the travel diary, defined as those under one mile, from collecting the data only on the last day of the travel diary to only on the first day. Thus, rather than lose an entire year of data, all 'short walk' trips are excluded from the main analysis. However, as this paper focuses on the travel patterns of telecommuters, of most relevance are the questionnaire changes in 2009 to who was asked about frequency of working from home, namely all participants of 16 years or over in employment, rather than only those who responded first to questions about whether they worked from home in the previous week, or could have done so (Department for Transport, 2017). As a result, almost all working participants answered the question from 2009 onwards, even if they never telecommute. Therefore, this paper uses the data from 2009 to 2016 and the question directed at all employed adults whose usual workplace is *not* 'home' to compare the non-work travel of individuals who self-identify as working from home at least once a week and those who say they telecommute either more occasionally or never.

The questionnaire or interview portion of the survey is accompanied by a week-long travel diary of trips. The data on frequency of working from home and other socio-economic and demographic characteristics are taken from the interview, whilst the number of trips by journey purpose are from the travel diary. In order to match the frequency of telecommuting to the week's travel diary, the variable for telecommuters was defined as those that indicated in the interview that they worked from home either 'once or twice a week' or '3 or more times a week', with all other answers coded as non-telecommuters. Other household and individual level characteristics are selected based upon the literature review of the socio-economic-demographic and geographic factors that most influence travel and access patterns, including the choice to telecommute (Clark et al., 2016; Hincks et al., 2018; Lovelace et al., 2014). These include: the presence of dependent children in the household, whether the household is within the top income quintile, whether the individual is full-time not part-time, an employee not self-employed, and usually works in the same place on at least two consecutive days a week not different places. For the purpose of controlling for the sustainability of travel patterns, variables were included to account for the presence of one or more motorised vehicles per adult in the household and whether the individual identifies the car as their usual mode of commuting, either as driver or passenger. To control for geography, we include a binary variable indicating urban or rural location. The above characteristics are weighted according to the NTS guidance to control for non-response bias, addressing, for example, those who did not complete the

travel diary, whilst the weighting for trip numbers additionally controls for drop-off in response over the course of the diary week, which varies by journey purpose (Department for Transport, 2017).

The survey breaks trips down into either eight or 23 different purposes, and as trip numbers for some of the latter categories are very small, this study uses mainly the eight broad trip types, but divides 'shopping' into food and non-food, and 'leisure' into recreational activities such as sport and entertainment, visiting in residential areas, and holidays / days out. These divisions capture where different journey purposes involve different land uses, are likely to be influenced differently by socio-economic characteristics, and manifest different travel behaviours. The same applies to the final category: 'other including just walk', and mainly consists of 'just walk' trips where walking is an activity in and of itself. The result is a single categorical, choice-based variable, with 11 options. The prevalence of these different journey purposes for those who do or do not telecommute once a week are compared and Welch's t-tests are estimated to determine the significance of the different travel patterns. Then, in order to identify the importance of space-time flexibility of working patterns and compare the relative influence of self-declared telecommuting status to other socio-economic variables on the probability of travelling more frequently for non-work purposes, the multinomial logit model (1) is calculated.

$$\ln(\mathrm{Pr}_t \neq \mathrm{Commute}) = \alpha + \beta_1 \mathrm{Telecommuter} + \beta_2 \mathrm{Household} + \beta_3 \mathrm{Individual} + \varepsilon \quad (1)$$

Such models have been used in transport studies before, usually with modal choice as the non-ordinal, categorical, dependent variable, and the most prominent mode, car driver, is usually the reference case (Saneinejad et al., 2012; Zhou, 2012). Similarly, Pr_t in equation (1) is the probability that a different share of trips are made for each of the ten journey purposes, with commuting, the most common journey purpose, set as the reference case. The model coefficients are the log odds of telecommuter status as defined above (β_1), and of other household (β_2) and individual (β_3) level characteristics making it more or less likely that more or less frequent trips are made to access one of the 10 activities other than the usual place of work. A chi-square test of the log-likelihoods of the model with the single explanatory variable for telecommuting, and for the complete model, both show a significant difference from the null model, and the model fit further improved with the addition of the other relevant variables.

Results: The Odds of Other Travel

The eight-year dataset analysed here includes a total of 958,167 trips made by 54,048 working individuals from 32,940 households once those who were not relevant to the analysis were excluded due to not being of working age, being unemployed, or identifying 'home' as their usual workplace location. Telecommuters who say they work from home once a week or more often make up 8% of the total. Table 1 shows the percentage of telecommuters characterised by the other socio-economic and demographic variables included in the analysis, and the percentage of those who either never telecommute or telecommute less frequently with the same characteristics.

Table 1: Percentage of Sample for each Explanatory Variable

Variable	Telecommuters	Non-Telecommuters
Full Time not Part Time	78%	76%
Employee not Self-Employed	70%	91%
Have Regular Workplace	58%	86%
Have Degree	56%	29%
Male not Female	58%	53%
Over 40	64%	52%
Car to work	67%	67%
Urban not Rural	76%	83%
Have Children	39%	36%
Have at least 1 Car per Adult in household	94%	97%
Income Top Quintile	48%	26%

As Table 1 shows, more frequent telecommuters are older, wealthier and better educated than non-telecommuters, all of which characteristics fit with the results of other studies, which also indicate more telecommuting among workers with professional and managerial roles (de Abreu e Silva and Melo, 2018; Gubins et al., 2017; Singh et al., 2013). More men than women, more individuals with dependent children in the house, and a higher percentage who are full-time telecommute, although these differences are not as large. After rounding, the same proportion of telecommuters and non-telecommuters say their usual mode of commuting is by car, but a slightly lower percentage of telecommuters live in households with at least 1 car per adult, despite a higher proportion living in 'rural' areas. This could be an indication, albeit a small one, that telecommuting practices can reduce the car access and dependency requirements of a household, and perhaps opens the door to a more sustainable lifestyle. A more obvious conclusion from Table 1 is that more telecommuters are self-employed and/or do not have a regular place of work.

Considering the large sample size, it is not surprising that any correlation between being a telecommuter and these characteristics or any others is 0.15 or less, yet having multiple workplaces or no regular workplace can change the journey purpose recorded from 'commute' to 'business'. Indeed, all work journeys by those who never go to an identified usual workplace are counted as 'business' trips, and for self-employed people there might be additional ambiguity between 'commute', 'business', and 'personal business' (here referred to as 'errands') journey purposes. Still, Table 2 shows how differences in the journey patterns by purpose for telecommuters and non-telecommuters remain, even where those with overlapping flexibilities such as no regular place of work or self-employment are removed from the total.

Table 2: Journey purposes by total number of trips for non-telecommuters, telecommuters, telecommuters with a regular, external workplace, and telecommuters who are employees with a regular workplace

	Non-Telecommuters	Telecommuters	Telecommuters, regular workplace	Employee, telecommute, regular workplace
Commute	33%	17%	23%	24%
Business	6%	13%	8%	7%
Escort Education	4%	6%	6%	6%
Other Escort	8%	11%	11%	11%
Food Shopping	8%	8%	8%	8%
Other Shopping	8%	9%	9%	8%
Errands	8%	9%	9%	9%
Leisure Trips	10%	13%	12%	12%
Visiting	9%	7%	7%	7%
Holidays	4%	5%	5%	5%
Other (just walk)	2%	2%	2%	2%

Whilst Table 2 shows the share of telecommuters' trips that are for purposes other than commuting, telecommuters are also making more trips for other purposes in absolute terms. This is explored graphically in Figure 1. Although both regular telecommuters and non-telecommuters take more commute trips per person in the diary week than any other type of trip, telecommuters take about half as many commute trips as those who telecommute less than once a week or not at all. They make almost 1.4 more 'business' trips from work or for other work purposes, although these do include all the work trips of those with no usual place of work. Telecommuters also record 0.6 more escort trips, 0.2 more errands or 'personal business' trips, and 0.4 more journeys to places for leisure and recreation per person per week than non-telecommuters. Yet there is little difference in shopping trips, both for food and other goods. Since, in total, telecommuters make an average of 19 trips per person during the diary week, compared to 19.9 trips per non-telecommuter, this analysis suggests that working adults have a similar trip-making 'budget' whether they telecommute or not, but telecommuting at least once a week allows for substantial shifts in the purpose of some of those journeys.

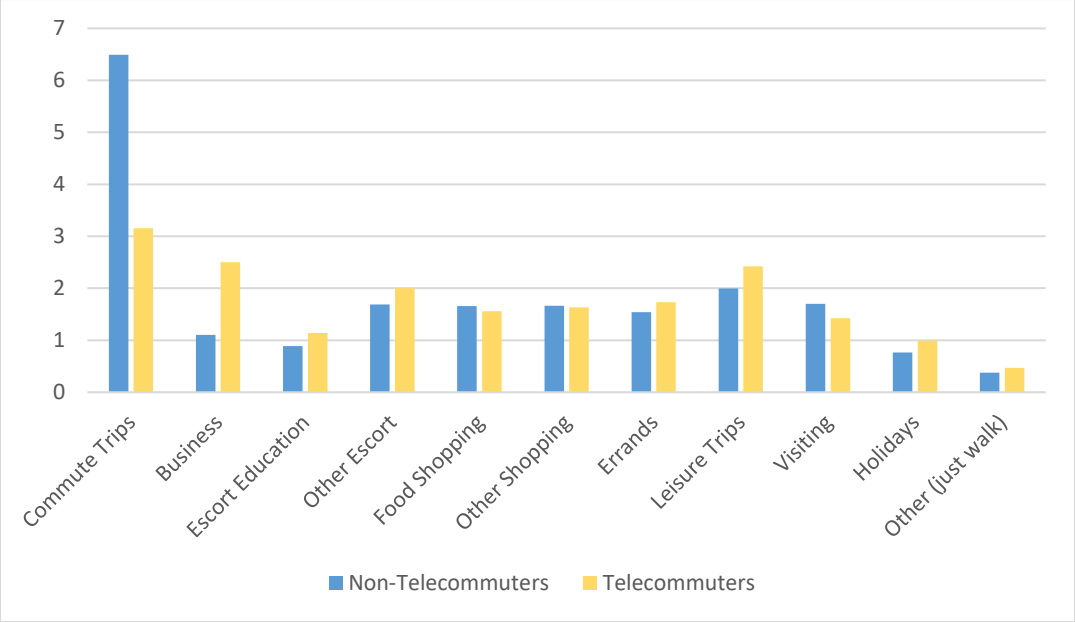

Figure 1: Trips per person in the diary week by journey purpose and telecommuting status.

Welch's t-tests further indicate that the difference between telecommuters' and non-telecommuters' trip numbers are significant, not only for commute trips, but also various other journey purposes. Indeed, telecommuters take significantly fewer, $p < 2.2e\text{-}16$, commuting trips and trips to visit friends and family per week than those who telecommute less or not at all. They take significantly more, $p < 2.2e\text{-}16$, business, education and other escort, leisure and holiday / day out trips, run more errands and make more 'other' trips for no utilitarian purpose. Only the difference in 'other shopping' trip frequency is not significant at all, and although the number of food shopping trips are on average slightly higher for non-telecommuters, the significance is lower at $p = 0.005$.

The multinomial logit (MNL) model further supports the relative prevalence of non-commuting trips for telecommuters. As Table 3 shows with the coefficients in bold, being a frequent telecommuter increases the likelihood or marginal utility of making trips for all non-commute purposes and does so significantly and at a scale greater than most of the other independent variables across the 10 categories of non-commute journey purpose assessed. The effect is even present for trips to visit friends and family, which is because, although telecommuters make significantly fewer of these trips than commuters in absolute numbers, the gap is smaller between the number of trips in the diary week for this purpose compared to the number of trips for commuting or indeed any other purpose. Both Figure 1 and Table 3 confirm that telecommuters' trips are much more evenly distributed by purpose than commuters' trips, although commuting, as the reference case, remains the dominant trip purpose for both, similar to car travel in mode choice MNL models (Saneinejad et al., 2012; Zhou, 2012). This dominance explains why all the intercepts or constants in Table 3 are negative, for if there were no independent variables, it is more likely that a given trip will be for commuting in the sample as a whole, as it is the most common journey purpose in a usual week for most working adults. Therefore, the results in Table 3 should be viewed in relative terms, where the size and significance of the positive coefficients highlight the importance of telecommuting status compared to the other socio-economic and demographic characteristics tested on the likely frequency and choice of non-commute trips of different types.

Table 3: Results from the multinomial logit model for the influence of 2009-2016 NTS individual and household characteristics on the week's travel diary recorded trip purposes. Coefficients are

highlighted in bold for the primary independent variable of telecommuting status, italics where the effects are of similar magnitude and significance to telecommuting status, and bold and italics where the magnitude is noticeably greater.

Dep Var: Trip Purpose (ref case commuting)	Business	Escort Education	Other Escort	Food Shopping	Shopping	Errands	Leisure	Visiting	Holidays	Other
Telecommute at least weekly	**0.696*****	**0.756*****	**0.620*****	**0.516*****	**0.500*****	**0.597*****	**0.593*****	**0.439*****	**0.657*****	**0.639*****
	(0.014)	(0.018)	(0.014)	(0.015)	(0.015)	(0.015)	(0.013)	(0.016)	(0.018)	(0.025)
Full Time not Part Time	-0.042***	***-1.322******	*-0.589****	*-0.491****	*-0.501****	*-0.517****	*-0.497****	*-0.492****	*-0.542****	*-0.499****
	(0.012)	(0.011)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.012)	(0.017)
Employee not Self-employed	-0.102***	-0.307***	-0.073***	0.029**	0.043***	-0.159***	-0.001	0.063***	-0.038***	0.125***
	(0.012)	(0.017)	(0.013)	(0.013)	(0.013)	(0.013)	(0.012)	(0.014)	(0.017)	(0.024)
Have Regular Workplace	***-1.845******	*-0.542****	*-0.562****	*-0.493****	*-0.522****	*-0.401****	*-0.607****	*-0.540****	*-0.588****	*-0.659****
	(0.011)	(0.015)	(0.011)	(0.012)	(0.012)	(0.012)	(0.010)	(0.012)	(0.015)	(0.020)
Have Degree	0.471***	0.047***	0.163***	0.069***	0.107***	0.234***	0.296***	0.008	0.310***	0.061***
	(0.009)	(0.011)	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.011)	(0.016)
Male not Female	-0.061***	-0.393***	-0.227***	-0.331***	-0.291***	-0.227***	-0.008	-0.282***	-0.065***	-0.198***
	(0.009)	(0.011)	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.011)	(0.015)
Over 40	0.261***	-0.127***	0.249***	0.264***	0.215***	0.187***	-0.097***	-0.243***	0.179***	0.351***
	(0.009)	(0.010)	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.011)	(0.015)
Car to work	0.447***	0.342***	***0.658******	0.274***	0.239***	*0.375****	0.144***	0.313***	0.218***	0.052***
	(0.010)	(0.011)	(0.009)	(0.008)	(0.008)	(0.009)	(0.007)	(0.008)	(0.011)	(0.015)
Urban not Rural	-0.086***	0.019	0.024**	0.056***	0.046***	-0.057***	0.020**	0.110***	-0.222***	-0.237***
	(0.011)	(0.013)	(0.009)	(0.010)	(0.010)	(0.010)	(0.009)	(0.010)	(0.012)	(0.017)
Have Children	0.034***	***1.823******	***0.927******	0.208***	0.166***	0.277***	0.013*	-0.060***	0.105***	0.124***
	(0.009)	(0.012)	(0.007)	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.011)	(0.015)
Cars Available	0.190***	-0.151***	-0.013	0.209***	0.147***	0.072***	0.211***	0.308***	0.042**	0.256***
	(0.017)	(0.021)	(0.015)	(0.016)	(0.016)	(0.016)	(0.015)	(0.017)	(0.021)	(0.031)
Income Top Quintile	0.185***	-0.124***	0.043***	0.051***	0.089***	0.130***	0.249***	0.018**	0.219***	0.230***
	(0.010)	(0.013)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.011)	(0.016)
Constant	-0.877***	-1.184***	-1.267***	-1.039***	-0.906***	-0.940***	-0.615***	-0.801***	-1.340***	-2.197***
	(0.018)	(0.021)	(0.015)	(0.015)	(0.016)	(0.016)	(0.014)	(0.016)	(0.022)	(0.029)
Note:										*p<0.1; **p<0.05; ***p<0.01

Only full time employment status and the presence of a regular or usual place of work have similarly significant and sizeable coefficients across the board, as shown in italics, but these coefficients are still generally smaller or barely different from those for telecommuters. They are also negative, which means that having a full time job and a regular workplace decreases the probability of trip making for all other purposes besides commuting. Conversely, if an individual's spatial and temporal working patterns are flexible because they are telecommuters, work part-time or in different places, they are likely to have a more even distribution of trips by purpose. Surprisingly, the coefficients for being an employee versus self-employed are mostly small and vary more with trip type, indicating that self-employed workers may not have more flexibility than other types of workers to spend on non-work journey purposes. Since, as shown in Table 1, telecommuters are more likely to be self-employed and to have no regular workplace, a sensitivity test was estimated for only employees with a regular workplace, whether they telecommute once a week or not. The regression table (A1) for this MNL model is included in Appendix A, but what is notable is that telecommuting status is still a significant influence on the probability of making non-commute trips across the board and has a greater effect than almost all other remaining individual and household characteristics tested.

The exception to this is whether a worker is full time or part time. In Table 3, being full time reduces the probability of taking many trips for non-commute purposes but the effects are smaller than for telecommuting status. In Table A1, once self-employed workers and those without a regular workplace are removed from the model estimation, the effects are slightly greater. Yet the largest effect in both tables is the coefficient showing that full time workers are much less likely to have

frequent responsibility for the school run. In other words, the probability is that escort education trips make up a greater share of part time workers' weekly trips than those of telecommuters, but both make the school run much more often than other full time workers. Indeed, considering that Table 1 shows a slightly greater proportion of telecommuters are full time than non-telecommuters, the modelling results in Table 3 are an indication of the temporal flexibility benefits secured by regular telecommuter, which may balance to some extent the constraints on full time workers and their ability to make time for non-commute trips.

Spatial flexibility, as represented by the binary variable of having a regular workplace or working in different places, has significant, although in this case negative, coefficients in Table 3 of a marginally smaller magnitude than telecommuting status, other than for business trips. This reflects the narrow definition of commuting in the NTS; commuting trips are only those which are direct between home and a 'usual' workplace. Thus every work trip for those who do not have a regular workplace will either be defined as a business trip or another journey purpose. For the latter, all linked trips on the way home from work to the gym or grocery store or to pick up a dependent are likely to be categorised as leisure or food shopping or escort trips, rather than as business trips, and none will be 'commute' trips. Therefore, although spatial flexibility appears to have some impact on the probable distribution of journey purposes per week, the strength of this effect is weaker than for those variables representing temporal flexibility. This conclusion is further supported by the results shown in Table A1. The coefficients for the binary variables for telecommuting status and full / part time workers who are employees with a regular workplace remain significant and of larger effect across almost all journey purposes than the other independent variables. Furthermore, the coefficients for full time / part time work are often of greater magnitude than telecommuting status in the subset tested, suggesting that it is the temporal rather than the spatial flexibility of telecommuters which enables them to have such a different relative distribution of trip making by journey purpose compared to other working adults.

This temporal flexibility appears to be particularly important to the probability of who undertakes escort journeys, both the school run, or escort education, and 'other escort'. Many 'other escort' journeys are still related to having dependent children, who are escorted to most of their activities, not just school. Therefore, it is not surprising that those with dependent children are most likely to have to make more escort trips per week than those with other socio-economic or demographic characteristics. Nor is it unrealistic to assume that those with work flexibility, such as telecommuters and part-time workers are more likely to have responsibility for the school run in households with dependent children than adults in the same household with less flexibility. Indeed, the causal direction may be that workers choose to telecommute or switch to part-time work because they have children and caring responsibilities, including escort duties (Singh et al., 2013).

However, escort duties can apply to caring responsibilities other than those related to dependent children. A sensitivity test of the sample *without* dependent children in the household is also included in Appendix A. The results in Table A2 indicate that spatial and temporal employment flexibility, including telecommuting status are still characteristics with a significant effect on the likelihood of making more escort trips. For telecommuters, the effect on the probability of 'other' escort journeys remains high, as it does indeed for those who regularly commute by car in both Table 3 and Table A2. These coefficients indicate a pattern where the 'other escort' journeys in question may be to work activities for the person being escorted. Those who regularly commute by car, whether driver or passenger, may be involved in car sharing, perhaps to adjacent workplaces, or otherwise escorting someone on their commute. Meanwhile, the other coefficients highlighted in bold and italics in Table A2 all indicate significant and large changes in the probability of making

escort education trips. These are suggestive of childcare arrangements where older relatives, who may be more likely to work part-time and have cars available, escort children to school who are not dependents within their own household, perhaps where parents do not have the opportunity to telecommute or otherwise have flexibility.

A final insight from Table 3 is that telecommuters are more likely than any other group included in the model estimation to make a greater proportion of their trips for no named utilitarian purpose. This 'other' category mainly refers to "walking trips for pleasure or exercise along public highways, including taking the dog for a walk and jogging" (Department for Transport, 2017, *National Travel Survey 2016: Notes and Definitions*: p11). Although the absolute number of 'other' trips per person per week is admittedly small, as show in Figure 1, frequent telecommuters are more likely to make such trips, suggesting they not only have the time and perhaps the dog-walking responsibilities, but also the desire to walk along pavements and local streets. Yet they may have insufficient amenities which they are willing to walk a mile or more to reach if such walks are not categorised as other journey purposes. Walks under a mile are excluded from the main analysis, but a brief review of the un-weighted single day of short walk trips recorded in the travel diaries each year between 2009-2015 shows that regular telecommuters not only make more short walk trips per person than those who don't regularly telecommute, but also make more short walk trips for purposes other than commuting, as shown in Figure 2.

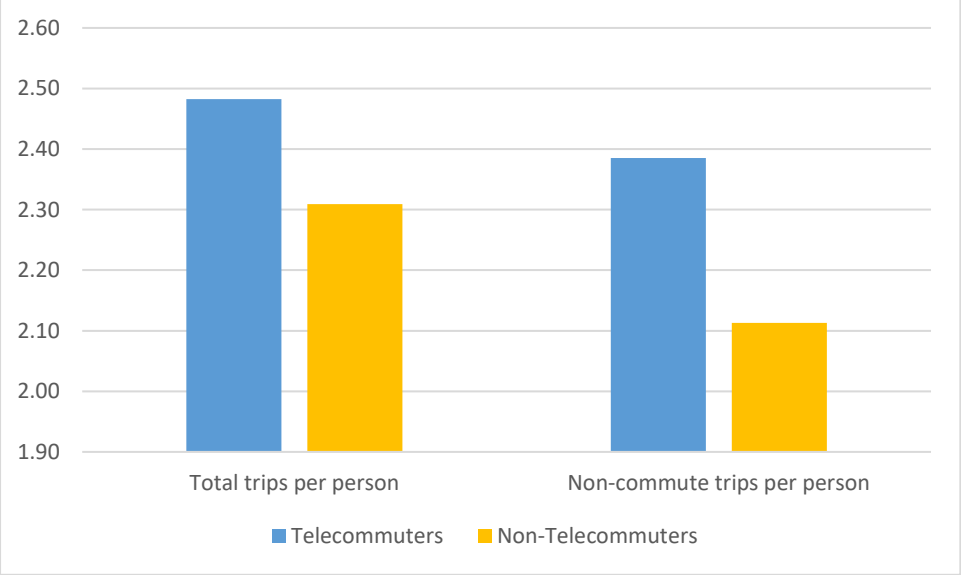

Figure 2: One day's short walk trips per person by telecommuting status 2009-2015. Note the y-axis is truncate to better show the portion of the graph with a difference in trips per person.

In summary, the MNL models clearly demonstrate a pattern where the temporal flexibility of telecommuters and part-time workers enable a wider variety and number of non-commute trips. Other variables, including spatial flexibility as represented by having a regular workplace, or demographic factors such as gender and age have smaller, less significant, and certainly more diverse effects on the probability of working adults making more trips for different purposes. Other socio-economic variables, such as income and education, also were less relevant to how the trip-making budget was distributed between purposes. And the inclusion of the urban / rural variable to represent the effect of geography, at least at a very basic level, did not offer particularly noteworthy results. Admittedly, other geographical and socio-demographic characteristics might have been included in the model estimation and given other insights. However, the MNL modelling does reveal the importance of temporal flexibility of work activities to the probability of allocating more of the

weekly trip-making budget to trips for non-work purposes generally and escort purposes in particular. Regular telecommuting is one of the major, and growing trends in the increasing temporal flexibility of employment, not least as the time required for commuting to work is eliminated.

Conclusion

Telecommuting in and of itself may not reduce car travel or increase sustainable travel. Although regular telecommuting reduces the number of commuting trips that workers make, the willingness of frequent telecommuters to live further from their place of work and to make more journeys for non-work purposes has led researchers from the USA to the Netherlands to question whether telecommuting practices result in fewer trips or mileage, or more than a marginal reduction in car travel at the household or even national scale (Gubins et al., 2017; Zhu, 2013). Yet even a UK-based study sceptical of the sustainability of telecommuting noted that two-worker households with one regular telecommuter appear to make more efficient journeys and redistribute travel to minimise mileage (de Abreu e Silva, 2018). And although no attitudinal data is included in this study, research into residential self-selection in the UK indicates that people do want to move to areas where they can drive less, including younger generational cohorts, but this will only be possible if such areas are available to them (Aditjandra et al., 2011; Melia et al., 2018). The density of local shopping and leisure options, as well as the proximity of schools and other escort and business destinations, is more relevant to the travel behaviour of telecommuters than of non-telecommuters. This means that accessible, mixed use areas could enable frequent telecommuters, who have the temporal flexibility to make more trips for purposes other than commuting, to do so more sustainably.

The purpose of this study is to assess the relationship between a common form of online accessibility, namely accessing work activities from home through telecommuting, and the demand of those telecommuters for spatial accessibility to other activities. The accessibility of such activities in terms of distance, transport options, and the convenience of 'intervening opportunities' will have a major influence on travel patterns and their resultant impact (Noulas et al., 2012), particularly for telecommuters. Other benefits from telecommuting and flexible working can be achieved with little effort, as fewer peak hour commute trips can result in reductions in congestion, smoother flows, and less emissions (Cairns et al., 2004). Furthermore, if flexible working patterns result in more flexible travel patterns, it can lead to more resilient travel behaviour as more people have an option that is recognised and supported by their employer not to travel during disruption (Marsden and Docherty, 2013). Yet without concerted action in terms of policy and planning, much wider potential benefits will be missed. If telecommuting is to result in not only a redistribution of motorised travel, but also less motorised travel in total, more attention must be given to the accessibility to land uses, activities and journeys other than the home to work commute, and particularly what type of amenities are in greater demand and where efforts to increase accessibility should be concentrated.

The planning and policy implications are to invest in walkable neighbourhoods with well-dispersed basic services and amenities that can support more active travel. Further research might usefully explore whether any regional differences in levels of telecommuting can be linked to urban form, mixed land uses, public transport networks, and local accessibility, in addition to the more obvious influence of spatial economic variation. It would also be useful to undertake qualitative research to assist in developing planning policy by gaining greater understanding into how telecommuters with different socio-demographic characteristics, such as gender, schedule and travel to work and non-work activities both within and outside their community. In any case, through focusing on journey purposes independently of distance or mode of travel, the empirical analysis clearly shows that those who telecommute at least once a week take half the number of commute trips, but more trips

for most other purposes. Furthermore, the MNL model estimations show that the probability of taking a greater proportion of trips for purposes other than commuting is higher if an individual frequently telecommutes than for most other independent variables tested, with other factors related to the space-time flexibility in work patterns also being influential.

As the numbers of working adults in England who telecommute or otherwise have more flexible working patterns grows, whilst the number and proportion of commuting trips is in decline (Le Vine et al., 2017), these results are important to planning for sustainable travel. Individuals who telecommute replace the commuting time they save on days they work from home not just with longer commute trips when they do go to work, but also with more trips for other purposes. This does not mean they want to spend more time travelling in congestion for those trips, nor are all those trips likely to be by car. Frequent telecommuters are slightly more likely to commute by train when they do go to work, take slightly greater numbers of short walks and 'other' walks per person, and a slightly higher proportion live in households with fewer cars per adult. The numbers are small, but significant, and do not suggest a demographic intent on car dependency. This has implications for future transport and land use planning policy and the sustainability of travel. There are many studies that highlight the benefits of mixed use development with residential densities that support accessible, local amenities (Banister, 2008; Headicar, 2015). This study provides additional evidence by considering how telecommuting practices also support the drive to plan for accessible neighbourhoods. Similar to other current technological trends, telecommuting will only enable sustainable, resilient communities if planning takes an active role in ensuring that result.

References

Aditjandra P, Cao, XJ, Mulley, C. (2012) Understanding Neighbourhood Design Impact on Travel Behaviour: An Application of Structural Equations Model to a British Metropolitan Data. *Transportation Research Part A Policy and Practice* 46: 22-32. DOI: 10.1016/j.tra.2011.09.001.

Allen TD, Golden, TD, Shockley, KM. (2015) How Effective Is Telecommuting? Assessing the Status of Our Scientific Findings. *Psychological Science in the Public Interest* 16: 40-68. DOI: 10.1177/1529100615593273.

Andreev P, Salomon, I, Pliskin, N. (2010) Review: State of teleactivities. *Transportation Research Part C: Emerging Technologies* 18: 17. DOI: 10.1016/j.trc.2009.04.017.

Asgari H, Jin, X. (2017) Impacts of Telecommuting on Nonmandatory Activity Participation: Role of Endogeneity. *Transportation Research Record: Journal of the Transportation Research Board* 2666: 47-57. DOI: 10.3141/2666-06.

Averley J, Saunders, M, Baines, H, Joshi, R. (2016) The Location of Development: Mapping planning permissions for housing in twelve English city-regions. Royal Town Planning Institute. https://www.rtpi.org.uk/locationofdevelopment.

Bailey DE, Kurland, NB. (2002) A review of telework research: findings, new directions, and lessons for the study of modern work. *Journal of Organizational Behavior* 23: 383-400. DOI: 10.1002/job.144.

Banister D. (2008) The sustainable mobility paradigm. *Transport Policy* 15: 73-80. DOI: 10.1016/j.tranpol.2007.10.005.

Cairns S, Sloman, L, Newson, C, Anable, J, Kirkbride, A, and Goodwin, P. (2004) Smarter Choices – Changing the Way We Travel London: Department for Transport.

Chen Y-J, Akar, G. (2017) Using trip chaining and joint travel as mediating variables to explore the relationships among travel behavior, socio-demographics, and urban form. *The Journal of Transport and Land Use* 10: 573-588. DOI: 10.5198/jtlu.2017.882.

Choo S, Mokhtarian, PL, Salomon, I. (2005) Does telecommuting reduce vehicle-miles traveled? An aggregate time series analysis for the US. *Transportation* 32: 37-64. DOI: 10.1007/s11116-004-3046-7.

Clark B, Chatterjee, K, Melia, S. (2016) Changes to commute mode: The role of life events, spatial context and environmental attitude. *Transportation Research Part A: Policy and Practice*: 89-105. DOI: 10.1016/j.tra.2016.05.005.

De Abreu e Silva J, Melo, PC. (2018) Does home-based telework reduce household total travel? A path analysis using single and two worker British households. *Journal of Transport Geography* 73: 148-162. DOI: 10.1016/j.jtrangeo.2018.10.009.

De Vos D, Meijers, E, van Ham, M. (2018) Working from home and the willingness to accept a longer commute. *The Annals of Regional Science* 61: 375-398. DOI: 10.1007/s00168-018-0873-6.

Department for Transport. (2017). *National Travel Survey, 2002-2016*. [data collection]. *12th Edition.* UK Data Service. SN: 5340, DOI: 10.5255/UKDA-SN-5340-8.

Ellen I, Hempstead, K. (2002) Telecommuting and the demand for urban living: a preliminary look at white-collar workers. *Urban Studies* 39: 749-766. DOI: 10.1080/00420980220119552.

Field A, Miles, J., Field, Z. (2012) *Discovering Statistics Using R,* London: Sage. ISBN: 978-1-4462-0045-2.

Felstead A. (2012) Rapid change or slow evolution? Changing places of work and their consequences in the UK. *Journal of Transport Geography* 21: 31-38. DOI: 10.1016/j.jtrangeo.2011.10.002.

Felstead A, Henseke, G. (2017) Assessing the growth of remote working and its consequences for effort, well-being and work-life balance. *New Technology, Work and Employment* 32: 195-212. DOI: 10.1111/ntwe.12097.

Gubins S, de Graaff, T, van Ommeren, J. (2017) Does new information technology change commuting behavior? Working Paper: http://thomasdegraaff.nl/publications/newinformationtechnology/.

Haddad H, Lyons, G, Chatterjee, K. (2009) An examination of determinants influencing the desire for and frequency of part-day and whole-day homeworking. *Journal of Transport Geography* 17: 124-133. DOI: 10.1016/j.jtrangeo.2008.11.008.

Hägerstrand T. (1970) What About People in Regional Science? *Ninth European Congress of the Regional Science Association.* 7-21.

Headicar P. (2015) Settlement Patterns, Urban Form and Travel. In: Barton H TS, Burgess S and Grant M (ed) *The Routledge Handbook of Planning for Health and Well-being.* Abingdon: Routledge.

Headicar P, Stokes, G. (2016) On the Move 2: Making sense of travel trends in England 1995-2014: Technical Report. Independent Transport Commission. http://www.theitc.org.uk/wp-content/uploads/2016/11/OTM2-Technical-Report-FINAL.pdf.

Heinen E, Mattioli, G. (2017) Does a high level of multimodality mean less car use? An exploration of multimodality trends in England. *Transportation*: 1-34. DOI: 10.1007/s11116-017-9810-2.

Hincks S, Kingston, R, Webb, B, Wong, C. (2018) A new geodemographic classification of commuting flows for England and Wales. *International Journal of Geographical Information Science* 32: 663-684. DOI: 10.1080/13658816.2017.1407416.

Hu L, He, SY. (2016) Association between Telecommuting and Household Travel in the Chicago Metropolitan Area. *Journal of Urban Planning and Development* 142: 04016005-04016001-04016005-04016008.

Järv O, Tenkanena,H, Salonena, M, Ahas, R, Toivonena, T. (2018) Dynamic cities: Location-based accessibility modelling as a function of time. *Applied Geography* 95: 101-110. DOI: 10.1016/j.apgeog.2018.04.009.

Kwan M, Dijst, M, Schwanen, T. (2007) The interaction between ICT and human activity-travel behavior. *Transportation Research Part A Policy and Practice* 41: 121-124. DOI: 10.1016/j.tra.2006.02.002.

Lavieri P, Dai, Q, Bhat, CR. (2018) Using virtual accessibility and physical accessibility as joint predictors of activity-travel behavior. *Transportation Research Part A Policy and Practice* 118: 527-544. DOI: 10.1016/j.tra.2018.08.042.

Le Vine S, Polak, J, Humphrey, A. (2017) Commuting Trends in England 1988-2015. Department for Transport.

Loo B, Wang, B. (2018) Factors associated with home-based e-working and e-shopping in Nanjing, China. *Transportation* 45: 365-384. DOI: 10.1007/s11116-017-9792-0.

Lovelace R, Ballas,D, Watson, M. (2014) A spatial microsimulation approach for the analysis of commuter patterns: from individual to regional levels. *Journal of Transport Geography* 34: 282-296. DOI: 10.1016/j.jtrangeo.2013.07.008.

Lyons G. (2015) Transport's digital age transition. *The Journal of Transport and Land Use* 8: 1-19. DOI: 10.5198/jtlu.2014.751.

Ma K-R, Banister, D. (2006) Excess Commuting: A Critical Review. *Transport Reviews* 26: 749-767. DOI: 10.1080/01441640600782609.

Marsden G, Docherty, I. (2013) Insights on disruptions as opportunities for transport policy change. *Transportation Research Part A: Policy and Practice* 51: 46-55. DOI: 10.1016/j.tra.2013.03.004.

Melia S, Chatterjee, K, Stokes, G. (2018) Is the urbanisation of young adults reducing their driving? *Transportation Research Part A Policy and Practice* 118: 444-456. DOI: 10.1016/j.tra.2018.09.021.

Miller HJ. (2005) A Measurement Theory for Time Geography. *Geographical Analysis* 37: 17-45.

Mokhtarian PL, Chen, C. (2004) TTB or not TTB, that is the question: a review and analysis of the empirical literature on travel time (and money) budgets. *Transportation Research Part A: Policy and Practice* 38: 643-675. DOI: 10.1016/j.tra.2003.12.004.

Noulas A, Scellato, S, Lambiotte, R, Pontil, M, Mascolo C. (2012) A Tale of Many Cities: Universal Patterns in Human Urban Mobility. *PLOS ONE* 7: 1-10. DOI: 10.1371/journal.pone.0037027.

Peters P, Tijdens, KG, Wetzels, C. (2004) Employees' opportunities, preferences, and practices in telecommuting adoption *Information & Management* 41: 469-482. DOI: 10.1016/S0378-7206(03)00085-5.

Reggiani A, Bucci, P, Russo, G. (2011) Accessibility and impedance forms: Empirical applications to the German commuting network. *International Regional Science Review* 34: 230-252. DOI: 10.1177/0160017610387296.

Saneinejad S, Roorda, MJ, Kennedy, C. (2012) Modelling the impact of weather conditions on active transportation travel behavior. *Transportation Research Part D: Transport and Environment* 17: 129-137. DOI: 10.1016/j.trd.2011.09.005.

Singh P, Paleti, R, Jenkins, S, Bhat, CR. (2013) On modeling telecommuting behavior: option, choice, and frequency. *Transportation* 40: 23. DOI: 10.1007/s11116-012-9429-2.

Transport for New Homes. (2018) Transport for New Homes: Project Summary and Recommendations. Foundation for Integrated Transport. http://www.transportfornewhomes.org.uk/.

van Wee B, Geurs, K, Chorus, C. (2013) Information, communication, travel behavior and accessibility. *The Journal of Transport and Land Use* 6: 1-16. DOI: 10.5198/jtlu.v6i3.282.

Wang D, Law, FYT. (2007) Impacts of Information and Communication Technologies (ICT) on time use and travel behavior: a structural equations analysis. *Transportation* 34: 513-527. DOI: 10.1007/s11116-007-9113-0.

Wang Y, Chen, BY, Yuan, H, Wang, D, Lam, WHK, Li, Q. (2018) Measuring temporal variation of location-based accessibility using space-time utility perspective. *Journal of Transport Geography* 73: 13-24. DOI: 10.1016/j.jtrangeo.2018.10.002.

White P, Christodoulou, G, Mackett, R, Titheridge, H, Thoreau, R, Polak, J. (2007) The role of teleworking in Britain: its implications for the transport system and economic evaluation. *European Transport Conference.* Leiden, the Netherlands: Association for European Transport.

Zhou J. (2012) Sustainable commute in a car-dominant city: Factors affecting alternative mode choices among university students. *Transportation Research Part A Policy and Practice* 46: 1013-1029. DOI: 10.1016/j.tra.2012.04.001.

Zhu P. (2013) Telecommuting, Household Commute and Location Choice. *Urban Studies* 50: 2441-2459. DOI: 10.1177/0042098012474520.

Appendix A: Multinomial Logit Modelling Sensitivity Tests

Table A1: Results from the multinomial logit model for the influence of 2009-2016 NTS individual and household characteristics on the week's travel diary recorded trip purposes, with only telecommuters (and non-telecommuters) who are employed and have a regular workplace included.

Dep Var: Trip Purpose (ref case commuting)	Business	Escort Education	Other Escort	Food Shopping	Shopping	Errands	Leisure	Visiting	Holidays	Other
Telecommute at least weekly	**0.632*****	**0.894*****	**0.569*****	**0.343*****	**0.254*****	**0.323*****	**0.305*****	**0.559*****	**0.559*****	**0.630*****
	(0.023)	(0.024)	(0.019)	(0.021)	(0.021)	(0.021)	(0.018)	(0.019)	(0.024)	(0.032)
Full Time not Part Time	-0.274***	***-1.490******	***-0.638******	***-0.552******	***-0.538******	***-0.606******	***-0.575******	***-0.581******	***-0.746******	***-0.733******
	(0.016)	(0.013)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)	(0.010)	(0.013)	(0.018)
Have Degree	0.552***	-0.176***	0.118***	0.122***	0.126***	0.251***	0.268***	0.009	0.222***	0.339***
	(0.012)	(0.013)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.012)	(0.017)
Male not Female	0.024**	-0.245***	-0.179***	-0.330***	-0.300***	-0.227***	-0.020***	-0.276***	-0.069***	-0.141***
	(0.012)	(0.013)	(0.009)	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)	(0.012)	(0.016)
Over 40	0.265***	-0.201***	0.260***	0.269***	0.204***	0.121***	-0.089***	-0.252***	0.251***	0.527***
	(0.012)	(0.012)	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)	(0.012)	(0.017)
Car to work	0.420***	0.324***	***0.627******	0.262***	0.211***	0.420***	0.174***	0.317***	0.027**	0.004
	(0.013)	(0.012)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.012)	(0.017)
Urban not Rural	-0.321***	-0.041***	-0.033***	-0.044***	-0.035***	-0.150***	-0.022**	0.072***	-0.106***	-0.328***
	(0.014)	(0.014)	(0.010)	(0.011)	(0.011)	(0.011)	(0.010)	(0.011)	(0.015)	(0.019)
Have Children	0.129***	***1.778******	***0.935******	0.205***	0.125***	0.298***	0.045***	-0.086***	0.104***	0.226***
	(0.013)	(0.013)	(0.008)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.013)	(0.017)
Cars Available	-0.379***	-0.595***	-0.494***	-0.039**	-0.062***	-0.135***	-0.138***	-0.030*	-0.117***	-0.232***
	(0.022)	(0.022)	(0.016)	(0.017)	(0.017)	(0.018)	(0.016)	(0.017)	(0.023)	(0.031)
Income Top Quintile	0.309***	-0.063***	0.126***	0.030***	0.025***	0.103***	0.228***	-0.013	0.357***	0.139***
	(0.013)	(0.015)	(0.010)	(0.010)	(0.010)	(0.010)	(0.008)	(0.010)	(0.013)	(0.018)
Constant	-2.247***	-1.406***	-1.378***	-1.155***	-1.038***	-1.188***	-0.786***	-0.869***	-1.730***	-2.215***
	(0.022)	(0.022)	(0.016)	(0.017)	(0.017)	(0.017)	(0.015)	(0.017)	(0.023)	(0.032)
Note:										*p<0.1; **p<0.05; ***p<0.01

Table A2: Results from the multinomial logit model for the influence of 2009-2016 NTS individual and household characteristics on the week's travel diary recorded trip purposes, with only telecommuters (and non-telecommuters) without dependent children in the household included.

Dep Var: Trip Purpose (ref case commuting)	Business	Escort Education	Other Escort	Food Shopping	Shopping	Errands	Leisure	Visiting	Holidays	Other
Telecommute at least weekly	**0.742*****	**0.303*****	**0.604*****	**0.508*****	**0.505*****	**0.610*****	**0.626*****	**0.463*****	**0.630*****	**0.722*****
	(0.018)	(0.049)	(0.021)	(0.019)	(0.019)	(0.019)	(0.016)	(0.019)	(0.023)	(0.030)
Full Time not Part Time	-0.065***	***-1.678******	*-0.487****	*-0.412****	*-0.461****	*-0.513****	*-0.486****	*-0.434****	*-0.535****	*-0.437****
	(0.014)	(0.021)	(0.013)	(0.011)	(0.011)	(0.012)	(0.010)	(0.011)	(0.015)	(0.021)
Employee not Self-Employed	-0.203***	0.109***	-0.149***	-0.058***	-0.026	-0.241***	-0.074***	-0.034**	-0.094***	0.047
	(0.015)	(0.040)	(0.018)	(0.017)	(0.017)	(0.017)	(0.015)	(0.017)	(0.021)	(0.029)
Have Regular Workplace	-1.792***	*-0.400****	*-0.510****	*-0.474****	*-0.502****	*-0.416****	*-0.572****	*-0.496****	*-0.545****	*-0.678****
	(0.013)	(0.033)	(0.016)	(0.015)	(0.015)	(0.015)	(0.013)	(0.014)	(0.019)	(0.024)
Have Degree	0.480***	-0.211***	0.049***	0.104***	0.073***	0.240***	0.312***	0.01	0.347***	0.122***
	(0.011)	(0.022)	(0.012)	(0.010)	(0.010)	(0.011)	(0.009)	(0.010)	(0.014)	(0.019)
Male not Female	-0.064***	-0.034*	0.096***	-0.235***	-0.191***	-0.086***	0.064***	-0.194***	0.008	-0.102***
	(0.011)	(0.019)	(0.011)	(0.009)	(0.009)	(0.010)	(0.008)	(0.009)	(0.013)	(0.017)
Over 40	0.254***	***-0.808******	*0.494****	0.372***	0.269***	0.271***	-0.177***	-0.205***	0.305***	0.432***
	(0.012)	(0.023)	(0.012)	(0.010)	(0.010)	(0.011)	(0.009)	(0.010)	(0.014)	(0.019)
Car to work	0.446***	0.140***	***0.727******	0.236***	0.185***	0.319***	0.121***	0.282***	0.183***	0.001
	(0.012)	(0.020)	(0.013)	(0.010)	(0.010)	(0.011)	(0.009)	(0.010)	(0.014)	(0.018)
Urban not Rural	-0.063***	-0.015	0.003	0.003	0.034***	-0.142***	0.047***	0.109***	-0.223***	-0.219***
	(0.013)	(0.027)	(0.014)	(0.012)	(0.012)	(0.012)	(0.011)	(0.012)	(0.015)	(0.021)
Cars Available	0.202***	***0.906******	0.197***	0.168***	0.099***	0.160***	0.201***	0.200***	0.044*	0.155***
	(0.021)	(0.050)	(0.022)	(0.020)	(0.019)	(0.020)	(0.018)	(0.020)	(0.025)	(0.035)
Income Top Quintile	0.193***	-0.028	-0.101***	0.019*	0.076***	0.111***	0.209***	-0.016	0.214***	0.157***
	(0.011)	(0.024)	(0.012)	(0.010)	(0.010)	(0.011)	(0.009)	(0.010)	(0.014)	(0.018)
Constant	-0.829***	-2.160***	-1.903***	-1.048***	-0.858***	-0.952***	-0.571***	-0.719***	-1.435***	-2.081***
	(0.022)	(0.038)	(0.020)	(0.019)	(0.019)	(0.020)	(0.017)	(0.019)	(0.026)	(0.035)
Note:										*p<0.1; **p<0.05; ***p<0.01

	Business	Escort Education	Other Escort	Food Shopping	Shopping	Errands	Leisure	Visiting	Holidays	Other
Telecommute at least weekly	0.742***	0.303***	0.604***	0.508***	0.505***	0.610***	0.626***	0.463***	0.630***	0.722***
	-0.018	-0.049	-0.021	-0.019	-0.019	-0.019	-0.016	-0.019	-0.023	-0.03
Full Time not Part Time	-0.065***	-1.678***	-0.487***	-0.412***	-0.461***	-0.513***	-0.486***	-0.434***	-0.535***	-0.437***
	-0.014	-0.021	-0.013	-0.011	-0.011	-0.012	-0.01	-0.011	-0.015	-0.021
Employee not Self-Employed	-0.203***	0.109***	-0.149***	-0.058***	-0.026	-0.241***	-0.074***	-0.034**	-0.094***	0.047
	-0.015	-0.04	-0.018	-0.017	-0.017	-0.017	-0.015	-0.017	-0.021	-0.029
Have Regular Workplace	-1.792***	-0.400***	-0.510***	-0.474***	-0.502***	-0.416***	-0.572***	-0.496***	-0.545***	-0.678***
	-0.013	-0.033	-0.016	-0.015	-0.015	-0.015	-0.013	-0.014	-0.019	-0.024
Have Degree	0.480***	-0.211***	0.049***	0.104***	0.073***	0.240***	0.312***	0.01	0.347***	0.122***
	-0.011	-0.022	-0.012	-0.01	-0.01	-0.011	-0.009	-0.01	-0.014	-0.019
Male not Female	-0.064***	-0.034*	0.096***	-0.235***	-0.191***	-0.086***	0.064***	-0.194***	0.008	-0.102***
	-0.011	-0.019	-0.011	-0.009	-0.009	-0.01	-0.008	-0.009	-0.013	-0.017
Over 40	0.254***	-0.808***	0.494***	0.372***	0.269***	0.271***	-0.177***	-0.205***	0.305***	0.432***
	-0.012	-0.023	-0.012	-0.01	-0.01	-0.011	-0.009	-0.01	-0.014	-0.019
Car to work	0.446***	0.140***	0.727***	0.236***	0.185***	0.319***	0.121***	0.282***	0.183***	0.001
	-0.012	-0.02	-0.013	-0.01	-0.01	-0.011	-0.009	-0.01	-0.014	-0.018
Urban not Rural	-0.063***	-0.015	0.003	0.003	0.034***	-0.142***	0.047***	0.109***	-0.223***	-0.219***
	-0.013	-0.027	-0.014	-0.012	-0.012	-0.012	-0.011	-0.012	-0.015	-0.021
Cars Available	0.202***	0.906***	0.197***	0.168***	0.099***	0.160***	0.201***	0.200***	0.044*	0.155***
	-0.021	-0.05	-0.022	-0.02	-0.019	-0.02	-0.018	-0.02	-0.025	-0.035
Income Top Quintile	0.193***	-0.028	-0.101***	0.019*	0.076***	0.111***	0.209***	-0.016	0.214***	0.157***
	-0.011	-0.024	-0.012	-0.01	-0.01	-0.011	-0.009	-0.01	-0.014	-0.018
Constant	-0.829***	-2.160***	-1.903***	-1.048***	-0.858***	-0.952***	-0.571***	-0.719***	-1.435***	-2.081***
	-0.022	-0.038	-0.02	-0.019	-0.019	-0.02	-0.017	-0.019	-0.026	-0.035
Note:										*p<0.1; **p<0.05; ***p<0.01