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Estimating Trip Generation of the Elderly and Disabled: An Analysis of London Data

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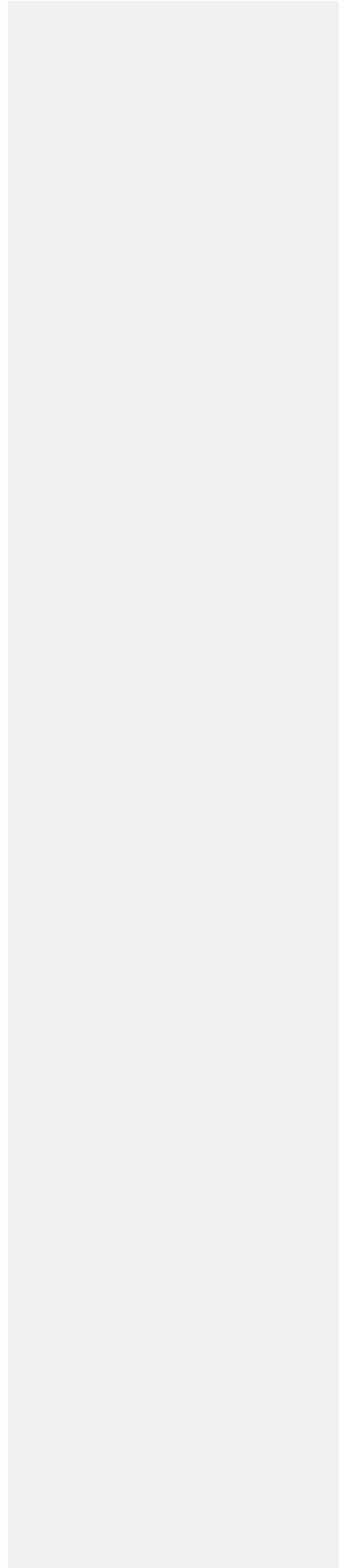
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Abstract

The aging of populations has implications for trip-making behaviour and the demand for special transport services. The London Area Travel Survey 2001 is analysed to establish the trip-making characteristics of elderly and disabled people. Ordinal probit models are fitted for all trips and trips by four purposes (work, shopping, personal business and recreational), taking daily trip frequency as the latent variable. A log-linear model is used to analyse trip length. A distinction must be made between the young disabled, the younger elderly and the older elderly. Retired people initially tend to make more trips, but as they get older and disabilities intervene, trip-making tails off. Household structure, income, car ownership, possession of a drivers license, difficulty walking and other disabilities are found to affect trip frequency and length to a greater or lesser extent.

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INTRODUCTION

Elderly populations in most western countries are growing at a fast rate. While many of the elderly currently use cars for their personal transport, as they age and acquire various disabilities, they are likely to need alternative sources of transport. Younger-disabled people are often already dependent upon alternatives to the car, but in all cases there is substantial variation in how disabilities affects mobility. A key issue for most societies, is how both the elderly and disabled can interact and engage in economic and social activities.

Various services are provided to the elderly and disabled to enable them to stay engaged in these activities. These include Dial-A-Ride or paratransit services that pick up and deliver customers to their destinations, but often require advanced booking of the trip. Public transport services are often provided free or at a discount to those over a certain age or with a disability, recognizing that they are disadvantaged from being unable to use personal vehicles. In London, those over age 60 can obtain a "Freedom Pass" which enables the holder to use all (non-peak) public transport free of charge. Most public transport agencies are upgrading or have upgraded their bus fleets to enable wheelchair access and easier access for those with walking difficulties. Many areas also provide subsidies for taxi services, which are provided in London via the Taxicard scheme. This provides a certain annual budget of subsidized trips per year.¹

Rosenbloom (2001) has identified the problem of growing elderly populations and the potential inadequacy of current policies to meet their mobility needs, especially while minimizing safety and environmental problems. Metz (2000) argues that mobility impairment which afflicts many of the elderly has several aspects and that measuring

¹ A fuller discussion of mode choice decisions by the elderly and disabled is available in Schmöker et al. (2004).

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impairment is extremely difficult. He argues that a reduced travel time budget as well as a lower number of journeys are indicative of mobility impairment.

This paper examines the demographic and disability effects on the pattern of trip generation among elderly and disabled people. The impact of policies that aim to increase the mobility of these groups (or provide them with opportunities for increased access to activities) are also analyzed. Specifically the role of taxi subsidies and public transport subsidies, as embodied in the Freedom Pass and Taxicard schemes in London, are analyzed. Of particular interest is whether various factors lead to lower trip generation rates and shorter distance trips than average.

In the following section the findings of some earlier studies on trip generation of the elderly and disabled are summarized. Most existing literature looks at trips made by the elderly while trips made by the younger-disabled population are not often examined. General observations about trip generation patterns in London are then summarized, followed by a discussion of the trip generation and distance models that are estimated. The paper concludes by pointing out some implications for transport policy.

TRIP MAKING AMONG THE ELDERLY

Several studies have analyzed different mobility aspects of the elderly and disabled population. Alsnih and Hensher (2003) correctly point out that this group is not at all homogenous. It is for example important to distinguish between the “young” and “old” elderly. As a threshold the authors suggest an age of 75, which is when their health often starts to decline. They further point out that the needs and habits of the elderly are changing as they are staying mobile much longer than previously. This is reflected in their mode choice (driving until older age), the kind of trips they make, and the trip distances that the elderly travel. The trend is to make more trips until old age, and especially more varied trips.

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The recreational activities of the younger elderly are very diverse and may also account for longer average trip distances. Hildebrand (2003) even found that the trip rate of 60-70 year olds increases, as leisure trips substitute for work trips. However, this also means that the “old” elderly often face additional hardships once their health does not allow them to continue to engage in their favourite activities. This is especially true if they have not moved to places that allow them easy access to their daily activities. In some cases mobility can deteriorate significantly. Tacken (1998) argues that it is important to keep the (old) elderly mobile, because to reactivate their desire for mobility when it becomes cumbersome, is extremely difficult.

Noble and Mitchell (2001) confirm these trends with an analysis of the U.K. National Travel Survey from 1996/98. After retirement the number of trips does not suddenly decline. Contrary to the above analysis, they find that the total number of journeys changes smoothly with age. They report that people aged over 80 make only half the journeys of those aged 50-54. They further find a clear trend of increasing travel distance over time, for all age groups. Compared to the previous National Travel Survey in 1985/86 men aged 75-79 travel nearly twice as much as in the 1996/98 survey.

Stern (1993) estimated trip generation models for a sample of the elderly and disabled in rural Virginia. His models included an inclusive value from a previously estimated mode choice model to represent the quality of various transport modes available in the area. Modal quality was found to have little impact on the total number of trips. Personal characteristics were also found to have little effect, while increased age and being female did reduce the total amount of trips taken. Educational level and those that were married took more trips, while those with walking difficulties took fewer.

Sweenly (2004) uses data from the Bureau of Transportation Statistics (BTS) *Transportation Availability and Use Survey* to study travel patterns of older and younger US

populations with disabilities and compares these patterns to those of older and younger people without any disabilities. Three broad categories of age are defined, less than 25 years, 25 to 64 years and, 65 years and older. The elderly disabled (aged 65 and older) leave home less often (4.0 days per week) than the younger-disabled (5.1 days for those aged 25-64 and 5.6 days for those less than 25) while the elderly non-disabled leave home 5.6 days per week. About 7.4 million of the elderly disabled (about 53% of total elderly disabled) are travel long distances of more than 100 miles one way. The study suggests that additional research is essential especially on the travel patterns of those older than 65.

Rosenbloom (2003) states “*As people age, they first lose the ability to drive; they then use public transit if it is available; when unable to use public transit they walk, and finally, unable to walk they use special transit services*”. She reports that older people are extremely dependent on the private car, either as a driver or a passenger. The older people make nearly 90% of all their trips in a car either as a driver or a passenger.

Understanding trip making by the elderly is in its infancy as this review indicates. The analysis that follows is an attempt to shed greater understanding on the number of trips made by the elderly and what factors are associated with increased trip distances.

DATA

The analysis in this paper is based on an interim version of the *London Area Travel Survey 2001* (LATS), made available by Transport for London (TfL) for this study. LATS has data on 67,252 individuals in 29,973 households based on home interviews throughout the Greater London Authority and some neighboring districts.² The survey includes four main datasets for each individual: Household information; personal information; details on vehicles owned by the household; and trip details of all trips done on one weekday. All interviews were done on a personal basis and the respondents were asked to fill in a one-day travel diary. In total,

² The Greater London Authority includes the 33 London Boroughs.

176,453 trips were made by respondents. LATS data only includes trips in and around London and does not include holiday trips outside the region, thus our analysis excludes a large possible source of extra trips made by the elderly.

From the interim LATS dataset records were extracted for all persons aged 65 or older (8012 records) and persons younger than 65 “with a longstanding health problem that affects their ability to travel or get about” as asked in the LATS interview (2427 records), henceforth referred to as the “younger-disabled”. The total sample includes 10,439 individuals and 22779 trips. 31.4% of these individuals did not travel on the day surveyed and the remaining sample made 9416 journeys. This means that 25.9% of all journeys consist of trip chains, i.e. are journeys with more than one destination.

Among the attributes recorded for each trip is the trip purpose. In the following analysis we distinguish “Work and Educational Trips”, “(Food) Shopping Trips”, “Personal Business Trips”, “Recreational Trips” and “Homebound trips”. Examples for “Personal Business trips” are trips to the post office, bank, hair-dresser or a routine visit to the doctor. Recreational trips include trips for entertainment, sport or other social activities like visits to friends and relatives.

Preliminary analysis of the data revealed that elderly London residents make fewer trips per day than the average. The overall average number of trips per day for respondents aged 5 or older is 2.78 trips/day, whereas for those 65 and over it is 2.13 trips/ day. Among the elderly 30.1% did not make any trip on the day they were surveyed. The younger-disabled make more trips than the elderly but fewer than the overall average, with an average of 2.37 trips/day. This clearly suggests that both age and disability have some effect on mobility.

Figure 1 shows the number of trips made by age and disability in more detail. Total trips per day and by trip purpose are shown. “Sample” refers to our sub-sample of the elderly and disabled as opposed to the entire LATS sample. Thus these two coincide on the graph

for the total over age 65. For those less than 65, the “total (sample)” refers to the younger-disabled.

The decreasing trip number by respondents aged over 44 can be clearly observed. The decrease in trip number is especially significant for people aged over 84. Therefore the figure does not confirm the findings by Hildebrand (2003) who mentioned that the trip rates of the 60-70 year olds stay almost constant. The figure does however show that working trips are substituted with more shopping trips and to some degree more recreational trips as found also by Hildebrand. The number of Personal Business trips stays relatively constant over a person’s lifetime and only declines for people older than 85. The old elderly might be forced to give up these often essential trips due to health-related problems. It can be seen that the difference between the able bodied and younger-disabled persons is substantial.

Trip distances also tend to decline with age as can be seen in Figure 3. However, recreational trip distances increase between about 60 to 80 years of age, relative to recreational trip distances for younger folk. No differences outside the trend towards shorter distances are found for other trip purposes (not shown in Figure). Figure 3 further illustrates that the young disabled make shorter journeys than those without a disability of the same age.

METHODOLOGY

Trip Generation Models

In order to understand the relative effect of various attributes on trip generation an Ordered Probit model is ~~estimated~~—estimated. Simple linear regression analysis would be inappropriate due to the large number of zero trips in the sample. The difference between making 0 trips and 1 trip might be far more significant than a difference between 5 and 6 trips. In other words, we cannot assume that the choice of number of trips is cardinal. An ordered probit model provides a technique to estimate regression models for this sort of data.

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Alternatively an Ordered Logit model would also be suitable. The difference between a logit and probit model is in the assumption of the distribution of the error terms. A probit model assumes a normal distribution, whereas logit assumes a Gumbel distribution. Long (1997) concludes that the choice between logit and probit is mainly a matter of convenience as both models normally come to the same result. Another method would be the use of a Poisson or Negative Binomial model for count data (Washington et al., 2003), which was used by Stern (1993) in his analysis of elderly/disabled trip-making in rural Virginia.

The Ordered Probit model has the following general structure:

$$y_n^* = \mathbf{X}_{in} \boldsymbol{\alpha}_m + \varepsilon_{in} \quad (1)$$

where y_n^* is a latent variable measuring the number of trips. Note that y_n^* is defined differently in the model for total trips (Table 1) and the models for specific trip purposes (Tables 2 and 3) respectively. For the model estimated and shown in Table 1 it is defined as

$$y_i = \begin{cases} 1 & \text{if } -\infty \leq y_i^* \leq \mu_1 \text{ (persons makes no trips)} \\ 2 & \text{if } \mu_1 \leq y_i^* \leq \mu_2 \text{ (persons makes 1 or 2 trips)} \\ 3 & \text{if } \mu_2 \leq y_i^* \leq \mu_3 \text{ (person makes 3 or 4 trips)} \\ 4 & \text{if } \mu_3 \leq y_i^* \leq \mu_4 \text{ (person makes 5 or 6 trips)} \\ 5 & \text{if } \mu_4 \leq y_i^* \leq \infty \text{ (persons makes more than 6 trips)} \end{cases} \quad (2)$$

whereas for the specific trip purpose models, only 0, 1, 2 and 3 or more trips are specified since not many people make more than three working or shopping trips per day. The threshold values μ_n are unknown parameters to be estimated. The parameters of the model are estimated by the method of maximum likelihood (Long, 1997). In equation (3), the partial change in y^* with respect to \mathbf{X}_n is $\boldsymbol{\beta}_n$. This implies that for a unit change in \mathbf{X}_n , y^* is expected to change by $\boldsymbol{\beta}_n$ units, holding all other variables constant. The predicted probability of the decrease, m , for given \mathbf{X}_i is

$$\hat{\Pr}(y = m | \mathbf{X}_i) = F(\hat{\mu}_m - \mathbf{X}_i \hat{\boldsymbol{\beta}}) - F(\hat{\mu}_{m-1} - \mathbf{X}_i \hat{\boldsymbol{\beta}}) \quad (3)$$

where F is the Gumbel distribution, but for this analysis the focus is on the estimation of $\hat{\beta}$ only.

Trip Distance Models

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In order to examine how various individual attributes effect trip distance, both linear and log-linear models could be used. After examining the test of model misspecification (Mackinnon et al., 1983), it was found that the log-linear model was not rejected. Therefore, this model is used and can be expressed as

$$\ln(y_i) = \alpha + \sum_{k=1}^k \theta_k X_{ik} + \sum_{j=1}^j \mu_j D_{ij} + \varepsilon_i \quad (4)$$

where y_i is the trip length (km) for an individual i , X is a $k \times 1$ vector of continuous explanatory variables, D is a $j \times 1$ vector of dummy explanatory variables. θ and μ are appropriately sized vectors of parameters to be estimated.

RESULTS of

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Trip Generation Models

The analysis focuses on those factors that are significantly associated with the number of trips taken by the elderly and disabled. A model for the total number of trips as well as models for specific trip purposes was estimated. This included models for work trips, shopping trips, personal business trips, and recreational trips.

In all the models estimated, increasing age results in fewer trips. In most cases, the value of the parameter estimates increase with increasing age, thus confirming the hypothesis

that the number of trips taken decreases with age. The reference case is for those aged 25-59, which in our sample are the young disabled, who make relatively more trips than elderly people.

Disabilities, independently of age effects, also have an impact on the total number of trips taken. Those with walking difficulties tend to take fewer total trips than those without walking difficulties. This result holds for shopping trips, recreational trips, and for personal business trips (the latter at the 90% confidence level). No statistically significant effect was found for work trips. A large fraction of the work trips in the sample are taken by the young disabled (58.7%) and the non-disabled elderly (36.7%). Therefore, those making work trips tend to be from the young disabled or from the elderly who have better health overall.

Hearing and sight disabilities have much less effect on reducing trip making. While the estimated coefficients generally have a negative sign, these are below the 95% level of confidence. The one exception is a statistically significant effect for those with hearing difficulties making fewer recreational trips.

Those who have difficulty understanding directions also make significantly fewer trips in total as well as fewer shopping and personal business trips. On the other hand, there is no significant impact on work trips and recreational trips. The former can be explained by the small number of those with this disability working (only 14 individuals in our sample) or by familiarity with a trip that is repeated. Recreational trips, such as visits to friends and families, may also be trips that are taken repeatedly and thus are familiar, thus avoiding the need for seeking directions (which might be needed for the other trip purposes).

Wheelchair usage has a statistically significant effect on reducing the number of trips taken for all trip purposes. Clearly this group would overlap with those who have walking difficulties and would represent those with the most severe walking disabilities.

Those listed as “unable to work” make significantly fewer trips relative to those working, those attending school and those who are retired.³ This group is dominated by the young disabled in the sample (92.7% of those unable to work are the young disabled). Those who are retired also tend to make more shopping, personal business, and recreational trips compared to those working or attending school and those unable to work.

Household structure also has some effects on trip generation. The data was categorized into the following groups: single (household consisting of one person – can be a pensioner or young disabled), single parent (one adult caring for a young disabled person), all pensioners (household consisting of two pensioners), and married/cohabiting with and without children in the home (at least one adult is not a pensioner). Most of those with children are those caring for the young disabled (76.1%), but some consist of two pensioners living with a child (23.9%). In terms of total trips made, single parents tend to make more while those married without children make relatively less. For work trips, relatively fewer trips are made by pensioners and those without children. Single parents make more shopping trips, although positive coefficients are also associated with pensioners and single people. There are no statistical differences in the number of personal business trips associated with different household structures. Those who are married appear to make fewer recreational trips compared to other categories.

Ethnic background has a significant impact for all trips except work trips. Those of a non-white ethnic background make significantly fewer trips. Gender has no effect on the total number of trips taken. This latter is a surprising result, as men are usually more likely to drive cars which would enable them to more easily make more trips more easily (Schmöcker et al., 2004).

³ Some who are retired may obviously be “unable to work” but in the survey are entered as “retired”.

Increasing income levels appear to increase total trip making. This effect is due entirely to increases in recreational trips as income increases, as there is no statistical significance in the models for other trip purposes. This finding suggests that as income levels for the elderly are expected to increase in the future (due to overall rising income levels) recreational trip making will increase. Those with driving licenses and with at least one car in the household also tend to make more trips. However, car ownership does not affect the number of work or shopping trips. The former result is not surprising as most work trips in London are made by public transport, although we would expect this sample to be less likely to use public transport, especially rail and underground services (Schmöcker et al., 2004). This result is also supported by the result for those living in Inner London showing that they make fewer trips, but not fewer work trips.

Those who hold a Freedom Pass for free public transport trips, tend to make fewer trips than those without one. This might be because those who hold Freedom Passes tend to be less mobile, as it seems implausible that providing Freedom Passes reduces mobility. While most car owners also hold a Freedom Pass (74.0%), slightly more of those who do not own a car hold a Freedom Pass (83.6%) Taxicard holders tend to make more personal business trips. This may again be endogenous in that those who hold Taxicards have them because they make more of these types of trips, which are likely to be less frequent and to areas less easily served by public transport.

The overall model fit, as shown by the calculation of McFadden's R^2 , is highest for the work trip model. This suggests that the personal attributes are better at explaining work trips than those other trip purposes examined here. Work trips would also tend to be more likely to be sampled in the data, while more discretionary non-daily trips, such as shopping or for recreation would be less likely to be captured by a one-day travel diary data as collected in LATS.

Results-Trip Distance Models Analysis

While elderly and disabled people tend to make fewer total trips, an analysis of the distances of trips shows some distinct patterns. As previously discussed, while average trip distances decrease with age, recreational trip distances increase at least until about age 80 (see Figure

2). The association of trip distances and individual attributes are estimated using a log-linear regression model (see equation (4) and

~~Various linear and log linear regression model specifications were estimated to examine how various individual attributes effect trip distance. After examining the test of model misspecification (Mackinnon et al., 1983), it was found that the log linear model was not rejected. Therefore, this model is used and can is expressed as~~

$$\ln(y_i) = \alpha + \sum_{k=1}^k \theta_k X_{ik} + \sum_{j=1}^j \delta_j D_{ij} + \epsilon_i \quad (4)$$

~~where y_i is the trip length (km) for an individual i , X is a $k \times 1$ vector of continuous explanatory variables, D is a $j \times 1$ vector of dummy explanatory variables. θ and δ are appropriately sized vectors of parameters to be estimated. Results are shown in Table 4.~~

The overall adjusted R^2 for the model is low (0.09) indicating that this model does not explain much of the variance in trip distance in this sample. However, there are several statistically significant parameters that provide expected associations.

Increasing age, over 60, is associated with shorter trip distances. The coefficient values are negative and decrease in value with increasing age. Trip distance by adults aged 85 and older is about 37% shorter⁴ than younger-disabled 25-59. Younger-disabled aged 5-14 also travel shorter distances than the reference age group of 25-59. Gender and ethnicity

⁴ This relative effect is calculated by $(e^\delta - 1) * 100$

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differences have no statistically significant association with trip distance, although as indicated earlier, women and minority non-white groups tend to take fewer total trips.

Increasing household income also is associated with longer trip distances. This suggests that as overall income levels increase, overall travel will increase, as also shown by the association with total number of trips as discussed above. This is a common result as increasing incomes are commonly found to be associated with increased travel.

The household structure variables show that single people and single parents tend to travel longer distances than others. These results are not surprising as these individuals would need to engage in longer distance trips as the only trip-maker in the household.

Those living in Inner London also tend to take shorter trips. This is most likely due to the greater proximity of destinations to residences for those living in Inner as opposed to Outer London, and is certainly consistent with the literature on the relationships between urban density and total travel (see e.g. Boarnet and Crane, 2001).

Other key factors associated with longer trip distances include work status (those working or attending school take longer trips), driver's license holders, and household car ownership. These results are not surprising as both those working and with vehicle access would tend to be more mobile.

Most of the disability categories do not have a significant effect on trip distances, with the exception of walking difficulties. Trip distance by people with walking difficulties is about 8 % shorter than to people without walking difficulties. The estimated coefficient for those who use a wheelchair is negative, but not statistically significant.⁵ These results suggest that the disability that negatively effects mobility is difficulty walking, while sight, hearing, and cognitive disabilities have no negative impact on trip distances.

⁵ It is possible that those who use wheelchairs (and who would clearly have difficulty walking) may use wheelchairs because they desire to be more mobile.

Those who hold Freedom Passes and Taxicards do not have longer trip distances than those who do not hold them. While we would not necessarily expect any difference in trip distance from using a Freedom Pass, the result for Taxicard holders is unexpected. Presumably having a Taxicard would enable some people to take longer trips than they otherwise would have, since using a taxi would be more convenient for certain trips than using a bus.

The model also controls for the total number of trips that individuals take. Those that take more trips, tend to travel shorter total distances. This could perhaps be explained by time constraints (or travel budgets) limiting the number of trips taken by those who travel longer distances. Or put another way, those who make shorter trips tend to take more trips because they are short.

The model also controlled for trip purpose (as opposed to estimating separate models). Work and school trips tend to be the longest, followed by shopping, personal business, and recreational trips in descending order.

CONCLUSIONS

An analysis of an interim release of the London Area Travel Survey 2001 yields insights into the trip-making characteristics of elderly and disabled people in London. The ordinal probit model is estimated on the dataset taking the daily trip frequency as the latent variable. A model for total trips as well as models for specific trip purposes, namely work trips, shopping trips, personal business trips and recreational trips, were estimated. A log-linear trip distance model was also estimated controlling for the different trip purposes.

In all models, increasing age results in both fewer trips and shorter distances travelled. Disability, independently of age, also has an impact on trip frequency. Those with walking difficulties make fewer shopping, recreational and personal business trips and travel shorter distances. Hearing and sight disabilities as well as wheel chair usage also tend to reduce trip-

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making, but have no effect on distance travelled. Those unable to work make significantly fewer trips than those working, attending school or retired. However, those who are retired make more shopping, personal business and recreational trips (and the latter tend to be lengthier). Household structure, car ownership and possession of a driving licence are also significant determinants of trip rate and distance. Increasing income appears to be associated with increasing recreational trip-making and increases in total distance travelled. Possession of a Freedom Pass is associated with fewer trips while possession of a Taxicard is associated with more personal business trips, although in both cases, these are unlikely to be causal relationships, and holding these passes has no effect on distance travelled.

This analysis has examined the associations between various demographic, disability, and policy factors and trip making and trip distances among the elderly and disabled. Our results suggest that as populations age the main disability negatively effecting mobility is difficulty walking. Other factors, such as increasing incomes, suggest that elderly trip-making and trip distances are likely to increase as the overall elderly income levels increase in the future. Many of these trips are likely to be made by cars as shown in our companion analysis of mode choice (Schmöker et al., 2004) confirming the forecast of potential safety and environmental problems made by Rosenbloom (2001). The policy tools available (such as subsidized public transport and taxi trips) have no effect on trip distance and it is not clear from this analysis whether they have an exogenous effect on total trips made. While overall elderly and disabled mobility appears likely to increase, future research needs to examine policy options that make this mobility safe and environmentally sustainable.

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this project. All errors and omissions are the sole responsibility of the authors. This paper does not represent the opinion or policies of Transport for London.

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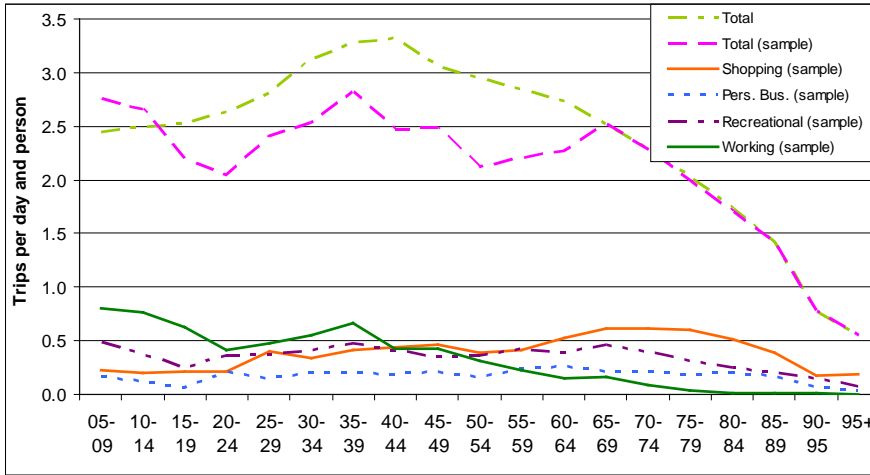


Figure 1 Total trips and trips by purpose per day and age



Figure 2 Trip Distance by age

Table 1 Ordered Probit Model - Total Trips

		% of observations	Coefficient	t-statistic
Age	05-14	1.64%	-0.189	-0.97
	15-24	1.11%	-0.472	-3.07
	25-59	16.00%	Reference	
	60-64	4.16%	-0.097	-1.29
	65-69	23.21%	-0.432	-6.82
	70-74	20.10%	-0.547	-8.23
	75-79	13.69%	-0.600	-8.57
	80-84	13.61%	-0.710	-10.11
	85-89	4.88%	-0.844	-9.93
	90+	1.60%	-1.318	-10.04
Gender	Male	43.60%	0.013	0.51
	Female	56.40%	Reference	
Ethnicity	White	84.39%	0.316	8.30
	Non-White	15.61%	Reference	
Household structure	Single	43.01%	0.076	1.12
	Single Parent	3.19%	0.269	3.02
	All pensioner	34.21%	-0.029	-0.42
	Married, no children	13.49%	-0.217	-3.26
	Married, plus children	6.10%	Reference	
Household income	0-5K	25.49%	-0.368	-4.80
	5-10K	30.81%	-0.223	-3.04
	10-25K	24.38%	-0.163	-2.27
	25-50K	15.61%	-0.136	-1.87
	50K+	3.72%	Reference	
Living in Inner/Outer London	Inner	37.24%	-0.098	-3.51
	Outer	62.76%	Reference	
Working status	Working	8.71%	0.699	10.80
	Education	2.51%	0.791	4.70
	Retired	77.87%	0.419	6.97
	Unable to work	10.90%	Reference	
Driving licence	yes	42.27%	0.311	9.08
	no	57.73%	Reference	
Household owns one or more cars	yes	48.60%	0.084	2.22
	no	51.40%	Reference	
Difficulty to walk	yes	34.20%	-0.204	-6.41
	no	65.80%	Reference	
Difficulty to hear	yes	4.72%	-0.096	-1.48
	no	95.28%	Reference	
Difficulty to see	yes	4.86%	-0.072	-1.14
	no	95.14%	Reference	
Difficulty to understand directions	yes	3.02%	-0.245	-3.00
	no	96.98%	Reference	
Using a wheelchair	yes	6.83%	-0.568	-9.63
	no	93.17%	Reference	
Holds a Freedom Pass	yes	21.66%	-0.157	-3.96
	no	78.34%	Reference	
Holds a Taxicard	yes	1.76%	0.150	1.46
	no	98.24%	Reference	
		% of observations	Threshold	t-statistics
Number of trips	0	28.25%	-0.651	-6.18
	1+2	37.69%	0.435	4.13
	3+4	22.60%	1.294	12.20
	5+6	8.09%	1.977	18.24
	6+	3.37%	--	--
Number of observations	7208			
Degrees of freedom	32			
Log likelihood (interecept)	-6775.85			
Log likelihood (final)	-6175.55			
Mc Fadden R2	0.084			
AIC	1.722			

Table 2 Ordered Probit Model – Working Trips and Shopping Trips

		Working Trips		Shopping Trips	
		Coefficient	t-statistics	Coefficient	t-statistic
Age	05-14	-0.212	-0.95	-0.138	-0.53
	15-24	-0.263	-1.33	-0.459	-2.32
	25-59	Reference		Reference	
	60-64	-0.317	-2.62	0.036	0.42
	65-69	-0.312	-3.35	-0.143	-2.01
	70-74	-0.406	-3.91	-0.217	-2.92
	75-79	-0.611	-5.07	-0.190	-2.44
	80-84	-0.932	-6.40	-0.307	-3.92
	85-89			-0.463	-4.89
	90+	-1.045	-4.89	-0.964	-6.16
Gender	Male	0.071	1.55	-0.018	-0.63
	Female	Reference		Reference	
Ethnicity	White	-0.051	-0.84	0.324	7.45
	Non-White	Reference		Reference	
Household structure	Single	-0.587	-6.32	0.130	1.64
	Single Parent	0.087	0.80	0.237	2.25
	All pensioner	-0.589	-6.05	0.131	1.65
	Married, no children	-0.577	-6.58	0.005	0.07
	Married, plus children	Reference		Reference	
Household income	0-5K	-0.152	-1.28	-0.047	-0.55
	5-10K	-0.001	-0.01	0.093	1.12
	10-25K	0.034	0.33	0.047	0.57
	25-50K	0.071	0.72	-0.064	-0.77
	50K+	Reference		Reference	
Living in Inner/Outer London	Inner	-0.060	-1.18	-0.091	-2.95
	Outer	Reference		Reference	
Working status	Working	1.644	17.87	0.054	0.73
	Education	1.349	6.77	-0.170	-0.77
	Retired	0.063	0.67	0.283	4.16
	Unable to work	Reference		Reference	
Driving licence	yes	0.296	4.92	0.071	1.89
	no	Reference		Reference	
Household owns one or more cars	yes	0.018	0.27	-0.052	-1.25
	no	Reference		Reference	
Difficulty to walk	yes	-0.057	-0.99	-0.194	-5.50
	no	Reference		Reference	
Difficulty to hear	yes	0.020	0.16	-0.108	-1.46
	no	Reference		Reference	
Difficulty to see	yes	-0.179	-1.44	-0.129	-1.78
	no	Reference		Reference	
Difficulty to understand directions	yes	-0.186	-1.45	-0.286	-2.87
	no	Reference		Reference	
Using a wheelchair	yes	-0.289	-2.64	-0.449	-6.40
	no	Reference		Reference	
Holds a Freedom Pass	yes	0.014	0.22	-0.102	-2.30
	no	Reference		Reference	
Holds a Taxicard	yes	-0.212	-0.93	0.020	0.17
	no	Reference		Reference	
Number of trips		Threshold	t-statistics	Threshold	t-statistics
	0	0.852	5.46	0.484	4.01
	1	1.878	11.78	1.544	12.70
	2	2.549	15.41	2.318	18.63
	3+	--	--	--	--
Number of observations	7208				
Degrees of freedom	32				
Log likelihood (interecept)	-2760.89		-4527.15		
Log likelihood (final)	-1788.78		-4282.21		
Mc Fadden Adjusted r2	0.34		0.05		
AIC	0.50		1.20		

Table 3 Ordered Probit Model – Personal Business Trips and Recreational Trips

		Pers. Business Trips		Recreational Trips	
		Coefficient	t-statistics	Coefficient	t-statistic
Age	05-14	-0.160	-0.59	-0.006	-0.02
	15-24	-0.109	-0.52	-0.341	-1.79
	25-59	Reference		Reference	
	60-64	-0.012	-0.12	-0.103	-1.15
	65-69	-0.257	-3.02	-0.280	-3.71
	70-74	-0.290	-3.25	-0.363	-4.58
	75-79	-0.321	-3.42	-0.463	-5.52
	80-84	-0.289	-3.08	-0.506	-5.98
	85-89	-0.289	-2.55	-0.686	-6.35
	90+	-0.673	-3.56	-0.702	-4.31
Gender	Male	0.032	0.91	0.012	0.40
	Female	Reference		Reference	
Ethnicity	White	0.121	2.32	0.263	5.54
	Non-White	Reference		Reference	
Household structure	Single	0.005	0.05	0.380	4.59
	Single Parent	-0.026	-0.21	0.291	2.71
	All pensioner	-0.110	-1.21	0.218	2.62
	Married, no children	-0.079	-0.90	0.063	0.78
	Married, plus children	Reference		Reference	
Household income	0-5K	-0.101	-0.98	-0.475	-5.43
	5-10K	-0.021	-0.21	-0.420	-5.06
	10-25K	0.011	0.11	-0.267	-3.30
	25-50K	0.102	1.04	-0.200	-2.45
	50K+	Reference		Reference	
Living in Inner/Outer London	Inner	0.025	0.66	-0.081	-2.39
	Outer	Reference		Reference	
Working status	Working	-0.113	-1.28	-0.061	-0.80
	Education	0.095	0.42	0.303	1.52
	Retired	0.205	2.54	0.149	2.06
	Unable to work	Reference		Reference	
Driving licence	yes	0.172	3.75	0.268	6.57
	no	Reference		Reference	
Household owns one or more cars	yes	0.099	1.93	0.180	3.96
	no	Reference		Reference	
Difficulty to walk	yes	-0.082	-1.91	-0.081	-2.09
	no	Reference		Reference	
Difficulty to hear	yes	-0.007	-0.08	-0.177	-2.12
	no	Reference		Reference	
Difficulty to see	yes	0.122	1.49	-0.031	-0.39
	no	Reference		Reference	
Difficulty to understand directions	yes	-0.256	-2.13	0.054	0.56
	no	Reference		Reference	
Using a wheelchair	yes	-0.269	-3.25	-0.319	-4.30
	no	Reference		Reference	
Holds a Freedom Pass	yes	-0.122	-2.27	-0.064	-1.35
	no	Reference		Reference	
Holds a Taxicard	yes	0.436	3.54	-0.163	-1.19
	no	Reference		Reference	
Number of trips		Threshold	t-statistics	Threshold	t-statistics
	0	0.996	7.05	0.638	5.15
	1	2.028	14.11	1.601	12.78
	2	2.609	17.34	2.170	16.98
	3+	--	--	--	--
Number of observations	7208				
Degrees of freedom	32				
Log likelihood (intercept)			-2678.71		
Log likelihood (final)			-2606.15		
Mc Fadden Adjusted r2			0.02		
AIC			0.73		

Table 4 Log-linear Regression model – Trip distance

		Coefficient	t-statistic
Age	05-14	-0.519	-2.85
	15-24	-0.231	-1.56
	25-59	Reference	
	60-74	-0.142	-2.54
	75-84	-0.248	-3.90
	85+	-0.468	-5.13
Gender	Male	-0.024	-0.86
	Female	Reference	
Ethnicity	White	0.001	0.03
	Non-White	Reference	
Household structure	Single	0.100	1.86
	Single Parent	0.170	3.06
	All pensioner	0.064	1.10
	Married, no children	0.004	0.07
	Married, plus children	Reference	
Ln (Household income)	(continuous)	0.054	2.97
Living in Inner/Outer London	Inner	-0.242	-8.21
	Outer	Reference	
Working status	Working	0.208	3.27
	Education	0.471	2.97
	Retired	0.003	0.05
	Unable to work	Reference	
Driving licence	yes	0.171	4.60
	no	Reference	
Household owns one or more cars	yes	0.210	5.32
	no	Reference	
Difficulty to walk	yes	-0.080	-2.44
	no	Reference	
Difficulty to hear	yes	0.078	1.04
	no	Reference	
Difficulty to see	yes	0.077	1.10
	no	Reference	
Difficulty to understand directions	yes	0.060	0.65
	no	Reference	
Using a wheelchair	yes	-0.080	-1.13
	no	Reference	
Holds a Freedom Pass	yes	0.016	0.38
	no	Reference	
Holds a Taxicard	yes	0.082	0.93
	no	Reference	
Ln (Trip Number)	(continuous)	-0.415	-15.03
Trip Purpose	Working/ Educational	Reference	
	Shopping	-0.560	-11.48
	Pers Business	-0.327	-5.96
	Recreational	-0.132	-2.66
Constant		0.683	2.32
Number of observations	7208		
Degrees of freedom	29		
R2	0.09		
Std Error s	1.30		