The Lived Experience of Accessibility: The Importance of Perceptions in Measuring Accessibility

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Abstract

This paper presents key results from a household survey undertaken in Nottingham designed to understand perceptions of accessibility. Emerging from the process of Accessibility Planning in the UK, the overall aim of this research is to relate the "lived experience" (or individuals' perceptions of their accessibility) to objective measures of accessibility used in transport planning. In order to achieve the desired outcomes (in terms of social inclusion/mode shift) it is important to understand individual (subjective) perceptions of accessibility which will ultimately influence behaviour (Morris, Dumble, & Wigan, 1979) and which may differ from objective measures of accessibility. While differences between objective and subjective social indicators are to be expected (Pacione, 1982), there is little understanding of the relationship in terms of accessibility indicators, or transport more widely. As van Acker et al. (2010) point out, there has been considerable work focusing separately on both objective and subjective measures in transport but rarely an understanding of how subjective measures relate to objective conditions. The results reported here find that perceptions of accessibility, while strongly related to objective measures, also vary considerably across demographic groups and individuals with different attitudes and lifestyles.

Introduction and background to measurement of Accessibility

The paper offers insights as to how and why individual perceptions of accessibility differ from objective measures of accessibility based on results of a household survey undertaken as part of PhD research. Other work undertaken, but not covered in detail in this paper includes secondary analysis of National Travel Survey (NTS) data, interviews with local authority officers responsible for Accessibility Planning and qualitative work using a mental mapping approach.

The backdrop for this research is the process of Accessibility Planning in the UK, and specifically the requirement for Accessibility Strategies as part of Local Transport Plan 2 (2006-2011) in England. The purpose of Accessibility Planning is to remove barriers to accessibility to key destinations for individuals, based on the theory that reducing inequalities in accessibility will reduce transport related social exclusion (Social Exclusion Unit 2003). Halden (2009) provides a more detailed overview of the process and its development in UK policy. Given the multi-dimensional nature of social exclusion, and wide-ranging influences on mode choice, a number of potential barriers to accessibility were recognised both in central government guidance (DfT, 2004) and by those responsible for delivering Accessibility Planning. Previous work undertaken as part of this PhD (Curl *et al*. 2011) suggests that local authorities see 'Accessibility' as an umbrella concept, capable of meeting multiple local objectives, but emphasised the potential mode shift and social exclusion benefits. Despite this recognition, the way in which accessibility is measured and progress against targets reported has tended to focus on more easily measureable journey time targets, and less so on more intangible or hard to measure factors such as cost, comfort, safety and quality. This is problematic if the barriers to accessibility faced by individuals', and therefore influencing their behaviour or exacerbating their exclusion, are not captured through time based measurement.

Recognition of a schism between measures and perceptions of accessibility is not new, and indeed precedes the development of Accessibility Planning. The importance of perceptions influencing behaviour was noted by (Morris et al., 1979) who suggested *"perceived* *accessibility and perceived mobility – the real determinants of behaviour – will be at variance with "objective" indicators of accessibility and mobility."*. Even so, much research in the field of accessibility measurement has progressed with a focus on seeking to measure *the* accessibility provided by the transport land-use system, with little regard to how this might be experienced by individuals and therefore reflected in their travel behaviour. In a similar vein a large body of research focuses on users of the transport system, their perceptions, experiences and behaviour but with little attention to whether or how this might relate to objectively measured accessibility. This gap was also highlighted by Van Acker *et al*. (2010) who suggest that while studies have included both objective and subjective variables, none have focussed on how perceptions relate to the objective environment. Pacione (1982), in analysis of objective and subjective measures of Quality of Life, suggested that agreement between the two is not necessarily expected as this would mean that both were not needed. Therefore it is not suggested that objective measures *should* be able to reflect different individual's perceptions of accessibility, but that it is important to understand where and why differences occur.

To address this gap in terms of measures of accessibility used in the UK transport planning context, the research reported in this paper used a household survey approach to understanding individuals' perceptions of their accessibility. The responses are then matched to area based objective measures of accessibility in order that the two approaches to measurement can be compared. The DfT Core Accessibility Indicators (CAI) are used as an objective measure of accessibility, and survey responses a subjective measure. Following a brief review of existing research into measuring and understanding perceptions of accessibility the paper is structured as follows: the next section outlines the survey methodology and approach to selection of sample areas; analysis focusing on the difference between objective and subjective measures of journey time accessibility is then presented before turning to address how individual's rate their level of accessibility; finally the analysis identifies which factors (objective and subjective) are important in explaining individuals' perceptions of accessibility.

Approaches to Measuring and understanding Accessibility

There are numerous approaches to measuring accessibility and these have been reviewed extensively elsewhere (e.g. Geurs & Ritsema van Eck 2001;Halden *et al*. 2000). In summary, traditional accessibility measures are spatial measures based on the separation of people from destinations using a deterrence factor (usually time or distance) and sometimes a measure of attraction of a destination, such as number of places available at a school. Such measures are useful in understanding the level of accessibility provided by the transport land-use system.

Many accessibility studies are based on cumulative opportunity, potential, gravity measures, following Hansen (1959) or focus on individual time-space measures of accessibility following the time-space geography of Hägerstrand (1970). In addition to accessibility measures, social indicators, such as Indices of Multiple Deprivation (IMD) are often used to assess accessibility or potential for accessibility problems. Many studies also utilise qualitative approaches based upon interviews, focus groups or workshops, for example. These provide an important dimension to understanding individual accessibility. As suggested by Handy & Clifton (2001) often the best approach is a combination of techniques. Qualitative methods are best placed to understand detailed accessibility requirements, but the tools for implementation are less developed in a practical sense. Framework and policy approaches, such as Accessibility Planning employed by Scottish Transport Appraisal Guidance (STAG) (Scotland, 2008) may incorporate more than one technique, for example combining accessibility measures, quantitative statistical analysis and qualitative approaches to form policy decisions.

There is a considerable body of work attempting to develop objective measures of accessibility and equally those that seek to understand people's perceptions and experiences of travel (usually based on qualitative approaches), there is limited work that directly compares the two approaches to understanding accessibility for the same people or places. Exceptions include Lotfi & Koohsari (2009) and Van Exel & Rietveld (2009). Lotfi & Koohsari (2009) use three objective measures (Infrastructure, Activity and Utility based) and compare these with a subjective approach based on interview and questionnaire data. What they find is that those areas with the highest "measures" of accessibility are not perceived as such by residents (in terms of satisfaction with access to facilities) due to issues of safety and security. Van Exel & Rietveld (2009) investigate transport choice sets for commuters, and found that the ratio of perceived to objective travel times strongly influenced modal choice. Car users over-estimated objective public transport times by 46%. If more can be done to understand the difference between perceived and policy measured accessibility, then improvements in perceived and therefore realised accessibility, may be achieved.

This highlights the need to incorporate perceptions and subjectivity into accessibility measures, because while accessibility is a geographical problem, it is also a social one, so two people in the same place may experience different accessibilities (Handy & Niemeier 1997) and equally the same person will experience different accessibility dependent upon the place they are in at any given time.. It is therefore important to understand how such measures relate to the everyday experiences of individuals and for transport planning policy and practice to be informed by local experience.

Sampling procedure and Survey Methodology

A survey was posted to 2400 households in the Greater Nottingham area in order to elicit perceptions of accessibility which could then be compared with a national dataset of objective measures of accessibility - the Core Accessibility Indicators (CAI) (DfT, 2009). The questionnaire asked questions relating to: travel activity; overall perceptions and satisfaction with accessibility in the local area; perceived journey times to a number of destinations; subjective ratings of key aspects of accessibility; and demographic information. Perceived journey time was measured by asking respondents how long it would take them to get to each of the six destinations measured in the CAI using walking, public transport and car.[1] They were also asked to rate the time taken, and other aspects of accessibility (eg frequency) on a five-point scale. The case study area of Greater Nottingham was selected following analysis of Core Accessibility Indicators, Indices of Multiple Deprivation, Rural-Urban Classifications and Census data and from a shortlist of Local Authorities with whom interviews (Curl *et al.* 2011) had been undertaken. Lower Super Output Areas (LSOA) within the Greater Nottingham Local Transport Plan area were stratified according to Core Accessibility Indicators (CAI), Indices of Multiple Deprivation (IMD) and mode of travel to work (TTW) (Census 2001), based on the median split of each of these three criteria, giving a categorisation of eight area types. Eight LSOAs in Greater Nottingham were randomly selected based on this categorisation (Figure 1), ensuring that the sample frame covered a range of demographic and geographical areas, relating to accessibility levels and the desired outcomes of mode shift and social exclusion from the process of Accessibility Planning.

A random sample of addresses in each of the eight areas was selected from the Royal Mail Postcode Address File (PAF) and supplemented with names from the electoral register where available.[2]. The overall response rate was 14% (n=328), varying considerably across geographical area and strongly influenced by IMD, with a response rate of 19% in the four least deprived areas compared to 8% in the four most deprived areas, as would be expected. Other recent household surveys have produced similarly low response rates (eg. Farrington et al., 2004; Sugiyama & Ward Thompson, 2007), which is perhaps representative of survey fatigue, and associated with the "cold call" nature of this survey.

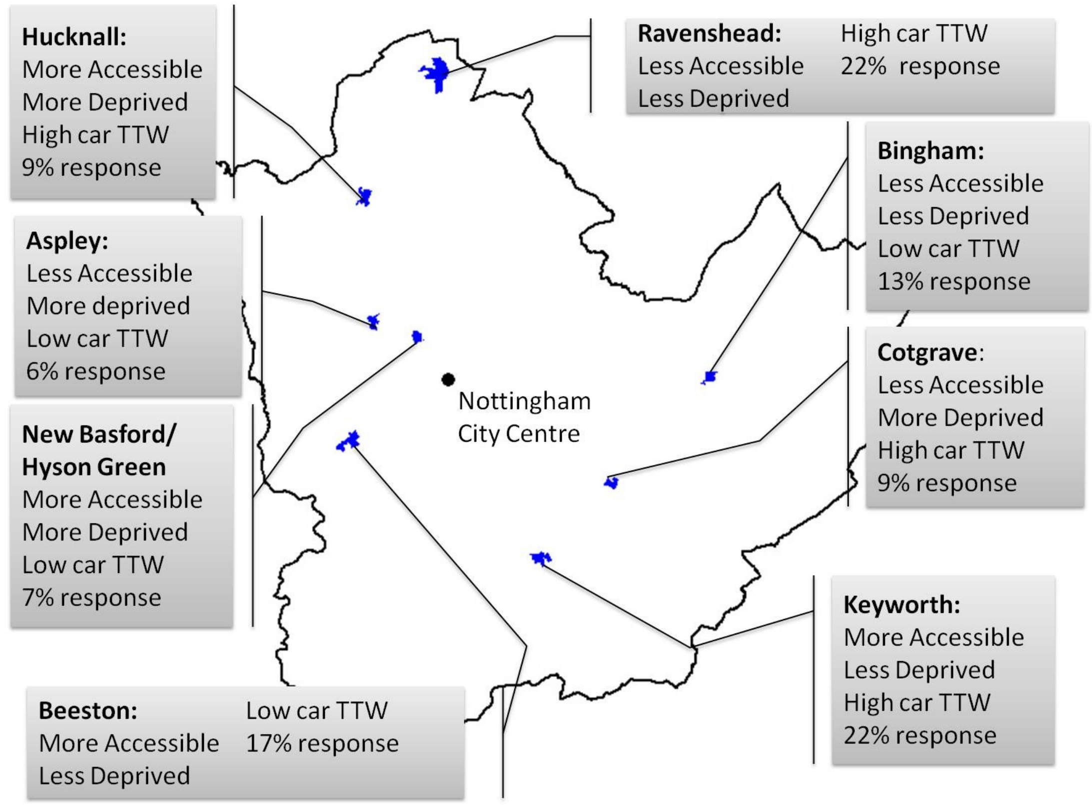
The rate of response among demographic groups was compared to the population using Census 2001 in order to check for non-response bias among some sections of the population. The sample is older, has fewer children, owns more cars, is mainly retired and has a higher level of education than the population of the sample areas. Males are over-

[1] The questionnaire asked respondents to answer even for places they didn't go to and using all modes of transport. They were asked to give how long it would take them if they had to arrive at 9am.

[2] Names for 47% of the addresses were available from the edited electoral register, with the remaining 53% being addressed to 'The Householder'. Evidence from the literature (eg Dillman et al. 2009) suggests that personally addressing surveys increases the response rate. However the response in this study suggests that no benefit was gained from personally addressing surveys, the response rate was almost identical amongst the two methods of addressing, although very slightly lower (-0.1%) for those that were personally addressed.

represented in the survey. Such discrepancies mean that the results are not representative of the population as a whole and are not generalisable. However, given that the purpose of this analysis is to look at relationships between variables and not to produce results that are representative of the population this is less of an issue (Babbie, 1990).

Figure 1 – Map of the Greater Nottingham LTP Area showing sample areas, selection criteria and response rates



Data Analysis is presented in the following three sections. Firstly an area-based comparison of objective (CAI) and subjective (survey-reported) journey time to a range of destinations is presented. Secondly, ratings of aspects of accessibility; time and frequency are explored in relation to objective measures and demographic and attitudinal variables. Finally overall assessments of accessibility are explored in relation to both objective and subjective factors.

Comparison of objective and subjective journey time measures of accessibility

The first section of analysis compares objective and subjective journey time measures of accessibility to a range of destinations.

Table 1 shows the Core Accessibility Indicator (CAI) measure of journey time to each of six destinations alongside the mean survey responses for that sample area. T-tests were used to test for differences between the two and significant results are starred. The CAI measures are geographically weighted means for the population within a LSOA. Therefore as the survey responses represent a random sample[3] of the population within each LSOA the mean of survey responses is expected to be the same as the CAI geographically weighted mean, in the null hypothesis. The mean differences (survey-CAI) for each area are reported for each destination and by car and public transport. As the CAI does not report times for walking and cycling the six destinations and two modes were chosen as they are the destinations and modes that are reported in the CAI and would therefore be possible to compare.

[3] Visual inspection of responses relative to population (based on postcode data) confirms the geographical representativeness of the survey responses, with at least one response at 56% of postcode points and no obvious geographical bias.

Table 1 – CAI and Survey journey time accessibility (minutes) by sample area (Bold results indicate negative difference meaning CAI > survey)

Area		GP			Hospital			Supermarket			Primary School			Secondary School			College		
		CAI	Survey Mean	*Mean difference*	CAI	Survey Mean	*Mean difference*	CAI	Survey Mean	*Mean difference*	CAI	Survey Mean	*Mean difference*	CAI	Survey Mean	*Mean difference*	CAI	Survey Mean	*Mean difference*
Hucknall	PT	2.80	14.63	11.83	23.60	43.62	20.02**	5.52	24.12	18.87	8.76	14.40	5.64	11.55	19.57	8.02	96.15	32.86	-63.29**
	Car	5.00	5.55	-0.55	5.35	24.44	19.09**	5.00	6.38	1.38*	5.00	12.83	7.83	5.00	15.75	10.75*	3.04	13.00	9.96
New Basford / Hyson Green	PT	8.91	23.18	14.27*	17.02	31.58	14.56**	4.71	11.50	6.79*	2.42	8.33	5.91	10.00	24.20	14.20	99.93	13.67	-86.26**
	Car	5.00	9.47	4.47**	5.00	18.16	13.16**	5.00	6.12	1.12	5.00	5.58	0.58	5.00	9.64	4.64	5.20	9.70	4.47
Keyworth	PT	11.67	15.78	4.11**	40.77	56.77	16.00**	2.98	42.17	39.19**	8.71	14.89	6.18	5.07	13.83	8.76*	100.00	34.13	-65.87**
	Car	5.00	5.54	-0.54	7.20	23.36	16.08**	5.00	12.97	7.79**	5.00	12.11	7.11	5.00	5.89	0.89	4.52	19.20	14.68**
Beeston	PT	4.40	21.63	17.23**	45.54	26.91	-18.63**	7.01	19.88	12.87**	5.46	19.50	14.04	12.37	17.73	5.36*	99.83	21.50	-78.33**
	Car	5.00	6.61	1.61**	5.00	18.68	13.68**	5.00	6.10	1.10*	5.00	6.00	1.00	5.00	10.54	5.54**	3.50	8.04	4.53**
Cotgrave	PT	9.84	16.93	7.09	29.17	64.50	35.33**	9.39	25.74	16.35**	9.60	13.22	3.62	26.39	28.18	1.79	88.45	43.18	-45.27**
	Car	5.00	6.45	1.45	28.01	29.05	21.79**	5.00	13.36	8.36**	5.00	7.00	2.00	6.38	16.67	10.29**	1.03	25.00	23.97**
Aspley	PT	10.86	19.06	8.20**	24.25	36.56	12.31**	11.21	29.69	18.48**	6.45	13.75	7.30	10.58	15.00	4.42	98.48	27.50	-70.98*
	Car	5.00	8.44	3.44*	5.00	18.44	13.44**	5.00	11.13	6.13**	5.00	5.25	0.25	5.00	4.60	-0.40	5.63	4.00	-1.63
Bingham	PT	11.43	23.88	12.45	24.57	58.80	34.23**	10.13	45.47	35.34**	7.62	20.00	12.38	25.81	39.53	13.72**	92.22	36.59	-55.63**
	Car	5.00	5.14	0.14	5.00	21.32	16.32**	5.00	16.21	11.21**	5.00	5.48	0.48	5.00	14.51	9.51**	2.59	15.47	12.88**
Ravenshead	PT	8.50	16.71	8.21	26.96	68.40	41.44**	8.59	35.24	26.65**	7.72	26.00	18.28	9.91	9.33	-0.58	100.00	41.33	-58.67**
	Car	5.00	6.31	1.31	9.20	37.26	-28.06**	5.00	16.56	11.56**	5.00	11.38	6.38	5.00	11.31	6.31	2.37	28.30	25.93**
TOTAL	PT	8.87	17.32	8.23	31.44	48.95	17.19	7.14	28.53	20.83	7.37	15.85	8.46	14.12	25.62	7.96	96.94	30.43	-66.01
	Car	5.00	6.23	1.23	6.22	22.91	16.83	5.00	11.84	6.84	5.00	5.02	0.02	5.12	9.78	4.67	3.37	15.52	12.10

**significant at p<0.01;*significant at p<0.05.

In the majority of cases the CAI measure is lower than the mean of survey responses, suggesting that the survey responses over-estimate the time taken, or that objective measures under-calculate the time taken. This is consistent with another element of work in this PhD comparing CAI to National Travel Survey (NTS) data, which found that in urban areas the CAI measures were lower than NTS responses. In a few cases, highlighted in bold the pattern is reversed and the CAI measure is greater than the mean survey response. It is notable that public transport journey times to colleges are much greater in the CAI than the survey responses, reversing of the general trend. Visual examination of the destinations reported by respondents and the destinations included as colleges in the CAI shows that discrepancy between the two (which does not occur to such a large extent for other destinations) could be one reason for this. However comparison of the public transport and car times for colleges in the CAI (Table 1) would suggest that there may be some level of error in the CAI calculations as it seems unrealistic that for example a 3 minute car journey could correspond to a 96 minute public transport journey, given the urban nature of the study. For this reason, colleges are excluded from further analyses in this paper.

One potential reason for survey responses being greater than CAI measures is rounding of survey responses. Focussing on reported versus measured distance, rather than time, Witlox (2007) found that rounding worked in both directions and did not affect the results overall. It is likely that differences occur between the two measures both because of inaccuracies in the CAI and inaccuracies in survey responses, with the ‘reality’ falling somewhere between the two. The CAI report and average journey time throughout the day, whereas the survey responses relate to a journey undertaken at 9am. Additionally car journey times in the CAI are based on set speeds dependant on road type and do not account for real conditions. Both of these offer potential reasons for the survey responses being greater than the CAI measures. However, it is also likely that differences occur between different individuals.

Regression analyses were undertaken to identify the contribution of factors other than the objective journey time measure which may influence variation in reported journey time. A series of regression models were estimated for hospitals, GP and supermarkets[4] using subjective journey time as the dependant variable. GP results are not presented as there were no significant relationships. This is not unlikely given that car and PT are not necessarily appropriate modes for travel to GP in such an urbanised setting (66% of respondents indicated they would usually walk to the GP and the CAI suggest all areas sampled are within a 5 minute drive of the nearest GP). The results presented here are therefore for subjective journey time to Hospital and Supermarket by car and PT.

Blocked regressions were undertaken to first confirm the percentage variance in subjective journey times explained by the objective measures and then to understand the additional variance explained by individual demographic factors. These factors were selected on the basis of correlation with subjective journey time or evidence from previous research, as well as insights from the qualitative aspect of this research. Table 2 shows the results of four separate blocked regression analyses. As expected, CAI journey time contributes significantly to the explanation of variance in the self reported journey time by both car and public transport to supermarkets and hospitals. Nevertheless, in all cases adding seven demographic predictors to the model in block 2 resulted in a higher R^2 meaning that the additional factors contribute to the variance in reported journey times.

Table 2 shows that age is a significant factor, with older people reporting longer journey times, after controlling for the objective journey time (ie even if older people in the sample live in more inaccessible areas, they still perceive longer journey times than younger people living in the same area). For car journey times to supermarkets both the frequency of going and the mode used also influence the reported journey time. Interestingly car users report *longer* journey times by car than non-car users. This could be explained by car users travelling further to the supermarket, whereas those who do not use a car perhaps use nearer supermarkets. The mean straight line distance travelled to the supermarket was 2.39 miles for car users compared to 0.72 miles for non-car users. After reporting the time taken,

[4] Colleges were excluded from this analysis for reasons outlined above. Primary and Secondary Schools were also excluded given the low response rates for these destinations.

respondents were asked to confirm whether they were listing their nearest or usual supermarket. Despite car users travelling further to the supermarket, they still reported that they were listing their nearest and the longer reported journey time for car users occurs even when only analysing those reporting the time to their nearest. This suggests a difference in perception of what constitutes nearest car and non-car users. For example for a car user the nearest supermarket may be a large out of town supermarket whereas for a non-car user it may be a more local store.

Table 2 – standardised ß values for blocked regression models where self reported journey time (by PT/car) to destinations is the dependant variable[5]

	Supermarket		Hospital	
Predictors	**PT**	**Car**	**PT**	**Car**
Block 1				
r^2	0.085	0.163	0.146	0.154
F	13.94	44.51	5.00	42.76
CAI journey time	0.291**	-0.404**	0.194**	0.393**
Block 2				
r^2	0.229	0.286	0.338	0.224
F	5.34	11.08	3.57	8.18
CAI journey time	0.297**	-0.352**	0.132*	0.361**
Age	0.219**	0.221**	0.217*	.086
HH income	.151	-.007	.094	-.101
Frequency of going to destination	.038	0.119**	.006	-.104
PT user (to destination)[a]	-.077	-	-.102	-
Car user (to destination)[a]	-	0.205**	-	.092
Gender[b]	-.003	-.014	-.089	-0.138*
Disability[c]	-.013	.011	.101	.066
Car Availability[d]	0.202**	.001	.072	.089

**significant at p<0.01;*significant at p<0.05. [a] (0=non user;1=user) [b] (0=female;1=male) [c] (0=no disability;1=disability) [d] (0=no car;1=car available)

In terms of car availability (regardless of reported mode used for the specific journey) those with a car available report longer public transport journey times to the supermarket than those without a car. This could be for the same reasons explored above, those with a car may consider further away destinations, or because those with a car perceive public transport to take longer.

This section has focussed on a direct comparison of objective journey time accessibility measures with survey responses reporting journey times. It has been identified that there is a strong relationship between objective measures of journey time accessibility and the journey time reported by survey respondents. However, differences do occur and on the whole reported journey times exceed those reported by the Core Accessibility Indicators. After controlling for objective measures, demographic variables, particularly age and car use are useful in contributing to understanding reported journey times for hospitals and supermarkets. This section has not explored whether certain levels of accessibility are seen as acceptable or not to respondents. For example, while for one person a journey of 30 minutes to a hospital may be seen as good, for another, this may be unacceptable. The following section focuses on how people assess the level of journey time accessibility to destinations.

Ratings of accessibility compared to objective measures

Rather than focussing on comparing the actual reported journey times to objective measures, this section compares whether an individual rates their journey time as good or bad (time satisfaction rating) compared to the measures of objective and subjective journey time.

[5] As CAI car journey time to supermarket is constant across sample areas a binary indicator of accessibility (based on CAI according to sampling methodology) was used instead to account to objective accessibility. (0=innaccessibile;1=accessible)
Area D (Beeston) was excluded from hospital analyses due to a potential error in the CAI

Respondents were asked to rate the time taken to destinations as poor to good on a 5 point scale (time satisfaction rating) using their usual mode of travel.[6] This analysis compares the (objective and subjective) time taken in minutes using the mode usually used for a particular destination to the time satisfaction rating. On the whole ratings were positive, with $\bar{x} > 3$ for time rating to all destinations. Spearman's correlation (Table 3) shows strong relationships exist between the rating of time taken, and both objective and subjective journey times to those destinations (using the mode usually used by the respondent). The negative correlation is as expected, longer journeys are rated more negatively than shorter journeys.

Table 3 –and correlation between journey time rating and the objective and subjective journey time by the respondent's usual mode of travel to that destination

			Correlation co-efficient (r_s) rating of journey time with:	
	Mean	**Standard Deviation**	**Objective time**	**Subjective time**
GP	4.59	0.77	-0.389**	-0.309**
Hospital	3.77	0.06	-0.027	-0.149*
Supermarket	4.17	0.05	-0.122	-0.349**
Primary School	3.76	0.06	0.158	-0.292*
Secondary School	3.48	0.06	-0.303	-0.497**
College	3.22	0.05	-	-0.403
City Centre	3.87	0.06	-	-0.083

**significant at p<0.01;*significant at p<0.05.

Partial correlations show that both objective and subjective time in minutes correlate with time satisfaction ratings, even when the other is held constant. One measure is therefore not a substitute for the other, but both objective and subjective measures are related to subjective ratings of journey time to destinations. Low standard deviations indicate relatively little variation in the ratings, so detailed analysis has not been undertaken. Non parametric tests indicate that time satisfaction ratings to destinations vary among demographic groups. Initial analyses suggest that there is high correlation between time satisfaction ratings and age, and that the ratings differ significantly among those who do and do not have a car. It is important that such analysis controls for objective accessibility however, to ensure that, for example, those with a higher income do not rate times more poorly, because they actually live in less accessible areas.

Controlling for objective accessibility (by breaking analysis down by area) shows no correlation between age and time satisfaction ratings, suggesting that older people in the sample live in more inaccessible locations, hence their rating the time more negatively when analysing the aggregate data. This is interesting given that the previous section showed older people reported significantly longer journey times, even after controlling for objective accessibility. This suggests that while older people may experience longer journey times than younger people living in the same area, they do not have a disproportionately negative view – perhaps suggesting older people's accessibility expectations adapt to their circumstances. After controlling for objective accessibility, there is a significant difference in journey time rating between those who have access to a car and those who don't for supermarkets and the city centre. Those who have a car rate time taken to supermarket more positively than those who don't, but time to city centre less so. More work needs to be done to understand the *relative* influence of each of these factors and other potential factors affecting time ratings.

The CAI also report a frequency measure of public transport to each of the destinations. Given the high level of agreement among frequency to each of the destinations in the CAI

[6] Although respondents were asked to give the time in minutes for all modes of travel in the rating questions they were only asked to consider their usual mode of travel, and so in this section the time satisfaction rating is compared to the time in minutes for the mode they reported they usually used to access each destination

(α=0.851) a combined objective frequency measure has been calculated. This shows significant correlation (r=0.410, p<0.01) with the questionnaire item asking respondents to rate frequency of public transport to local destinations (on a five point scale from infrequent – frequent).

Regression analysis was undertaken to establish other factors other than the CAI measure explaining variation in rating of public transport frequency (Table 4). After controlling for the objective frequency measure several other factors were also significant in explaining variation in the rating of frequency. Age, perceived ease of using public transport and satisfaction with provision of public transport were significant. Income, frequency of public transport use and car availability were also included in the model but were not significant. This suggests that those who have a positive attitude towards public transport are more likely to perceive it to be more frequent, after controlling for objective frequency. However, it is important not to presume causation. It is also possible that perceiving public transport to be frequent causes a greater level of satisfaction and greater perceived ease. What the results may indicate is a tendency for some people to score all items relating to public transport use more favourably, indicating an underlying positive attitude towards public transport.

Table 4 – Regression results for rating of frequency of public transport

	standardised ß
Block 1 (r^2=0.168,F=49.75)	
Objective Frequency Measure	.410**
Block 2 (r^2=0.361,F=19.37)	
Objective Frequency Measure	.225**
age	.120*
Ease of using public transport	.247**
Satisfaction with Provision of Public Transport	.264**
Frequency of using public transport	.002
Car Availability	-.019
Income	-.020

**significant at p<0.01;*significant at p<0.05.

Overall perceptions of Accessibility

The analysis so far has focussed on journey time measures of accessibility, and understanding how subjective measures and time satisfaction ratings relate to objective measures. The purpose of this section is to explore perceptions of accessibility more broadly, and understand which aspects of accessibility (eg time) and demographic factors are related to individuals' perceptions of their accessibility.

Respondents were asked to rate destinations firstly by 'ease of access' on a 5 point Likert scale of disagree-agree and secondly by how 'accessible' they are. Although conceptually these two items may seem to measure the same thing analysis of the responses makes it clear that although there is high agreement there are also differences in the way in which the questions were answered, with 'ease of access' being answered on a more individual basis, but 'accessibility' relating to area accessibility. For example a respondent may have answered that they personally found it difficult on ease of access, but that accessibility was good on the 'accessible' measure. For this reason these two measures were multiplied and used to represent overall perceptions of accessibility. This section presents aggregate analysis of perceptions of accessibility across destinations. Separate analyses of perception to different destinations and by different modes could also be undertaken but are not presented in this paper. Firstly the difference in perceptions dependant on objective accessibility is explored, before building in demographic and attitudinal factors.

Overall perceived accessibility differs across sample areas as confirmed by Kruskal-Wallis test (H=41.96,p<0.01). However, when undertaken separately on areas categorised as accessible[7] (H=7.25,p>0.05) and inaccessible (H=5.56,p>0.05) the difference amongst

[7] according to CAI based on the categorisation of areas in the sampling methodology which sampled areas based on the median split of overall accessibility across destinations

sample areas is not significant. This suggests that the overall perception of accessibility does differ significantly dependent upon objective accessibility. Objective accessibility is included as a binary variable as the main objective is to ensure this is controlled for in the analysis, and as this analysis is focussed on overall perceived accessibility it would be difficult to include a mode or destination specific value of accessibility.

Table 5 shows the results of a regression model with demographic predictor variables. After controlling for objective accessibility, both age and disability are significant. Having a disability and being older mean perceptions of accessibility are worse.

Table 5 – Regression analysis for overall perceived accessibility with demographic predictors ($r^2 = 0.244$; F=19.07)

	Standardised ß
Objective Accessibility	.253**
age	-.260**
Gender	.011
Car Availability	.028
Disability	-.237**

**significant at p<0.01;*significant at p<0.05.

Table 6 shows the same regression including ratings of aspects of accessibility. This shows that time-satisfaction rating is more important than objective time in minutes, and being satisfied with destinations is important in determining overall perceived accessibility.

Table 6 - Regression analysis for overall perceived accessibility with demographic and 'ratings of accessibility' predictors ($r^2 = 0.600$; F=54.87)

	Standardised ß
Objective Accessibility	.087*
age	-.156**
Gender	.051
Car Availability	.001
Disability	-.055
satisfaction with destinations	.287**
choice-satisfaction	.075
time-satisfaction	.419**

**significant at p<0.01;*significant at p<0.05.

The results suggest that objective accessibility is an important predictor of overall perceived accessibility, but that after controlling for this, age and satisfaction with destinations, and time-satisfaction are important for accounting for differences among individuals. The survey also asked questions to measure individual's attitudes to car use, neighbourhood and the environment, and further analysis will be undertaken to understand whether these are related to perceptions of accessibility.

Discussion, Conclusions and Further Research

Results suggest that while there is some correlation between the survey reported (subjective) and core accessibility indicator (objective) journey times across different destinations and modes, one is not a perfect substitution for the other. T-tests of the equality of means suggest there is a significant difference between the values in the two datasets. Differences are partly as a result of inaccuracies in perceptions but also inaccuracies in calculation of objective measures. This study also suggests differences occur between individuals' with the same levels of objective accessibility which can be attributed to socio-demographic. Subjective ratings of journey times (poor-good) and public transport frequency (infrequent-frequent) are related to the objective indicators, but ratings are also strongly related to individual attributes. Not all individuals in a given area (with the same level of objective accessibility) perceive this in the same way and again these differences can be explained by individual attributes, particularly age and car ownership.

Differences in the way in which different individual's perceive their accessibility can be important in terms of equality and inclusion outcomes. Traditional accessibility analyses may be undertaken for demographic groups in terms of geographical location. In other words analysis may find that an area with a high proportion of elderly people has poor accessibility and come to the conclusion that accessibility needs to be improved for the elderly. However, added to this, this analysis suggests that regardless of objective accessibility, elderly people are also likely to perceive, (and probably do have) worse (journey time) accessibility as than other population groups. This means that suggested inequalities may actually be much worse than geographical analysis of accessibility would suggest. Of course the reverse is also true, in some cases geographical analysis may suggest poor accessibility for a group where this is not an issue for them, (eg car users). Despite having worse journey time accessibility, older people do not rate this as worse suggesting a tendency to adapt to or accept circumstances.

Equally it is important to include objective conditions in such analyses. Many social surveys are undertaken with limited consideration of the objective condition, for example public transport satisfaction surveys are often not geographically analysed with consideration given to the level of provision in different areas. In such cases, differences identified among demographic groups could be as a result of the geographic dispersion of demographic groups and related to the actual levels of public transport.

Perceptions of accessibility are related to both objective conditions and individual attributes. If, as suggested by other work in this PhD, policy approaches such as Accessibility Planning wish to alter travel behaviour to achieve mode shift and social inclusion outcomes they should focus on both the objective or measurable levels of accessibility through the land-use planning system and individual perceptions of accessibility. As suggested by Stanley & Vella-Brodrick (2009), policy based on neither objective or subjective measures alone are sufficient. Rather, both are needed if desired policy goals are to be achieved. Although perceptions can also be affected by changes in accessibility brought about through infrastructure or land use changes, they might also be changed by focussing on more individualised interventions as this work suggests that individuals demographics and familiarity with trip are as important as actual levels of accessibility in influencing their perceptions and therefore potentially their behaviour.

It is important to acknowledge such differences and to understand why, and what the implications of this are both for research and in influencing travel behaviour. There has been tendency in transport modelling especially to believe that an objective measure is the ‘actual’ measure, and therefore efforts are focussed on achieving the objective truth. In the same paper it is noted that there is a difference between perceived and actual distances, and that *“obviously, it is important to make use of the “correct” actual data”*. (Witlox 2007) While for some applications this is true, such an approach misses the fact that inaccuracy is possible in measures of actual time/distance and more importantly that people’s travel behaviour may be influenced more strongly by their perceptions (‘right’ or ‘wrong’).

Analysis of variables influencing perceptions has highlighted that, in addition to potential inaccuracy in the calculation of objective measures, perceptions may differ for two reasons. Firstly, because for a particular individual, (eg an elderly person) accessibility is worse than for the average individual for whom an accessibility measure is calculated. Secondly, because an individual’s attitudes or lifestyle (eg car user) means that they perceive accessibility to be different to what it is. Each reason would clearly lead to very different policy responses to improve accessibility and therefore warrants further research to understand the reasons for such differences. If the aim is to influence behaviour, for example in accessibility planning to achieve social inclusion or mode shift goals, then both objective and subjective measures, the differences between the two and the reasons for these need to be clearly understood.

This paper has presented exploratory analysis focussed around three research questions. Firstly, a comparison of objective and subjective measures of journey time accessibility, secondly exploring how ratings of accessibility relate to objective measures and thirdly exploring perception based measures of accessibility, and what factors are related to this. A strong theme emerging from qualitative work is that people judge whether a journey time is acceptable according to how long it ‘should’ take, often using the car as a reference point. The ratio of car to public transport journey time is therefore potentially important in understanding perceptions of accessibility by public transport and warrants further investigation using quantitative data. Further work will also illuminate these findings from quantitative survey analysis with the results of qualitative mental mapping interviews undertaken as follow up work with some survey respondents.

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