PERSONAL FACTORS INFLUENCING WALKING AND CYCLING IN URBAN AREAS

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ABSTRACT

Research to further understanding of walking and cycling for everyday local trips is being conducted across four UK urban areas. The research uses an innovative mixed-methods approach involving questionnaires, a range of qualitative research methods (including accompanied trips, ethnographies and interviews), as well as mapping and measurement of built environment factors. A key objective is to develop a better understanding of the personal factors and household interactions that combine to support or form barriers to walking and cycling for short local journeys. This paper reports specifically on the questionnaire findings.

Two large sample questionnaires (covering walking and cycling separately) were distributed across each study area to collect individual level data that are being used to investigate how personal preferences combine at a household level to result in travel and mode choice decisions. The questionnaires have a strong theoretical underpinning to ensure a structured approach to identifying personal factors that influence walking and cycling. The Theory of Planned Behaviour (TPB) was chosen to provide this theoretical underpinning. The sampling strategy ensures that a full range of neighbourhood characteristics are surveyed, from the most to the least deprived socio-economic groups.

The TPB is a widely used explanatory theory of intentions and behaviour with a proven track record within the transport field and in relation to other behaviours. The questionnaires explored individuals' attitudes, norms (social and personal), feelings of control and past behaviour, as well as intentions and actual journeys made, in accordance with the structure of the TPB. In addition, further questions were used to investigate social norms in greater depth to establish who influences individuals' travel and how, for example, the extent to which children influence ability to walk or cycle for short trips in the local neighbourhood.

1. INTRODUCTION

It is widely recognised that an increase in walking and cycling for short journeys in urban areas could significantly reduce traffic congestion, improve the quality of the urban environment, promote improved personal health, and contribute to a reduction in carbon emissions. This is demonstrated by a wide range of policy initiatives by national and local governments, by health authorities and a variety of non-governmental organizations. Recent reviews of research on travel behaviour have emphasised that the ways in which travel decisions are made remains poorly understood, especially in the context of complex and contingent household travel arrangements. The research described in this paper, part of a wider project on *Understanding Walking and Cycling* (UWAC), seeks to fill this research gap through an in-depth analysis of household decision making with respect to short journeys in urban areas.

In the UK and many other places walking and cycling are secondary modes of transport – the environment for these modes and level of provision of facilities is often poor; levels of risk of injury are generally higher than for motorised modes; perceptions are often negative, while the status associated with these modes is generally low; and the role that they play in society and individuals lives has the potential to be substantially enhanced. Cycling and walking are both widely recognised as environmentally friendly and healthy modes of transport and the potential for increasing levels is substantial (for example nearly two thirds of trips are under 8kms in length (42% under 3kms), and 25% of car trips are under 1.6kms), however, both have been in long term decline in Britain (DfT, 2007a). Cycle traffic declined from 23 to 5 billion passenger kilometres between 1952 and 2006, though there is some evidence of a slight increase since the late 1990s (DfT, 2007a). Between 1995/7 and 2006 the number of trips per person made by bicycle fell by around 20% and the average distance travelled by 9% (DfT 2007a). The proportion of people cycling to work in Britain fell from 3.8% in 1981 to 3.0% in 2006 (DfT, 2007a). Within Britain there is wide divergence in the use of cycling, with cities such as York, Cambridge and Oxford having much higher levels than the national average. In Britain walking accounted for 35% of all trips in 1975/76, but this fell to 24% in 2006 (DfT, 2007a). Despite this fall it is still an important mode of transport and in the UK it accounts for 80% of all trips under 1 mile (DfT, 2003). Whilst most people walk on a daily basis, the amount of walking is not equally distributed across the population, for example households without a car walk on average 65% further than those with a car.

Internationally, the United States and Canada have even lower levels of cycling, with approximately 1% and 2% of urban trips being made by bicycle in these countries respectively. In contrast, much higher levels of cycling are apparent in some parts of Northern Europe, with 28% of urban trips in the Netherlands made by bicycle (Pucher and Dijkstra, 2003), perhaps partly as a result of provision of high quality facilities and recent initiatives to promote policies such as bike and ride (Martens, 2006). Bassett et al (2008) make a comparison of proportions of walking and cycling trips between various countries – the UK population makes around a quarter of trips by walk or cycle, compared to just over 30% in Denmark, Finland, Germany and Sweden and close to 50% in the Netherlands. In many European cities, walking and cycling account for over 50% of all trips, and most recently in the UK the Sustainable Travel Demonstration Towns (DfT, 2007b) have already recorded substantial increases in walking and cycling. However, formidable obstacles to walking remain such as low density sprawl generating long trip distances, narrow or non-existent footways, inadequate crossing facilities and the growth of motorised traffic.

Cycling in countries such as the Netherlands, Germany and Denmark is often perceived as a good example of what can be achieved in terms of quantity and status. However, it was not

always the case (Pucher and Buehler, 2008), as levels of cycling fell considerably between 1950 to 1975 in all three countries. It was only through changes in transport and planning policy in the mid 1970s and beyond that the current success story was generated. Whilst there is clearly potential for increasing levels of walking and especially cycling in the UK, there is a need for greater understanding of the motivations the kinds of travel choices made and how these can be changed.

The research reported here is based on two large sample questionnaires (covering walking and cycling separately) which were distributed across 4 study areas in the UK and are being used to investigate how personal preferences combine at a household level to result in travel and mode choice decisions. The paper is split into a number of sections: section 2 describes the survey method and approach, section 3 looks at response to the survey across the different study areas and populations, section 4 gives an overview of some findings from an initial analysis of the data and an analysis using the Theory of Planned Behaviour (TPB), section 5 gives some initial conclusions.

2. SURVEY METHOD

Sampling strategy
A total of 15,000 postal surveys were sent to households, evenly split across 4 study locations in the UK (Lancaster, Leeds, Leicester and Worcester). In order to obtain a spread in terms of socio-demographic statistics across the locations, the Index of Multiple Deprivation (IoMD) was used to stratify the sample. The IoMD is measured at the level of Lower Super Output Area (LSOA), which are areas defined throughout the country and contain a minimum of 1000 people or 400 households. The combination of IoMD with LSOA's lends itself to the identification of neighbourhoods for the subsequent qualitative work as it would be possible to deduce relationships from the findings regarding IoMD and attitudinal variables from the questionnaire, thus providing a format for linking areas/neighbourhoods with attitudes.

The IoMD is based on 7 domains, within which there are 37 indicators. The domains are income, employment, health and disability, education skills and training, barriers to housing and services, living environment and crime. Many of the domains, or indicators within them, are likely to underpin some of the measured attitudes towards, and levels of, walking and cycling. Thus, the IoMD provides a useful variable with possible explanatory benefits (in reality there may be a series of other factors which underpin attitudes and subsequently IoMD might not have any explanatory power but it will still be possible to identify attitudes within a certain IoMD group). Within England there are 32,482 LSOA's. Each LSOA is given a score for each domain, from which an IoMD score is derived. Each LSOA is then ranked in terms of IoMD score. The most deprived LSOA in England has an IoMD rank of 1 and the least deprived LSOA in England has an IoMD rank of 32,482 (a rank for each LSOA for each of the 7 domains is available should it be desirable to use this information for the selection of a sampling strategy for the qualitative work).

Given the project aims to target urban areas, all non-urban LSOAs were removed from the sample using the 2004 Rural and Urban Classification (RUC), which usefully classifies LSOA's based on hectare grid squares, using postcode information and the Office of the Deputy Prime Minister's defined settlement polygons. Each hectare grid square was assessed in terms of its Settlement Form i.e small town, hamlet, urban; and given a scarcity score based on the number of households in the surrounding hectare squares up to a distance of 30 kilometres. Thus, each hectare square could be classed as, for example, a village which is relatively sparse. The RUC was based on output areas which each contain

around 125 households. At this level, 8 classes can be used however when aggregating up to LSOA level (containing around 4 output areas), 3 classes are available (urban, town and fringe, and other (more dispersed settlements e.g., village/hamlet). In terms of the 4 study locations, the RUC classifies all LSOA's within Leicester and Worcester as urban whilst in Lancaster 64 LSOA's are urban, 16 are town and fringe and 8 are 'other'. In Leeds 449 LSOA's are urban, 13 are town and fringe and 14 are 'other'.

The IoMD was split into 3 groups, creating the 'most deprived', 'deprived', and 'least deprived' groups. Table 1 shows the spread of LSOAs in each area based on the 3 IoMD groups.

Table 1: Number of LSOA's in each IoMD group and location.

	IoMD group 1 (most deprived) [1]	IoMD group 2[2]	IoMD group 3 (least deprived) [3]	Total
WORCESTER	16	19	26	61
LANCASTER	29	22	14	65
LEICESTER	124	52	11	187
LEEDS	189	132	128	449

[1]contains LSOA's ranging from IoMD rank 1 to 10,827.
[2]contains LSOA's ranging from IoMD rank 10,828 to 21,654.
[3]contains LSOA's ranging from IoMD rank 21,655 to 32,482.

An equal amount of surveys (1250) were sent to each IoMD group within each study location, selecting 25% of the LSOAs that are shown in table 1, i.e. not all of the LSOAs in each study area were sampled. The LSOAs were also selected to ensure a spatial spread in each location.

The surveys were all posted at the same time (September 2009) with the offer of entry into a prize draw if the survey was returned by a given date (allowing around 2 weeks to complete and return the survey after receiving it). The majority (around 90%) of surveys were returned within this cut off period and were thus entered into the prize draw. Several prizes were offered, aimed at incentivising completion of the survey.

Description of the survey

The survey was around 10 pages long and largely consisted of quantitative, closed questions with some opportunities to provide text responses. Two questionnaires were developed, one aimed at ascertaining views on walking, the other on cycling, though aside from this difference the two were very similar in structure and focus of the questions (it is important to note that the questionnaires were not aimed exclusively at either walkers or cyclists, rather they sought views of all people on these modes of travel). The purpose of the questionnaire was to assess attitudes about walking and cycling in the 4 study locations in addition to providing context and grounding for future stages of the UWAC project. The first page included instructions on how to complete the survey (it was requested that the survey be completed regardless of whether the respondents walked or cycled as the survey was designed to incorporate this in order to be more inclusive and thus obtain a larger sample). A set of questions were included that provided detailed travel behaviour (across all modes) and a section to collect sociodemographic data. The majority of questions were based on the Theory of Planned Behaviour (TPB) to provide a theoretical grounding of the questionnaire, thus allowing a greater depth of knowledge than a more technical structure. In addition, the TPB element provided a basis for regression analysis.

3. RESPONSE RATES

This section provides an overview of the socio-demographic statistics and survey response rates for both the walking and cycling surveys. Table 2 provides an overall response rate for each study location for each of the questionnaires. The cycling survey achieved an overall response rate of 8.3%. A low response was expected given the low rate of cycling activity throughout England, however the actual return was higher than expected in comparison to the pilot survey returns. The walking survey achieved a slightly higher response (9.3%), which was slightly lower than expected in comparison to the pilot survey returns. Although response rates for both surveys are low, this level of response is not unusual in unsolicited postal surveys (Moser and Kalton, 1979).

Table 2: Response rates from each location.

Cycling					
	LEICESTER	LANCASTER	LEEDS	WORCESTER	Total
Sample	121	193	175	130	619
Response rate %	6.5	10.3	9.3	6.9	8.3
Population	292600	143500	761100	93700	1290900
% of population sampled	0.04	0.13	0.02	0.14	0.05
Walking					
Sample	166	244	201	187	798
Response rate %	8.9	13.0	10.7	9.9	9.3
Population	292600	143500	761100	93700	1290900
% of population sampled	0.06	0.17	0.03	0.20	0.06

Lancaster and Leeds have a similar response rate, which was not necessarily expected based on the pilot response (very low for cycling in Leeds). It is possible that this was a result of the characteristics of the 4 LSOAs that were sampled for the pilot, compared to those included in the main survey (for example, a wider variety of locations). A higher response was expected for Lancaster given its current Cycling Demonstration Town status and the higher levels of cycling compared to Leeds. Worcester and Leicester were expected to be lower for local reasons. This is also applicable to the walking response rates, which follow the same pattern as the cycling response (highest in Lancaster and lowest in Leicester). In each location, response to the walking survey is higher than response to the cycling survey. This was expected due to the higher levels of walking used as everyday travel means in comparison to cycling. Overall, the response rates seem positive (more details later in relation to the impact on disaggregation opportunities).

The sample was stratified using the Index of Multiple Deprivation (IoMD) 2007. 3 categories of deprivation were derived and each LSOA was categorised on this basis. An equal percentage (25) of LSOAs from each location and deprivation group were included in the sample. ArcGIS was used to ensure that a geographic spread of LSOAs and deprivation category was obtained in each location. Only urban LSOAs were included in the sample (only Leeds and Lancaster had non-urban LSOAs). The following table shows the returned sample from each location split by IoMD group.

Table 3: Sample size by location and IoMD (%).

	LEICESTER	LANCASTER	LEEDS	WORCESTER	Total
Cycling					
MOST DEPRIVED	22	21	28	35	26
DEPRIVED	34	41	26	28	33
LEAST DEPRIVED	44	38	46	37	41
Walking					
MOST DEPRIVED	26	25	28	33	28
DEPRIVED	34	39	30	32	34
LEAST DEPRIVED	40	36	42	35	38

In relation to the cycling survey, for each location the highest response results from the least deprived group. This is the same for the walking survey, except for Lancaster. For both modes, the most deprived group most often has the lowest response. Overall, the response rate has a negative relationship with deprivation (response increases with decreasing levels of deprivation), with only a small variation in proportions from each deprivation group for the walking and cycling surveys.

Table 4 shows the sample split by gender and location, with totals for each.

Table 4: Gender by location (%)

	LEICESTER	LANCASTER	LEEDS	WORCESTER	Total
Cycling					
MALE	45	47	43	44	45
FEMALE	55	53	57	56	55
Walking					
MALE	46	37	40	43	41
FEMALE	54	63	60	57	59

Overall, gender has similar proportions of response for each mode. A higher rate from females occurs in both the walking and cycling surveys. This was expected as it is generally more typical for females to complete surveys compared to males. It is possible that the higher rate for females in the walking survey compared to the cycling survey and higher rate for males in the cycling survey compared to the walking survey to some extent reflects usage patterns of each mode (more men than women currently cycle in the UK and more women than men currently walk).

In England, the population of males and females is almost equal (according to the 2007 estimates from the National Statistics Census, 2001). This is also applicable to each study location, where males account for 49% of the local population.

Table 5 shows the sample split by age group and location, with totals for each.

Table 5: Age group and location (%).

Years	LEICESTER	LANCASTER	LEEDS	WORCESTER	Total
Cycling					
16 – 24	6	6	8	4	6
25 – 34	17	13	17	15	16
35 – 44	16	14	19	22	17
45 – 54	22	22	22	23	22
55 – 64	19	20	20	15	19
65 – 74	13	18	9	17	14
75+	6	7	6	4	6
Walking					
16 – 24	4	2	4	4	4
25 – 34	21	12	15	16	16
35 – 44	23	18	20	17	19
45 – 54	20	17	19	20	19
55 – 64	13	21	20	21	19
65 – 74	8	17	13	13	13
75+	10	13	9	8	10

As expected, the lowest response rates occur within the youngest and oldest age groups (with some exceptions to this pattern). To some degree, for the oldest age group this was a result of access issues (unable to physically complete and return survey), and also lack of completion where potential respondents felt the survey was not applicable to them due to their age and current lack of walking and/or cycling, even if they had previous experience of using such modes. There are no distinct patterns of response within the remaining age groups. Generally, for cycling the response increases with age, peaking around the 45-54 age group, then declining thereafter (for most locations). This is also true for the walking data, with response peaking around the 55-64 age group (for most locations) and then declining. The response according to age group is likely to some extent reflect availability and willingness to complete the survey and also current usage patterns regarding walking and cycling.

In terms of response by income, there were no clear patterns for the different income groups, or between modes. The lowest responses were expected from the highest and lowest income groups, however this is not the case for the majority of locations and modes. There was a slight over representation of car ownership in the sample and a greater representation of lower occupancy households than expected compared to national averages. Our sample is also over representative of people with higher educational attainments than the national average and people who are in employment.

4. RESULTS

4.1 Overview of findings

This section considers some key differences in response by gender, age group and household car ownership. Separate consideration is given to findings from the walking and the cycling questionnaires.

Most of the questions in the questionnaire required the respondent to tick boxes on a response scale. The relationships described here are derived from the way these responses were coded. In some cases these are obvious (young age categories were coded low, high age categories high) for others they are less obvious (gender was coded 1 for male and 2 for female). The relationships described take account of the codings used so where a response scale of strongly agree (1) to strongly disagree (5) was used a positive correlation with age suggests that younger respondents were more likely to agree.

Walking

Table 6 shows a number of correlations between frequency of journeys made on foot and gender, age and car ownership.

Table 6: Journeys on foot

		Gender	Age group	How many cars or vans does your household own?	In the past, how often have you made journeys on foot?	Nowadays how often do you make journeys on foot?
Gender	Correlation Coefficient	1.000	-.160**	-.109**	.013	.033
	Sig. (2-tailed)	.	.000	.005	.728	.372
	N	789	777	655	764	744
Age group	Correlation Coefficient	-.160**	1.000	-.060	.007	.051
	Sig. (2-tailed)	.000	.	.130	.843	.168
	N	777	782	649	757	737
How many cars or vans does your household own?	Correlation Coefficient	-.109**	-.060	1.000	.171**	.156**
	Sig. (2-tailed)	.005	.130	.	.000	.000
	N	655	649	658	633	617
In the past, how often have you made journeys on foot?	Correlation Coefficient	.013	.007	.171**	1.000	.759**
	Sig. (2-tailed)	.728	.843	.000	.	.000
	N	764	757	633	770	748
Nowadays how often do you make journeys on foot?	Correlation Coefficient	.033	.051	.156**	.759**	1.000
	Sig. (2-tailed)	.372	.168	.000	.000	.
	N	744	737	617	748	750

** - Correlation is significant at the 0.01 level (2 tailed)

A number of correlations are significant at the p<0.01 level. Not surprisingly past walking behaviour is highly positively correlated with current walking behaviour. Car/van ownership is slightly correlated with lower levels of walking (past and current) – as car ownership increases levels of walking decline. Gender (female) is slightly negatively correlated with car ownership.

Table 7 looks at the influence of other people on walking and considers correlations between this and gender, age and car ownership.

Table 7: Influence of other people on walking

		Gender	Age group	How many cars or vans does your household own?	How often are you unable to make journeys on foot because somebody else who is important to you thinks there is too high a risk of you being involved in a road accident?	How often are you unable to make journeys on foot because somebody else who is important to you thinks there is too high a risk of you being attacked?
Gender	Correlation Coefficient	1.000	-.160**	-.109**	-.096**	-.257**
	Sig. (2-tailed)	.	.000	.005	.009	.000
	N	789	777	655	748	743
Age group	Correlation Coefficient	-.160**	1.000	-.060	-.087*	.111**
	Sig. (2-tailed)	.000	.	.130	.017	.003
	N	777	782	649	740	735
How many cars or vans does your household own?	Correlation Coefficient	-.109**	-.060	1.000	.056	.118**
	Sig. (2-tailed)	.005	.130	.	.159	.003
	N	655	649	658	625	623
How often are you unable to make journeys on foot because somebody else who is important to you thinks there is too high a risk of you being involved in a road accident?	Correlation Coefficient	-.096**	-.087*	.056	1.000	.464**
	Sig. (2-tailed)	.009	.017	.159	.	.000
	N	748	740	625	754	745
How often are you unable to make journeys on foot because somebody else who is important to you thinks there is too high a risk of you being attacked?	Correlation Coefficient	-.257**	.111**	.118**	.464**	1.000
	Sig. (2-tailed)	.000	.003	.003	.000	.
	N	743	735	623	745	748

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

This shows a significant and slightly positive correlation at the 0.01 level between gender (female) and both the inability to make journeys on foot because of risk of a road accident and because of fear of attack ("often" had a low value code and "never" a higher value code). It also shows a significant and slightly positive correlation between car ownership and inability to make journeys on foot because of fear of attack.

Table 8 considers view on walking and how these are correlated with gender, age and car ownership.

Table 8: Views on walking

		Gender	Age group	How many cars or vans does your household own?	For me, walking is an important form of transport	Generally, I am confident that I can make journeys on foot	Generally, it is entirely up to me whether I make journeys on foot
Gender	Correlation Coefficient	1.000	-.160**	-.109**	.034	.104**	.037
	Sig. (2-tailed)	.	.000	.005	.355	.004	.312
	N	789	777	655	763	764	758
Age group	Correlation Coefficient	-.160**	1.000	-.060	.067	.203**	-.001
	Sig. (2-tailed)	.000	.	.130	.066	.000	.970
	N	777	782	649	755	756	750
How many cars or vans does your household own?	Correlation Coefficient	-.109**	-.060	1.000	.147**	.008	.021
	Sig. (2-tailed)	.005	.130	.	.000	.847	.591
	N	655	649	658	634	634	633
For me, walking is an important form of transport	Correlation Coefficient	.034	.067	.147**	1.000	.577**	.143**
	Sig. (2-tailed)	.355	.066	.000	.	.000	.000
	N	763	755	634	769	766	762
Generally, I am confident that I can make journeys on foot	Correlation Coefficient	.104**	.203**	.008	.577**	1.000	.274**
	Sig. (2-tailed)	.004	.000	.847	.000	.	.000
	N	764	756	634	766	770	762
Generally, it is entirely up to me whether I make journeys on foot	Correlation Coefficient	.037	-.001	.021	.143**	.274**	1.000
	Sig. (2-tailed)	.312	.970	.591	.000	.000	.
	N	758	750	633	762	762	764

** - correlation is significant at the 0.01 level (2-tailed)

The table shows significant and slightly negative correlation between the perceived importance of walking and car ownership, however there are significant positive correlations between perceived importance of walking with confidence in making journeys on foot and slightly with autonomy in making journeys on foot. Confidence in making journeys on foot is correlated with gender (male), but negatively correlated with age (the question about confidence could be answered from “strongly agree” (low) to “strongly disagree” (high)). Confidence in making journeys on foot is slightly positively correlated with autonomy in making journeys on foot.

A range of other correlations were tested looking at other aspects of the questionnaire response. Significant outcomes at the 0.01 level of confidence include in relation to affective attitudes:

‘If I make, or were to make, journeys on foot…

I would find walking enjoyable’ is slightly negatively correlated with age

(when it is daylight) I would be afraid of being attacked’ is correlated with gender (female)

(when it is daylight) I would be afraid of being attacked' is negatively correlated with car ownership

(when it is dark) I would be afraid of being attacked' is correlated with gender (female)

(when it is dark) I would be afraid of being attacked' is negatively correlated with car ownership

(when it is daylight) I would be afraid of being involved in an accident' is negatively correlated with car ownership

(when it is dark) I would be afraid of being involved in an accident' is correlated with gender (female)

(when it is dark) I would be afraid of being involved in an accident' is negatively correlated with car ownership

it would provide me with space and time to think' is correlated with gender (female)

it would provide me with space and time to think' is negatively correlated with age

Significant correlations in relation to instrumental attitudes include:

'If I make, or were to make, journeys on foot it would…

benefit my health' is correlated with gender (female)

benefit my health' is negatively correlated with age

be too far to walk to the places I usually travel to' is correlated with car ownership

save me money' is negatively correlated with age

be a bad experience using the existing footpaths' is correlated with gender (female)

be a bad experience using the existing footpaths' is negatively correlated with car ownership

get me to the places I usually travel to on time and without any delay' negatively is correlated with car ownership

mean I contribute less to climate change' is negatively correlated with age

be too much physical effort' is correlated with age

more than likely expose me to wet or windy weather' is negatively correlated with age

increase my exposure to air pollution' is correlated with gender (female)

allow me to choose when I travel' is negatively correlated with car ownership

help me avoid getting stuck in traffic jams' is negatively correlated with age

give me a number of choices over which routes I take' is negatively correlated with car ownership

mean I contribute less to local air pollution' is negatively correlated with age

take me too long to get to the places I usually travel to' is correlated with car ownership

be difficult to carry the things I often have to carry' is correlated with gender (female)

be convenient for me' is negatively correlated with car ownership

be safe when crossing the road' is negatively correlated with age

Cycling

Table 9 shows a number of correlations between journeys by bicycle and gender, age and car ownership.

Table 9: Journeys by bicycle

		Gender	Age group	How many cars or vans does your household own?	In the past, how often have you made journeys by bicycle?	Nowadays how often do you make journeys by bicycle?
Gender	Correlation Coefficient	1.000	-.130**	-.023	.167**	.134**
	Sig. (2-tailed)	.	.001	.587	.000	.001
	N	612	611	583	608	609
Age group	Correlation Coefficient	-.130**	1.000	-.092*	-.018	.145**
	Sig. (2-tailed)	.001	.	.026	.664	.000
	N	611	613	584	609	610
How many cars or vans does your household own?	Correlation Coefficient	-.023	-.092*	1.000	.023	-.005
	Sig. (2-tailed)	.587	.026	.	.578	.901
	N	583	584	584	581	582
In the past, how often have you made journeys by bicycle?	Correlation Coefficient	.167**	-.018	.023	1.000	.489**
	Sig. (2-tailed)	.000	.664	.578	.	.000
	N	608	609	581	615	615
Nowadays how often do you make journeys by bicycle?	Correlation Coefficient	.134**	.145**	-.005	.489**	1.000
	Sig. (2-tailed)	.001	.000	.901	.000	.
	N	609	610	582	615	616

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

This shows that females make significantly less trips by bicycle, both for past and current trips (trip frequency was coded from "daily" (low) to "never" (high) and the gender code for females was higher than that for males). Age is slightly correlated with fewer current bicycle trips. Past bicycle trips is positively correlated with current bicycle trips.

Table 10 looks at what respondents think about cycling by gender, age and car ownership.

Table 10: Thoughts on cycling.

		Gender	Age group	How many cars or vans does your household own?	If you make journeys by bicycle, or if you were to do so, generally how easy or difficult is it for you?	How hilly is it where you live?	If your journey to work, college or training is around 3 miles long or less, how hilly is it?
Gender	Correlation Coefficient	1.000	-.130**	-.023	.173**	.025	.015
	Sig. (2-tailed)	.	.001	.587	.000	.541	.715
	N	612	611	583	560	606	567
Age group	Correlation Coefficient	-.130**	1.000	-.092*	.194**	.108**	.302**
	Sig. (2-tailed)	.001	.	.026	.000	.007	.000
	N	611	613	584	561	607	568
How many cars or vans does your household own?	Correlation Coefficient	-.023	-.092*	1.000	.049	-.116**	-.031
	Sig. (2-tailed)	.587	.026	.	.260	.005	.470
	N	583	584	584	535	580	542
If you make journeys by bicycle, or if you were to do so, generally how easy or difficult is it for you?	Correlation Coefficient	.173**	.194**	.049	1.000	-.193**	.089*
	Sig. (2-tailed)	.000	.000	.260	.	.000	.040
	N	560	561	535	567	566	535
How hilly is it where you live?	Correlation Coefficient	.025	.108**	-.116**	-.193**	1.000	.344**
	Sig. (2-tailed)	.541	.007	.005	.000	.	.000
	N	606	607	580	566	613	573
If your journey to work, college or training is around 3 miles long or less, how hilly is it?	Correlation Coefficient	.015	.302**	-.031	.089*	.344**	1.000
	Sig. (2-tailed)	.715	.000	.470	.040	.000	.
	N	567	568	542	535	573	574

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Significant correlations included that females found it more difficult than males to make bicycle trips; as age increased people found it more difficult to make journeys by bicycle. Households with more cars tended to think it was more hilly where they live as do people who think it is more difficult to make journeys by bicycle.

Table 11 shows how other people influence views on cycling by gender, age and car ownership.

Table 11: Influence of others on views on cycling.

		Gender	Age group	How many cars or vans does your household own?	How often are you unable to make journeys by bicycle because somebody else who is important to you thinks there is too high a risk of you being involved in a road accident?	How often are you unable to make journeys by bicycle because somebody else who is important to you thinks there is too high a risk of you being attacked?
Gender	Correlation Coefficient	1.000	-.130**	-.023	-.097*	-.151**
	Sig. (2-tailed)	.	.001	.587	.023	.000
	N	612	611	583	554	550
Age group	Correlation Coefficient	-.130**	1.000	-.092*	.153**	.202**
	Sig. (2-tailed)	.001	.	.026	.000	.000
	N	611	613	584	554	550
How many cars or vans does your household own?	Correlation Coefficient	-.023	-.092*	1.000	-.077	-.050
	Sig. (2-tailed)	.587	.026	.	.078	.255
	N	583	584	584	530	526
How often are you unable to make journeys by bicycle because somebody else who is important to you thinks there is too high a risk of you being involved in a road accident?	Correlation Coefficient	-.097*	.153**	-.077	1.000	.675**
	Sig. (2-tailed)	.023	.000	.078	.	.000
	N	554	554	530	560	552
How often are you unable to make journeys by bicycle because somebody else who is important to you thinks there is too high a risk of you being attacked?	Correlation Coefficient	-.151**	.202**	-.050	.675**	1.000
	Sig. (2-tailed)	.000	.000	.255	.000	.
	N	550	550	526	552	556

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

This shows that females feel they are more likely than males to be unable to make journeys by bike because somebody else thinks there is a high risk of being attacked (responses to the questions about ability to make journeys by bicycle were coded from “often” (low) to “never” (high)). This is also the case as age increases.

4.2 Theory of Planned Behaviour Analysis

The TPB states that behaviour is the combined result of intentions and perceived behavioural control (PBC). PBC is the perceived ease or difficulty of carrying out a behaviour successfully; it is assumed to reflect past experience as well as anticipated practical impediments and obstacles (Ajzen, 1988). For example, perceived ease or difficulty of walking or cycling. The TPB also sets out the basis for the formation of intentions, stating that

they are formed from the combined effects of attitudes towards behaviour (ATBs), subjective norms, and further influence from PBC. Attitudes towards a particular behaviour are a set of learned (positive/negative) beliefs about a behaviour, its context and its outcomes that result in a tendency to respond in a particular way in a particular situation. This project was specifically concerned with ATBs regarding walking and cycling. Subjective norms (SNs)are an individual's perception of social pressure from significant others to perform (or not) a specific behaviour (e.g., to travel by car or van). The TPB is relatively simple compared with other theories seeking to explain behaviour, and has been widely applied resulting in a proven methodology (DfT, 2009).

The UWAC application of the TPB utilises the two-factor model, which breaks down the core TPB variables into two factors each. The antecedent beliefs are broken down as follows:

- ATBs are split into affective attitudes (emotions), and instrumental attitudes (covering practical aspects).
- SNs are split into injunctive norms (the same as conventional subjective norms), and descriptive norms (which cover what other people do).
- PBC is split into perceived confidence and perceived control.

The variables used in the TPB analysis were derived from a collection of items in the questionnaire. The internal consistency of each group of items was tested using Cronbachs Alpha – all groups had a score of 0.7 of more, indicating a high level of internal consistency.

Most items were measured on a 5 point bi-polar scale ranging from positive to negative, except current behaviour which was measured on a 7 point scale ranging from positive to negative response options.

The following tables show the results of a correlation analysis followed by a regression analysis to predict intentions and behaviour. This is provided firstly for walking, followed by cycling. All models were checked for co-linearity issues and none were found.

Intentions models

Table 12: Correlations and descriptive statistics for intentions to walk (N= 632)

Variable	1	2	3	4	5	6	Mean	SD
1. Intentions to walk		.56	.40	.28	.59	.42	1.71	.84
2. Instrumental Attitudes	.56		.33	.26	.44	.44	2.22	.50
3. Injunctive Norms	.40	.33		.21	.29	.30	2.44	.82
4. Descriptive Norms	.28	.26	.21		.15	.12*****	1.74	.55
5. Perceived Confidence	.59	.44	.29	.15		.26	1.90	.94
6. Personal Norms	.42	.57	.30	.12*****	.26		2.05	.68

Note: all correlations are significant at p<.001, except ***** which is significant at p<.005.

Table 12 shows that all relationships between the variables were positive and statistically significant. The intentions to walk variable is positively correlated with all TPB components, with Perceived Confidence and Instrumental Attitudes having the strongest relationships. The results imply that as intentions to walk become positive, other related attitudes and norms also become more positive.

Table 13: Regression analysis to predict intentions to walk (N = 632)

Predictors	R^2	ΔR^2	F*	β*
Instrumental Attitudes	.503	.503	126.67	.23
Injunctive Norms				.14
Descriptive Norms				.11
Perceived Confidence				.40
Personal Norms				.14

*****all significant at p<.001

The model results show that collectively the predictors explained more than 50% of the variance regarding the intention to walk in the local area. Perceived Confidence made the largest contribution at 40%, with Instrumental Attitudes also making a substantial contribution (23%). These findings suggest that confidence to perform waking trips largely influences whether or not a person intends to walk, similarly, practical issues regarding walking (instrumental attitudes), relating to for example, convenience, cost, health benefits and weather conditions are found to be important in explaining intentions to walk (table 12 showed that intentions to walk increase as such factors become more positive i.e. a person believes there are health benefits and cost savings related to walking). To a smaller extent, the perceived approval/disapproval of significant others regarding the behaviour (injunctive norms) and an individuals own motivations and personal beliefs regarding walking (personal norms) were also important. Affective attitudes (related to emotional aspects of walking such as enjoyment), were omitted from the model as they were not significant in explaining intentions.

Table 14: Correlations and descriptive statistics for intentions to cycle (N= 388)

Variable	1	2	3	4	5	6	7	Mean	SD
1. Intentions to cycle		-.28	-.39	.59	.32	.52	.75	2.90	1.35
2. Affective attitudes	-.28		.53	-.26	-.14*	-.04***	-.47	3.34	.74
3. Instrumental attitudes	-.39	.53		-.27	-.15*	.08**	-.51	2.36	.47
4. Injunctive norms	.59	-.26	-.27		.30	.39	.56	2.78	1.00
5. Descriptive norms	.32	-.14*	-.15*	.30		.24	.23	2.35	.48
6. Personal norms	.52	.04***	.08**	.39	.24		.32	2.18	.79
7. Perceived Confidence	.75	-.47	-.51	.56	.23	.32		2.69	1.14

Note: all correlations are significant at p<.001, except * which is significant at p<.005; ** which is significant at p<.05 and *** which is not significant (p>.05).

Table 14 shows that all of the relationships between the variables were significant (except personal norms and affective attitudes), with around 50% being positive and 50% being negative. The intentions to cycle variable is negatively correlated with affective and instrumental attitudes, implying that as intentions to cycle increase, attitudes towards the behaviour become increasingly negative. This could possibly be a result of negative past experiences amongst cyclists who intend to cycle due to necessity but who don't necessarily enjoy the experience or rate it as convenient. It also implies that there are issues related to practical aspects of cycling such as safety, availability of cycling infrastructure and cycle storage. Intentions correlate positively with injunctive norms implying that as barriers to cycling reduce, such as giving a lift to a dependant person or being unable to cycle due to concerns of important others, intentions to cycle increase. Personal norms were also positively correlated with intentions, implying that as an individual increasingly feels they should cycle, for example due to environmental concerns or health benefits, their intention to cycle also increases. Perceived confidence also relates very positively to intentions, which implies that as cycling becomes easier to perform and an individual feels increasingly confident about performing such behaviour, their intentions to do so will also increase.

Table 15: Regression analysis to predict intentions to cycle (N = 388)

Predictors	R^2	ΔR^2	F**	β
Affective attitudes	.69	.69	138.99	.11*
Instrumental Attitudes				-.16
Injunctive Norms				.14
Descriptive Norms				.08*
Personal Norms				.30
Perceived Confidence				.53

Note: all Betas are significant at p<.001 except ***** which are significant at p<.05. ****** significant at p<.001

Table 15 shows that the TPB predictors explain almost 70% of the variance regarding the intention to cycle in the local area, which is a very good level of explanation. As with the walking model, Perceived confidence made the largest contribution at 53%, with personal norms also making a substantial contribution (30%). This implies that the ease of cycling and the confidence to do so are very important to determining intentions to cycle. In addition, an individuals own motivations and personal beliefs e.g., that they feel they should cycle for the health benefits, for environmental reasons or to save money, are also very important. Whilst being less significant than instrumental attitudes, affective attitudes were a significant predictor in the cycling model, despite not being significant in the walking model. This implies that emotional attitudes, such as those related to enjoyment of the behaviour, and concerns regarding personal safety, are important when predicting intentions to cycle but not so for walking. This is possibly a result of the very different requirements and levels of exposure, for example to road traffic, involved in cycling rather than walking. In addition, it is possible that in some cases cycling will only be performed if it is enjoyable and other modes would be used otherwise, whereas walking is perhaps more of a necessary stage of many journeys compared to cycling, for example, walking to the bus stop, walking to the car, walking to the local shops.

Behaviour models

Table 16: Correlations and descriptive statistics for walking behaviour (N= 751)

Variable	1	2	3	Mean	SD
1. Frequency of walking		.69	.49	2.53	1.62
2. Intentions to walk	.69		.58	1.75	.86
3. Perceived Confidence	.49	.58		1.93	.95

Note: all correlations are significant at p<.001

Table 16 shows a strong positive relationship with frequency of walking and intentions to walk, which is a logical relationship. Current behaviour also has a positive relationship with perceived confidence, which is also logical as it suggests that frequency of walking increases as an individual increasingly perceives it to be easy to perform and feels increasingly confident doing so.

Table 17: Regression analysis to predict walking behaviour (N = 751)

Predictors	R^2	ΔR^2	F*	β*
Intentions to walk	.49	.49	353.67	.62
Perceived Confidence				.13

*****all significant at p<.001

Table 17 shows that the model predictors explained almost 50% of the variance related to current cycling levels. Intentions to walk made a very large contribution at 62%, with

perceived confidence contributing only 13%. This is a very logical outcome as it would be expected that intentions to walk would be the largest predictor of walking.

Table 18: Correlations and descriptive statistics for cycling behaviour (N= 494)

Variable	1	2	3	Mean	SD
1. Frequency of cycling		.65	.77	5.35	1.98
2. Perceived Confidence	.65		.75	2.76	1.14
3. Intentions to cycle	.77	.75		2.95	1.34

Note: all correlations are significant at p<.001.

Current cycling levels are strongly and positively related to both intentions to cycle and perceived confidence in terms of performing cycling behaviour, implying that frequency of cycling increases as individuals intentions to do so increase and as they feel increasingly confident to do so.

Table 19: Regression analysis to predict cycling behaviour (N = 494)

Predictors	R^2	ΔR^2	F*	β*
Intentions to cycle	.602	.602	371.955	.629
Perceived Confidence				.184

*****all significant at p<.001

Table 19 shows that the predictors explained 60% of current cycling behaviour, with intentions to cycle being the most substantial contributor at 63%. Perceived confidence also explains a substantial amount at 18%. The cycling behaviour model is able to explain cycling to a higher degree in comparison to the walking model which suggests that the relationships related to cycling behaviour maybe more linear, for example, intentions relating to cycling are more likely to reflect current behaviour compared to intentions related to walking. This implies that intentions to cycle are more likely to be translated into behaviour in comparison to intentions to walk and behaviour. Therefore, intervening circumstances are more likely to disrupt intentions regarding walking from translating into behaviour in comparison to intentions regarding cycling being disrupted and not being translated into behaviour.

CONCLUSIONS

This paper has reported on some initial findings from a study using two questionnaires to explore attitudes to walking and cycling. A wide range of findings have been reported here, though there is considerable potential for further analysis of the database. Some of the key insights are summarised below.

The level of both walking and cycling increases as an individuals' intentions to do so increase, as an individual increasingly perceives it to be easy to perform and feels increasingly confident doing so.

For both walking and cycling, perceived confidence was the largest predictor of intentions to perform the behaviour, suggesting that ease of performing the behaviour and confidence to do so are very important for both modes.

The results regarding the prediction of intentions reflect the differences between walking and cycling. Whilst being less significant than instrumental attitudes, affective attitudes were a significant predictor in the cycling model, despite not being significant in the walking model. This implies that emotional attitudes, such as those related to enjoyment of the behaviour, and concerns regarding personal safety, are important when predicting intentions to cycle but

not so for walking. This is possibly a result of the very different requirements and levels of exposure, for example to road traffic, involved in cycling rather than walking.

Intentions to perform the behaviour was the largest predictor of both walking and cycling behaviour. The cycling behaviour model explained cycling to a higher degree in comparison to the walking model which suggests that the relationships related to cycling behaviour may be more linear. For example, intentions relating to cycling are more likely to reflect current behaviour compared to intentions related to walking. This implies that intentions to cycle are more likely to be translated into behaviour in comparison to walking. Therefore, intervening circumstances are more likely to disrupt intentions regarding walking from translating into behaviour in comparison to intentions regarding cycling being disrupted and not being translated into behaviour.

The TPB results suggest some key issues to address in terms of increasing levels of walking and cycling. Firstly, both modes need to be considered as practical and easy to perform in order to increase intentions and thus levels of walking and cycling. Confidence is more relevant to cycling than walking, which could possibly be addressed through learning schemes and practice such as bike buddy schemes which help individuals to overcome their uncertainty and fears. Emotional aspects of cycling such as enjoyment could be addressed through practice and would possibly increase with confidence. For issues relating to personal safety whilst cycling, other kinds of measures may be required, for example, separation from other road traffic which could possibly occur through the provision of consistent, connected and direct off road cycle paths. For walking, it is possible that better planning of trips through simple practical measures could increase levels, for example, easy access to appropriate clothing to prevent weather conditions disrupting intentions to walk.

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