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papers for the ISCTSC, Costa-Rica 2004

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Publication date:

2004

Permanent link:

<https://doi.org/10.3929/ethz-a-004753186>

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Originally published in:

Arbeitsberichte Verkehrs- und Raumplanung 216

Immobility and mobility seen through trip based versus time use surveys

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Mobility surveys are not the only data source giving insights on trip making, especially on immobility for which an overestimation can sometimes be suspected because of "soft refusal" [Axhausen et al., 2003]. Different approaches can be adopted to describe mobility:

- in trip based surveys, information on movements is collected (time and location of departure and arrival, purpose, mode, etc.) with sometimes a question on "reasons for staying at home" if no trip is recorded on the surveyed day,
- in time use surveys (TUS), activities (not only trip purposes) are registered all along the day on a precoded grid with 10 mn time brackets.

These survey sources give different points of view on the same phenomena: trip making. The main issues to be discussed concern both data quality and data analysis. The study is based on surveys conducted in Belgium and in France.

1- Presentation of the data

1.1 Data on mobility

The French NPTS 1993-94 is the fourth survey conducted by INSEE since mid sixties on this topic. It retains the definitions and the essential principles used previously to maintain the statistic continuity so as to enable the measurement of evolution. The purpose of this survey is to describe the trips made by households who are living in France, as well as their use of public and private transport means. Specifically, we have attempted to describe all trips made, whatever their purpose, mode of transport, length, period in the year or time of the day. we are also interested in the level of access to public transport and in the private transport ownership of each household. To describe short distance trips, we have chosen an individual (over 5 years old) at random from the selected household in the sample to record all trips made the day before and the previous week-end. The sample of more than 14000 respondent was spread over 8 waves from May 1993 to April 1994 in order to neutralize the seasonal effects.

In 1999 the Belgium National Institute of Statistics conducted a survey on mobility and travel (MOBEL). A sample of about 3000 respondent households was spread all along the year. All member over 6 years old of the selected household was asked to describe their mobility of one day chosen at random (same day for all member of the household). The Transport Research Group in the University of Namur (GRT) coordinated the transport survey for a federal and governmental project.

1.2 Data on time use survey

At the end of 90's, EUROSTAT has coordinated Time Use Surveys (TUS) in most of European countries. The French time use survey 1998-99 is the third survey conducted by INSEE since mid seventies on this topic. It retains the definitions and the essential principles used previously to maintain the statistic continuity so as to enable the measurement of evolution. The main objective of these surveys is the knowledge of daily life time use in quantifying daily activities with a time grid of 10 minutes. The day is divided according 4 daily fundamental times : professional work, homework, free time and physiologic

time. This survey tackle the following themes : time budget, activity, professional work, domestic work, leisure, transport, body care, care to children, sleep, alimentation and social relation. To describe the daily activities, all individuals over 15 years old from the selected household in the sample have to record all activities made during one day (fixed at random by the interviewers) in a time use questionnaire. The sample of more than 15000 respondent was spread over 8 waves in order to neutralize the seasonal effects.

During the year 1999, the Belgium National Institute of Statistics conducted a time use survey. The sample of about 4300 respondent households was spread all over the year. To describe the daily activities, all individuals over 12 years old from the selected household in the sample have to record all activities made during one day (fixed at random by the interviewers) in a time use grid of 10 minutes.

1.3 Comparison of methodologies

Travel surveys serve different purposes than TUS but both could give daily mobility indicators. The methodology of the French NPTS and the French TUS and MOBEL and the Belgium TUS (table 1) are different, so that the indicators are not expected to be strictly equal. It is commonly known that trips and activities agenda give different results for transport analysis (Stopher 1992).

Table 1 : Methodology of the French NPTS, MOBEL, and the TUS in France and in Belgium

	France		Belgium	
	Mobility and travel	Time use	Mobility and travel	Time use
Data collection	Face to face interview	Self administrated form with a face to face interview	Postal, self administrated form, with telephone calls for explanation, reminders, etc.	Self administrated form with two face to face interviews
Period under review	>From May 1993 to April 1994. Except August 3 rd to August 22 1993.	From May 1998 to April 1999.	From December 1998 to December 1999	From December 1998 to February 1999
Number of interview per Household	One member of the household over 6 years old randomly selected	All member of the households over 15 years old	All member of the households over 6 years old	All member of the households over 12 years old
Respondent sample size	14 150	15 441	5 146	8 382
Type of questionnaire	Questionnaire filled by the interviewer	Activities agenda	Trips agenda	Activities agenda
Unit of time	Continuous time (e.g. Trip from 14h13 to 14h18)	10 minutes interval (e.g. 14h00 to 14h09: activity)	Continuous time (e.g. Trip from 14h13 to 14h18)	10 minutes interval (e.g. 14h00 to 14h09: activity)
Activity	Reasons for travel are pre-coded within a list of types of activities	Open description of activities which motivate trips	Reasons for travel are pre-coded within a short list of types of activities	Open description of activities which motivate trips
Geography	Precise locations	Poor geographical indications	Precise locations and descriptions	Rough geographical indications
Mode of transport	Descriptions of various means of transport used successively	No indication	Descriptions of various means of transport used successively	Main mean of transport during 10 minute interval
Day of interview	One day chosen (more or less at random) by the interviewer and by the respondent	One day chosen at random	One day chosen at random	Two reference days for each household: one weekday, one Saturday or Sunday chosen at random

For this study and to have comparable data, in France we will work only on individual over 15 years old and over 12 in Belgium. But there are some technical problems to make the data compatible because descriptions of travel time, trips, as well as their definitions, are not exactly the same. In order to make this comparison we tried to adapt transport survey data, so that we could reproduce the 10-minute slot structure of the TUS. How would a MOBEL respondent have filled the TUS questionnaire? We assumed that the times would have been round figures, and that travel of four minutes or less would not have been considered. Then we changed travel times, times of departure and arrival in MOBEL to round figures, and we disaggregated compound trips with different segments of different modes.

2. The question of immobility (staying at home) and/or soft refusal

In both country, the immobility rate seen throughout Mobility and Time Use surveys are statistically different. In TUS we have a lower rate of immobility and the gap of immobility rate between the two types of surveys is about the same 8.2 points for Belgium and 9.1 points for France (cf. table 2). This gap is more important for female (9.4 point in France and 9.0 points in Belgium).

Table 2 : Immobility rates according to gender

Gender	French NPTS			French TUS		
	Immobility rate	Lower level at 95%	Upper level at 95%	Immobility rate	Lower level at 95%	Upper level at 95%
Male	13.9%	13.0%	14.8%	5.6%	5.0%	6.3%
Female	20.3%	19.4%	21.3%	10.9%	10.1%	11.6%
All	17.4%	16.8%	18.1%	8.3%	7.8%	8.9%
Gender	Belgium MOBEL			Belgium TUS		
	Immobility rate	Lower level at 95%	Upper level at 95%	Immobility rate	Lower level at 95%	Upper level at 95%
Male	17.5%	16.0%	19.0%	10.2%	9.3%	11.1%
Female	25.8%	24.1%	27.4%	16.8%	15.7%	17.9%
All	21.8%	20.7%	23.0%	13.6%	12.8%	14.3%

Sources : French NPTS 1993-94, French TUS 1998-99, Belgium MOBEL 1999, Belgium TUS 1999

It's in the age band 20 to 49 years old where people are less immobile, in the Time use surveys we found about 3% to 4 % of immobile in France and 6% in Belgium (cf. table 3). Then this rate rise with the age, in France we found 7.3% of immobile for the age band 50-59 years old then 13.0% for 60-69 years old and then 26.0% for those who are over 70. In Belgium, the figures are respectively 14.7%, 22.7% and 38.6% for respectively the age band 50-59, 60-69 and over 70 years old.

In both countries, the gap between the estimations of immobility rates with Mobility and Time Use surveys is light for the age band 20 to 49 years old, and it's rise with the age (and also with the immobility rate) (cf. table 3). In France, it is for those who are over 60 years old that the gap is important between the two surveys (over 15 points in France and 8 points in Belgium), and this explain why the gap is bigger in France than in Belgium.

Table 3 : Immobility rates according to age

Age	Immobility rates			
	French NPTS	French TUS	MOBEL	Belgium TUS
12 or 15 - 19	12.7%	4.5%	16.9%	6.9%
20 - 29	6.9%	2.8%	15.0%	6.1%
30 - 39	7.4%	3.7%	11.8%	6.5%
40 - 49	10.2%	4.0%	17.0%	6.2%
50 - 59	16.6%	7.3%	23.4%	14.7%
60 - 69	28.0%	13.0%	30.7%	22.7%
over 70	43.5%	26.0%	46.3%	38.6%
All	17.4%	8.3%	21.8%	13.6%

Sources : French NPTS 1993-94, French TUS 1998-99, Belgium MOBEL 1999, Belgium TUS 1999

According to Time use surveys, in both countries, Friday is the day where there are the less immobile (7.9% in France and 9.9% in Belgium) (cf. table 4). In France it's on Monday and Wednesday that people stay more often at home (about 9%) and in Belgium it's on Tuesday and Wednesday (about 15%). Let's note that there is no school for children on Wednesday in France and in Belgium there is no school only on Wednesday afternoon.

In both countries, the gap between the estimations of immobility rates with Mobility and Time Use surveys is the largest for Monday (about 12 point in France and 8 point in Belgium), it's also the day where immobility is important (cf. table 4). There are more concordance between Mobility and time use surveys for Tuesday and Friday in Belgium (gap of about 5 points) and for Tuesday in France (gap of about 7 points).

Table 4 : Immobility rates according to the day of description

Day of description	Immobility rates			
	French NPTS	French TUS	MOBEL	Belgium TUS
Monday	21.4%	9.0%	22.4%	14.9%

Tuesday	14.9%	8.0%	22.7%	15.9%
Wednesday	18.5%	8.8%	22.5%	15.3%
Thursday	16.3%	8.2%	16.9%	12.1%
Friday	16.2%	7.9%	15.5%	9.9%
Weekday	17.4%	8.3%	21.8%	13.6%

Sources : French NPTS 1993-94, French TUS 1998-99, Belgium MOBEL 1999, Belgium TUS 1999

In the French NPTS, we found that on Monday there is 21.4% of immobile and on Tuesday this share is the lowest (about 14.9%) (cf. Table 4). According to the protocole of the survey, people describes the trips they have made the day before the interview. So, on Tuesday people describes their Monday mobility. But Tuesday, we could also interviewed more persons that are immobile (because those who were mobile were not at home).

Table 5 : Immobility rates according to social category

Social category	Immobility rates	
	French NPTS	French TUS
Farmers	45.3%	22.1%
Craftsmen / Tradesmen	22.8%	9.6%
Executives	10.7%	4.8%
Technicians	10.8%	4.9%
Employees	15.8%	8.5%
Workers	18.1%	9.4%
None	18.4%	8.2%
All	17.4%	8.3%

Sources : French NPTS 1993-94, French TUS 1998-99

In France, it is the farmers who stay more often at home (about 22% in the Time Use survey). Probably that more often they worked at home (cf. Table 5). At the opposite it is the executives and the technicians who are less immobile (about 5% in the Time Use survey). In Belgium, it's those who went to the university that are the less immobile (cf. Table 6).

Table 6 : Immobility rates according to instruction level (person above 18 only)

Instruction level	Immobility rates	
	MOBEL	Belgium TUS
Primary school or no diploma	42.1%	26.2%
Secondary inf school	21.9%	15.2%
Secondary sup school		8.6%
Superior and university	11.8%	7.3%
All	21.8%	13.6%

Sources : Belgium MOBEL 1999, Belgium TUS 1999

Of course, there are some technical problems to make the data compatible because descriptions of travel time, trips, as well as their definitions, are not exactly the same. In the mobility surveys, a trip is a movement by a person from one place to another preceded and followed by two activities, different from transport. In the TUS, it is, quite naturally, a continuous period of travel with one mean of transport.

These differences cause some technical biases, for instance:

- a very short trip (for instance taking the dog out for two minutes) may appear as an activity involving no travel, while it should theoretically be noted in a mobility survey. Similarly, a very short activity (for instance buying cigarettes) breaking a phase of transport should split the trip in two while there would be only one trip in a TUS.
- a 5 or 15-minute trip (and there are many of them in a mobility survey) can overlap one or two time slots and then appear if it had lasted 10 or 20 minutes in the TUS.

In Belgium, activity based approaches give a better description of short (mainly walk) trips; thus, if an overestimation of immobility is due to the omission of short trips, a better description of immobility could be expected from them.

3. Comparison on mobility

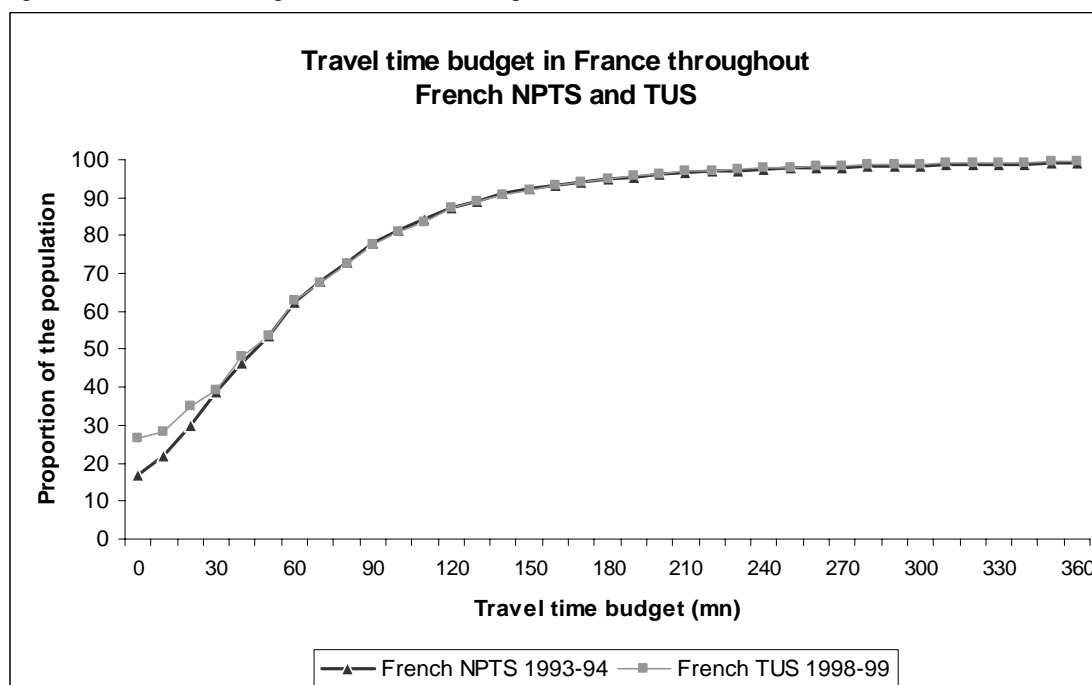
In this section, we will compare the Time Use surveys and the mobility surveys in term of travel time budget (e.g. time dedicate to travel per person and per day) and also in term of number of trips per day and per person.

For french Time use survey there is only one variable "LITRA" that explain (location and trips) which is coded 0 to 4 (0: at home; 1: at work location; 2: outside; 3: home – work trip; 4: other trip) and with only one choice possible. Immobile in the TUS is person where the value of variable "LITRA" is equal to 0 for all day long. Travel time budget for a person is the some of duration where the variable "LITRA" equal to 3 or 4. We could have another definition of immobile (those who have a travel time budget equal to zero) and both definition gives diferent results.

3.1 Mobility in term of daily travel time budget

With the following definition of immobility: travel time budget equal to zero, in the French Time Use survey, there is 26.7% of immobile people (instead of 8.3% see section 2). For the french case this difference is probably due to low mobile (in term of duration) people, because if we compare the cumulative frequency of daily travel time budget of the NPTS or the TUS, until a daily travel time budget of half an hour, the cuve for the NPTS is "under" the curve for the TUS (cf. Figure 1).

Figure 1: Travel time budget in France according French NPTS 1993-94 and TUS 1998-99



Sources : French NPTS 1993-94 and French TUS 1998-99.

The measurement of time is a crucial point in the comparison: fixed grid of 10 mn interval versus a spontaneous response on time of departure and of arrival often rounded [Madre et al., 1997]. For Belgium, we tried to adapt transport survey data, so that we reproduce the 10-minutes slot structure of the TUS. For France we did not change the estimation of duration.

In both countries, the male have a travel time budget more important than the female (+ 15 minutes in France and +19 minutes en Belgium according to mobility survey) (cf. Table 7). The Time Use surveys overestimate the daily travel time budget of 2 minutes in France and this figure of about 26 minutes in Belgium.

In both countries and with both methodologies, the travel time budget rise until the age band 20-29 years old and then it decrease (cf. Table 7). The maximum travel time is then 77 minutes in France and 75 minutes in Belgium (Mobility surveys) and the minimum is for aged people (over 70 years) where these figures are 30 minutes in France and in Belgium. For France the difference between the two surveys remain in the confidence interval (at the level of 95%).

Table 7: Travel time budget according to gender, age, reporting day

Socio-demographics	Travel time budget (mn)			
	French NPTS	French TUS	MOBEL	Belgium TUS
Gender				
Male	72	69	68	92
Female	57	56	49	77
All	64	62	59	85
Age				
12 or 15 – 19	63	70	51	86
20 – 29	77	81	75	102
30 – 39	74	77	74	100
40 – 49	77	70	66	95
50 – 59	61	63	51	81
60 – 69	48	38	52	72
Over 70	30	25	30	44
All	64	62	59	85
Day of description				
Monday	59	63	52	79
Tuesday	67	59	65	80
Wednesday	61	58	59	79
Thursday	63	65	57	81
Friday	69	66	67	101
Weekday	64	62	59	85

Sources : French NPTS 1993-94, French TUS 1998-99, Belgium MOBEL 1999, Belgium TUS 1999

By age band in France, the gap between of the estimations of daily travel time budget with Mobility and Time Use surveys is less than ± 5 minutes except for the age band 15-19 (-7 minutes), 40-49 (+7 minutes) and for the age band 60-69 (+10 minutes) (cf. Table 7). In Belgium the minimum gap between these two survey is for aged people (over 70 year old -14 minutes).

In both countries, Friday is the day where the time dedicated to travel is the biggest (69 minutes in France and 67 minutes in Belgium), then come Tuesday in average 2 minutes less than the Friday (cf. Table 7). The day where people reduce they travel time budget is Monday (59 minutes in France and 52 minutes in Belgium). Let's notes that these figures are inversely proportionnel with the immobility rates.

In France, the gap between of the estimations of daily travel time budget with Mobility and Time Use surveys by reporting day is high when for Tuesday +8 minutes. In Belgium the highest gap is for Friday (-34 minutes) and Monday (-27 minutes).

In France, the Executives and the technicians are those who dedicated the biggest daily travel time budget (90 minutes for Executives and 77 minutes for technicians) (cf. Table 8). Farmers are those who have the lowest travel time budget (30 minutes) probably because they Home to work trips are very short. Let's notes that these figures are inversely proportionnel with the immobility rates. In Belgium, those who went to the university dedicated the biggest daily travel time budget (86 minutes) (cf. Table 9).

Table 8 :Travel time budget according to instruction level (person above 18 only)

Social category	Travel time budget (mn)	
	French NPTS	French TUS
Farmers	30	26
Craftsmen/Tradesmen	58	56
Executives	90	79
Technicians	77	73
Employees	62	58
Workers	57	55
None	62	67
All	64	62

Sources : French NPTS 1993-94, French TUS 1998-99

Travel time budget estimation is difficult with TUS surveys, as we can see TUS under-estimates the travel time budget of 8 minutes in France and gives an over-estimation of 26 minutes in Belgium. The comparison of the two methodologies according some socio-demographic variables says that these

differences are parallel (tables 7 to 9), and if we calibrate a correlation this coefficient is 0.94 for France and 0.92 for Belgium.

Table 9 :Travel time budget according to instruction level (person above 18 only)

Instruction level	Travel time budget	
	MOBEL	Belgium TUS
Primary school or no diploma	30	63
Secondary inf school	54	79
Secondary sup school		93
Superior and university	86	103
All	59	85

Sources : Belgium MOBEL 1999, Belgium TUS 1999

3.2 Mobility in term of daily trips frequency

In France, the male have a daily trips frequency more important than the female (+0.26 trips in the NPTS and +0.21 trips in the TUS) (cf. Table 10). The French Time Use survey underestimate the daily travel time budget of 0.88 trips (0.91 trips for the male and 0.86 trips for the female).

In France and with both methodologies, the daily trips frequency rise until the age band 30-39 years old and then it decrease (cf. Table 11). The maximum of frequency is 4.18 trips per day (Mobility surveys) and the minimum is for aged people (over 70 years) where these figures are 1.58 trips.

By age band in France, the gap between of the estimations of trips frequency with Mobility and Time Use surveys is minimum either for young people (+0.48 trips per day) or for aged persons (+0.57 trips per day) (cf. Table 11). For the age band 30-49 this gap is over one trips per day.

In France, Tuesday, Thursday and Friday are the days where trips frequency is high (3.51 trips per person on Tuesday, 3.33 trips on Thursday and 3.40 trips on Friday). At the opposite, Monday and Wednesday people do less trips (3.00 trips per person on Monday and 3.09 trips on Wednesday) (cf. Table 11).

The gap between of the estimations of daily trips frequency with Mobility and Time Use surveys by reporting day is high for Tuesday (+1.16 trips) and is minimum for Monday (+0.58 trips) (cf. Table 11). Because the estimation of trips frequency according the reporting day with the Time Use surveys gives similar results and in the NPTS, Monday is low mobile day and Tuesday an high mobile day.

In France, the Executives and the technicians are those who are very mobile (3.71 trips per day for the Executives and 3.77 trips per day for the technicians) (cf. Table 11). Farmers are those who produce the lowest trips frequency (1.91 trips per day) (cf. Table 11).

Table 10: Number of trips per day according to gender

Gender	French NPTS			French TUS		
	Number of trips per day	Lower level at 95%	Upper level at 95%	Number of trips per day	Lower level at 95%	Upper level at 95%
Male	3.40	3.35	3.44	2.49	2.44	2.54
Female	3.14	3.07	3.20	2.28	2.23	2.34
All	3.26	3.20	3.32	2.38	2.34	2.42

Sources : French NPTS 1993-94. French TUS 1998-99

Table 11: Number of trips per day according to socio-demographics characteristics

	Number of trips per day	
	French NPTS	French TUS
Age		
15 – 19	3.06	2.58
20 – 29	3.85	2.97
30 – 39	4.18	3.16
40 – 49	3.76	2.72
50 – 59	3.00	2.34
60 – 69	2.41	1.43
Over 70	1.58	1.01
All	3.26	2.38

Day of description		
Monday	3.00	2.42
Tuesday	3.51	2.35
Wednesday	3.09	2.24
Thursday	3.33	2.45
Friday	3.40	2.47
Weekday	3.26	2.38
Social category		
Farmers	1.91	1.09
Craftsmen / Tradesmen	3.02	1.98
Executives	3.71	2.76
Technicians	3.73	2.83
Employees	3.43	2.38
Workers	3.18	2.20
None	2.95	2.45
All	3.26	2.38

Sources : French NPTS 1993-94, French TUS 1998-99

4 Conclusion

This comparison reveals that estimation of mobility with a TUS is subject to bias in term of immobility rates and travel time budget. It can be said as well that TUS biases time budgets because it rounds durations of very short trips to too large values.

The Belgian time use survey catches more trips than the transport surveys, but the two surveys correspond qualitatively well. The gap is larger for mobility rates than for transport time budgets and larger for time budgets than for number of trips or modal share.

At last, corrections made on the assumptions of how a mobility survey respondent would have filled in the TUS questionnaire always make the indicators converge better.

It was also possible to compare indicators for different levels of education training. That comparison shows off that the lower the education level is, the more the surveys diverge. This seems to prove that the challenge to fill such a questionnaire bother many respondents with average or under-average education level. They will fill in the household and individual parts, but not that on trips. The workload of the respondent may have caused a "soft refusal" (Axhausen et al 96).

We can also see, when comparing the indicators for types of activity that the surveys diverge less for working people than not working, perhaps because home to work trips are much easier to conceptualise and write down in a transport survey questionnaire.

In Belgium TUS seems more reliable and amasses more trips but not in France. Mobility surveys have advantages: its gathers precise description of trips combining different modes, and better geographical information. We could assess from this analysis that the two surveys correspond qualitatively well to one another, especially on weekdays. Daily number of trips per person, and modal shares in travel time are quite similar, though the time-use survey bias may exaggerate the share of walking. It seems both conceivable and potentially advantageous to combine the two databases in order to improve estimations for further modelling.

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