


# Leisure travel in a historical perspective - changes in the structures of time and space use

**Working Paper****Author(s):**

Schlich, Robert; Schönfelder, Stefan; Hanson, Susan; [Axhausen, Kay W.](#) 

**Publication date:**

1999

**Permanent link:**

<https://doi.org/10.3929/ethz-a-004348179>

**Rights / license:**

[In Copyright - Non-Commercial Use Permitted](#)

**Originally published in:**

Arbeitsberichte Verkehrs- und Raumplanung 107

---

# **Leisure travel in a historical perspective - Changes in the structures of time and space use**

**Robert Schlich, Stefan Schönfelder, Susan Hanson and Kay W.  
Axhausen**

**Arbeitsbericht Verkehrs- and Raumplanung 107**

**January 2002**

**Institut für Verkehrsplanung, Transporttechnik, Strassen- and Eisenbahnbau (IVT)**



**Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich**

Working paper 107

## **Leisure travel in a historical perspective - Changes in the structures of time and space use**

Robert Schlich, Stefan Schönfelder and  
Kay W. Axhausen  
IVT  
ETH  
CH-8093 Zürich  
Switzerland

Susan Hanson  
Clark School of Geography  
Clark University  
Jefferson Academic Center Room 212  
950 Main St. Worcester, MA 01610  
United States

Telephone: 0041-1-633 30 85  
Fax: 0041-1-633 10 57  
Email: [schlich@ivt.baug.ethz.ch](mailto:schlich@ivt.baug.ethz.ch)

Telephone: 001-508-793-7323  
Fax:  
Email: [shanson@clarku.edu](mailto:shanson@clarku.edu)

May 2002

### **Abstract**

Leisure activities play a more and more dominant role in our daily lives and their importance has increased steadily over the last 40 years compared to other activities. Considering leisure travel, one would expect to discover this trend in recent empirical work. Unfortunately, this has not been possible in Germany or other countries due to lack of suitable data. The lack of suitable data is mainly caused by the fact that different leisure activities are performed very sporadically and are influenced by changing conditions like weather, traffic conditions etc. It is thus desirable to obtain data over periods substantially longer than one or even several days (*longitudinal data*).

Two surveys are analysed here (*Mobidrive* and Uppsala) which are unique concerning their observation period duration. They allow to compare intrapersonal behaviour at two different points in time (i.e. 1971 and 1999). Regardless of methodological problems, a comparison provides at least first hints about which changes occurred over almost 30 years and which trends exist in leisure travel.

### **Keywords**

Leisure travel – time and space structures – long-term travel data – historical changes – ETH Zürich – Institut für Verkehrsplanung and Transporttechnik, Strassen- and Eisenbahnbau (IVT)

# 1 Introduction

Leisure is the most important trip purpose with respect to travelled kilometrage. In 1997, 41% of all person kilometres in Germany were travelled for leisure purposes (combined with holiday trips the share rises to 48%), which is twice the amount than for commuting (Bundesministerium für Verkehr, Bau- and Wohnungswesen, 2000). Due to the dispersion of leisure activity locations, the inefficiency of public transport serving these places and the advantages of motorised individual modes in flexibility and comfort, most of the leisure trips (80%) are made by private car. Therefore leisure travel is a major contributor to the negative effects of emissions caused by motorised car traffic and should be a major concern for infrastructure planning as well as environmental policy.

Despite the significant contributions of leisure travel to the overall traffic volume, it has received relatively little attention in mobility analysis and forecasting. Researchers have so far dealt with commuting and peak hour traffic - generally because of the importance of work traffic for peak load and the heterogeneity of leisure trips. For many reasons, leisure travel is much more variable than travel for any other activity purpose – for example concerning the embedding into our daily life structures (i.e. the activity chains like “home-work-leisure-home”) and the underlying motivations for leisure activities. Generally, leisure travel may be characterised by less rigid temporal and also spatial constraints compared to travel to work or school.

## ***Leisure travel and the developments in time use***

It is common practice in the activity based travel analysis to understand travel as a derived demand (for example Jones, Koppelman and Orfeuil, 1990). To create effective measures to influence travel patterns - such as policies to encourage travellers to use predominantly public transport instead of the own car for visiting leisure locations - it is necessary to understand changes in the structure of leisure activities in the past. Leisure activities are influenced by several constraints which have changed notably over the last 30 years. Important factors influencing the disposable time budget for example are the socio-demographics, the settlement structures and car ownership (see Lücking and Meyrat-Schlee, 1994). The changing travel behaviour is thus partially caused by a steady increase of the leisure time budget and the reduction of working hours to the current average 40-hourweek in Germany. Garhammer (1999) showed that the average weekly working time decreased from 48.3 hours/week to 38.1 hours/week in Germany between 1965 and 1995 and from 52.5 to 42.0

hours per week during the same period in the United States. Additionally, workers have been granted a growing number of vacation days and a decrease in the retirement age. A parallel relevant tendency is the decline of reproduction time in the households, i.e. the decreasing obligations in housework due to technological progress (Robinson and Godbey, 1997). These trends are accompanied by a number of other developments: Garhammer explains that the strict separation of working time from leisure time is getting weaker and that the number of people working at five days a week from 8 A.M. to 5 P.M. (standard working time in the fordistic area) dropped to 17% in Germany from the mid 1960s to 1995 while at the same time a growing number of people have to or wish to work on weekends. Together with a steadily increasing average income and better accessibility of leisure facilities due to the increased car ownership and usage, this had important impacts on the performance of leisure activities.

The changing time use patterns and the growing societal importance of leisure are reflected in the change of leisure and holiday activities and the related travel behaviour. People tend to go on holidays more frequently and for shorter durations to destinations even further away. In addition to that, the structure and performance of every-day leisure activities have also been changing. The number and variety of different activities performed during leisure time have increased significantly and the activities themselves have been getting more and more specialised - e.g. every kind of extreme or fun sports instead of traditional sports (Cordell, Betz and Green, 2002). Other studies (Robinson and Godbey, 1997 and Fastenmeier, Gstalter and Lehning, 2001) showed that the number of activities performed in clubs or associations have decreased since the 1960s while the importance of individually performed sports or hobby activities have increased significantly and have been getting more and more specialised, too.

### ***Existing databases and empirical analysis in travel behaviour research***

One would expect to discover these trends in the recent empirical work of travel behaviour research. Unfortunately, this has not yet been the case for Germany or other countries due to a lack of suitable data. At present, there is not even clear evidence if the share of leisure travel is increasing compared to other trip purposes (Brunsing, 2000). The German national travel survey KONTIV and projections based on this survey indicate an increase of mileage travelled for leisure purposes by 57% from 1976 until 1997 (Bundesministerium für Verkehr, Bau- and Wohnungswesen, 2000). This increase does not differ much for other trip purposes, though. During the same time, the number of yearly leisure trips per person didn't change much (Brunsing, 2000). The KONTIV database like other regional and/or national travel databases does not cover this question in detail because of its limited differentiation between

trip purposes. In addition, leisure trips are not divided into different sub-categories such as 'visiting friends', 'active sports' etc.

To analyse leisure activities as well as leisure travel and especially the changes over time, the generation of more detailed databases seems crucial. The lack of relevant data is mainly caused by the fact that different leisure activities are performed very sporadically and are influenced by changing conditions like weather, traffic conditions etc. It is thus desirable to obtain data of travellers over extended periods substantially longer than one or only few days (*longitudinal data*). In addition to that, it would be helpful to collect data that is comparable at several different - and fairly distant - points in time (*panel data*). Because it is expensive to conduct panel or longitudinal studies, neither has been performed often. Besides, data based on one single day (common *cross-sectional data*) like the National Travel Survey in the U.S. or the KONTIV survey in Germany contains biases concerning leisure traffic, as described above, and is therefore not sufficient for a detailed investigation of leisure time budgets and leisure travel. Another major advantage of longitudinal databases is that it allows the analysis of temporal aspects of travel behaviour such as the rhythms of daily life or intrapersonal variability.

This paper addresses the described research deficits and attempts to answer questions about how leisure activities and leisure travel have changed over the last 30 years. The focus of the investigations is on three different aspects: First, we have a brief look at general trends and characteristics in leisure activities and related leisure travel. Then the aspect of intrapersonal variability of travel behaviour is addressed, i.e. the question to which extent individual travel behaviour varies from day to day or is repetitious. Finally, some notes are made concerning the spatial variability of leisure travel (i.e. distances travelled and locational choice).

## 2 Database

### *Survey Design*

The main reasons for the lack of suitable data for the analysis of longitudinal aspects of travel such as intrapersonal variability are the difficulties and the expense of obtaining individual long-term travel data. The specific problems within longitudinal surveys result mainly from the high response burden for the participants and the danger of fatigue effects. Apart from that, it must be ensured that self-selection effects which would bias the results are eliminated. Additionally, people may forget to report short or “unimportant” trips with increasing duration of the survey (*fatigue effects*) (Golob, 1986).

The investigation of leisure travel here is based on longitudinal data and on data at different points in time. We chose two of the few existing travel datasets which on the one hand cover a multi-week period of time and on the other hand are representative for the particular populations: (1) the Uppsala (Sweden) dataset from 1972 with a 5 week reporting period and (2) the German *Mobidrive* dataset of 1999 covering 6 weeks. It would have been desirable to compare behaviour of the same travellers at two points in time, but unfortunately there was no suitable panel survey data available.

The *Mobidrive* dataset is the result of a six-week travel diary implemented in the context of the research project *Mobidrive*. Funded by the German Federal Ministry for Education and Research, a total of 361 persons were interviewed in the cities Karlsruhe and Halle/Salle in spring and autumn of 1999<sup>1</sup>. A documentation of sampling procedures, the survey instruments, and data administration is given in Axhausen, Zimmermann, Schönfelder, Rindsfuser and Haupt (2002). Frequencies and statistics of all variables are documented by Schönfelder, Schlich, König, Aschwanden, Kaufmann, Horisberger and Axhausen (2002a, b)<sup>2</sup>. The interviewed persons reported about 52,000 trips on 14,500 person days over the six weeks of survey period. It could be shown that – due to an intensive contact of the project consortium with the participants – the quality of the data is very high and that neither a drop-out nor a fatigue effect could be detected (Axhausen *et al.* 2002).

---

<sup>1</sup> The project consortium consisted of the PTV AG (Karlsruhe), the Institut für Stadtbauwesen at RWTH Aachen and the Institute of Transport Planning, Traffic, Highway and Railway Engineering (IVT) at ETH Zurich. Further information is available at <http://www.ptv.de/mobidrive/>

<sup>2</sup> Both papers are available at [http://www.ivt.baug.ethz.ch/vrp/arbeitsberichte\\_d.html](http://www.ivt.baug.ethz.ch/vrp/arbeitsberichte_d.html)

The questionnaire was explained to the participants in a face-to-face interview. It consisted of a diary for each week of the six-week survey. The respondents were asked to report every trip of the day and to add relevant information about each trip (see Figure 1 for the questionnaire).

Figure 1: Questionnaire *Mobidrive*

---



An welchem **WOCHENTAG** haben Sie diesen Weg unternommen? → Mo Di Mi Do Fr Sa So ①

Um wieviel Uhr haben Sie diesen Weg **BEGONNEN**? → Beginn (Uhrzeit)

Zu welchem **ZIEL** bzw. **ZWECK** haben Sie diesen Weg unternommen?  
Bitte geben Sie genau einen Grund an.

Mit welchem **VERKEHRSMITTEL** bzw. mit welchen Verkehrsmitteln sind Sie zu Ihrem Ziel gelangt? Wieviel **ZEIT** haben Sie dafür jeweils gebraucht (in Minuten, ohne Wartezeiten)?

Bitte geben Sie die **ZIELADRESSE** so genau wie möglich, d.h. mit Straße, Hausnummer und Ort an.

Wieviele Haushaltsmitglieder und/oder andere Personen haben Sie auf diesem Weg **BEGLEITET**? Haben Sie Ihren Hund ausgeführt?

Welchen **GELDBETRAG** haben Sie für oder im Verlauf der Aktivität ausgegeben?

Welchen Geldbetrag haben Sie für Fahrscheine, Parkgebühren oder das Taxi ausgegeben (keine Treibstoffkosten)?

Um wieviel Uhr sind Sie am Ziel **ANGEKOMMEN**?

Bitte schätzen Sie die **ENTFERNUNG** des Weges möglichst genau.

Jmd. Abholen/Wegbringen  
 Erledigung/Dienstleistung  
 Dienstlich/geschäftlich  
 zur Ausbildung/Schule  
 zur Arbeit  
 Einkauf  
 täglicher Bedarf  
 langfristiger Bedarf  
 Freizeit, und zwar  
  
 Sonstiges, und zwar  
  
 nach Hause

nur zu Fuß  
 zu Fuß zum Verkehrsmittel  
 Fahrrad  
 Mofa, Motorrad  
 Pkw als Fahrer  
 Pkw als Mitfahrer  
 Bus  
 Straßen-/Stadtbahn  
 Eisenbahn  
 zu Fuß zum Ziel

(Straße, Haus-Nr.)  
(Ort)

Haushaltsmitglied(er)  
 Andere Person(en)  
 Hund

keine Ausgaben  
 bis DM 10,--  
 über DM 10,-- bis DM 25,--  
 über DM 25,-- bis DM 100,--  
 über DM 100,--

Fahrschein, Parkgebühr, Taxi etc.  
 DM, Pf

Ankunft (Uhrzeit)

km  m

Weitere Wege bitte auf der nächsten Seite eintragen!

A pre-paid return envelope was sent with the new diary to the respondents each week. The household members were contacted each week by phone and they themselves could contact the survey firm anytime during the reporting period. The respondent got an incentive, which was larger than symbolic, but smaller than a true payment for the time needed (100-200 DM depending on the household size). Compared to other representative studies in those cities (based on single-day travel diaries), little difference in the general indicators of travel

behaviour could be found – given the massive methodological differences to those studies (Axhausen *et al.*, 2000). Although this comparison does not ensure that the composition of the sample does not bias the results, there is no indication that it does.

The *Mobidrive* survey is unique in terms of the length of the reporting period and completeness of available data items. There is one comparable example, which covers a period of five weeks - the Uppsala Household Travel Survey (see Figure 2 for the questionnaire). This survey was conducted in 1971 and is the basis of a series of publications by Hanson and collaborators concerning the stability of travel behaviour (e.g. Hanson and Huff, 1982, 1986, 1988a, 1988b, Hanson and Burnett, 1981, 1982, Huff and Hanson 1986, 1990).

The city of Uppsala is located approximately 70 km northwest of Stockholm. A random sample of 20 percent of the total population was drawn. The persons who agreed to an interview were divided into 5 waves of equal proportion of 6 different life cycle groups and began on five sequential days to fill in a diary for five weeks. The final sample size was 278 households with 488 persons of which 92 households( respectively 144 persons) were chosen for further analysis by Susan Hanson and colleagues. This group was representative for the whole Uppsala population. A detailed description of the sampling procedure and the survey instruments is given in Marble, Hanson and Hanson, 1972.

Figure 2: Questionnaire Uppsala

---

When did you leave home? 7<sup>50</sup> hours

Is this a continuation from another sheet? Yes No

Stop number <u>1</u>	Did you plan to make this stop when you left home? <span style="float: right;"><input checked="" type="radio"/> Yes <input type="radio"/> No</span>
Means of Travel	1 foot    2 bicycle    3 bus    4 <input checked="" type="radio"/> car (driver) 5 car (passenger)    6 taxi    7 moped    8 other _____
Were you accompanied by someone from your household? Yes <input type="radio"/> No <input checked="" type="radio"/>	If yes, by how many? _____
Where did you make this stop? (please give address) <u>V. Agatan</u>	New? <input type="checkbox"/>
When did you arrive at this place? <span style="border: 1px solid black; padding: 2px;">7<sup>55</sup></span> hours	When did you leave this place? <span style="border: 1px solid black; padding: 2px;">12<sup>05</sup></span> hours
What did you do at this place?	Expenditure
1) <u>Worked</u>	<input type="text"/>
2) <u>took a coffee break</u>	<input type="text" value="1.00"/>
3) _____	<input type="text"/>
4) _____	<input type="text"/>

Similar to the *Mobidrive* study, the interviewed persons were contacted frequently. Due to this, the number of participants who dropped out of the survey was below 15%. No signs of fatigue effects could be detected (Hanson and Burnett, 1982).

### Comparison issues

A comparison between the two studies is difficult for a number of reasons, which can be separated into two groups. First, the sizes, the spatial structures and the provision transport infrastructure of the survey cities are different. Uppsala is much smaller than the German cities of Halle and Karlsruhe and the number and accessibility of shopping and leisure facilities therefore differs between the cities. Hence, differences in the observed behaviour may also be due to differences in the spatial and structural characteristics of the cities. Besides, it is also possible that differences in the observed mobility patterns are caused by climate or mentality differences which may be found between the case study cities and their inhabitants.

The second group of doubts concerning a consistent comparison of the two data sets is connected with differences in the survey design. For example, a different terminology was used in the studies to describe the same facts or variables: In the Uppsala survey, a trip was defined as a home-to-home circuit with one or more stops, whereas a trip in *Mobidrive* is a

movement between two activities at different places. Such kind of movement is defined as a stop in the Uppsala survey. Despite the different terminology, the same basic movement unit in the centre of the questionnaires is analysed. Nonetheless, there are many differences in survey details, like the coding of items or the categorisation of responses.

A last concern could be addressed by a weighting procedure of the *Mobidrive* data to avoid biases due to different sample compositions. The data was weighted concerning the following variables:

- Sex (m/f)
- Age (<25, 25-65, 65+)
- Household size (1,2, 2+ members/household)
- Working type (unemployed / part-time / fulltime)]

Keeping in mind the difficulties of comparison as mentioned above, a comparison is worth a try. Both studies are unique given the duration of their observation period, so that interpersonal behaviour can be compared at two different points in time (i.e. 1971 and 1999). A comparison provides at least first hints about which changes occurred over almost 30 years and which trends exist in leisure travel.

## 3 Empirical Results

### 3.1 General trends

#### *Basic mobility parameter*

Transportation planning usually considers travel behaviour by a wide range of parameters covering person as well as trip-specific characteristics (Herz, 1984). The most often used parameter are

- the average trip duration per day by mode and/or activity purpose
- the average trip distance per day by mode and/or activity purpose
- the amount of trips made by day and person
- the share of the different activity purposes
- the share of immobile persons, e g. the share of the population which does not leave the house (on any day during the reporting period)

These determinants are input variables in widely applied forecasting tools such as transport models which generate essential output for the support of planning and decision making.

A first look at a selection of these basic mobility parameters (frequencies and shares) provides some general differences in the results of the two studies. First of all, the analysis indicates that the mean distance per trip as well as the mean duration is higher in the *Mobidrive* data than Uppsala in 1971. This is also true for leisure trips – the higher rates here are nonetheless just average and only moderate compared to the other trip purposes. Although the trip distances of males are bigger than those of females, the trip durations are mainly equal (or even longer for females) which indicates the use of faster travel modes by males, both in *Mobidrive* and Uppsala. The absolute differences may be as well due to the different city structure with different travel distances and modal split situations. The Uppsala data shows a large percentage of people walking and cycling which is connected to shorter travel distances in general.

Table 1: Summary statistics for *Mobidrive* and Uppsala by gender

	<i>Mobidrive</i>		Uppsala	
	Female	Male	Female	Male
Mean distance per trip [km]				
All trips	8.1	10.7	3.9	4.7
Leisure trips	13.2	13.5	8.6	6.8
Mean duration per trip [min]				
All trips	21.1	22.1	14.8	15.6
Leisure trips	26.7	27.0	20.5	18.8
Mean person trips per day				
All trips	3.93	3.86	4.48	4.81
Leisure trips	0.67	0.66	0.75	1.23
Working trips	0.57	0.74	0.66	0.92
Household related trips	1.01	0.82	1.44	0.96
Back home	1.68	1.64	1.62	1.71

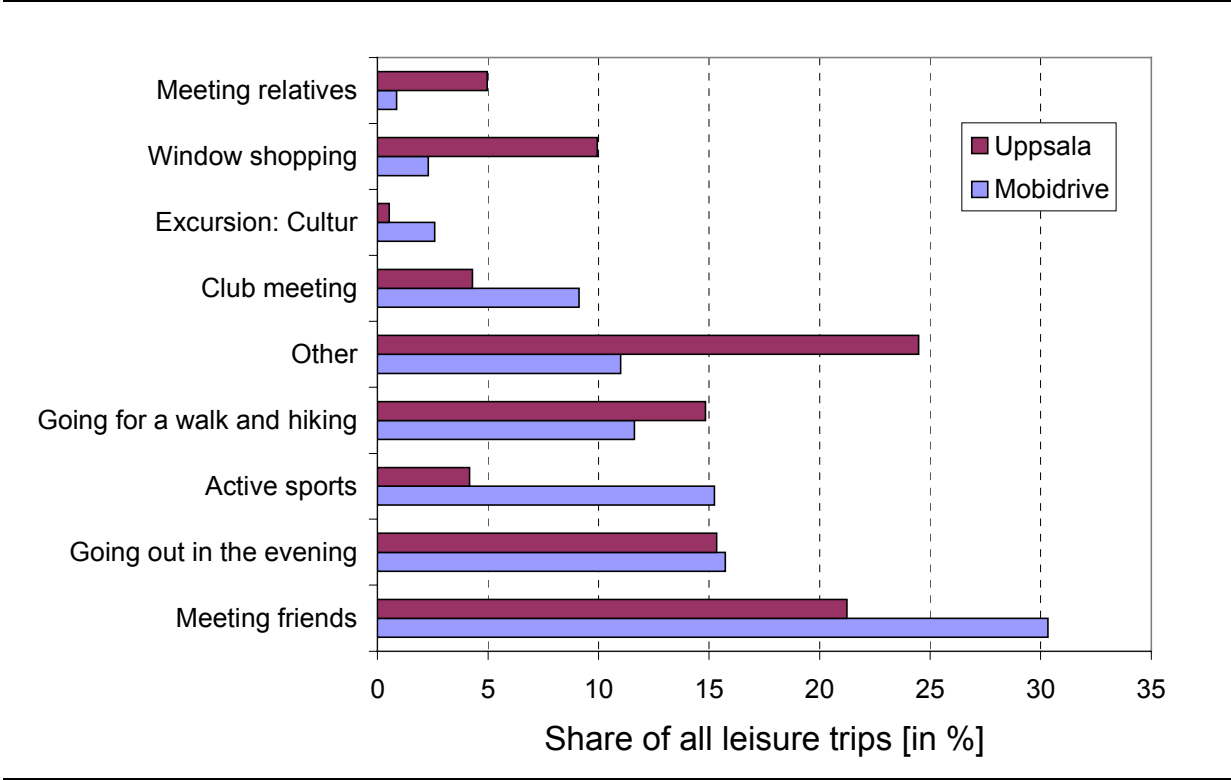
The number of reported trips per day is, for both studies, higher than in most other surveys, which is not surprising because usually people report a higher number of trips per day in travel diaries with an intensive contact to the participants (Canzler and Knie, 1998). Still the large number for Uppsala seems to be an outcome of the survey design and should not be interpreted as a trend of a decreasing number of trips from 1971 to present. Considering leisure trips, it is interesting that the gender differences are diminishing.

Leisure is a very general activity purpose category and contains several different types of activities. Table 2 and Figure 3 illustrate the major differences in the shares and the distances of the distinct purposes.

First of all, the results confirm recent findings of Lanzendorf (2000) and Zängler (2000) who report that the most frequent and obviously most important leisure activities are social interactions (meeting relatives and friends, going out in the evening etc.). It is interesting that “Meeting friends” has a much higher share of all leisure trips in *Mobidrive* while in Uppsala “Meeting relatives” may be found considerably more frequently than in the newer German data. This finding is in accordance with a study of Fastenmeier *et al.* (2001) who found that time spent for activities together with friends are replacing leisure time spent with the family. Another interesting aspect is the shift from the activity purpose “Going for a walk” to

“Making active sports” which possibly satisfies the same needs but which has much bigger requirements concerning its infrastructure. The discrepancy in the category “Other” are due to a slightly different coding of activities.

Figure 3: Share of types of leisure activities



Those activities which have the highest share are also those which had the biggest growth in trips distances between the studies – except from the activities “Meeting relatives” which is shows shorter distances in Mobidrive than in Uppsala. The increasing distances in leisure traffic are thus mainly caused by a few different activities purposes and the fact that social networks nowadays obviously cover larger distances than 30 years ago (for similar suggestions see Gebhard, 1995; Blinde and Schlich, 2000).

Table 2: Mean distances by leisure activity and gender [km]

	<i>Mobidrive</i>		Uppsala	
	Female	Male	Female	Male
Excursion: culture	28.5	31.5	(58.9)	(59.0)
Meeting friends	17.8	18.1	7.2	5.4
Meeting relatives	14.3	11.0	17.7	16.9
Going for a walk/ Hiking	10.2	13.5	2.9	2.7
Going out in the evening	8.7	8.1	8.9	2.9
Active sports	7.9	7.8	2.1	7.6
Window Shopping	7.3	5.6	1.5	1.8
Other	7.1	7.2	15.1	11.4
Club meeting	5.5	8.0	3.6	6.5
All	13.2	13.5	8.8	6.8

### **Mode choice**

One main advantage of multi-week studies is the possibility to analyse the long-term travel behaviour for distinct persons instead of a cross-sectional investigation of single-day data. One interesting application in this context is the mode choice of single persons over time.

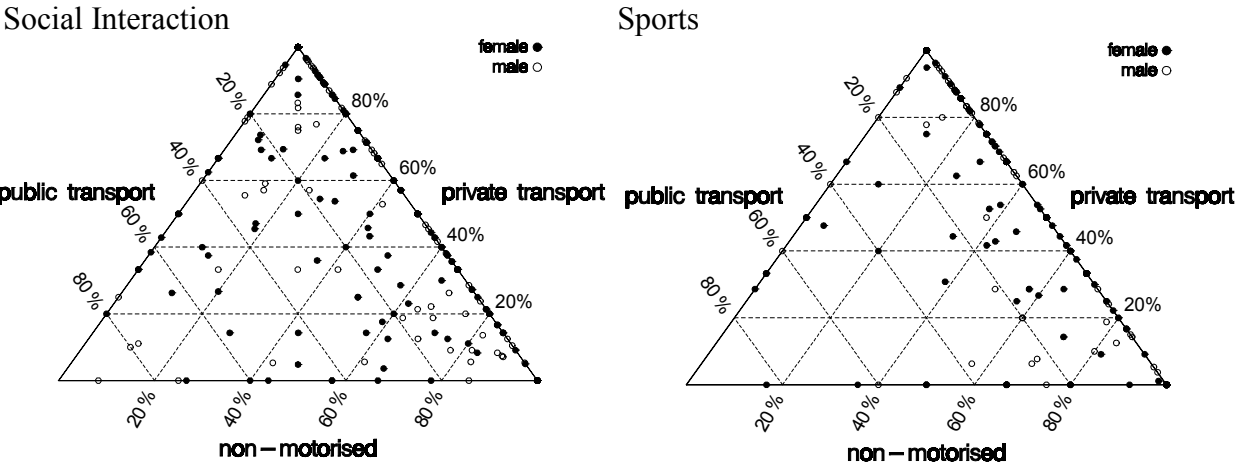
Mode choice – also known as modal split – describes the share of trips from each origin to each destination made by the different modes of transportation. Mode choice has considerable implications for transportation policy, especially if new infrastructure projects are to be implemented (Pas, 1995). As mentioned earlier, leisure travel is mainly connected with using one’s own car – with all the well known negative effects such as congestion in the large metropolitan areas, emissions and noise. The question though are: (1) is the car dominance also visible for a more detailed analysis of leisure activity purposes and (2) have the alternatives such as walking or public transport modes lost even more importance for daily life travel in the historical perspective (keeping in mind that motorisation has increased rapidly in the Western world since the 1960s)?

As the modal shares differed too much between the both studies (due to the socio-demographic structure of the sample and the different car-availability) a historical comparison between participants of the two surveys did not really seem to make sense at this place. The following graphics show the share of different modes over the entire survey period (public transport, private transport, nonmotorised) for each person in the *Mobidrive* survey. Only the



most important activities “social interactions” and “sports” are considered. Each dot or circle shows the individual combination of different modes of one person over the survey period. At each axis, the individual share of this mode is given.

Figure 4: Mode choice for different leisure trips (Mobidrive)



It can be seen for the “social interactions” category that all combinations of modal use exist: (respondents who travel nearly exclusively by public transport or private transport or non motorised modes as well as combinations of these modes)., But still there is a higher percentage of people who do not use public transport for this activity at all. This share is much higher for the activity active sports where private transport dominates the mode choice. No significant differences between males and females can be found for either of the activities in both figures.

Summarising the results, it can be shown that the mode choice turns out to be more variable for the distinct activity purposes than for the generic category leisure – which again strengthens the necessity to look at leisure activities in more detail. The increasing importance of sports and specialised sport activities is one of the reasons for the high and still growing share of private transport in leisure travel.

### 3.2 Temporal analysis

The question of how regular and repetitious travel behaviour actually is has been the subject of investigation for many years (see for example the intensive earlier investigations of the

Uppsala Household Travel Survey data by Hanson and others). An overview is given by Pendyala, Muthyalagari and Parashar (2000) or Schlich and Axhausen (forthcoming). However, the aspect of intrapersonal variability (different behaviour of one person from day to day) has played a minor role in travel behaviour research in comparison with research on the interpersonal variability (variability in the behaviour between different persons).

The analysis of the temporal variability of travel behaviour is important, though. One of the reasons for the failure of demand matching transport strategies in the past was the poor knowledge of the variability of individuals' and households' mobility patterns and its motivations (such as variety seeking or adaptation to the changing travel environment). Up to now, most of the travel demand forecasts and the resulting transport strategies have been based on the simplified assumption that travellers have a highly routinised travel behaviour. This assumption depends very much on the investigation of conventional one-day travel diary data (cross-section perspective) which provides only few observations for each participant in a survey, such as trips or activities.

However there is no empirical evidence for this assumption – on the contrary, Huff and Hanson (1986) showed that although there are repetitious elements in human behaviour, there are several different patterns of mobility for each traveller and that there is a high amount of day-to-day variability. It seems reasonable that the amount of variability differs for the different types of activities and a trip to work is obviously much more stable than a leisure trip. As leisure is the most important trip purpose nowadays, an analysis of leisure trips is an important contribution to answer the question of intrapersonal variability.

Fastenmeier, *et al.* (2001) assume that leisure activities are performed also highly repetitious, but more on a weekly level. Whether this assumption is true or if leisure activities are totally variable will be analysed in the following section.

To address this question, a trip cannot be regarded as independent from its travel context and from the other activities performed on the same day. It is hence common practice in travel behaviour research to look at the chain of trips (each connected to an activity) performed each day. The cumulative share of differently composed chains is given in Figure 5, frequencies of the most common chains are shown in Table 3. Those daily chains consist mostly of two or four trips which is in common with general findings.

If weekend days and week days are regarded separately, the cumulative share of the most frequent trip chains is, as expected, higher for weekend trips – especially with the chain “leisure – going home”. Due to a high percentage of people who do not work or attend school on weekends and the very limited possibilities to go shopping – at least in the European context – this result is not surprising. Both in Uppsala and in *Mobidrive*, the ten most frequent

activity chains at weekends cover about 20 percent more than the ten most frequent chains during the week. This bigger share may be partially caused by a smaller number of observed days at weekends; still it is likely that the chains (not the activities themselves) show less variability at weekends because still most people do not go to work or attend school.

Figure 5: Cumulative Share of activity chains sorted by their rank

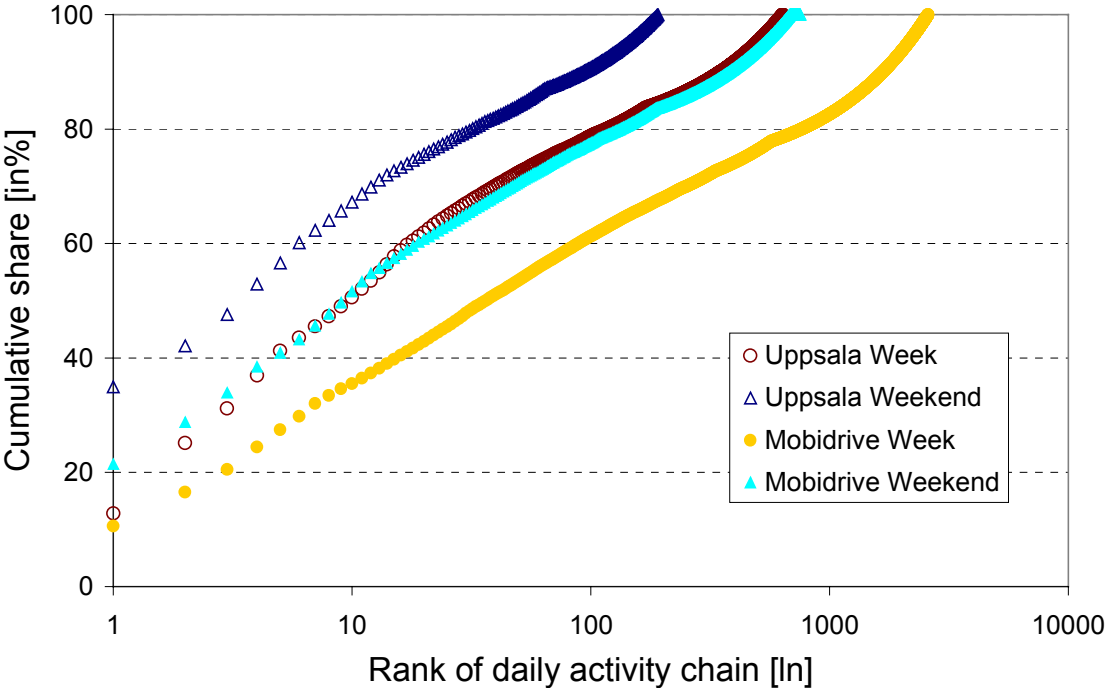


Figure 5 shows interesting differences between the two studies. First of all, altogether there are fewer different chains in Uppsala than in Mobidrive. For the same number of different trip chains, their cumulative share on all trips is higher than in Mobidrive, indicating less variability between all days. Although this may again be caused by less observed trips in Uppsala, it seems plausible that the complexity of daily behaviour increased. The total number of different daily patterns increased since the 1970ies both for weekdays and for weekends.

Second the simple daily programme “Going to work and coming back home” decreased in importance from about 12.5% to 10.5% while its importance increased at weekends. This may be caused by an decreasing number of people who work in fulltime jobs just during week and increasing number of people working halftime or at weekends. Another interesting fact is that

the total share of the chain “Leisure – coming back home” increased from Uppsala to Mobidrive.

Table 3: Type and frequency [%] of three most frequent activity chains (total sample)

	Mobidrive		Uppsala	
	Activity chain	[%]	Activity chain	[%]
Week	wh.....	10.5	lh.....	12.8
	sh.....	6.0	wh.....	12.3
	shlh.....	4.0	wdh.....	6.1
	sum	20.5	sum	31.2
Weekend	lh.....	21.4	lh.....	21.1
	dh.....	7.4	h..... <sup>1</sup>	6.8
	wh.....	5.1	lhlh.....	5.0
	sum	33.9	sum	47.6

w: working; s: school, l: leisure; d: daily shopping, h: returning home

<sup>1</sup> roundtrip

A more detailed analysis of variability is possible if the trips are distinguished by more travel characteristics than the sole activity purpose. Hanson and Huff (1986) developed an index  $R_j$  (*overall repetition measure*) to measure the amount of variability and repetition over the whole observation period.  $R_j$  counts each combination of activities which have the same trips purpose and one other characterisation of a trip in a contingency table. The sum of the deviations from the uniform distribution in relation to the concentration of all activities in only one cell is an index of repetition. The closer this index is to 1 the more concentrated are all trips in a small number of cells and the more repetitious the behaviour is.  $R_j$  is calculated with equation (1)

$$R_j = \frac{\sum_{i=1}^n |P_i - E_i|}{M_n} \quad (1)$$

with

$n$ : number of cells in contingency table

$P_i$ : share of activities in cell  $i$

$E_i$ :  $1/n$  or the share of all activities in cell  $i$ , in case of a uniform distribution  $i$

$M_n$ : maximum possible value for a table with  $n$  cells =  $2(n-1)/n$

A calculation of  $R_j$  for the *Mobidrive* data and the Uppsala data with identical categories was done for the variables mode choice (9 categories), trip destination (10 categories), trip distance (5 categories) and trip arrival time (4 categories) – combined each with the variable trip purpose (10 categories). The results are presented in Table 4. Calculations based on more combinations of characteristics can be found at Schlich, König und Axhausen, 1999 for *Mobidrive*, respectively Hanson and Huff, 1986 for Uppsala.

Table 4: Overall repetition index for all trips by different trip purposes and other characteristics

	All Trips	
	Uppsala	<i>Mobidrive</i>
Mode choice – trip purpose	0.76	0.84
Trip purpose – trip destination	0.77	0.84
Trips distance – trip purpose	0.61	0.72
Trip arrival time - trip purpose	0.64	0.70

Surprisingly, in the *Mobidrive* survey the amount of reported repetition is slightly higher than in Uppsala – for all combinations of characteristics. The level of the overall repetition is very high in general – this means that just a few of all possible combinations are performed at all. This indicates that the performance of different activities is very habitual concerning their characteristics, such as mode choice. The calculation was then done just for leisure trips which were separated into those 9 different activity groups presented in Figure 3. The results (shown in Table 5) are similar to the results based on all activities with a slightly increased level of repetition. The closer one looks at similar activities the more stable the observed behaviour is.

Table 5: Overall repetition index for leisure trips by different leisure activities and other characteristics

	Leisure Trips	
	Uppsala	<i>Mobidrive</i>
Mode choice – leisure activity	0.91	0.91
Leisure activity – trip destination	0.81	0.82
Trip distance - leisure activity	0.79	0.81
Trip arrival time - leisure activity	0.82	0.86

The index  $R_j$  is limited to measuring an overall repetition index for single trips - but according to Shapcot and Steadman (1978) or Pas (1988) the main observation unit should be the day instead of the trip. Hence, Huff and Hanson (1986) developed a second method to measure the similarity across all days for each person. This index takes the different attributes into account as well as the number of daily trips. The measure  $S_{ij}$  (*similarity index*) notes the number of matches between patterns on two different days  $i$  and  $j$  based on the contingency tables and divides this by the number of stops in the longer activity chains.  $S_{ij}$  is thus defined with equation (2)

$$S_{ij} = \left[ 1 - \frac{1}{2} \sum_k |P_{ik} - P_{jk}| \right] \frac{n_i}{n_j} \quad n_j \geq n_i \quad (2)$$

- $P_{ik}$  : share of trips in cell  $k$  of the contingency table on day  $i$
- $i, j$  : index for the days to compare (with  $i, j = 1, 2, \dots, n$ , if  $i \neq j$ )
- $n_i, n_j$  : number of trips on  $i$  and  $j$

A value of 1 indicates identical travel patterns on two different days, while a value of 0 will occur when two days have no trips with the same attribute combination in common. The average similarity of all pairs of days for each person based on the attributes trip purpose and travel mode can be seen below.

Table 6: Similarity index  $S_{ij}$  for leisure trips by different leisure activities and other characteristics

	Mobidrive		Uppsala	
	Female	Male	Female	Male
All days	0.17	0.21	0.14	0.17
All week days	0.24	0.29	0.16	0.21
All weekend days	0.07	0.08	0.13	0.14

Although the reported level of repetition is high for two characteristics over the whole period the daily repetition level is very low (see Table 6). The results correspond to the analysis of trip chains which also indicate that the level of daily variability is high. The activities themselves may be getting more and more habitual but the linking and scheduling of activities on a daily level getting more complex and less stable.

### 3.3 Spatial Analysis

The previous analysis focused on the question how repetitious behaviour is over longer periods. The following analysis will add a spatial perspective to the investigation of the longitudinal datasets.

While analysing the spatial characteristics of leisure travel, several interrelated factors should be considered:

- (1) the spatial structure of land use patterns and especially the allocation of leisure activity opportunities as well as spatial interactions (e.g. places of living of relatives or friends)
- (2) the spatial configuration and service quality of the transportation system in the survey area
- (3) the spatial knowledge and orientation of the travellers (mental mapping capability)
- (4) the potentials for linking different activities in chains, or in other words, the distance between the main activity locations such as work and grocery

All these factors together with the temporal constraints of daily life lead to the person-specific (here: leisure related) activity space. The longitudinal characteristic of the two surveys allow– for the first time – to map the activity space of travellers over prolonged periods. Most of the destinations were geocoded which made it possible to assign a unique x-y-coordinate to the locations visited by the survey respondents. Selected aspects of the activity space such as travel distances or the dispersion of activity places of the respondents are documented in the following.

Table 7: Share of trips within 1000 m of home [%]

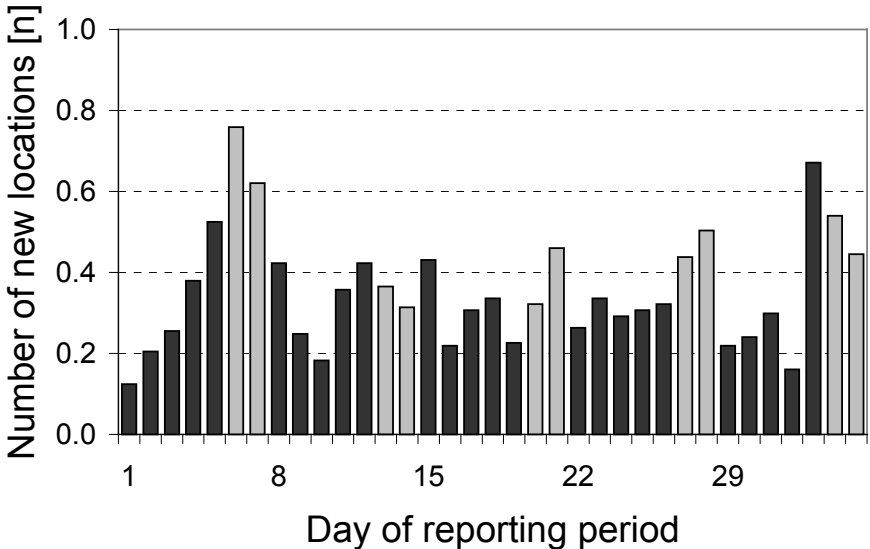
	<i>Mobidrive</i>	Uppsala
Daily shopping	47.1	55.9
Private business	32.5	44.5
Leisure	25.8	32.5
Long term shopping	14.5	15.1
Pick up/Drop off	14.3	8.0
School/	10.9	10.5
Work	9.0	19.1
Other	6.2	16.7
Work related	5.8	3.3
All trips	17.4	25.2

In a first step, the share of all trips within a radius of 1000 meters from home is calculated (see Table 7). Regardless of the different infrastructural preconditions in both cities, it can be shown that the number of trips with the destination in close proximity to home decreases for all activities over the last 30 years. Still for Karlsruhe and Halle in 1999, nearly one out of five trip ends close to the home. A good basis of commercial and social infrastructure as well as opportunities to spend one’s leisure time in the vicinity of home were found to reduce the distances travelled in a range of studies dealing with local accessibility and travel behaviour (see e.g. Naess, 2000 or Simma, 2000 for recent findings).

The temporal analysis indicated substantial intra-personal variability in travel behaviour over the prolonged observation periods. But is this also true for the locations visited or do people have a restricted number of places they know and they eventually visit?

The following figures (Figure 6 and Figure 7) show the average number of additional leisure locations per day that had not yet been visited during the observation period. Obviously there is an almost unlimited number of places people know, because even after five or six weeks there are still places people “discover” as new destinations. As expected for leisure activities, the number of those new places increases significantly on weekends compared to week days. This trend can be seen both for the Uppsala and the *Mobidrive* data, although the weekend rhythms are even more notable in the *Mobidrive* survey. Similarly, there are no big differences in the number of newly visited locations.

Figure 6: Average number of new locations (Uppsala)

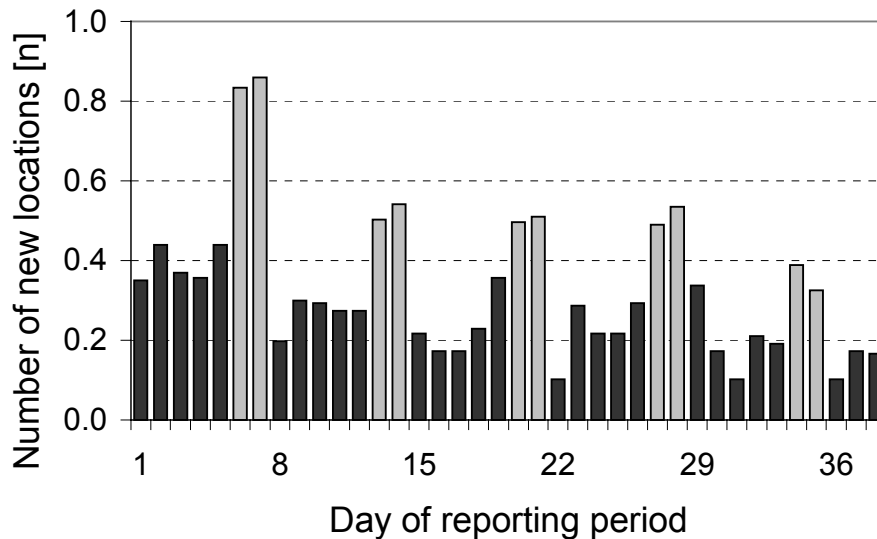




---

Figure 7: Average number of new locations (*Mobidrive*)

---



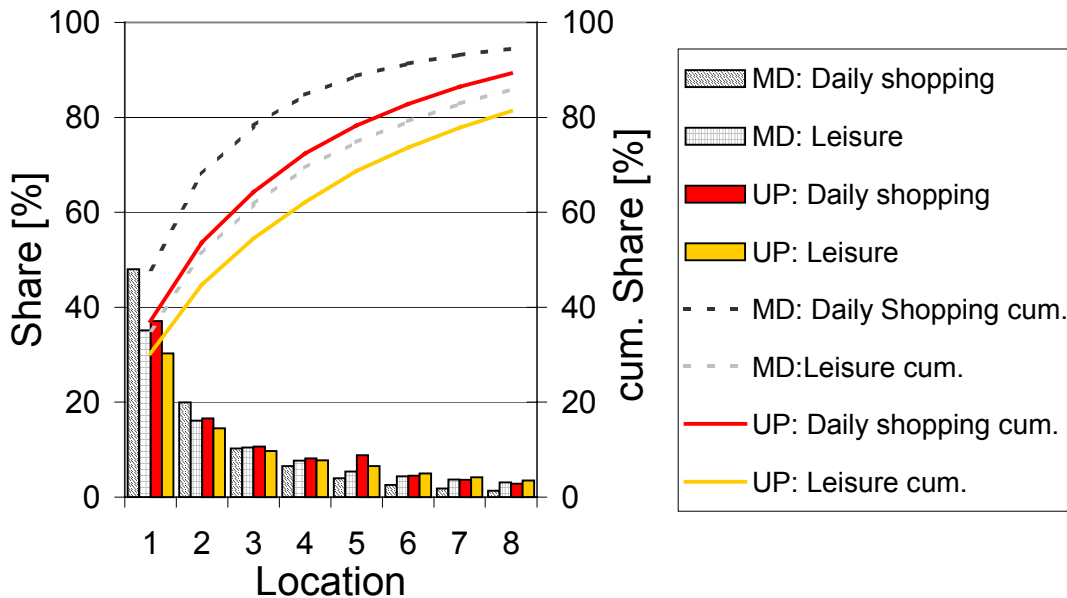
These results indicate that especially in leisure variety seeking is an important motif in human behaviour. This again confirms recent findings on the variability and flexibility in leisure travel and underlines the fact that demand oriented transport policies for leisure travel have to be more user sensible and probably more taylor-made for specific groups of travellers (e.g. travel demand groups as students, young professionals, pensioners etc.).

Although people seem to have no limit to the number of places they visit in their leisure time, this does not mean that each place is visited with the same frequency. On the contrary, there is a small number of locations which is dominant for particular activities within the observation period. From a methodological but also from a planning point of view it seems interesting to know how many locations are necessary to know to describe a substantial part of one's travel behaviour. Especially for future longitudinal-oriented travel behaviour surveys for which the extensive support of the respondents cannot be guaranteed as done in *Mobidrive*, this aspect seems crucial.

For leisure activities, the cumulative share of the eight most important locations is about 80% of all visits – both for the *Mobidrive* and the Uppsala survey. As expected, the number of locations frequented is lower for the more compulsory activities like work, shopping or education. As an example, the cumulative share of the locations visited for daily shopping is

shown in Figure 8. Here, only the four most frequent activities count for approximately 80% of all activities.

Figure 8: Share of most important locations



The results confirm the assumption that spatial behaviour is habitual and variable at the same time – similar to what could be earlier shown for the temporal patterns of travel behaviour. Although the behaviour related to different activities was shown to be stable, a generally high level of overall variability was found. Similar trends are visible for the spatial variability of the travel patterns, too. Despite the fact that over whole observation periods new locations are visited, there is, even for leisure activities, just a small number of places which dominate the travellers' destination choices. This is again true both for *Movidrive* and Uppsala. Surprisingly, the cumulative share of the most important activities in the Uppsala data is lower than in *Movidrive*, which indicates an enforcement of habitual behaviour.

## 4 Conclusions

The descriptive analysis of the longitudinal Uppsala Household Travel Survey and the *Mobidrive* datasets mainly confirmed historical trends and developments in leisure activities formulated elsewhere. The new dimension and the added value of this empirical investigation of the leisure time budgets and leisure related travel lies in the intra-personal perspective. This temporal phenomenon can be only addressed by the consideration of individual long-term data. The occurrence of a wide range of different lifestyles, the growing autonomy in the organisation of our daily life and the consequences for personal mobility make it necessary to especially deepen this approach of analysis. The findings presented here provide an important insight into the temporal and spatial structure of leisure travel demand, eventually leading to improved and tailor-made transport strategies as well as services supplied by private and public bodies.

The findings may be summarised as follows:

- The leisure time budget is still dominated by social interactions with friends or relatives. It seems that with the dissolution of fixed family structures and the growing importance of social networks outside the core family, social interactions with friends and colleagues more and more substitute for those with family members.
- For a prognosis of the future leisure travel demand it is crucial to distinguish in detail between the various leisure purposes. The range of leisure activities has been getting significantly wider in the last 30 years (more specialised activities e.g. new types of active sport instead of going for a walk) which implies distinct temporal and spatial demand patterns for every activity sub-type. Besides, due to the growing importance of leisure in our daily lives – not least as an indicator for self-realisation – the present assumptions about the spontaneous and variable character of leisure activities are subject to change.
- The analysis of intrapersonal variability indicates that the level of daily variability is high. The activities themselves may be getting more and more habitual but the linking and scheduling of activities on a daily level is getting more complex and less stable.
- Daily life is a balance of variety seeking and routines. On one hand, just a few (leisure) locations dominate the spectrum of mobility and destination choice on the other hand, new locations are discovered by travellers after even 5 or 6 weeks of observation.
- Suburbanisation and the full motorisation of the society lead to a disperse structure of locations and a diffuse, less predictable travel demand. In common with this general trend, the results show that there is a tendency to perform less leisure activities in the vicinity of home. But still, about a quarter of all leisure activity locations may be found within walking distance from home.

## 5 References

- Axhausen K.W., A. Zimmermann, S. Schönfelder, G. Rindsfuser and T. Haupt (2002) Observing the rhythms of daily life: A six-week travel diary, *Transportation*, **29** (2) 95-124.
- Blinde, J. and R. Schlich (2000) Freizeitmobilität and Wohnumfeld, *Arbeitsberichte Verkehrs- and Raumplanung*, **54**, Institut für Verkehrsplanung, Transporttechnik, Strassen- and Eisenbahnbau, ETH Zürich, Zürich.
- Bundesministerium für Verkehr, Bau- and Wohnungswesen (2000) *Verkehr in Zahlen 1999*, Deutscher Verkehrsverlag, Berlin.
- Brunsing, J. (2000) Freizeitverkehr - Bedeutung, Ursachen and Auswirkungen, *Verkehrszeichen*, **15** (3) 27-33.
- Canzler, W. and A. Knie (1998) *Möglichkeitsräume – Grundrisse einer modernen Mobilitäts- and Verkehrspolitik*, Böhlau, Wien.
- Cordell, H.K., C.J. Betz and G.T. Green (2002) Recreation and the Environment as Cultural Dimensions in Contemporary American Society, *Leisure Sciences*, **24** (1) 13-41
- Fastenmeier, W., H. Gstalter and U. Lehnig (2001) Subjektiver Freizeitbegriff und Mobilitätsmuster – Ergebnisse einer bundesweiten Haushaltsbefragung, *Bericht aus dem Institut mensch – verkehr - umwelt*, **1**, München.
- Garhammer, M. (1999) *Wie Europäer ihre Zeit nutzen - Zeitstrukturen and Zeitkulturen im Zeichen der Globalisierung*, Edition Sigma, Berlin.
- Gebhardt H. and G. Schweizer (1995) Zuhause in der Großstadt. Ortsbindung and räumliche Identifikation im Verdichtungsraum, *Kölner Geographische Arbeiten*, **61**, Geographisches Institut der Universität zu Köln, Köln.
- Golob, T.F. and H. Meurs (1986) Biases in response over time in a seven-day travel diary, *Transportation research*, **13** (2) 163-181.
- Hanson, S. and J.O. Huff (1982a) Assessing day-to-day variability in complex travel patterns, *Transportation Research Record*, **891**, 18-24.
- Hanson, S. and J.O. Huff (1986) Classification issues in the analysis of complex travel behaviour, *Transportation*, **13** (4) 273-291.
- Hanson, S. and J.O. Huff (1988a) Repetition and day-to-day variability in individual travel patterns: Implication for classification, in R.G. Golledge and H. Timmermans (eds.) *Behavioural Modelling in Geography and Planning*, Croom Helm, London.
- Hanson, S. and J.O. Huff (1988b) Systematic variability in repetitious travel, *Transportation*, **15** (2) 111-135.
- Hanson, S. and K.O. Burnett (1981) Understanding complex travel behaviour: Measurement issues, in A.H. Meyburg and W. Brög P.R. Stopher (eds.) *New Horizons in Travel-Behaviour Research*, 207-230, Lexington, Massachusetts/Toronto.
- Hanson, S. and K.O. Burnett (1982b) The analysis of travel as an example of complex human behaviour in spatially-constraint situation: Definition and measurement issues, *Transportation Research A*, **16** (2) 87-102.

- Herz, R. (1984) Verkehrsverhaltensänderungen 1976-1982, Ergebnisse einer vergleichenden Auswertung der KONTIV 76 und 1982, Institut für Städtebau und Landesplanung, Universität, Karlsruhe.
- Hörning, K., A. Gerhard and M. Michailow (1991) *Zeitpioniere. Flexible Arbeitszeiten - neuer Lebensstil*, SuhrkampVerlag, Frankfurt/Main.
- Huff, J.O. and S. Hanson (1990) Measurement of habitual behaviour: Examining systematic variability in repetitive travel, in P.M. Jones (ed.) *Developments in Dynamic and Activity-Based Approaches to Travel Analysis*, 229-249, Adlershot, Gower.
- Huff, J.O. and S. Hanson (1986) Repetition and variability in urban travel, *Geographical Analysis*, **18** (2) 97-114.
- Jones, P.M., F. Koppelman und J.O. Orfeuil (1990) Activity analysis: State-of-the-art and future directions, in P.M. Jones (ed.) *Developments in Dynamic and Activity-Based Approaches to Travel Analysis*, 34-55, Gower, Aldershot
- Lücking, J. und E. Meyrat-Schlee (1994) Perspektiven des Freizeitverkehrs, Determinanten und Entwicklungen, Teil 1, Eidgenössisches Verkehrs- und Energiewirtschaftsdepartement, Bundesamt für Strassenbau, Bern.
- Marble, D.F., P.O. Hanson and S. Hanson (1972) Field Operations and Questionnaires, Household Travel Behavior, Study 1, Department of Human Geography, State University of New York at Buffalo, Buffalo.
- Naess, P. (2000) Urban structures and travel behavior: Experiences from empirical research in Norway and Denmark, Paper presented at the International Conference Land Use and Travel Behaviour, Amsterdam, June 2000.
- Pas, E.I. (1988) Weekly travel-activity behaviour, *Transportation*, **15** (1) 89-109.
- Pas, E.I. (1995) The urban transportation planning process, in S. Hanson (Ed.) *The Geography of Urban Transportation*, Guildford, New York, 53-77.
- Pendyala, R.M., A. Parashar and G.R. Muthyalagari (2000) Measuring day-to day variability in travel characteristics using GPS data, paper presented at the 79th Annual Meeting of the Transportation Research Board, January 9-14, 2001 Washington.
- Robinson, J.R. and G. Godbey (1997) *Time for Life - the Surprising Ways Americans Use Their Time*, Pennsylvania State University Press, University Park, Pennsylvania,
- Schlich, R., A. König and K.W. Axhausen (2000) Stabilität and Variabilität im Verkehrsverhalten, *Strassenverkehrstechnik*, **44** (9) 431-440.
- Schlich, R. and K.W. Axhausen (forthcoming) Habitual travel behaviour: Evidence from a six-week travel diary, *Transportation*.
- Schönfelder, S., R. Schlich, A. König, A. Aschwanden, A. Kaufmann, D. Horisberger and K.W. Axhausen (2002a), Mobidrive: Data Format Guide (2002), Part A: Basic survey details, data processing and imputation, *Arbeitsbericht Verkehrs- und Raumplanung*, **116a**, IVT, ETH, Zürich.
- Schönfelder, S., R. Schlich, A. König, A. Aschwanden, A. Kaufmann, D. Horisberger and K.W. Axhausen (2002b), Mobidrive: Data Format Guide (2002), Part B: Variables, *Arbeitsbericht Verkehrs- und Raumplanung*, **116b**, IVT, ETH, Zürich.

- Simma, A. (2000) Verkehrsverhalten als eine Funktion soziodemografischer und räumlicher Faktoren, Dissertation an der Leopold-Franzens Universität, Institut für Straßenbau und Verkehrsplanung, Innsbruck.
- Shapcott, M. and P. Steadman (1978) Rhythms of urban activity, in T. Carlstein, D. Park and N. Thrift (eds.) *Human Activity and Time Geography*, 49-74, Arnold, London.
- Zängler, T.W. (2000) *Mikroanalyse des Mobilitätsverhaltens im Alltag and Freizeit*, Springer, Heidelberg.