Does the car make elderly people happy and mobile? Settlement structures, car availability and leisure mobility of the elderly

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According to gerontological mobility research, appropriate settlement structures at the neighbourhood level and car availability are both playing a prominent role in the maintenance of mobility of elderly people. However, car availability is strongly connected to other individual attributes like age, health and gender. The paper presents empirical results from Germany, which support the thesis that car availability is not a cause for mobility, but rather a result of a specific life situation and way of life of elderly people, which is associated with a specific type of mobility. What is more, there is no evidence for a significant influence of settlement structures on mobility. The contribution is based on multiple regression analyses of leisure mobility of elderly people living in three different spatial contexts.

Keywords: leisure mobility, senior citizens, car availability, travel behaviour, settlement structures.

1. Introduction

It has frequently been claimed, that beyond a certain age, the daily mobility of individuals starts to decrease. This view is grounded on numerous empirical findings: the number of trips, which declines with age; activity spaces, which are more and more confined to the neighbourhood; as well as an overall decline of mobility participation (Brög, Erl and Glorius, 1998; Tacken, 1998; Evans, 2001). Thus, the neighbourhood and the dwelling get ever more important with age (Gant, 1997; Schwanen, Dijst and Dieleman, 2001). This becomes evident not least in the shift in recreational activities in favour of in-home and 'passive' activities, such as watching television and reading (Strain et al., 2002; Gauthier and Smeeding, 2003).

The reasons for these age-related changes are health restrictions (mainly visual, hearing and motion system problems), the loss of commuting and business trips, but also external restrictions such as lack of accessibility to retail and leisure facilities, and deficiencies in the transport system.
For definition, an age limit of 60 years is frequently set, in line with the current average retirement age (at least in Germany). This limit is said to mark a watershed in life, characterised by significant changes in time budgets and travel purposes.
Because of the loss of job-related trips, leisure mobility is of particular significance in the travel behaviour of elderly people. The share of leisure among the out-of-home activities accounts for 27 percent among people between 18 and 59 years. At the age of 60 years, it grows to 35 percent and it continues to grow to 43 percent above this age (Brög, Erl and Glorius, 1998, p. 89).
A closer look at everyday mobility of elderly people reveals a more differentiated picture (Hildebrand, 2003; Alsnih and Hensher, 2003). Recently, German men from 61 to 75 years own a private car almost as often as the younger age groups (table 1). Only among the very old (more than 80 years of age), car ownership decreases sharply. Elderly women do not own cars as often as men. A considerable decrease sets in at the age of 65, which gets even sharper at the age of 75, when the share of solitary (often widowed) persons strongly increases. Because of their higher life expectancy, this concerns women much more than men. These single women rarely own a car, while women in two- or multi-person-households mostly live in motorised households (although they often do not hold a license).

Table 1. Car availability by age group, household size and gender in Germany

	men			**women**			**all**
age	**one-person-household**	**multi-person-household**	**all men**	**one-person-household**	**multi-person-household**	**all women**	**persons**
18 to 29	57	90	84	48	85	79	81
30 to 39	77	95	90	72	93	90	90
40 to 49	74	94	91	69	94	92	91
50 to 54	69	97	92	71	92	90	91
55 to 59	59	92	86	71	91	87	86
60 to 64	53	92	85	58	91	83	84
65 to 69	62	90	86	46	87	73	79
70 to 74	64	86	83	41	79	63	72
75 to 79	55	84	79	22	76	44	57
80 and older	38	65	56	7	70	21	31
All	66	91	86	42	90	78	82

Share of persons living in motorised households.
Source: socio-economic panel (SOEP) 2003 (own analysis).

In future, we can expect higher mobility participation and more transport intensive life styles among older adults, due to growing life expectancy, longer lasting health and strongly increasing availability of driving licenses and cars (Rosenbloom and Ståhl, 2002). However, a delayed occurrence of health restrictions must not lead to the false conclusion that the mobility chances of the elderly will generally increase. According to an analysis of birth cohorts, the number of trips slightly increased in all age groups between 1982 and 1997,

except in the oldest group (75 years and older) (Brög, Erl and Glorius, 1998). In 1982, the number of trips dropped sharply at the age of 60, in 1997 at the age of 65 years. In future, mobility may simply decrease at an ever higher age.

On the basis of these considerations, the following questions are investigated in this contribution:

(a) Does the private car have an independent effect on leisure mobility of elderly people, as is frequently assumed in mobility research?
(b) Do settlement structures have an independent effect on leisure mobility of elderly people, so that spatial planning efforts to improve mobility seem reasonable?
(c) Or are the frequently asserted connections only pseudo-correlations emerging from the overlay of settlement structures, car availability and socio-demographic, socio-economic and health related aspects?

The discussion of these questions may shed new light on the determinants of the elderly population's mobility. Moreover, the questions are relevant to transport and spatial planning activities as well as to the formulation of political programs regarding an ageing population. If the results indicate, for instance, that car availability does not have an independent impact on leisure mobility of elderly persons, the car should consequently be discarded as a solution for their mobility problems.

The political as well as the scientific relevance should become clear in the following section, which provides an overview of the roles individual life situations, car availability, and local settlement structures play with regard to the daily mobility of the elderly. The delineation concentrates on trip/activity frequency and distances. Modal choice is not considered as it cannot be the subject of empirical investigation within the constraints of this paper. On the basis of a review of the available literature, own empirical analyses are undertaken. Section 3 elaborates the methods applied, while section 4 presents the results. In section 5, some conclusions are being drawn.

2. Determinants of everyday mobility of the elderly

2.1 The role of life situations

In a number of studies, the importance of individual life situations for elderly persons' mobility has been demonstrated. Given the specific subject of this contribution, life situations are primarily considered for control reasons, whereas the main focus is on car availability and settlement structures. Hence, only the most important results concerning life situations are referred to at this point.

Several studies have highlighted that the frequency of trips markedly declines with age, as does the percentage of persons who leave their home at a randomly selected day as well as the average time spent out of home. The activity spaces of seniors are more often limited to their respective residential area than is the case with younger people. This means that elderly persons cover relatively small distances compared to younger persons (Brög, Erl and Glorius, 1998; Tacken, 1998; Horgas, Wilms and Baltes, 1998; Evans, 2001).

The frequency of leisure activities also declines with age (Schwanen, Dijst and Dieleman, 2001). Regarding the role of gender for out-of-home activity frequency, there are contradictory results. According to Marottoli et al. (2000), men are less active than women,

while the results of Schwanen, Dijst and Dieleman (2001) point into the opposite direction, at least for leisure activities.
Furthermore, high educational status corresponds with high out-of-home activity frequency and high mobility participation (Evans, 2001; Schwanen, Dijst and Dieleman, 2001). This may be due to the fact that higher education not only implies higher cultural resources, but is also tied to stronger economic and health resources.
With regard to health, the most pronounced problems are those of the visual, hearing and motion systems. Such problems grow more severe and more frequent with age. The share of persons with severe impairments is sharply increasing with age (Tacken, 1998). The mobility participation and the activity frequency of persons with mobility handicaps is clearly reduced (Mollenkopf and Flaschenträger, 2001).
The social network might also play an important role for the mobility of senior citizens. Single elderly go out more frequently and spend more time out of home than elderly couples (Schwanen, Dijst and Dieleman, 2001; Tacken et al., 2003).
Beside differences in the activity level and mobility participation, it is worth bearing in mind that many of the cited works also highlight differences in modal choice. Yet, as mentioned at the outset; considerations of modal choice are fall beyond the scope of this paper.

2.2 The role of the private car

Gerontological transport research attributes overriding importance to the private car for the compensation of age-related health restrictions. Accordingly, elderly without a car are "among the least mobile, and among those most at risk for the social isolation and inadequate service availability that can follow from reduced mobility" (Evans, 2001, p. 153 for the USA, see also Marottoli et al., 2000; Schwanen, Dijst and Dieleman, 2001; Mollenkopf, Marcellini and Ruoppila, 1997). The corresponding empirical finding is always: "the share of elderly people (…) who pursue activities outside the house is clearly lower than that of the population as a whole while the amount of activities of older car drivers decreases only slowly with advancing age" (Mollenkopf, Marcellini and Ruoppila, 1997, p. 12).
This argument has led to consequences being drawn even on the political level. The German Federal Ministry for Family, Seniors, Women and Youth concluded that the car could contribute decisively to the "maintenance of a autonomous life (…) to a feeling of autonomy and independence and to the maintenance of an image of self-competence" (BMFSFJ, 2001, p. 211). Cessation of driving would even be a "risk factor for a depressive development" (BMFSFJ, 2001: 212, see also Fonda, Wallace and Herzog, 2001). Apparently it is a "widely accepted notion" (Evans, 2001, p. 153) that the private car guarantees high mobility, autonomy, social integration and the satisfaction of out-of-home activity needs.
However, there is considerable uncertainty about the causality of this relationship. Although the findings of Siren, Hakamies-Blomqvist and Lindeman (2004) confirm that the well-being of elderly persons (in this case: women) who gave up driving is worse than the well-being of those who continue to drive, the authors point out that a decision about cause and effect is impossible. Other studies show that health problems are frequently the *cause* for the cessation of driving (Dellinger et al., 2001).
Investigating the influence of car availability on mobility, the problem occurs that car availability itself is closely related to personal life circumstances. It's the hale, healthy and therefore more satisfied and more mobile seniors who frequently own a car.

2.3 The role of settlement structures

Besides the car, settlement structures on the neighbourhood level seem to play an important part in the maintenance of an autonomous and mobile life of the elderly (Gant, 1997; Mollenkopf and Flaschenträger, 2001). A closer investigation of this influence is therefore highly relevant for spatial planning.

According to the results of a Berlin survey, the attachment to the neighbourhood seems to increase strongly with age: Assuming a hypothetical relocation, only a fourth to a fifth of the 18 to 64-years-old, but about half of the persons aged 65 or more, state their own housing district as the preferred district (figure 1). Strong bonds to the neighbourhood might have something to do with a need for security and stability. This need is however insufficiently fulfilled: The elderly feel particularly insecure in the dark (Scheiner and Holz-Rau, 2002).

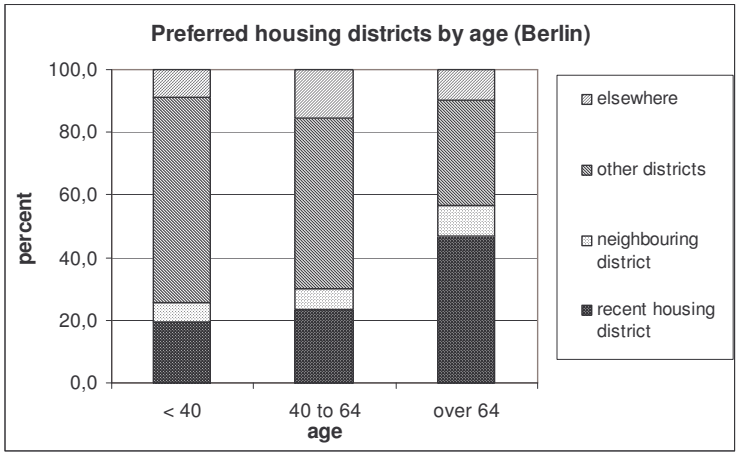

Figure 1. Preferred housing district by age in percent
Source: Scheiner and Holz-Rau (2002) (survey in Berlin 1998)

Besides aspects of security and safety, the demands of elderly people include the spatial and temporal accessibility of opportunities, such as retail, doctors, pharmacies, or chance meeting places. Consequently, higher residential density is associated with higher mobility participation of senior citizens (Evans, 2001), even when this is partly outweighed by an opposite effect of central city areas, which is interpreted by Evans as an effect of security problems in these areas.

However, the micro-spatial accessibility of opportunities and facilities deteriorated in the past decades. Responsible for this development is the ongoing concentration of retail outlets and services in ever bigger units. Recently, this situation has been aggravated by the 'ageing of the periphery': Young families who moved to the urban fringes in the 1960s have become older couples living in Suburbia or in large peripheral housing developments (Scheiner and Holz-Rau, 2002). In the USA, this has been discussed for some time now under the heading 'the graying of the suburbs' (Logan, 1984).

The accessibility of supply facilities for elderly people could be enhanced by the 'city of short distances' with a micro-spatially mixed use and a high, though limited housing density, supplemented by an attractive public transport system. This would, however, presume that there are indeed effects of spatial difference on mobility. At least for leisure mobility, there is no research consensus about this (see e.g. Holz-Rau et al., 1999; Dijst et al., 2005).

3. Methods

3.1 Sample and study areas

The following analysis are based on a net sample of 4.500 personally interviewed persons in the city of Bonn (located at the Rhine in the West of Germany), the left-Rhine suburban space of Bonn, and a part of the Eifel, a rural area about 50 km from Bonn (figure 2). The data was collected and analysed within the project 'FRAME – Leisure Mobility of Senior Citizens' between November 2001, and July 2002. An even seasonal distribution was roughly realised. The net sample represents 28.4 percent of those contacted.

The sample was drawn from the municipalities' population offices. In order to ensure adequate sample sizes for spatially differentiated analyses, it was stratified accordingly. The resulting data include 250 to 300 interviewees, respectively, in four selected, typical areas of the city of Bonn (inner city quarters, highly urbanised former villages, satellite towns with good public transport, satellite towns with less developed public transport); 949 interviewees distributed over all other areas of Bonn to ensure the calculation of results for the city of Bonn in total, 1.536 interviewees in the suburban study area, and 895 interviewees in the rural study area. Within the suburban and the rural areas, spatially differentiated analyses were possible as well. Therefore, five more spatial categories were distinguished: central places in suburbia, other settlements with sufficient provision of supply (retail outlets, services) in suburbia, settlements without sufficient provision of supply in suburbia, central places in the rural area, and other rural places (peripheral villages). Hence, ten spatial categories can be distinguished in total. The only exception is the category comprising the 949 interviewees evenly distributed over Bonn, which therefore remains spatially unspecific.

Additionally, the sample was stratified by age category (60 to 69, 70 to 79, 80 and older) and gender. The proportions of the six resulting groups (three age categories by two gender categories) in the sample reflect the real proportions in the population of each study area.

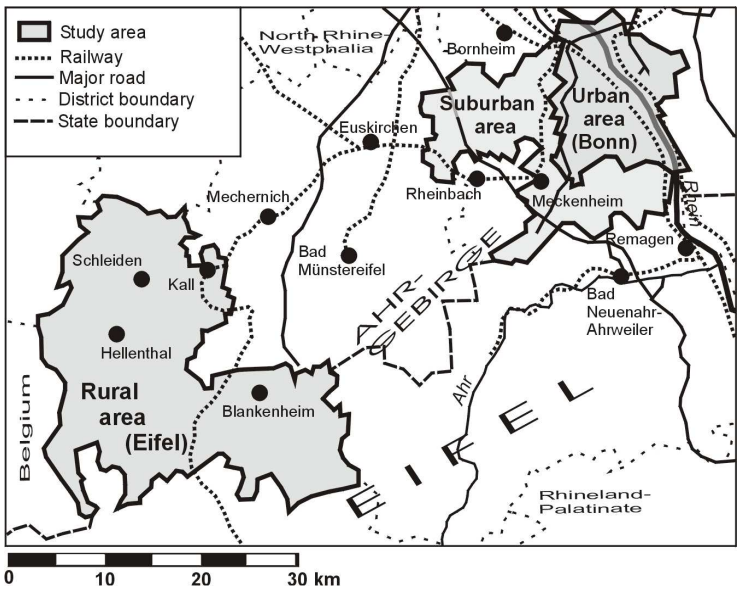

Figure 2: The study areas
Design: Scheiner.

The selection of the study areas allows for an investigation of spatially caused differences in the mobility of elderly people. Therefore the urban, suburban and rural area are starkly contrasting in terms of population density, social structure, land use and public transport network. The population density in the district of Euskirchen (which includes the rural study area) amounts to only 149 inhabitants per km², compared to 491 in the Rhein-Sieg-Kreis (where the suburban area is situated), and 2.157 in Bonn (BBR, 2001).
Bonn, the former German capital, is a city of about 300.000 inhabitants. It has a well developed public transport system and a large variety of leisure facilities, ranging from neighbourhood oriented meeting places for senior citizens to museums of national standard. The settlement structure is compact with a prominent city centre complemented by local district sub-centres.
The suburban space consists of a large number of scattered medium to small size settlements, whose function essentially is restricted to housing. In terms of leisure these do not offer much. Here and there, there are pubs, sports grounds and parish meeting places for senior citizens. Only the town of Meckenheim (17.500 inhabitants in the core town) has a broader range of supply and leisure facilities.
The Eifel is a 'classic' rural area about 50 km from Bonn. The supply is ensured by a net of medium and low order central places. The location is distinctly remote, with distances up to 25 km to the next train station and up to 54 km to the next motorway exit.
In the suburban as well as the rural area, public transport supply is ensured in all places, yet in many places only by flexible forms of service (arranged passenger transport). The line density in the suburban space is about twice as high as in the rural area, the net density three times as high. In the rural area, medium centres are not accessible without transfer from most places.

3.2 Dependent variables: What is mobility?

The focus of the analysis undertaken here lies on the explanation of certain aspects of leisure mobility of elderly persons. The first task, however, lies in clarifying the notion of mobility itself.
A broad debate about the notions mobility and transport emerged in the last decade. In this debate, some contributors have emphasised that mobility does not (or not only) mean realised action, but (also) the dimension of chances to undertake activities; in other words: a potential emerging on the one hand from the individual life situation (e.g. health, financial resources), and on the other hand (supply side) from the accessibility of opportunities (Scheiner and Holz-Rau, 2002; Alsnih and Hensher, 2003). Hence, mobility is not only a way of acting, but also marks a kind of ‘space of possibility’ (Knie, 1997). This definition has rarely been used by empirical research. Usually, parameters of realised behaviour are investigated as mobility indicators, e.g. modal choice, the number of trips or the covered distances within a given period. However, such indicators cannot be interpreted as mobility chances because of the heterogeneity of mobility needs, especially in leisure transport. Fewer trips or shorter distances do not imply restricted mobility. Mobility restrictions in terms of chances or potentials might rather be investigated via the existence of unfulfilled needs or dissatisfaction with individual mobility (see, e.g. Mollenkopf and Flaschenträger, 2001; Siren and Hakamies-Blomqvista, 2004).
For the remainder of the paper, a distinction will be drawn between realised mobility and mobility as a chance to meet one's needs.

(a) Mobility as a chance is investigated by the aspects 'unfulfilled activity wishes' and 'satisfaction with out-of-home leisure activities'. This is based on the idea that mobility is not sufficiently ensured, if a person cannot fully realise her or his wishes for out-of-home leisure (i.e. if she or he has unfulfilled activity wishes) or if she or he is not satisfied with her/his out-of-home leisure.
(b) The realised mobility will be studied using the parameters 'annual frequency of leisure activities', 'activity diversity' (number of different leisure activities), and 'annual leisure distances'.

The realised leisure mobility was recorded by means of the frequent activities method, which is often used in transport science (e.g. Kagermeier, 1997; Holz-Rau et al., 1999; Scheiner and Holz-Rau, 2002). For 24 different activities, frequency, usual activity place, usual mode of transport, accompanying persons and trip duration was recorded. The alternative way would be trip diaries. This method, however, does not make behaviour patterns on the individual level visible, because it is based not only on a random sample of persons, but also on a random sample of days. The activities included, among others, private visits paid to relatives and friends, walks, church visits, attending cafés, pubs or restaurants, senior meetings, dancing, active sports, sport spectator, excursions, garden work, various cultural events (public festivals, museums, concerts…) and educational courses. The distances between housing location and activity places were calculated using geographical coordinates.

Leisure satisfaction was recorded on a four-point graphic scale (from 'very satisfied' to 'very unsatisfied'). Unfulfilled activity wishes were being recorded with an open question. The analysis is based on the information whether an interviewee had an unfulfilled activity wish or not.

The said aspects form the dependent variables to be explained in five multiple regression analyses. These are based on logit models, which allow nominal-scaled dependent variables. Regarding the existence of unfulfilled activity wishes (yes/no), this is appropriate . Leisure satisfaction has a very skewed distribution. 60 percent of the interviewees are 'very satisfied', another 37 percent 'rather satisfied'. Only 3 percent (n=144) are 'rather unsatisfied' or 'very unsatisfied'. In the following analyses I will therefore only distinguish between 'very satisfied' and 'rather or very unsatisfied'. The middle range of those who are 'rather satisfied' will be excluded. Contrasting two extremes may deliver a sharper, accentuated picture[1].

The indicators of realised mobility show very high variations, and in their precise level they seem highly arbitrary in nature. This is being reflected in the very low variance explanation rate in many an analysis (Lanzendorf and Scheiner, 2004). What is more, the age-differentiated analyses of Georggi and Pendyala (2001) show that the explanatory power of the models for senior citizens is particularly weak. Therefore, the indicators of realised mobility are transformed into ordinal scales with three equally large groups of interviewees. Then, the 'upper' and the 'lower' third of the interviewees are compared – in other words, the 'highly mobile' with the 'least mobile'. Thus, we get binary variables ('highly mobile' yes/no). The middle third is excluded from the analysis. Again, comparing the extremes should give a more accentuated picture of the determinants of mobility. By excluding the 'middle third', it is being aimed at achieving a comparatively high share of explained variance.

[1] This analysis was replicated with a random sample of the very satisfied interviewees ('very satisfied' n=144 v. 'rather or very unsatisfied' n=144) in order to control for the bias that may have resulted from the anomalous distribution, with no substantive effect on the fit of the model nor on the significant effects.

However, the sample is being reduced substantially by this method. The final sample varies from n=1.359 to n=2.074 for each analysis (see table 3). Besides the exclusion of interviewees already mentioned, missing data on household income (1.746 cases) contributes to the reduction of the sample size. Nevertheless, income has been included in the analyses, as it is hypothesised to have an important impact on mobility.

3.3 Independent variables: How shall mobility be explained?

As explaining (independent) variables, the analysis includes a range of potentially relevant features. According to the guiding questions of the analysis, car availability as well as a number of spatial attributes of the environment (study area, equipment of the place of residence with leisure facilities, subjective quality of the neighbourhood) are included. The study area represents a selection of three areas, which differ substantially from one another in terms of density, equipment with leisure facilities (number, diversity) and quality of public transport (see below). The selection of study areas allows for testing the hypothesis of influences of settlement structures.
In addition to car availability, the possession of a season ticket for public transport is investigated as well. To control the interrelations discussed above, socio-demographic personal attributes, health and social network are also included in the analysis. All variables are shown in table 3.
In compliance with the model restrictions of regression analyses, the explaining variables have to be metric or binary scaled. The exact procedure followed two considerations:

(a) Regression analyses assume the independence of the explaining variables from one another. Yet this is practically never the case in social science analyses. Thus, interaction terms should be included as explaining variables, otherwise interaction between several determinants might not be recognised. Constructing interaction terms between metric and binary variables is not always appropriate.
(b) The use of metric variables presumes a linear scaling of influence (f.i. 'the more…, the stronger…'). Often, however, this can not be assumed. In many cases there are more threshold interrelations between conditions and action ('if… then…'). An example is the connection between age and car availability: The share of men with car among all men is almost constant from the age of 60 upwards, with a sudden decrease at the age of 80 determined by age cohort (table 1).

Following these considerations, the regression analyses are solely based on binary variables. They are constructed by decomposing metric variables into a number of binary variables. First, this allows the detection of interactions by the use of interaction terms. An interaction term then means the occurrence of two conditions at the same time (e.g. very old age as well as car in the household). Second, the thresholds within scales can be identified whenever a strong connection is being detected, f.i. at which point in ageing does mobility change[2].
This requires an appropriate and economical definition of category limits for the construction of the binary variables. Therefore, bivariate analyses made using very fine categories preceded the regression analyses. From the results of these, adequate categories were defined for the multiple regressions. They will be explained in the context of the presented results.

[2] An alternative would be logarithmic transformations of some variables. Yet this diminishes significantly the overall comprehensibility of the models. Moreover, it does not solve the problems in the construction of interaction terms.

The significance level for the analyses is set to α=0.01. This comparatively high level was used because of the large sample. A lower significance level would imply marginal and therefore (with regard to the content) meaningless connections appearing significant. The presented multivariate analyses are undertaken with unweighted data to avoid distortions of significance.

4. Results

4.1 Car availability and leisure activities in the study areas

As a background to the results, some descriptive findings on car availability and leisure activities in the three study areas shall be outlined briefly.

In total, two thirds of all interviewees (66 percent) live in motorised households. Only a small portion of these (4 percent) do not hold a license. Car availability differs sharply between the study areas. Whereas 39 percent of the interviewed Bonn residents live in households without a car, this share is 20 percent and 34 percent for the suburban and the rural study area, respectively[3].

These differences are reflected in mode use. The most frequent travel mode in leisure time is walking. In Bonn and suburbia, 58 percent of all trips are undertaken by foot. Surprisingly, in the rural area the share of foot trips is notably higher than in the other areas (70 percent). In suburbia, every third trip is undertaken by car (33 percent; sum of driver and passenger). In the city of Bonn and in the Eifel, this is true for only every fourth trip (24 percent and 26 percent, respectively). Public transport holds a certain proportion in Bonn (11 percent), but does not play any role in the suburban and rural area (2 percent and 1 percent, respectively).

The most frequent activities are social activities (private visits, in particular), walking and sports. These three activity types account for 77 percent of all reported activities. Social activities rank first with 36 percent of all activities. Other frequent activities are restaurant or pub visits (8 percent), excursions (6 percent) and club activities or honorary posts (6 percent). Educational and cultural activities, garden work and sports spectator are much less common, although it should be noted that lower frequency does not imply lower importance. For instance, no less than 70 percent of the interviewees visited at least one cultural event or educational course in the year before the survey (as compared to only 62 percent doing sports). Even so, the average frequency of cultural or educational activities is much lower because those doing sports do it much more often.

A spatial comparison reveals an explanation for the high proportion of walking trips in the rural area. It is due to a specific spatial behaviour and activity behaviour: in the rural area, elderly people tend to undertake more activities within their neighbourhood, and they undertake fewer 'specialised' activities, such as cultural activities, restaurant visits, and

[3] This is roughly in line with the findings of the survey 'Mobilität in Deutschland 2002' (MiD, see www.kontiv2002.de). According to the MiD data, the proportion of persons living in non-motorised households among those aged 60 or older, is 38 percent in core cities of agglomerations, 21 percent in high density suburban districts of agglomerations, and 25 percent in rural districts of agglomerations (author's own analysis). The difference regarding the rural area might indicate a less developed character of the rural study area that is not yet subject to being suburbanised.

excursions. The rural elderly are more focussed on social and traditional activities, such as private visits or church attendance.
After this short introduction to the empirical results, the remainder of the section shall be focussed on the determinants of leisure mobility.

4.2 Frequency of out-of-home leisure activities

The frequency of activities ranges among the most important mobility indicators. With a small experiment, the complex connections between the different influencing factors of activity frequency can be shown.

Table 2. Influences on leisure activity frequency of elderly people: results of four stepwise logistic regression models

	Model 1	Model 2	Model 3	Model 4
car in the household	0.392	0.302	0.195	n.s.
70-84 years		-0.334	-0.318	-0.296
85 years or older		-0.608	-0.530	-0.568
gender (male)		-0.256	-0.255	-0.216
weak social network			-0.867	-0.840
medium social network			-0.510	-0.488
suburban space			n.s.	n.s.
rural space			n.s.	n.s.
bad health condition				-0.606
medium health condition				-0.267

The table shows the standardised regression coefficients B (logit coefficients) (Tiede, 1995) of the significant explaining variables (α=0.01). The standardised coefficients are independent from the measured scale of the respective variables and therefore decisive for the interpretation of the strength of the influence. The algebraic sign indicates the direction of the connection.
n.s.: not significant;
grey: excluded from the analysis.
Source: FRAME household survey (own calculations)

In four stepwise logistic regression models to explain the frequency of out-of-home leisure activities, an increasing number of explaining variables are successively being introduced (table 2):

- In model 1 solely car availability (car in the household);
- in model 2 additionally age (reference: 60-69 years) and gender (reference: female);
- in model 3 additionally the study area (urban, suburban, rural; reference: urban = Bonn) and the social network (dense, medium, weak; reference: dense network);
- in model 4 additionally health (good, medium, bad; reference: good health).

The strong positive influence of car availability on activity frequency becomes evident in a superficial analysis (model 1). Yet we recognise that this influence decreases from one model to another, the more determinants are included, until it appears insignificant in the last step (model 4). An influence of settlement structures is not recognisable at all. The influence of other variables decreases as well, the more determinants are included, however not the same magnitude as the influence of car availability disappears.

Table 3 shows the complete model. We can see that, despite the comprehensive consideration of explaining variables, only a small part of the activity frequency can be explained. The explained variance amounts to only 11 percent (R^2=0.113). The most important influences for the frequency of out-of-home leisure activities of elderly people are their physical ability to move and their social network. While the respective medium category (medium ability to move, medium size social network) reduces the activity frequency significantly, bad ability to move and a weak social network cause a near complete cessation of out-of-home activity level. 'Weak social network' means that there are not more than eight persons (relatives or friends) to whom there is personal or telephone contact at least once a month (medium social network: 8 to 13; dense network: more than 13 persons).

The ability to move is measured by the ADL (activities of daily living) concept (Horgas, Wilms and Baltes, 1998). Good ability to move means that a person suffers from none or only small physical restrictions, i.e. may not be able to accomplish heavy housework or is not able to carry heavy objects like beverage boxes. This is true for 85 percent of all interviewees. Medium ability to move implies distinct restrictions such as not being able to walk 2 km, to go shopping or do light housework (12 percent of the interviewees). Bad ability to move implies that autonomous moving out of the house is impossible. This is true for only 2 percent of the interviewees (85 persons). It is mainly this last category, which heavily influences activity frequency. This means that even persons with distinct health restrictions (the medium category) are highly active outside of home[4].

Further negative effects on activity frequency arise from a generally bad health condition[5] and from being older than 70 years of age, if this is complemented by living in partnership. This amazing result might possibly be explained by two factors: First, elderly people living alone are more forced to satisfy their needs for social contact out of home. Second, the high number of persons needing care among couples in very old age might reduce the activity frequency of the respective partner. Consequently, among the interviewees who are 85 years or older, only one percent of those without partner, but 8 percent of the persons with partner (mainly women) state that they nurse another person (exact Fisher-test significant, α=0.01).

[4] Because of the overriding importance of the ability to move, sensitivity analyses were undertaken for all mobility indicators by excluding persons with restricted (medium or bad) ability to move. The results confirm the results presented in this paper.

[5] Health was measured by an additive index of two items reflecting the evaluation of one's own health and the satisfaction with one's own health (r=0.74; Cronbach's α=0.85). This index, ranging from 2 to 8, was decomposed into three categories (values from 2 to 4: bad health; 5 to 6: medium health; 7 to 8: good health).

Table 3. Determinants of leisure mobility of elderly people: results of five logistic regressions

	Activity frequency		Activity diversity		Leisure distance		Unfulfilled activity wish		Leisure satisfaction	
Variable	**B**	**Std. B**	**B**	**Std. B**	**B**	**Std. B**	**B**	**Std. B**	**B**	**Std. B**
age (reference category: 60-69 years)										
70-84 years			-1.154	-0.811	-0.938	-0.660	-0.262	-0.184		
85 years or more			-2.306	-1.320	-1.775	-1.016				
sex male (reference category: female)	-0.409	-0.289					-0.412	-0.292		
income above average			0.529	0.374	0.706	0.499				
employed							0.415	0.224		
education (reference: elementary school or no graduation)										
education: intermediate high school					1.018	0.655				
education: high school			0.596	0.410	0.558	0.384				
health condition (reference: good)										
bad health condition	-0.834	-0.506	-1.211	-0.734	-0.981	-0.595	0.619	0.375	-1.669	-1.012
medium health condition	-0.399	-0.280								
ability to move (reference: good)										
bad ability to move	-3.006	-1.192			-1.900	-0.753				
medium ability to move	-0.801	-0.466	-1.675	-0.975						
social network (reference: dense social network)										
weak social network	-1.215	-0.831	-1.908	-1.306	-1.112	-0.761			-0.843	-0.577
medium social network	-0.497	-0.342	-0.562	-0.387	-0.591	-0.406				
living in partnership					0.617	0.426			0.759	0.524
availability of transport means										
car in household			1.288	0.882	1.332	0.912				
season ticket for public transport*			0.754	0.490	1.028	0.668				
study area (reference: urban [Bonn])										
suburban space										
rural space (Eifel)										
comprehensive leisure offers at place of residence										
high neighbourhood satisfaction			0.486	0.344						
living in partnership * 70-84 years	-0.660	-0.430								
living in partnership * 84 years or older	-1.107	-0.463								
constant	1.291		0.197		-0.635		0.299		3.662	
R^2 (McFadden)	0.123		0.389		0.333		0.021		0.092	
N	1.359		1.510		1.583		2.059		2.074	

* season ticket, Bahncard or other ticket with reduced fares (f.i. severely handicapped pass)
Interaction terms were included if the correlation coefficient between two variables exceeded r>0,4 resp. r<-0,4. Interaction terms between the following variables were included: living in partnership, car in household, age, education, sex, income.
The table shows the un-standardised and the standardised regression coefficients B (logit coefficients) (Tiede, 1995) of the significant explaining variables (α=0.01). The standardised coefficients are independent from the measured scale of the respective variables and therefore decisive for the interpretation of the strength of influence. The algebraic sign indicates the direction of the connection.

R^2 (McFadden) is calculated by comparing the log-likelihood-function of the complete model with the log-likelihood-function of the constant model. It is a measure for the model improvement compared to the initial model, and serves as a proxy for the explained variance of the dependent variable.
Source: FRAME household survey (own calculations)

The *in*significant variables require attention as well. Firstly, it is remarkable that age itself does not seem to have an influence on activity frequency. Rather, the impact of age seems to conceal age-related attributes like ability to move, health and household structure (partnership). Second, settlement structures do not seem to be of any relevance for activity frequency. Neither the area type (urban, suburban, rural) nor the equipment of the place of residence with leisure facilities[6] or the perceived quality of the neighbourhood have a recognisable impact[7]. Third, car availability does not have an independent effect, contrary to the assumptions discussed in section 2.2. Instead, it appears that persons with a car are no more active than persons without a car.
For further examination of spatial effects and effects of car availability, a sensitivity analysis was undertaken by including dummy variables of the ten fine-scaled spatial units named in section 3.1 to represent the inner diversity of the study areas, ranging from high-density inner city quarters in Bonn to peripheral villages in the Eifel[8]. The result did not differ from the findings discussed in this paper.

4.3 Diversity of out-of-home leisure activities

The following section will investigate how many *different* leisure activities a person undertakes at least once a year. The explained variance of this model is very good (38 percent, R^2=0.383). According to Urban (1993, p. 62), values of 0.2 to 0.4 are judged as a good model fit. The activity diversity can therefore be more than sufficiently explained by the variables included here.
Again, the most important variable for the explanation of activity diversity is the ability to move. Persons with poor ability to move undertake significantly less diverse activities than others. Severe restrictions are also caused by very old age, a weak social network and a generally bad health condition.

[6] The construction of the indicator for the equipment of the place of residence with leisure opportunities is based on extensive mapping of the Geographical Institute of the University of Bonn. The mapped leisure facilities were first grouped into eight categories (church/graveyard, pubs/cafés/restaurants, health, sports, senior meeting places, culture, education, outdoor facilities). From the categories, an indicator was calculated which represents the diversity and depth of the local leisure offers. The indicator was reduced to a binary variable distinguishing only between comprehensive and limited leisure supply quality. Comprehensive means that out of the eight categories at least five are locally represented (diversity of the supply), and that at least three of these are represented by at least three different facilities (depth of the supply). The spatial base are not the municipalities, but the settlements (mostly villages) which are parts of the municipalities. In the suburban and rural area, the settlements are mostly entities which are separated from each other by quite long distances.
[7] The perceived quality of the neighbourhood was recorded by eight items which included perception of security, supply, condition of the quarter (cleanness) and neighbourhood contact. A reliability analysis shows that the use of a mean index is appropriate (Cronbachs α=0.58).
[8] Furthermore, dummy variables for license holding as well as an interaction term for license and car in the household were included as a proxy for the ability to drive a car. The results differ in no way from the findings discussed above. This is also true for all other investigated mobility indicators except for the travel distances, where the effect of car availability (see below) was replaced by an effect of the interaction term between car availability and license -holding. This effect had the same direction and similar strength as the effect in the model presented in this paper.

It is apparent that activity diversity can be explained more fully than activity frequency by health and socio-demographic factors. This calls into question the classic image of frail, lonely and therefore immobile seniors in very old age. The said factors strongly influence the diversity, but only slightly the frequency of the undertaken activities. Consequently, seniors with serious health restrictions and a weak social network are very active, but not in such a diverse way as more healthy, younger persons with a dense social network. This also becomes visible in the fact that the standardised effects of health and ability to move on activity diversity are much stronger than on activity frequency.

A positive influence on the diversity of the undertaken activities can be attributed to high income and high satisfaction with the neighbourhood. The latter might be interpreted in that a favourable neighbourhood quality and equipment with a variety of facilities makes a high activity diversity possible. But although this interpretation seems plausible, it is not necessarily conclusive. There might also be a correlation between satisfaction and activity, which discriminates satisfied and active from less satisfied and active persons without any causal relationship to the neighbourhood.

The fact that the objective spatial frame conditions (urban, suburban, rural) do not seem to have any independent influence also casts doubt on the impact of settlement structures. This is even more true with regard to the contrasting selection of study areas. In other words: If there are no differences between the areas studied here, it is highly unlikely for such differences to be found between less distinctive areas.

What is more, persons with car availability undertake a higher variety of activities than persons without car. Although according to the model this is an independent effect of car availability, it must not be interpreted as an 'impact' of the car. Why this? Because the availability of a season ticket for public transport (including the 'BahnCard', a ticket that reduces train fares to 50 percent) also has a positive effect on activity diversity. However, a ticket can not cause activities. The availability of a car or season ticket should therefore not be interpreted as a cause for mobility. It seems more plausible that the availability of a car or season ticket is a consequence of a certain way of life (although this causality can not be derived from the data either), an effect of individual attributes of a person, which are not expressed sufficiently in the other included variables. These 'unexplained' attributes distinguish persons with diverse leisure interests from other persons. These preferences for a big variety of (possibly highly specialised) offers foster the purchase of a car or a season ticket. High diversity of leisure activities is positively associated with season ticket and car availability. Both might facilitate, but certainly not cause, a mobile and active way of life.

4.4 Leisure distances

This dependent variable is the sum of trip distances to all leisure activities travelled by a person within one year. The explained variance of this model is again good (32 percent, R^2=0.322). Regarding the travelled distances, it becomes particularly evident that linear relationships between the independent variables and the dependent variable may not be assumed, because with a linear regression model (not documented here), only 7 percent of the variance could be explained using the same explanatory variables.

The most important influence for the leisure distances is car availability. Persons with a car in the household travel distinctly longer distances than persons without a car. Again, this is not an 'impact' of the car, as the availability of a season ticket for public transport also has a positive effect on the travelled distances. Apparently, this is again a distinction between

persons with a travel intensive way of life and persons with a more 'transport saving' way of life. This distinction possibly implies a differentiation of life styles, leisure preferences or mobility preferences, or it simply means that there are relatives or friends living far away, which favours the purchase of a car or a season ticket or 'BahnCard'. The availability of a car or a season ticket is, thus, an expression of a certain way of life with low distance sensitivity.
The interaction between very old age and living in partnership implies reduced distances. This might be interpreted the same way as discussed in the former section. The significant interaction between car in the household and the middle age category (70 to 84 years) seems hard to interpret and requires further investigation.
Further variables that increase leisure distances are (in descending order of importance) good ability to move, a dense social network and living in partnership, high education and high income, and good health. Summing up, younger seniors with good health, manifold social contact and high social status cause the highest leisure transport volume.
Notable spatial effects had been expected with regard to travel distances. Therefore, the analysis was replicated again by including the fine-scale spatial units already mentioned. The findings indicate that residents of inner city quarters in Bonn travel shorter distances than elderly living in the reference category 'peripheral villages' in the rural area. The standardised effect is -0.379 - the smallest coefficient of the model. No other spatial category was significant. This singular effect, distinguishing the extremes (high-density quarter in a large city v. peripheral village), does not serve as good evidence for the relevance of spatial structures for transport volume generation in leisure travel, as it is exactly the 'transport saving' inner city quarters of cities that attract a considerable amount of incoming traffic because of their centrality.
However, there is an interesting finding when one distinguishes centre-oriented from other activities. Centre-oriented activities include visits of educational facilities, restaurants, pubs and cafés, cultural events and museums, senior meetings, and shopping. Due to lack of space, this cannot be elaborated in detail here, but the key findings are as follows.
The separate analyses for centre-oriented and other activities essentially lead to the same effects as the analysis of all activities in total. What is more, there are spatial effects now: In suburbia and in the rural study area, the annual leisure distances for centre-oriented activities are longer than in Bonn, whereas the distances for other leisure activities are shorter (the latter is significant only in the rural area). The respective separate analyses for activity frequency lead to the same results. This means that there are indeed differences between the study areas with respect to the structure of activity demand. These are reflected in the travel distances. However, they outweigh each other so that there is no significant difference in total leisure travel demand.

4.5 Unfulfilled activity wishes

Having examined realised mobility, we now revisit mobility as a chance to satisfy activity needs. Only to a very small degree can the existence of unfulfilled activity wishes be explained by the investigated variables, although the model is highly significant (explained variance: 2 percent). Factors augmenting the probability of unfulfilled wishes are bad health, employment, and gender (women state unfulfilled wishes more frequently).
The results reveal that persons who are still in employment often have more unfulfilled wishes than those who are retired. This might be explained by their restricted time budget, especially while being in an age when the view is already directed towards the post-

employment phase and its leisure possibilities – thus there might be a tendency to postpone wish-fulfilment at this stage of life. Health problems enforce unfulfilled wishes. Their impact seems particularly strong with regard to the expectations towards life in comparatively 'young' age.

But altogether it is remarkable that unfulfilled wishes cannot be ascribed to a certain group of elderly persons. In particular, the classical frail and lonely elderly do not seem to have unfulfilled wishes with particular frequency. This might be interpreted in the sense that people measure their own needs against those of a 'comparison group', possibly people in the same age group. Younger seniors compare themselves and their needs with other younger seniors, who might already be retired and have a lot of leisure time. Seniors in very old age compare themselves with other seniors in this age group with equally low realised mobility, and accordingly they are not unsatisfied with their restricted range of out-of-home activities.

This is underlined by another regression analysis (which is not documented here for lack of space), which included activity variety as an additional explaining variable. The results essentially conform to those documented here, with the difference that activity variety is additionally significant: The more different activities somebody undertakes, the more likely it is that he or she still has unfulfilled wishes.

Two *in*significant aspects shall also be mentioned here: the spatial context and car availability. First, between the local leisure offers and the existence of unfulfilled activity wishes, a negative connection was to be expected. Second, a negative connection between car availability and the existence of unfulfilled activity wishes was to be expected according to existing researches, i.e. a lower share of persons with unfulfilled wishes among car owners. Apparently, this is not the case.

4.6 Leisure satisfaction

It is equally difficult to explain individual satisfaction with the personal out-of-home leisure time using the variables included (explained variance 8 percent). If anything can be said, then it is that lower leisure satisfaction seems to be caused by bad health, a weak social network, and living alone. Again, health is most important, but only notably bad health causes a decrease in satisfaction.

The results show that persons living in partnership, with a dense social network and with no (or at least no severe) health problems are most satisfied with their leisure. As already discussed above, it becomes clear that minor health problems do not cause restricted mobility (i.e. here: low satisfaction).

5. Conclusions

It is well-known from mobility research that the realised daily mobility strongly varies between individuals, and that it can be explained only to a limited extent even when numerous independent variables are considered. By comparing the highly mobile with the least mobile persons in logit models, a very good explanation of variance was being achieved at least for leisure distance and activity variety. With respect to activity frequency, the fit of the model was only moderate, however.

According to the above analyses, the explanation of unequal mobility *chances* seems to be even more difficult than the explanation of realised mobility. Neither satisfaction with out-of-

home leisure activities nor the existence of unfulfilled wishes can be explained to a noteworthy degree from socio-demographic, spatial and health related variables, although unfulfilled wishes could be expected particularly with regard to mobility-impaired individuals (Cvitkovich and Wister, 2001). This is likely to be attributable to the adaptiveness of man to the possibilities and potentials provided by the individual life situation and the environment. More valid indicators for the empirically difficult term 'mobility as a potential' have yet to be developed.

According to this result, the options of elderly people to realise personal mobility wishes can only be explained to a small degree. If any, still employed persons and persons with health problems have unfulfilled activity wishes. From that, the thesis might be derived that people measure their wishes at their respective life situation using a 'comparison group', possibly people in the same age group. This thesis, however, needs further investigation.

High mobility is maintained for quite a long time, even if health restrictions occur. With increasing restrictions in the ability to move and with deteriorating health, it is activity diversity that is narrowed rather than activity frequency. Hence, persons with such restrictions do not become less active, but they concentrate on the remaining, physically possible activities. This is in line with previous findings (Herzog et al., 1989) and lends support to the SOC-model established by Baltes and Baltes (1990). This model is based on the terms selective optimisation and compensation (SOC) that describe the changing allocation of resources in the process of aging caused by the increasing importance of the regulation of functional losses and functional maintenance, as compared to functional growth.

The spatial context does not seem to have any influenceon realised mobility or on mobility chances and wishes. For influencing leisure mobility with spatial planning concepts (e.g. city of short distances, mixed use, density), this evidence is not particularly encouraging. It should be noted, however, that only a small selection of rather global mobility indicators was investigated in this paper. Modal choice might be spatially differentiated (Schwanen, Dijst und Dieleman 2001), but was not studied here. Activity specific analyses lead to significant spatial differences, yet these tend to outweigh each other. Hence, they are irrelevant for travel generation in total, although they might be highly relevant for the societal participation of the elderly or - because of activity specific patterns of time use - for the temporal distribution of traffic. More detailed activity specific analyses might lead to a more accentuated picture of spatially differentiated leisure patterns. For instance, cultural leisure activities might be more prevalent in urban areas with their manifold facilities, than in rural areas.

Studying non-leisure activities might lead to more distinctive spatial effects as well. For shopping and maintenance trips, the spatial distribution of supply is highly important (Limanond and Niemeier, 2003), and individuals without a car are particularly reliant on shopping facilities in the neighbourhood.

Car availability does not seem to have any influence on leisure mobility and the fulfilment of leisure needs. Where it plays a role at all (with respect to realised mobility), the availability of a season ticket for public transport indicates an influence into the same direction. Thus, it is not the car, which makes elderly persons mobile and satisfied, as frequently assumed in gerontological mobility research. Rather it is the healthier, more mobile and more satisfied seniors who frequently own a car and/or a season ticket for public transport. The availability of transport means rather represents a certain type of individual with a certain mobility behaviour than being a determinant for mobility. To ascribe causal effect on mobility maintenance, fulfilment of needs or social integration to the car is a misrepresentation of cause and effect resulting from three methodical problems: First, from the comparison of

incomparable groups, namely elderly with and without a car, while crucial background variables (e.g. health) remain uncontrolled. Second, the use of invalid measures, namely indicators of realised mobility as a measure for the fulfilment of needs (exception: Mollenkopf and Flaschenträger, 2001), and third (the easiest way), non-car drivers simply do not get asked (Fonda, Wallace and Herzog, 2001).

In conclusion, some considerations on the spatial generalisation of the findings (that might be limited in a number of ways) shall be outlined.

First, a wider range of spatial structures from urban to rural might lead to more distinctive spatial effects. Less mobile population groups in remote rural areas of Scandinavia or Ireland might be more disadvantaged than the respective groups in the rural area investigated in this study. In Finland, absence of a driver license and rural-type residence proved to be predictors for hindered mobility (Siren and Hakamies-Blomqvist 2004). For West German standards, however, the studied areas cover quite a wide spatial range.

Secondly, the disadvantages of individuals without a car might become more distinct in more car-dependent societies, such as the United States. Consequently, the absence of a car might have a stronger effect on mobility in such countries.

Thirdly, the city of Bonn is characterised by skilled middle and upper class residents (civil servants), who are likely to travel long distances - a fact that distinguishes Bonn from the Eifel. In a region with lower-skilled population (Berlin, Ruhr area), the core city residents might show a more neighbourhood-oriented (leisure) travel behaviour. Hence, in such cities the travel distances might be distinctly shorter as in the surrounding suburban and rural space.

The findings of this study challenge some of our assumptions about the mobility of the elderly. Therefore, the validity of the results should be verified in future studies. It should be kept in mind that the findings are derived from cross-sectional comparison. They do not contradict panel studies indicating restrictive effects from cessation of driving on mobility (Marottoli et al., 2000). They suggest, though, that the car does not make 'happy and mobile' - however, public transport does not either.

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