

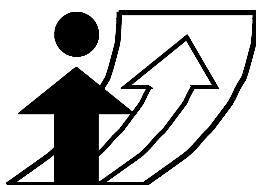


## **Methodological Advances in National Travel Surveys:**

### **Mobility in Germany 2002**

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**Moving through nets:**

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## **Methodological Advances in National Travel Surveys: Mobility in Germany 2002**

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## **Abstract**

In Germany a National Travel Survey was conducted in the year 2002. This paper describes the process needed to make empirical based decisions on main design characteristics of this survey. It outlines the survey operation that was used in the field during the year 2002, reports on the relevance of different contact strategies to minimize selectivity and nonresponse and refers to issues of data processing and of dissemination of the data. Finally some key results are presented.

## **Keywords**

National Travel Survey, Method Mix, CATI, International Conference on Travel Behaviour Research, IATBR

## **Preferred citation**

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## 1. Introduction

National Travel Surveys (NTS) may be defined as large scale, multi purpose cross-section surveys financed and supervised by some national authority. They attempt to measure personal travel behaviour in conjunction with its assumed determinants, i.e. the socio-demographic characteristics, the regional inventories and the available means of transportation. Household travel surveys make use of mail, telephone or the interviewer to obtain information on the daily travel and other activities of a representative sample of the population. Typically, eligible persons in randomly selected households are asked to record in survey diaries all travel or activities conducted during a randomly assigned period, mostly of one day.

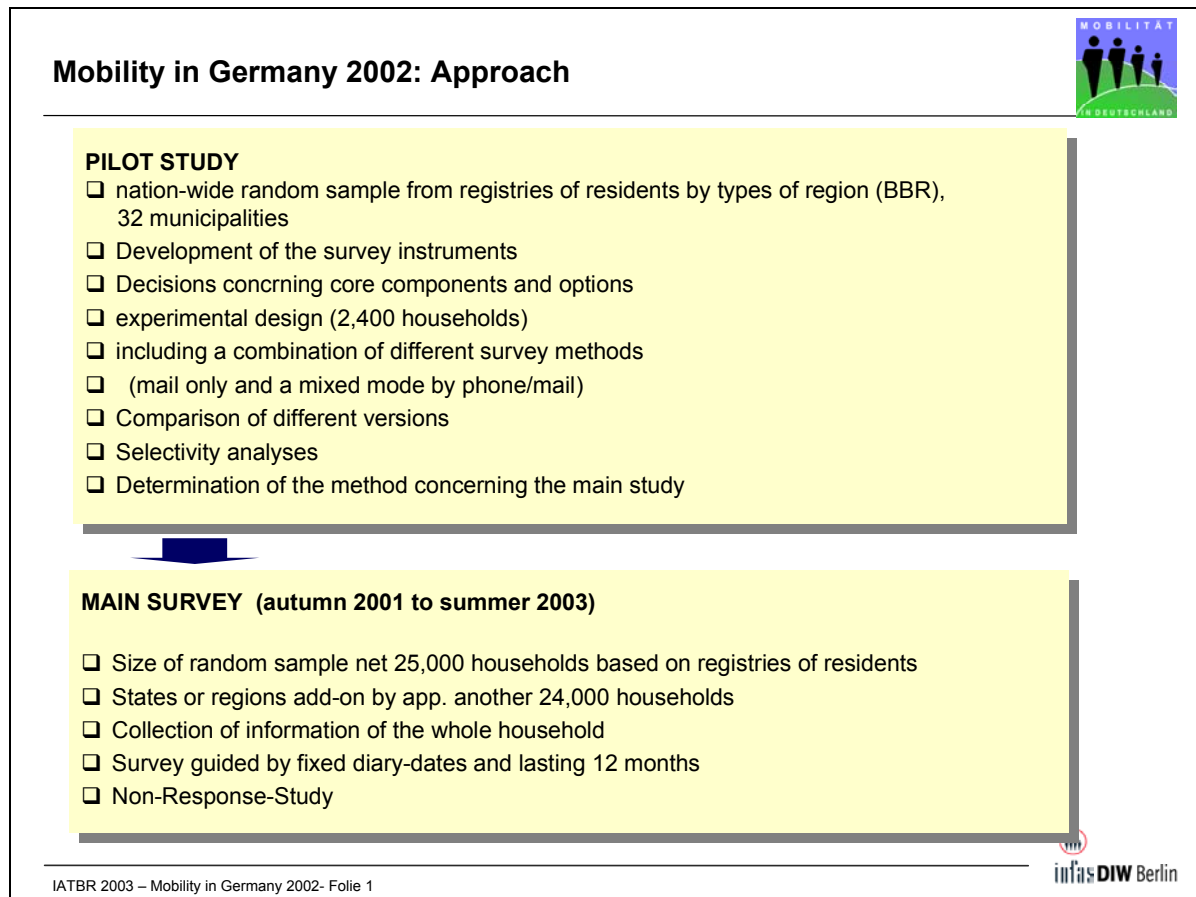
All NTS are cross-section surveys by nature even though the field period may span a year or may be continuous, but no repeated measurements of the same units (i.e. households or persons) are attempted. Yet in countries where NTS were conducted more than once, repeated cross-section data is generated and may be used for time-series presentation (Bundesministerium für Verkehr, Bau- und Wohnungswesen, 2002; Hjorthol, R.J., 1999; U.S. Department of Transportation, 1993).

In Germany, a new National Travel Survey was conducted in the year 2002. This paper describes the process to prepare for empirical based decisions on main design characteristics of this survey, outlines the survey operation that was in the field during the year 2002, reports on the relevance of different contact strategies to minimize selectivity and nonresponse and refers to issues of data processing and of dissemination of the data. Finally some key results of the survey are presented.

## 2. Study Design: Pilot ► Main Survey

As there has been no NTS in Germany for more than a decade and none after the reunification of Germany and because methodological developments in survey design have taken place it was decided to explore different options for the NTS with a pilot study. The DIW Berlin and infas-Institut für angewandte Sozialwissenschaft Bonn had been assigned by the Federal Department of Transportation to carry out both the methodological study and the main survey. Both parts of the study were accompanied by a scientific advisory board and by a board of future users of the NTS data. This general approach is depicted in [Figure 1](#).

Figure 1 Mobility in Germany 2002: Approach



Some decisions about important design elements were made in cooperation with the sponsor and the advisory board at the beginning of the project. These design elements were no options to be tested in the pilot:

- Stratified random sampling from official person registers including foreigners. The use of registers for drawing the sample was proposed to control the process of sample loss on the basic variables supplied by the registers (gender, age, nationality).
- Record of the full household-structure and socio-demographics and travel of at least all persons above a certain age of eligibility to allow for household context analysis.
- Continuous field over 12 month to capture seasonal variations in travel.
- Record of one travel day per person to avoid recall and fatigue effects.
- Creation of key representative mobility indicators for each of the sixteen states of Germany.
- Integrated nonresponse survey to assess the socio-demographics and mobility of non participating persons.

- Definition of link variables to other current surveys to facilitate comparisons and connected analysis.

### 3. Pilot Design

In this pilot study we reviewed experiences with NTS in other countries (Kunert *et al.*, 2002) and we examined innovative methodological approaches to transportation survey design. The empirical part of the study evaluates different combinations of design-elements by testing the instruments and the implementation in a sample of 2 400 households in the early summer of 2001. There were four dimensions of the empirical test:

- the survey mode: mail out and back SAQ vs. mixed mode by CATI and mail;
- the trip reporting formats: trip diary, trip diary including a question for “stops on the way”, activity diary;
- the length of questionnaire depending on the survey content;
- the use of incentives.

In this manner 24 combinations of the above dimensions were tested in an experimental design with 100 households per cell. The pilot study was based on a nation-wide random sample from population registers stratified by types of region. There were several other issues and elements to be evaluated in all design versions:

- The eligibility of children: from what age can children participate and what is the appropriate design of the instrument?
- A question on income was to be asked the first time in a nationwide mobility survey: how should it be constructed and what is the effect on response?
- Vehicles within the household: with what detail can the technical characteristics and the use be recorded?
- Trip purposes: collecting evidence on the occurrence of purposes to construct detailed lists for the main survey.
- Travelling on the job: design of an extra module to capture trips for the respondents job or business.
- Long distance journeys: design of an extra module to capture the rare long distance trips.

### 4. Pilot Results and Recommendations

In the pilot study, information was collected from 5 900 persons in over 2 400 households, giving details for some 17 800 trips.

The assessment of the reporting formats “trip diary” vs. “trip diary with the additional question for stops on the way” showed ambiguous results and significant differences in trip reporting by instrument design. In the mail-SAQ survey the average number of trips reported by mobile persons for the two formats was 3,34 (including the “stops” counted as trips). Counting trips only, the number resulting in the classical reporting format of a trip diary was significantly higher than in the format including the additional question for a “stop on the way” (3,21 vs. 2,98). However, in the latter diary format additionally 0,49 stops were reported. The average number of trips reported was higher in the telephone survey (3,89) and we observed no significant difference in the reported number of trips for the two instrument designs in this survey mode.

The reporting format “activity concept” needed additional editing and screening in the mail mode. On the other hand, with the complete daily schedule this concept has a high potential and yielded the most complete coverage of trips in the CATI mode. It was therefore developed for use as a memory jogger to be send by mail in the main survey.

The comparison of the two survey modes favoured the CATI as the completeness, quality and consistency of the data are enhanced. We observed less item nonresponse, fewer forgotten return-trips and more households with complete interviews for all members. Also the response rate was higher in CATI (31 % composite rate over all steps of sample formation in the household and person interviews) than for the mail mode (25 %). We expected substantial higher response rates in the main survey without the restrictive field conditions in this pilot (short field time, no recontacting). The length of the questionnaire and the use of incentives did – c. p. – not have significant effects on the survey results.

The findings supported the substantially extended survey content: It is possible to portray the full household context including children with instruments streamlined in respect to length, wording, trip purposes etc. Additional information on the household, vehicle, person and trip level can be collected without putting to much burden on the respondent (e.g. now 38 trip purpose categories). In all, the first phase of the project has demonstrated the feasibility of a complex survey design that is not apparent to the respondents. Also the report of numerous trips on the job is feasible with an integrated component that cuts short on detail but improves coverage and gathers additional information on type of job, mileage and branch of industry.

However a method mix is essential to improve coverage and reduce selectivity of the approach. Also the mail mode had to be improved by streamlining materials and enhancing transparency for the respondents. Then the approach can generate data of higher scope and detail than was the standard in NTS.

Although the analysis of selectivity of the pilot sample shows only few significant effects that more concern the socio-demographic than the methodical variables, it was highly recommended to design an integrated nonresponse study with the main survey. This conclusion was also based on the experience that it is difficult to achieve response rates with a voluntary population survey that make you not think about the characteristics of non-respondents.

Furthermore the pilot results in experiences concerning field implementation, CATI programming, contact and reminder sequence and – most importantly – the training of the interviewers. Further results of the pilot are reported in Engelhardt et al. (2002 a) and infas, DIW Berlin (2001).

## 5. Main Survey Design

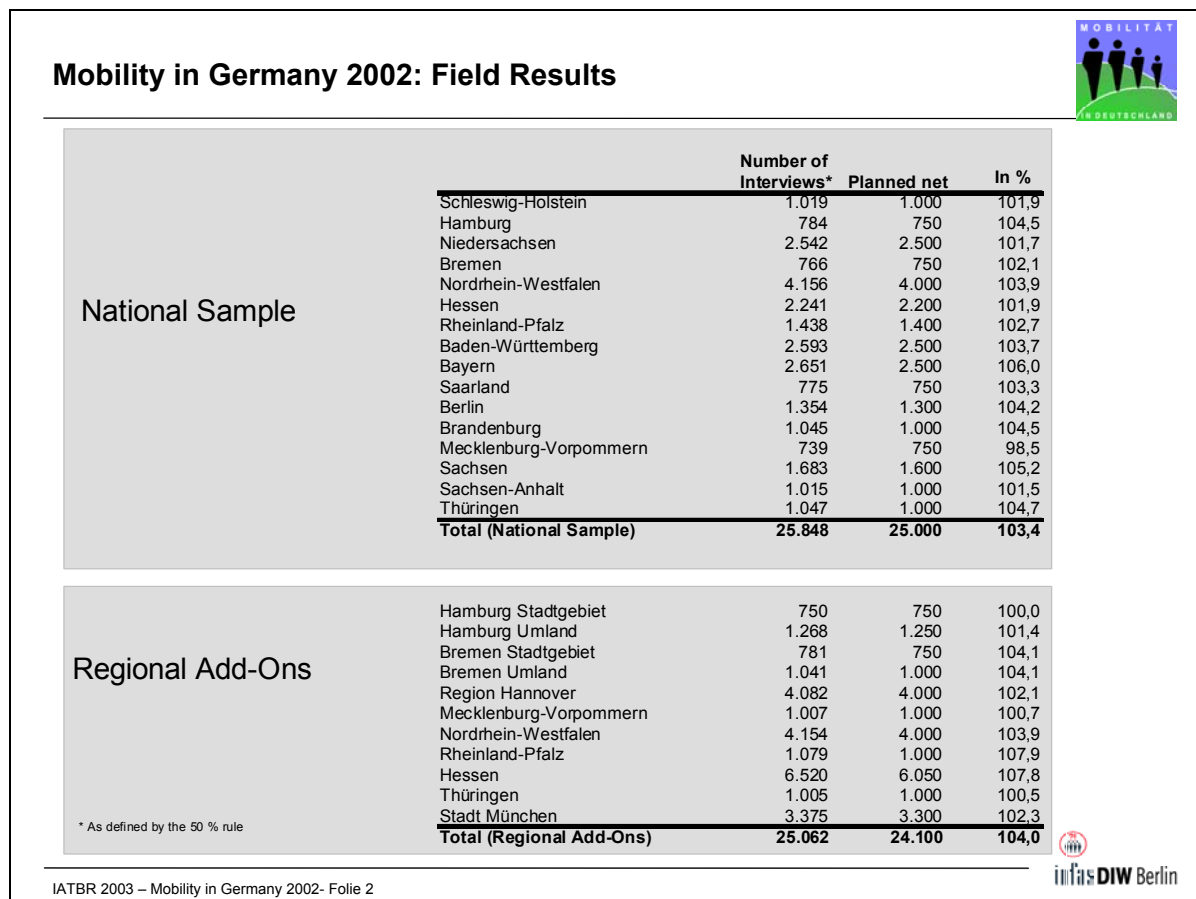
For the main survey – now given the label MOBILITY IN GERMANY 2002 – the national random sample of 25,000 households net is based on population registers of 300 municipalities stratified by types of regions. From these registers persons 14 years and older are drawn. States or regions commissioned nine add-on samples of approximately another 24,000 households (Figure 2). Given this sampling frame, MOBILITY IN GERMANY is a survey of the population of Germany regardless of nationality or ethnic background. Institutionalized persons are included provided they are registered within the municipality.

According to the recommendations resulting from the pilot and supported by the discussion with the advisory board the survey process was formed as a mixed mode approach that puts the main emphasis on the CATI mode and can briefly be reviewed with the following steps (the main components presents Figure 3):

For the persons sampled from the population registers (containing names, address, gender, age, nationality) the telephone numbers could be traced in 60 % of all cases. To these households an advance letter was sent that explains and legitimises the contact and announces a soon call (right side of Figure 3). In this call the household was – via an adult member – recruited for participation in the survey. The CATI protocol established the socio-demographics of the full household and other basic variables (see households and vehicles in Figure 4) and the household address was verified. As the survey was guided by fixed diary-dates there was already a travel-day assigned for all members of the household at this time and the next contact could be announced at the end of this interview. In the meantime the mentioned memory joggers were customized (name, day, date, child or adult) and send. One day before the travel day the household received a reminder call. Starting the day after the

travel-day the person and trip information were collected via CATI by trying to communicate with each person above 13 years of age. For children between the ages of 10 and 13 the parents had to decide for a proxy or direct interview whereas for kids younger than 10 a proxy interview was mandatory.

Figure 2 Mobility in Germany 2002: Field Results

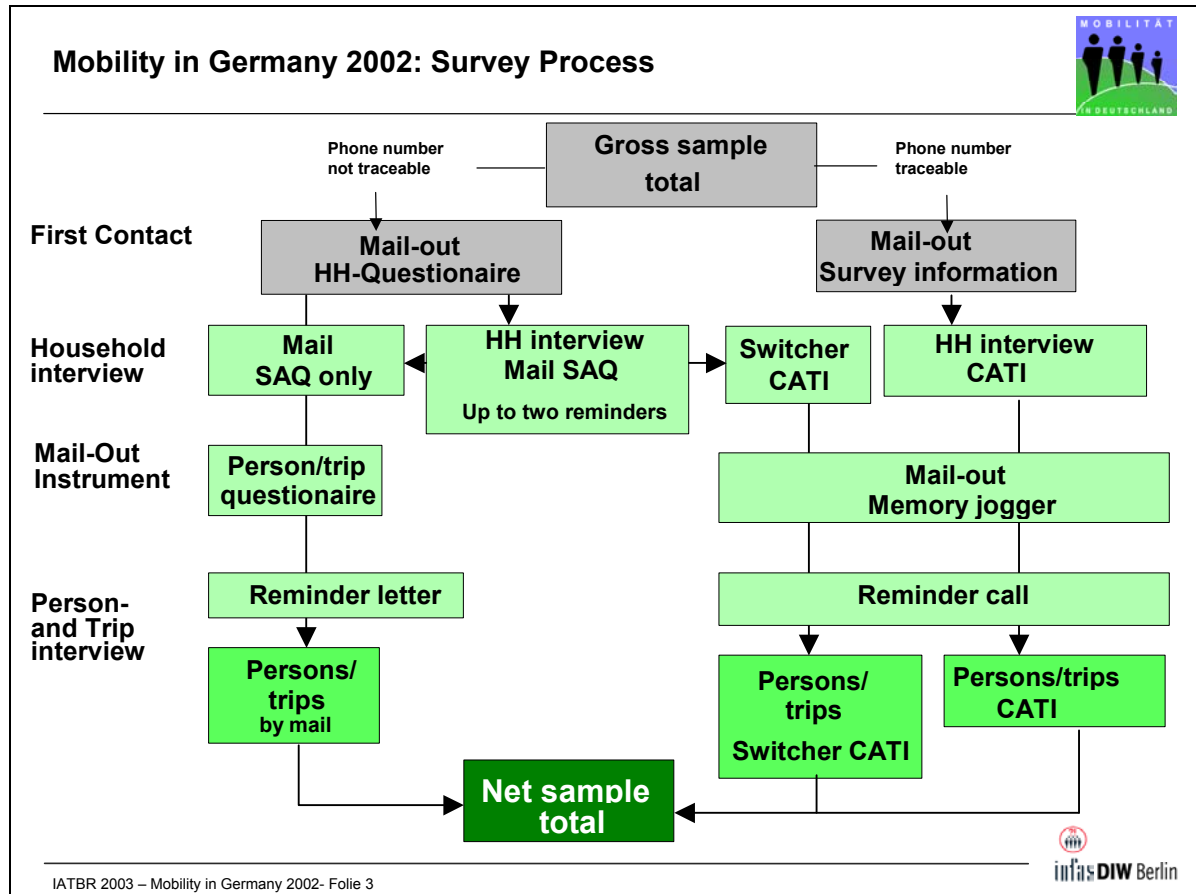


The data collection process was guided and supported by scheduling procedures (patterns for callbacks via computer scheduling, appointments for the person interviews, etc.) and rules concerning the presence of the memory jogger and the requirements for proxy interviews.

In addition to the design components and the survey contents confirmed by the pilot, further elements were included in the survey, e.g. instruments in Turkish and very detailed trip purposes in CATI.

The level of detail and the complexity of the data collected (see outline of survey content in Figure 4) was supported by the CATI programming, that included household rostering, a trip matrix for each person, and the possibility to copy the information of trips that household members made together in order to reduce respondent burden.

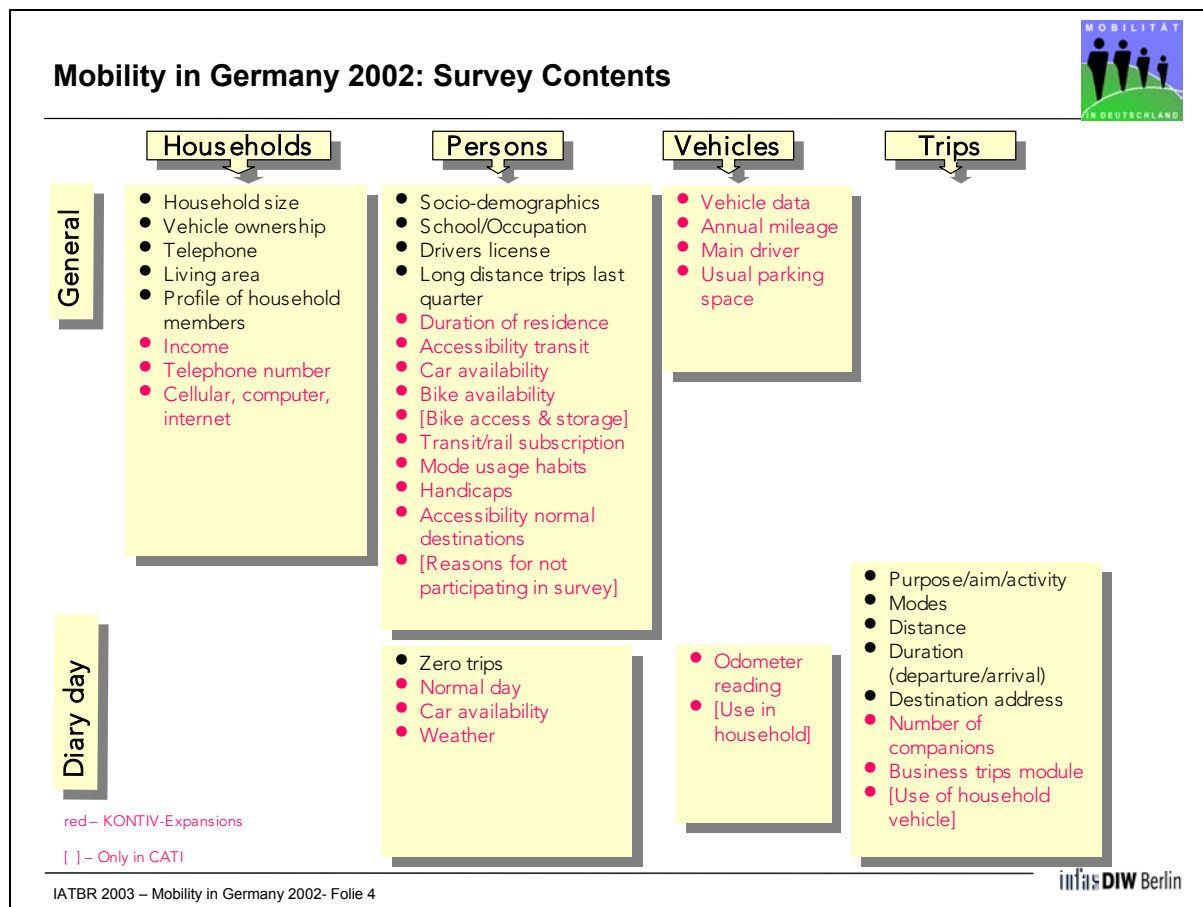
Figure 3 Mobility in Germany 2002: Survey Process



For the further 40 % of the persons drawn from the population registers for whom the telephone number could not be traced, the household recruitment and collection of basic variables was conducted via a postal-SAQ survey. However, completing this stage of the survey, over 80 % of these households had supplied their telephone numbers and could be switched to the CATI mode for the person and trip level interviews.

The third succession of contacts collected the information on the person and trip levels in those households that did not reveal their telephone number in the recruitment phase (left side of Figure 3). Here questionnaires customized for the persons in each household (adult or children, name, day) were mailed for self completion.

Figure 4 Mobility in Germany 2002: Survey Contents



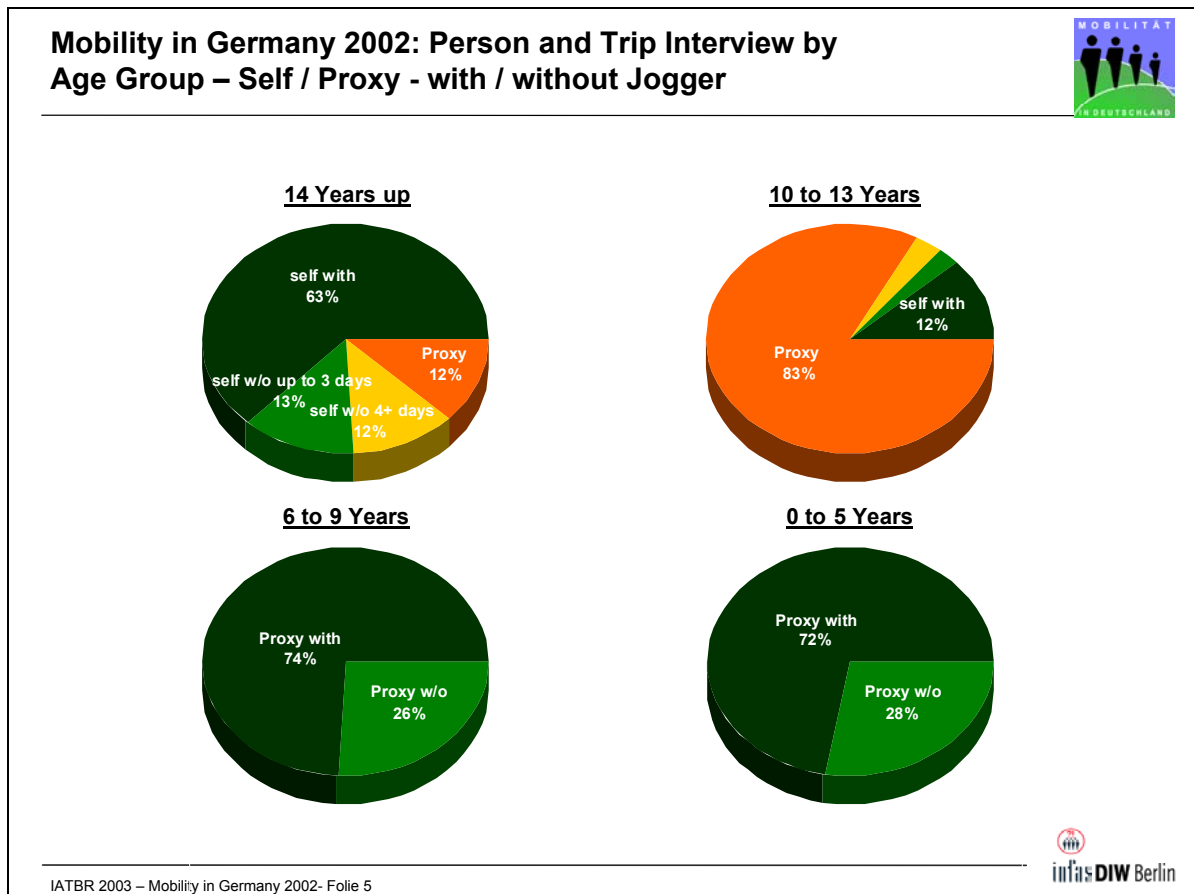
## 6. Field

95 % of the information that is finally available for analysis is gathered via CATI. Especially in this survey mode detailed field information on contact sequences and results were available for most of the sample. The detailed recording of contact results was valuable in the field to steer recontacting of households and to attempt refusal conversion with specialized interviewers. Field variables will also be available in the delivery datasets to make possible the analysis of methodological effects.

Because of the long field period and the continuous survey process, the repeated contact effort in the CATI achieved a high proportion of the in-scope sample members being reached (household recruitment level 92 %, person interview level 88 %). On the person interview level it was the objective to speak to all persons from 14 years of age on. It turned out that nearly 90 % of the respondents from age 14 up gave a personal interview (for 12 % it is a

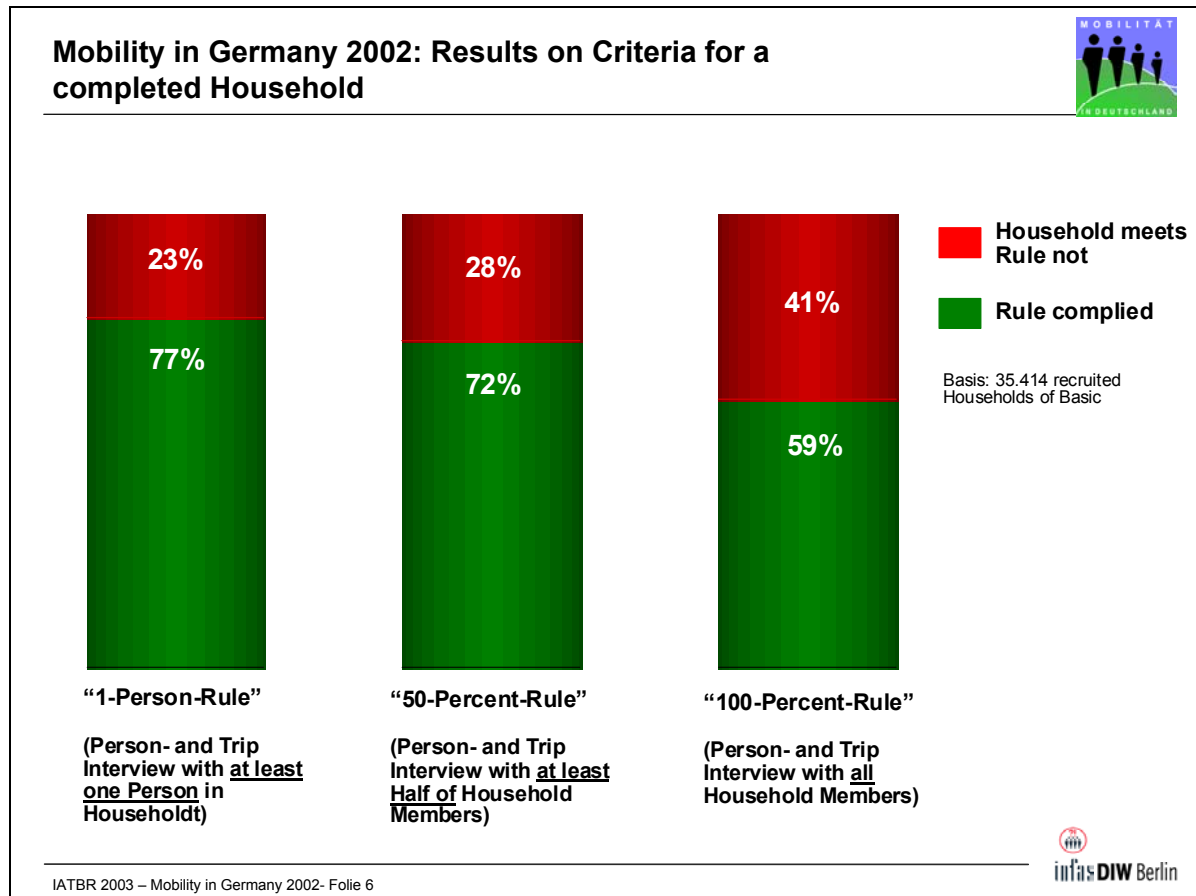
proxy) and seven out of ten of them had their memory jogger at hand. Further contact details shows Figure 5.

Figure 5 Mobility in Germany 2002: Person and Trip Interview by Age Group – Self/Proxy – with/without Jogger



Household travel surveys differ in their definition of eligible persons (e.g. minimum age of the respondent) and the extent to which household members are included. Most NTS restrict the eligibility and in many only one person from each household is interviewed. Yet MOBILITY IN GERMANY takes the most comprehensive approach by attempting to include every member of each household in the sample. This could be accomplished for two out of three households that participated in the person level interview. However, our definition of a completed household to be included in the final data set requires that 50 % or more of the household members be interviewed. Therefore we had to deleted some 20 % of the household level cases that did not fulfill this requirement from the final data sets. Thus 80 % of the available cases present complete person and trip information for all members of the household (Figure 6).

Figure 6 Mobility in Germany 2002: Results on Criteria for a completed Household



The scope of the study, the complexity of the CATI system and the long field phase made interviewer training and interviewer monitoring key elements of MOBILITY IN GERMANY. A staff of 333 interviewers received separate training for recruitment, person and trip level interviews. After the first training, interviewers were always assigned first to the recruitment calls. Having successfully accomplished 50 hours of recruitment calls, interviewers were trained and assigned to the person interviews. Continuous monitoring, feed-back and training were important aspects of survey quality control. The extension telephones and computer displays for monitoring were also open for the clients.

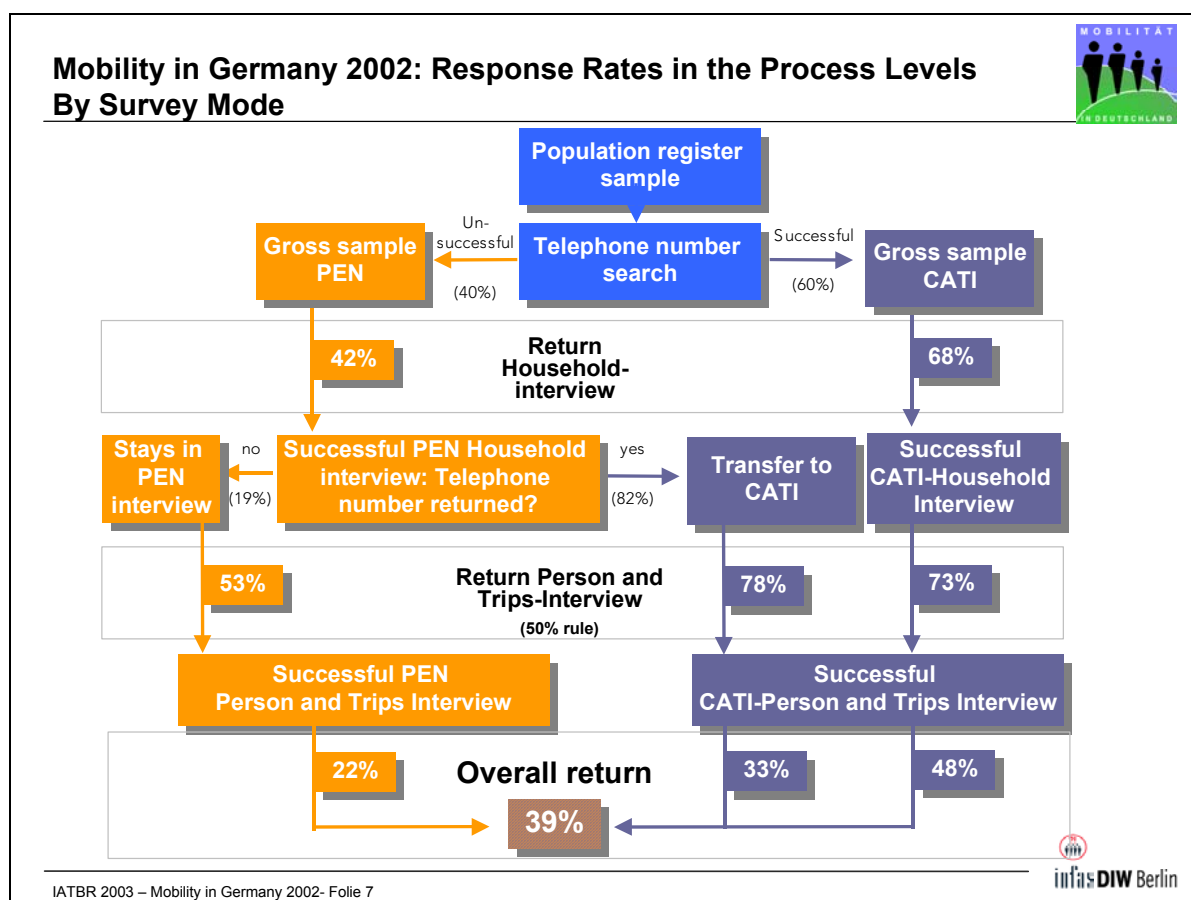
## 7. Selectivity and Nonresponse

The response rates attained over the process levels by survey mode after 54 weeks of field work reports Figure 7. The overall return (on the household level and in respect of the in-scope units) resulted in the pure CATI mode in a satisfactory 53 %, for the mail mode in 23 % and for the mode switchers in 34 %. For the whole study the overall return rate is 42 %. Note that response rates are affected by the scope of the study (eligibility, household context). As

problems of nonresponse of parts of the sample are associated with all kinds of travel surveys we therefore decided at the start of the study

- to have an assessment of the effects of selectivity by testing on the variables given with the population registers for the responding sample versus the nonresponding sample, and
- that the significance of the nonresponse necessitates recontacting efforts on refusing households and an integrated additional examination of its magnitude and impacts by means of a follow up survey.

Figure 7 Mobility in Germany 2002: Response Rates in the Process Levels by Survey Mode



To study selectivity – that is nonignorable unit nonresponse – on the household level we contrasted the participating with the non participating sample on three methodological and three content variables with dichotomous logit response models for different stages of attrition. Due to the necessary transfer of the person-sample to a household-sample, purely person level variables were not included in this analysis. We find no significant effects of the assigned travel day (day of the week) and of the type of region the household lives in (a seven level variable reflecting the settlement structure). But there are significant effects of the nationality of the target person drawn from the register (assuming that this information holds

for the household; giving a higher response probability for Germans) and we find – not surprisingly – significantly higher response probabilities for households with traceable phone numbers. Further, there is a weak effect by the sixteen states of residence of the households (with higher response in West-Germany, in part also a consequence of a somewhat lower phone number listing – not holding – of East-German households) and by the survey field period (grouped in six blocks at approximately 10 weeks), presumably some holiday period effect. Given the modest magnitude of the detected selectivity effects we conclude that there is no reason to reweight the sample other than the post-stratification on socio-demographic variables by states that is done anyway.

Apart from this study of selectivity, MOBILITY IN GERMANY employed two basic strategies to deal with nonresponse. First were the continuous efforts to maximize response by

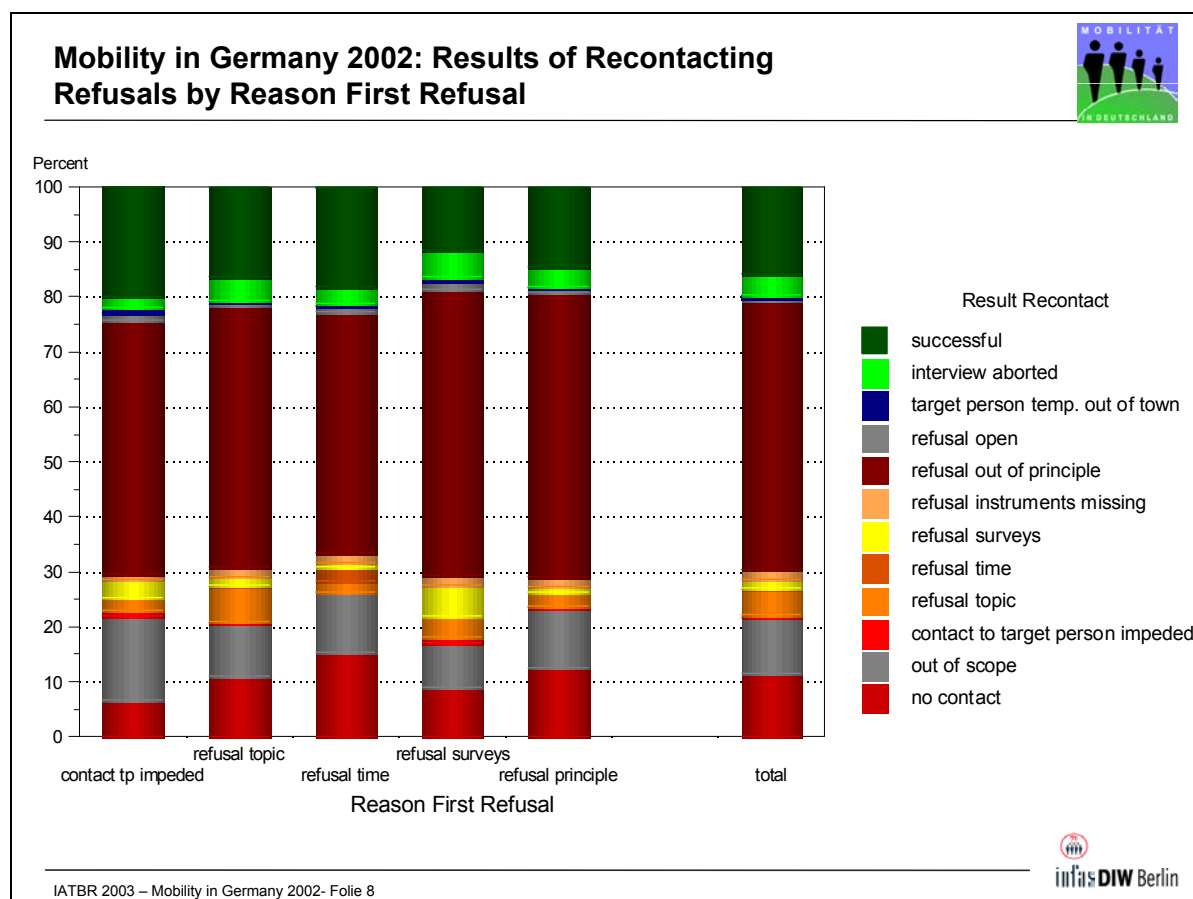
- second and third send-outs of the survey material in the mail mode to the households to be recruited and
- rigorous contact sequences and recontacting of “soft refusals” by specially skilled interviewers in the CATI mode.

E.g. one out of six initially refusing households recontacted via phone could finally be recruited for the survey (Figure 8).

The second approach was targeted at a sample of the “hard refusals” with a follow up survey designed with a few basic questions on mobility and socio-demographics on the household and person levels. This nonresponse survey was applied via personal interview to one adult member of households that were in the mail mode in the main survey and via CATI to those contacted by phone in the main survey. The face-to-face survey yielded a 70 % and the CATI survey a 44 % response rate thus allowing us to analyse a total of 700 cases. We tested the effects of the available variables on the response probabilities in the main versus the follow-up survey and find – naturally – that the response probability in the mail mode in the main survey is significantly lower than with the personal interview in the follow-up. The second design variable day of the week is not significant. For the textual variables the model indicates that persons above 64 years of age, women, persons with a non-German nationality and persons with no or few trips on the travel day are less likely to respond in the main survey compared to the other groups. There is also a significant effect of household size with a lower response probability in the main survey contrasted to the follow-up with increasing size of the household. This will be due to the fact that the participants in the main survey knew up-front that the complete household was to be interviewed. The test of interaction of the variables age group, gender and mobility group (zero trips versus one plus trips) points to the fact that

especially older women with no or little mobility tend to be underrepresented in the main survey.

Figure 8 Mobility in Germany 2002: Results of Recontacting Refusals by Reason First Refusal



The evidence given by the examination of selectivity and of nonresponse is essential to inform the future users about nonignorable effects associated with the data. However, we conclude in all that poststratification on gender, age household size etc. will take care of those effects to some extent. In addition the data set will provide the inverse mills' ratio from the model of selectivity as a variable that indicates the nonselection hazard and may be used in statistical analysis to control (partly) for the selection process. We reason further, that motivating the respondents for a mobility survey has to pay special attention to the groups with no or little mobility. Or – viewed from another perspective – high results of mobility indicators of a survey do not per se stand for valid measurements of behaviour. For more details on selectivity and nonresponse see infas, DIW Berlin (2003).

## 8. Data Processing and Dessimination

Data processing is quite complex for a mixed mode survey. The PAPI survey questionnaire results have to fit in adequately with the CATI results. And those are filtered on several stages as some items were not asked to children, some items not if the memory jogger was missing, some items not if it was a proxy interview. So expansion factors vary for some items. Finally additional information is added to the data sets (e.g. geocodes, external variables describing the dwelling area surrounding the respondents household).

From its launch on the project MOBILITY IN GERMANY was present on the web with detailed information and downloads for the participants and for the public. Thus the methodology of the study is documented and readily available with interim and final reports. Also tabulated results will be publish via the project homepage <http://www.kontiv2002.de>. It is planned that the micro data collected will be available soon via the Clearing House for Transport Data at <http://www.clearingstelle-verkehr.de/>. Further a data analysis tool is being developed that allows easy access to some one hundred variables with up to three dimensional crosstabs and weighted and expanded results.

## 9. Some Results

The delivery data sets of MOBILITY IN GERMANY provide information on 61,700 persons in 25,800 households owning 34,000 cars and making 178,000 trips on the travel day (basic sample without 9 separate regional add-on-samples). This data may be used for numberless analysis on the micro-level and estimations of totals for the population. Figures 9 to 15 present some key results for basic variables and for travel. In Germany in 2002 one out of five households is without a car and there are considerable differences in household car ownership between the states which are predominantly caused by multiple car ownership. Within the last 14 years the share of households with multiple car ownership increased by 9 %-points to 28 %.

The strong correlation between income and car ownership (or travel-indicators) is quantified for the first time with the novel data for Germany. For driver license holdings a sizeable increase since earlier survey years and disparities both between the sexes and between East and West Germany can be shown. On any given weekday almost 90 % of the population engage in out of home activities, this share is noticeably lower on Saturdays (82 %) and Sundays (75 %). Equally, the quantity of travel varies over the days of the week: e.g. the average number of trips per person is 3.8 on a Friday and 2.2 on a Sunday. That those without

cars are the most intense users of public transport and of non motorised modes is demonstrated by Figure 14; in other words: as soon as there is a car in the household it is used for most of the travel of the household members.

Figure 9 Mobility in Germany 2002: Car Ownership of Households by States

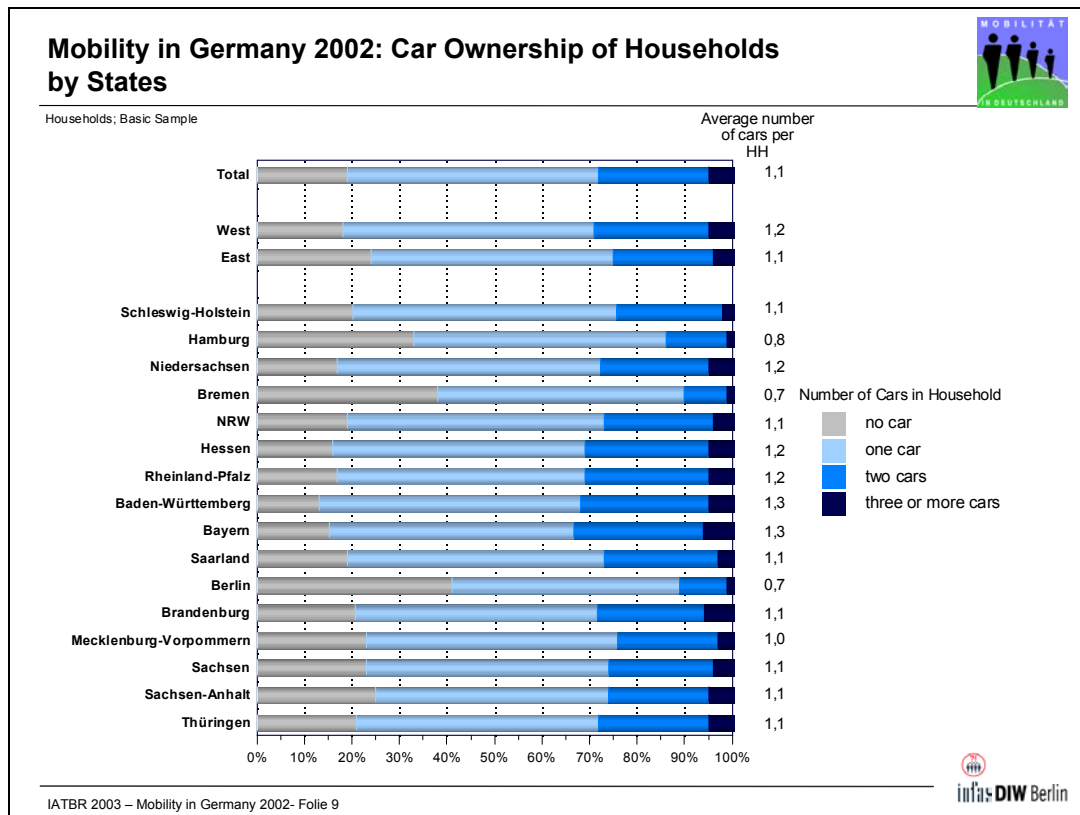


Figure 10 Mobility in Germany 2002: Car Ownership of Households by Income

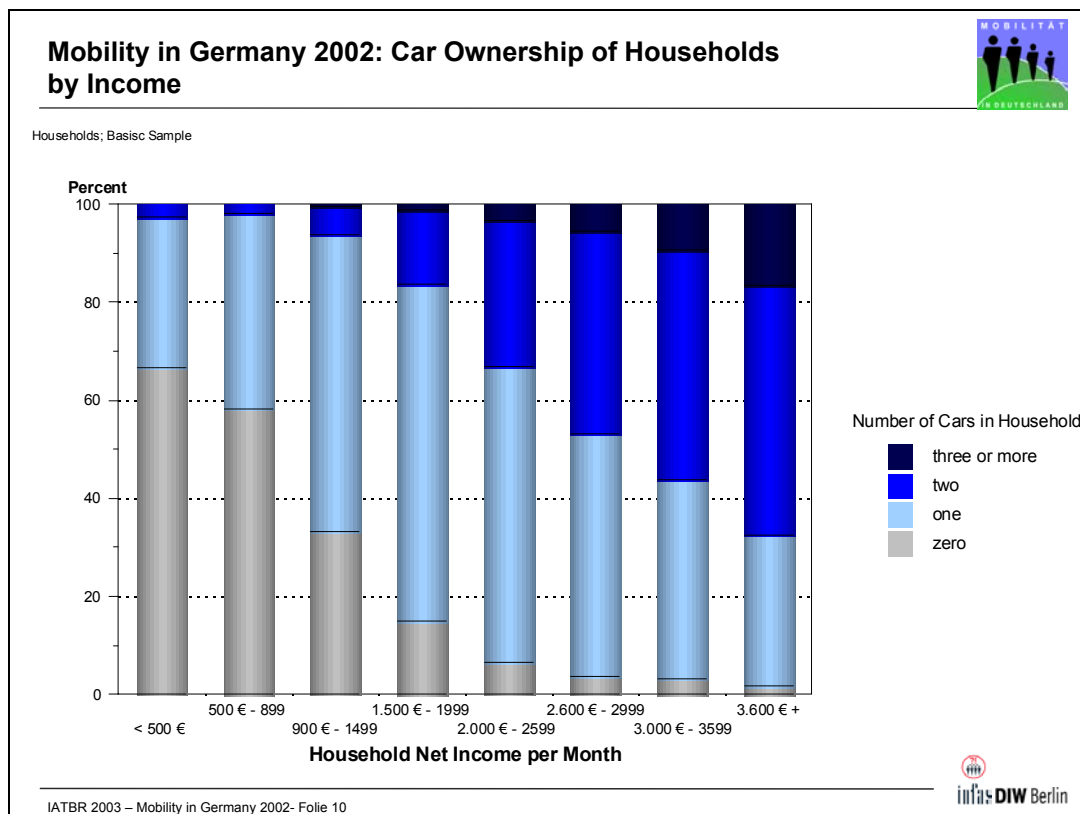


Figure 11 Mobility in Germany 2002: Drivers License Holdings for East- and West Germany

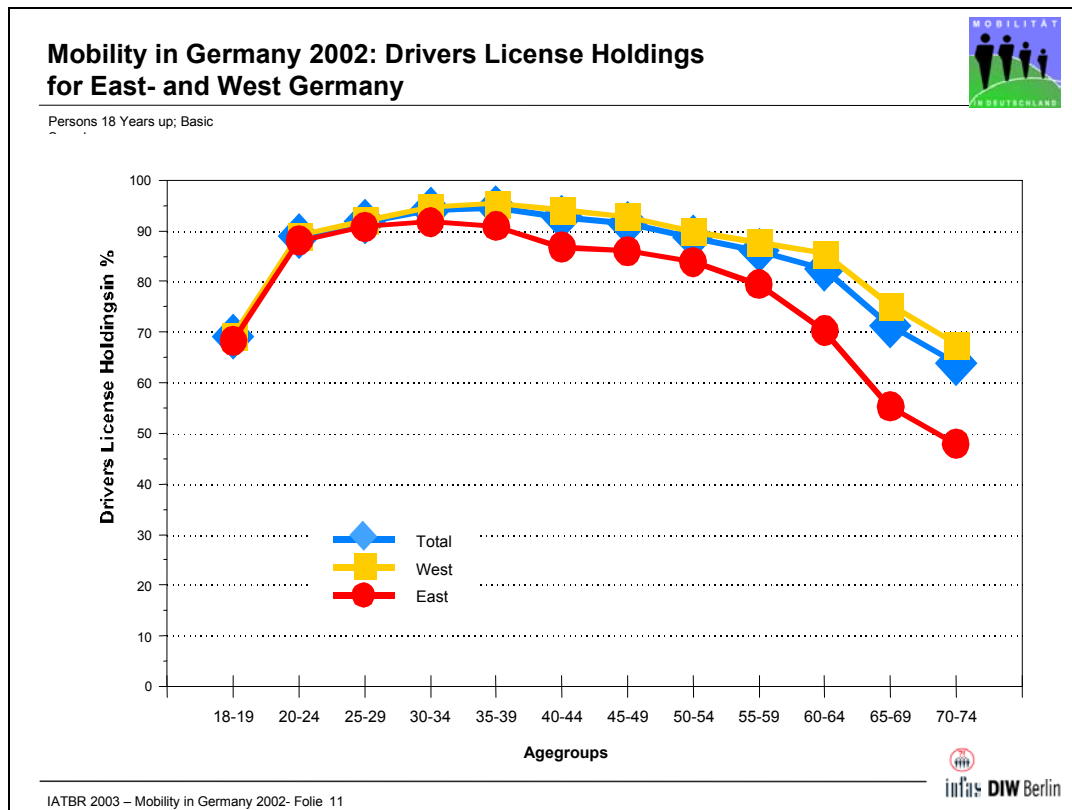


Figure 12 License Holdings by Age and Gender

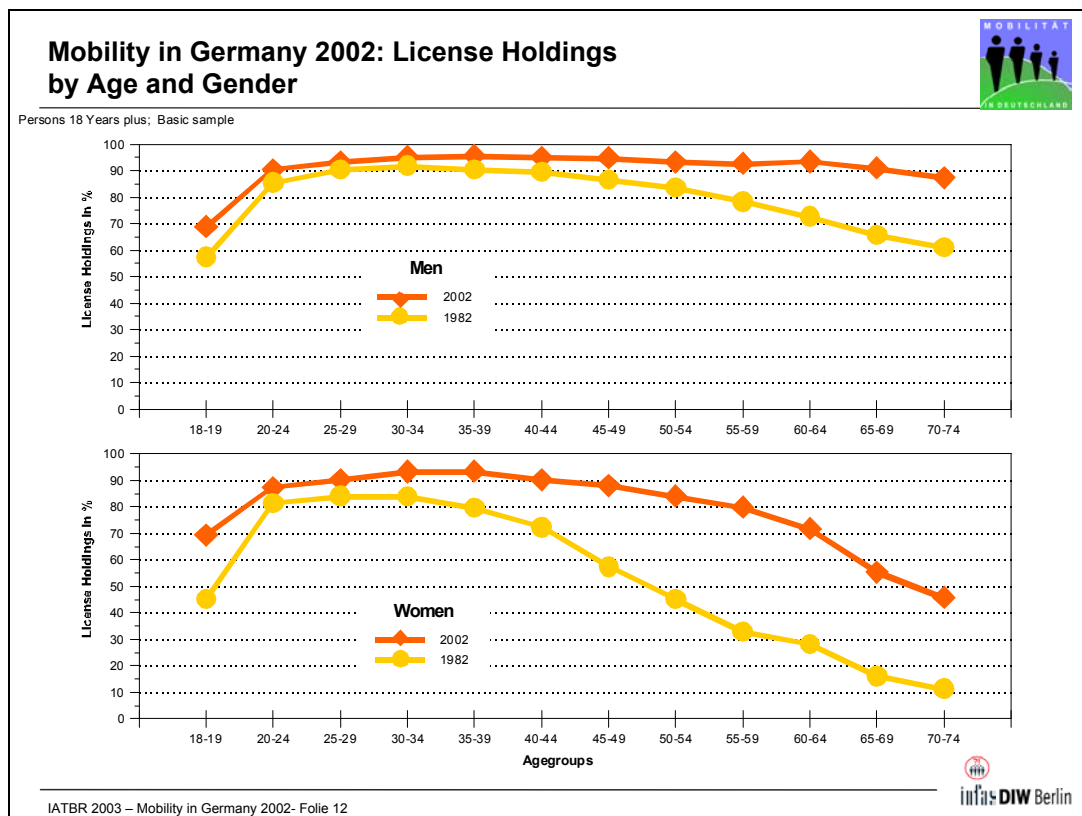


Figure 13 Mobility in Germany 2002: Mobility Participation by Day of the Week

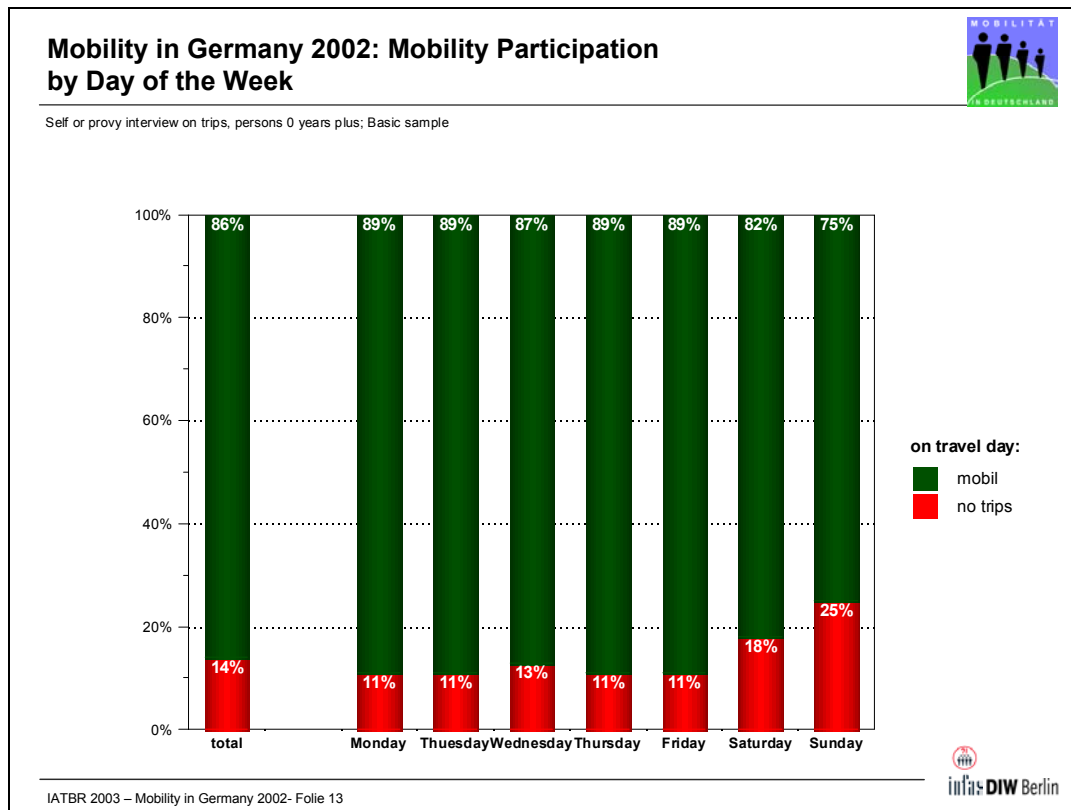


Figure 14 Mobility in Germany 2002: Trips per Day by Day of the Week with/without Trips on the Job

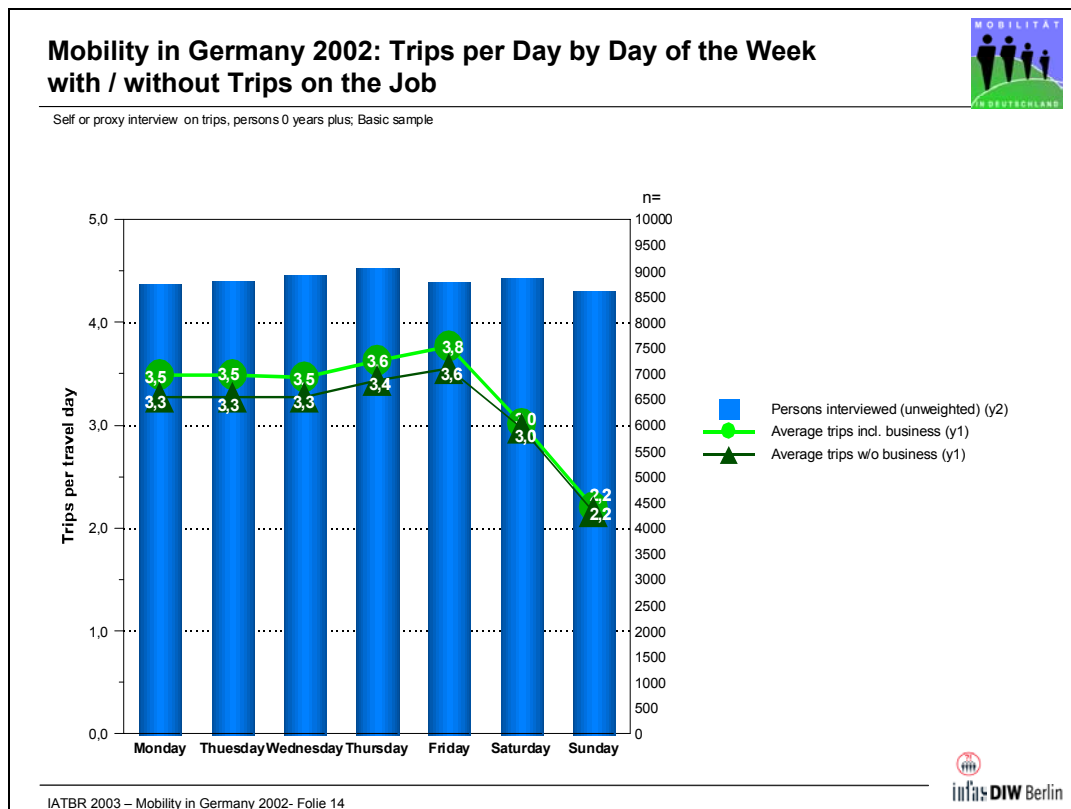
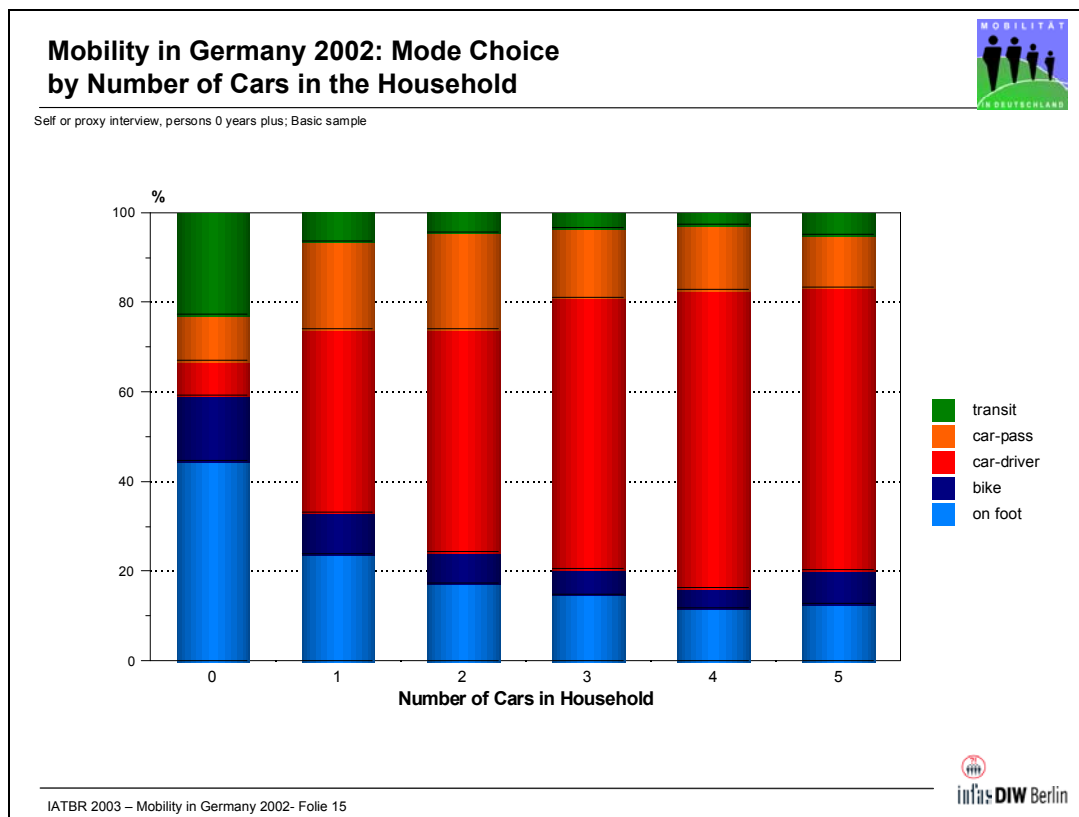


Figure 15 Mobility in Germany 2002: Mode Choice by Number of Cars in the Household



## 10. Outlook

A total survey design is complex and involves more elements than were detailed in this summary of MOBILITY IN GERMANY. The novel NTS 2002 for Germany is quite different from its predecessors, it employs a method mix of CATI and postal SAQ instruments while improving the accuracy and scope of the data gathered. It should have become evident in this outline that there is a strong interaction of instrument design and the possible scope and contents of a mobility survey.

Much more information than by the former German NTS was gained by the survey and this allows analysis and research of new topics like household income and travel behaviour, or household interactions of travel patterns.

The collected data will also be used to estimate population totals for example in car-ownership, the amount of travel, vehicle mileage, mode-use, etc. Also the data will be used for modeling and numerous analysis of specific research questions, e.g. to estimate exposure values for safety analysis or to research issues of mobility in respect to gender and age. In Germany the NTS data is also one of the inputs used to estimate time series of national travel

demand, which are then used to forecast future demand-patterns over a 15-years time horizon. Those forecasts are one of the basis to formulate national transportation and infrastructure policies.

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