ETH zürich Research Collection

Working Paper

Mobidrive: Data format guide
Part A: Basic survey details, data processing and imputation

Author(s):
Schönfelder, Stefan; Schlich, Robert; König, Arnd; Aschwanden, Alain; Kaufmann, Andrea; Horisberger, David; Axhausen, Kay W.

Publication Date:
2002-08

Permanent Link:

https://doi.org/10.3929/ethz-b-000023640 →

Rights / License:

In Copyright - Non-Commercial Use Permitted →

This page was generated automatically upon download from the ETH Zurich Research Collection. For more information please consult the Terms of use.

ETH Library

38	K_O_OS2	Num	8	306	2nd off-street space: Kind
42	K_O_OS3	Num	8	338	3rd off-street space: Kind
66	K_RENTED	Num	8	450	Rented: Kind
6	LOC_HH	Num	8	50	Location of HH (zone)
89	LOC_HH_H	Num	8	756	Household location (zone) Halle
90	LOC_HH_K	Num	8	764	Household location (zone) Karlsruhe
91	LOC_HH_X	Num	8	772	Location of household (relative)
74	N_O_BEM	Num	8	636	Number of email business
19	N_O_CC	Num	8	154	Number of all motorcycles
76	N_O_CON	Num	8	652	Number of connections
11	N_O_CYC	Num	8	90	Number of bicycles
9	N_O_D	Num	8	74	Number of dogs
8	N_O_EM	Num	8	66	Number of external HH members
72	N_O_FAX	Num	8	620	Number of faxes
23	N_O_G	Num	8	186	Number of garages
7	N_O_HHM	Num	8	58	Number of HH members
87	N_O_LIHH	Num	8	740	Number of licenced persons/household
14	N_O_MC	Num	8	114	Number of motorcycles
12	N_O_MCY	Num	8	98	Number of mot. cycles
71	N_O_MOB	Num	8	612	Number of mobiles
13	N_O_MP	Num	8	106	Number of mopeds
17	N_O_MV	Num	8	138	Number of mot. vehicles
33	N_O_OS	Num	8	266	Number of off-street spaces
73	N_O_PEM	Num	8	628	Number of emails private
75	N_O_PH	Num	8	644	Number of phones
46	N_O_PP	Num	8	370	Number of private spaces
10	N_O_PV	Num	8	82	Number of personal vehicles
88	N_O_STHH	Num	8	748	Number of season tickets/household
70	N_O_TEL	Num	8	604	Number of telephones
15	N_O_TR	Num	8	122	Number of trucks
16	N_O_V	Num	8	130	Number of all vehicles
18	N_O_VEH	Num	8	146	Number of vehicles
86	N_O_WPHH	Num	8	732	Number of working persons/household
68	OTHER_F	Char	50	546	Features: Other
65	RENTED	Num	8	442	Rented
4	STUDY	Char	17	25	Study name
2	STUDYCOD	Num	8	8	Study code
53	S_O_ACC	Num	8	426	Accommodation: Size
69	S_O_GAR	Num	8	596	Size of garden
63	TERR	Num	8	506	Features: Terrace
48	U_D_BS	Num	8	386	Bus stop: Unit
26	U_D_G1	Num	8	210	1st garage: Unit

Mobi*drive*

Mobi*drive:* Data format guide (2002)
Part A: Basic survey details, data processing and imputation

S. Schönfelder, R. Schlich, A. König, A. Aschwanden,
A. Kaufmann, D. Horisberger and K.W. Axhausen

Arbeitsbericht **116a**
Verkehrs- und Raumplanung **August 2002** (19/08/2002)

IVT *Institut für Verkehrsplanung, Transporttechnik, Strassen- und Eisenbahnbau*

ETH *Zürich*

CONTENTS

CONTENTS ..... **I**

LIST OF TABLES ..... **II**

ABSTRACT **1**

KEYWORDS **1**

1 INTRODUCTION **2**

2 PRELIMINARY PLANNING **3**

2.1 ADMINISTRATIVE DETAILS OF THE SURVEY 3
2.2 WHAT WERE THE OBJECTIVES OF THE PROJECT TO WHICH THIS SURVEY CONTRIBUTED? 4
2.3 WHAT WERE THE SPECIFIC OBJECTIVES OF THIS SURVEY? 4
2.4 WHAT PRIOR INFORMATION WAS AVAILABLE? 4
2.5 WHAT SPECIFIC HYPOTHESES, IF ANY, WERE T O BE TESTED? 5
2.6 WHAT DEFINITIONS ARE BEING USED BY THE SURVEY TEAM FOR KEY ITEMS? 5

3 SURVEY INSTRUMENT DESIGN **6**

4 ADMINISTRATION OF THE SURVEY **8**

5 SAMPLE DESIGN **10**

6 DATA PROCESSING **14**

7 DATA EDITING, CORRECTION AND EXPANSION **15**

8 LITERATURE RELATED TO THE MOBI*DRIVE* SURVEY DESIGN **17**

APPENDIX A EXPANSION **19**

APPENDIX B STRUCTURE OF THE DATA SETS **21**

APPENDIX C MOBI*DRIVE* DATABASE: DATA IMPLEMENTATION AND CORRECTION STRATEGY 23

APPENDIX D IMPUTATION PROCEDURE AND FILES **28**

APPENDIX E FIGURES **31**

LIST OF TABLES

Table 1 Administrative details 3
Table 2 Definitions 5
Table 3 Survey instrument design 6
Table 4 Administration of the survey 8
Table 5 Timetable of the Mobi*drive* 1999 survey in Halle and Karlsruhe 9
Table 6 Sample design 10
Table 7 Pilot Survey 11
Table 8 Screening experience 13
Table 9 Structure of sample by household type 13
Table 10 Data Processing 14
Table 11 Data editing, correction and expansion 15
Table 12 Comparison of trip dimensions: Mobi*drive* vs. recent one-day diary studies in Halle and Karlsruhe (weekdays only) 19
Table 13 Comparison of share of trip purposes: Mobi*drive* vs. recent one-day diary studies in Halle and Karlsruhe (weekdays only) 20
Table 14 Expansion factors Karlsruhe 20
Table 15 Expansion factors Halle 20
Table 16 Content of the data sets 21
Table 17 Size of the data sets (number of records) 22
Table 18 Imputation in file HH_SUM 28
Table 19 Imputation in file P_SUM 29
Table 20 Imputation in file V_SUM 29

Mobi*drive*: Data Format Guide (2002)
Part A: Basic survey details, data processing and imputation

Working paper

Stefan Schönfelder, Robert Schlich, Arnd König, Alain Aschwanden, Andrea Kaufmann, David Horisberger, Kai W. Axhausen
IVT
ETH Zürich

Contact: Stefan Schönfelder, schoenfelder@ivt.baug.ethz.ch, phone 0041-1-633.3092

August 2002

ABSTRACT

This working paper contains a description of the design and the results of a six-week travel diary survey realised within the research project Mobi*drive*. The survey was conducted in the German cities Karlsruhe and Halle/Saale during spring and autumn 1999.

Part A of the Data Format Guide contains information about the planning, design and implementaion process of the survey, the sampling as well as the data processing steps. In addition to that, the appendices A-D provide expansion factors in respect to recent one-day diary data in the case study cities, the strcuture of the generated data files and an overview about the data imputation strategy applied. Appendix E presents figures particularly interesting for the visualisation of longitudinal household surveys.

KEYWORDS

Mobi*drive* – survey design – travel behaviour diary - list of variables – ETH Zürich – Institut für Verkehrsplanung und Transporttechnik, Strassen- und Eisenbahnbau

1 INTRODUCTION

Within the German research project Mobi*drive*, a six-week continuous travel diary was conducted in order to analyse temporal and especially longitudinal aspects of individual travel behaviour (see Axhausen, Zimmermann, Schönfelder, Rindsfüser and Haupt (2002) for a detailed description). This paper describes the implementation and conduct of the survey which was performed in the cities of Halle/Saale and Karlsruhe. Travel diaries represent a substantial investment in terms of money and time. The documentation and archivation of surveys provide considerable support for researchers designing and administrating future surveys.

The contents of the working paper (Part A of the Data Format Guide) is as follows: In a first part the structure and procedure of the survey and the data preparation are introduced. This section mainly covers the survey design checklist prepared by Richardson, Ampt and Meyburg (1995). Some of the detail questions are ignored, though, due to the fact that not all survey aspects discussed in the check list are contained or relevant in Mobi*drive*. In addition to that, a documentation of the used programs as well as files is added.

Variable descriptions and frequencies may be found in Part B (Arbeitsbericht Verkehrs- und Raumplanung No. 116b).

2 PRELIMINARY PLANNING

2.1 Administrative details of the survey

Table 1 Administrative details

Name of the survey	Mobi*drive*
Project consortium	PTV AG – project coordination Stumpfstraße 1, D-76131 Karlsruhe Institut für Stadtbauwesen der RWTH Aachen (ISB) Mies-van-der-Rohe-Straße 1, D-52074 Aachen Institut für Verkehrsplanung, Transporttechnik, Strassen- und Eisenbahnbau der ETH Zürich (IVT), CH – 8093 Zürich
Who sponsored the study?	Ministry of Research and Education, Federal Republic of Germany
Who designed the study?	PTV AG together with ISB and IVT
Who collected the survey data?	Karlsruhe: PTV AG Halle: Ingenieurbüro Stadtplanung H + B, Halle
Who analysed the survey data?	IVT, ETH Zurich
Was there an advisory committee?	No
Dates and duration of the survey?	All steps: 15.05.1999-14.12.1999

2.2 What were the objectives of the project to which this survey contributed?

The main objective of the Mobi*drive* was to detect, analyse and model rhythms within individual travel behaviour. Those rhythms are believed to be determined by a coordinated rhythmic structure of the travel environment, especially by weekly or annual rhythms. So far, rhythms of daily life have been widely neglected as predictor variables for travel behaviour. Basic aim of the pilot study period was to extend the knowledge about the dynamic and the periodicity within rhythms and routines with respect to day-to-day variability of individual behaviour. Such knowledge is crucial for a development of models covering temporal aspects of behaviour as well as for the prediction of behavioural changes due to reactions to political and planning measures in the transport field.

2.3 What were the specific objectives of this survey?

For many decades, rhythms in traffic flows and travel behaviour have been observed and analysed at an aggregate level, in particular as traffic or passenger counts. The analysis of rhythms of individual travel behaviour has been only possible so far by aggregating single day survey data (Schmiedel, 1978; Herz, 1983). From a statistical point of view, this is a unsatisfactory procedure. While multi-day travel behaviour surveys have become more frequent in the last years, most of them only cover a two to three day period. Usually, they are motivated by an attempt to capture most of the behavioural variance rather than its temporal structure (e.g. Cambridge Systematics, 1996). The focus of the data collection effort in Mobi*drive* was conducting a survey with a reporting period long enough to capture the rhythms of daily life in detail – at least on a monthly basis.

2.4 What prior information was available?

The only known prior example of a survey with a substantially longer reporting period is the Uppsala Travel Survey of 1971 which is by now in many respects antiquated and only partially available[1]. Other efforts have focused only on a part of the total pattern, such as various studies in Austin, TX, which mainly studied commuting patterns (Mahmassani, 1997; Mahmassani and Hatcher, 1992; Mahmassani, Hatcher and Caplice, 1997).

The Uppsala data is based on a sample of 149 randomly chosen persons from 97 households in the region of Uppsala (Sweden). The survey proved, that surveys with such long reporting periods (five

[1] The Hamilton Travel Diary is a partial exception with its two week duration (Webber, 1979).

weeks in this case) are possible given proper attention to the respondents throughout the reporting period.

2.5 What specific hypotheses, if any, were t o be tested?

Basically, the aim of the study was rather to identify behaviourial patterns than to test any hypotheses. The underlying hypothesis, though, was the assumption that external rhythms of the travel environment, such as holiday rhythms, fixed working or opening hours, seasonal effects or the periodic occurrence cultural events, have an impact on the routinised travel behaviour and the rhythms of daily life (e.g. allocation of the individual time budget) in general.

2.6 What definitions are being used by the survey team for key items?

Table 2 Definitions

Journey	Sequence of trips that begin and end at home (including subtours)
Tour	Sequence of trips that begin and end at the same place
Trip	Movement between two activity locations
Stage	Part of a trip with only one mode used
Purpose	Description of the activity at the end of a trip (including returning home and activity)

3 SURVEY INSTRUMENT DESIGN

Table 3 Survey instrument design

What types of information are being sought in the survey?	1. Data concerning households, persons and vehicles (Appendix A) 2. Travel diaries for six weeks (Appendix A) 3. Data concerning attitude and value inventory
How are trips and activities being sought from respondents?	Respondents are asked to document each movement between two activity locations (a more detailed investigation was not possible due to the length of the study and burden to the respondent).
What is the physical nature of the survey forms?	Diary A4 spiral bounded booklet - readability was given priority over portability.
Where did the classification categories come from?	1. Own development 2. Diary adopted from PTV AG (slightly modificated), based on KONTIV-format (Brög, Meyburg and Wermuth, 1983; Axhausen, 1995), 3. Project City:mobil (Götz, Jahn and Schultz, 1997) and Gawronsky and Sydow, 1999.
What attitude questions were asked?	Two different scales were applied: The first type addressed the attitudes of respondents towards different modes in general and car driving in particular. The second scale was more general and looked at the dimensions "traditional" and “humanistic values" as the core of political and personal values. The scales originally contained 142 items. To limit the response burden, the items with the lowest factor loading were excluded and the scale reduced to 121 items.
What questions were asked as closed questions?	See Appendix B and original Mobi*drive* questionnaires (PTV AG, Fell, Schönfelder and Axhausen, 2000)
What questions were asked as open questions?	1. All questions with "other, please specify" or "type of work" 2. "trip purpose: leisure" and "trip purpose: other": to get more detailed information; further coding according to Götz *et al.*, 1997

Who designed the layout of the survey form?	Institut für Soziologie, Universität Karlsruhe: household, person and vehicle form PTV: travel diary IVT: attitude form
How has the question wording been tested for:	Simple vocabulary/ words appropriate to the audience/ length of questions/ ambiguous questions/double-barrelled questions/ vague words/ loaded questions/ leading questions/ double negatives/stressful questions/ grossly hypothetical questions/ the effect of response styles/ periodicity questions? None of the topics was tested directly, but to all of them was paid attention during the pilot test.
In what order were the questions arranged?	Logical order (e.g. sensitive questions last), but not separately tested.
What instructions were provided for respondents and interviewer?	The companies collecting the data were responsible for the instructions given.

4 ADMINISTRATION OF THE SURVEY

Table 4 Administration of the survey

Pre-contact procedures	Announcement letter signed by the local mayor .
Mail-out procedure/ Handing over	1. Face-to-face interview on household, person and vehicle form 2. The diaries were handed out and explained personally after the face-to-face interviews 3. After finishing the diaries the attitude forms were sent out together with receipts for the incentives and the first results of the survey.
Call-back procedures	The diaries were sent back every week in pre-paid and addressed envelopes.
Maintenance of diaries	The diaries were checked every week regarding completeness and correct filling in immediately after reception. In case of particularities the respondents were called. Additionally there was a hotline in case of questions from the respondents.
Non-response interview	Almost nobody refused to proceed after the recruitment - so interviews were not necessary within this group. Persons, who refused to participate in the survey at all, were asked about socio-demographic topics and their travel resources.
Respondent payment method	Respondents were paid 100, 150 and 200 DM respectively after finishing the diaries (depending on household size).
Interviewer payment method	The interviewers were paid a fixed amount, irrespective of the number of filled in forms.
Field supervisor tasks	Field supervisor tasks were conducted by PTV staff in both survey cities, Halle and Karlsruhe.

Table 5 Timetable of the Mobi*drive* 1999 survey in Halle and Karlsruhe

	Pretest	Main Study	
	Karlsruhe	Halle	Karlsruhe
Distribution of announcement letter	from 15. 5. on	18.8./2. 9.	28.8./9.9.
Start of screening period (2 weeks)	from 22.5. on	23.8/6.9.	30.8./13.9.9.
Start of face-to-face interviews (2 weeks)	from 22. 5. on	30.8./13.9.	6.9./20.9.
Start/end reporting period 1st wave	31.5.-11.7.	13.9.-24.10.	20.9.-31.10.
Start/end reporting period 2nd wave	14.6.-25.7.	4.10.-14.11.	4.10.-14.11.
Distribution of attitude/value instrument	-	13.10./3.11.	5.11.-23.11
Last attitude/value instrument received	-	29.11./15.12.	14.12.

Source: Axhausen, Zimmermann, Schönfelder, Rindsfüser and Haupt (2002), S. 100

5 SAMPLE DESIGN

Table 6 Sample design

What was the population for the survey?	Households of the city of Karlsruhe and Halle consisting of one or two adults and families including children at a minimal age of 6 years.
What unit was used for sampling?	Members of a household aged at least 6 years.
What sampling frame was used?	Address data base of a Deutsche Telekom owned publisher of phone books (July 1999). (no alternative available since the registration couldn't provide a stratified sample)
Accuracy of sampling frame?	Amount of misspelled numbers is low.
Completeness of sampling frame	A slight bias might exist due to the fact that some people don't have telephone access and others don't provide their personal telephone number for publishing.
Up-to-dateness of sampling frame	New editions of the telephone data base are published regularly. However, problems arise from new addresses after a move.
What sampling method was chosen?	Random sample
What sources of sampling bias were considered?	Because of the high response burden it is presumed that above all people with great interest in traffic would participate in the survey.
How serious were these sampling biases considered to be?	This bias was considered as very seriously. According to the exploring character of the survey and limited temporal and financial resources, it was accepted that there could be a lack of representatively.
What steps were taken to overcome these sources of bias?	In a first screening procedure, attention was paid to a possibly equal representation of different socio-demographic groups and groups with varied travel resources (this doesn’t automatically guarantee a full range of motivation and attitudes, though).

Was the selected sample representative for the entire population?	Representativeness was not a primary goal. A comparison with other studies indicates that there are no significant differences in relevant mobility indeces.
What was the specific sampling procedure?	Random number generator
What was the final sample size?	2 * 720 households (Karlsruhe and Halle)
What stratifications were used in the sample design?	Minimum of 1/3 one-person households, 1/3 two persons-households and 1/3 families with children older than 6 years. Children older than 6 (Pretest:9) were ignored, as well as person who indicated to be in vacation for longer than one week.

Table 7 Pilot Survey

What pilot testing was performed?	Recruitment and heterogeneity of respondents; concept and survey administration, survey instrument.
Size of the pilot survey	Planned: 20 households; realised: 23 households
How adequate was the sampling frame?	No further biases than expected; slightly more than 10% of the persons with wrong telephone numbers.
What was the variability within the survey population?	See table 9; due to the problems in recruiting households with children, the age limit was reduced from 9 to 6 years in oder .
How suitable was the survey method?	Out of 26 households just 3 abandoned the survey – the survey is believed to be suitable.
How well did the questionnaire perform?	Questions concerning bicycles were reduced because they were too detailed - no further problems.
What response rate was achieved?	13.7% (see table 7)
How effective was the interviewer training?	No problems emerged.

Did the coding, data entry, editing and analysis procedures work satisfactorily?	No problems emerged.
Duration of the Pilot study	See table 5

Table 8 Screening experience

Step	Pre-test			Main study					
	Karlsruhe			Halle			Karlsruhe		
	Number	% of sample	% of available	Number	% of sample	% of available	Number	% of sample	% of available
Total sample	240	-	-	720	-	-	720	-	-
Quality neutral non-contacts	40	16.7	-	98	13.6	-	34	4.7	-
Pre-emptive refusal by household	12	5.0	-	21	2.9	-	87	12.1	-
Not reached after seven attempts	20	8.3	-	190	26.4	-	200	27.8	-
Available for screening	168	70.0	-	411	57.1	-	399	55.4	-
Not eligible	26	10.8	15.5	77	10.7	18.7	59	8.2	14.8
Not used, as quota was filled	-	-	-	4	0.6	1.0	5	0.7	1.3
Refused on contact	116	48.3	69.0	238	33.1	57.9	249	34.6	62.4
Recruited	26	10.8	15.5	92	12.8	22.4	86	11.9	21.6
Dropped out at interview/shortly after	3	1.3	1.8	24	3.3	5.8	15	2.1	3.8
Completed households	23	9.6	13.7	68	9.4	16.6	71	9.9	17.8

Source: Axhausen, Zimmermann, Schönfelder, Rindsfüser and Haupt (2002), S. 104

Table 9 Structure of sample by household type

Household type	*Pre-test*		Main study			
	Karlsruhe		Halle		Karlsruhe	
	House-holds	Persons	House-holds	Persons	House-holds	Persons
Singles	11	11	18	18	22	22
Couples	7	14	23	46	24	48
Family households	5	19	27	94	25	89
Total	23	44	68	158	71	159

Source: Axhausen, Zimmermann, Schönfelder, Rindsfüser and Haupt (2002), S. 106

6 DATA PROCESSING

Table 10 Data Processing

What physical method was used for data coding?	Self coded paper forms with boxes
What coding frame was used?	Closed question coding frame with each question coded separately and no coding of the open questions during the input of data.
What location-coding method was used?	Geocoding with Geocode-Engine 2.0 (PTV)
What special data entry programs were developed?	The entry of the data was performed using Microsoft Access with self-defined entry masks; application of additional correction procedures to avoid obvious entry errors.
What training was provided for coders and data engineers?	Training was provided by the involved companies.
How was the coding administered?	Final coding resp. re-coding by IVT using the SAS software package.

7 DATA EDITING, CORRECTION AND EXPANSION

Table 11 Data editing, correction and expansion

What in-field checking was done by the interviewer/supervisor	None
What checking was done on receipt in survey office?	Each diary was checked on correctness and obvious plausibility after the receipt at the end of each week.
Was data entry verified for accuracy?	There were some checks made, e.g. time of return after time of arrival (see also above).
Were special data editing programs developed (Program language)?	Data editing was performed with SAS software package (see Appendix C for a list of files).
What logic or permissible range checks were applied (Program language)?	Some checkings were made in SAS programs to detect errors (see Appendix C), obvious error were corrected where context was unambiguous, otherwise the values were set as missing.
How was missing data coded?	Missing values were classified into *structural* (questions not applicable to the respondent) and *real* (not answered) missing values, which were coded with a special number.
Were estimates made of missing value?	Imputation with SOLAS 2.0 software, Hot deck technique (household, person, vehicle, value and attitudes form).
What secondary data was used for sample expansion?	Secondary data was available for the City of Karlsruhe (Socialdata, 1992) and for the City of Halle (SrV- survey 1991, 1994 and 1998).
What variables were used of expansion purpose?	Age and gender
Was expansion based on cross-tabulations or marginal totals?	Cross-tabulation

Expansion factors	See Appendix A
Were non-response factors calculated?	No

8 LITERATURE RELATED TO THE MOBI*DRIVE* SURVEY DESIGN

(contact IVT-ETHZ for a list of papers published after 2000 on the actual Mobi*drive* data analysis)

Axhausen, K.W. (1995) Travel diaries: An annotated catalogue, 2nd Edition, *Working Paper*, Institut für Strassenbau und Verkehrsplanung, Leopold-Franzens-Universität, Innsbruck.

Axhausen K.W., A. Zimmermann, S. Schönfelder G. Rindsfüser and T Haupt (2002) Observing the rhythms of daily life: A six-week travel diary, *Transportation*, **29*(2)***, 95-124.

Axhausen, K.W., M.J: Alves (1994) Kontiv - Data Format Guide, *Working Paper*, University of London, Centre for Transport Studies

Brög, W., A.H. Meyburg and M.J. Wermuth (1983) Development of survey instruments suitable for nonhome activity patterns, *Transportation Research Record*, **944**, 1-12.

Cambridge Systematics (1996) Data collection in the Portland, Oregon metropolitan area, report for the Travel Model Improvement Program, Department of Transportation, Cambridge Systematics, Oakland.

Gawronski, G. and H. Sydow (1999). Wertorientierungen und Präferenzmuster: Vorstellung eines zweidimensionalen Wertesystems zur Beschreibung potentieller Kundengruppen, presentation at *20th Kongress für angewandte Psychologie*, October 1999, Berlin.

Götz, K., T. Jahn and I. Schultz, (1997) Mobilitätsstile: Ein sozial-ökologischer Untersuchungsansatz, *Forschungsbericht Stadtverträgliche Mobilität*, **7**, Forschungsverbund City:mobil, Frankfurt am Main.

Hanson, S. and K.O. Burnett (1981) Understanding complex travel behavior: Measurement issues, in P.R. Stopher, A.H. Meyburg and W. Brög (eds.), *New Horizons in Travel-Behaviour Research*, 207-230, Croom Helm, New York.

Hanson, S. and P. Hanson (1981) The travel-activity patterns of urban residents: Dimensions and relationships to socio-demographic characteristics, *Economic Geography*, **57** (3) 332-347.

Hanson, S. and J.O. Huff (1982) Assessing day-to-day variability in complex travel patterns, *Transportation Research Record*, **891**, 18-24.

Hanson, S. and J.O. Huff (1986) Classification issues in the analysis of complex travel behaviour, *Transportation*, **13** (3) 271-293.

Hanson, S. and J.O. Huff (1988a) Repetition and day-to-day variability in individual travel patterns : Implications for classification, in R. Golledge and H. Timmermans (eds.) *Behavorial Modelling in Geography and Planning*, 368-399, Croom Helm, New York.

Hanson, S. and J.O. Huff (1988b) Systematic variability in repetitious travel, *Transportation*, **15** (1-2) 111-135.

Herz, R. (1983) Stability, variability and flexibility in everyday behaviour, in S. Carpenter and P.M. Jones (eds..) *Recent Advances in Travel Demand Analysis*, 385-400, Gower, Aldershot.

Huff, J.O. and S. Hanson (1986) Repetition and variability in urban travel, *Geographical Analysis*, **18** (2) 97-114.

Huff, J.O. and S. Hanson (1990) Measurement of habitual behaviour: Examining systematic variability in repetitive travel, in P.M. Jones (eds.) *Developments in Dynamic and Activity-Based Approaches to Travel Analysis*, 229-249, Gower, Aldershot.

Mahmassani, H.S. and S.G. Hatcher (1992) Day-to-day variability of commuter behavior: Analysis of path selection, trip timing and trip chaining using two-week trip diaries, paper presented at the 6th World Conference of Transportation Research (WCTR), Lyon, Juli 1992.

Mahmassani, H.S., Hatcher, S.G. and Caplice, C.G. (1997) Daily variation of trip chaining, scheduling and path selection behaviour of work commuters, in P.R. Stopher and M.E.H. Lee-Gosselin (Hrsg.) *Understanding Travel Behaviour in an Era of Change*, 351-379, Pergamon, Oxford.

PTV AG, B. Fell, S. Schönfelder und K.W. Axhausen (2000) Mobi*drive* questionaires, *Arbeitsbericht Verkehrs- und Raumplanung*, **52**, Institut für Verkehrsplanung, Transporttechnik, Strassen- und Eisenbahnbau, ETH Zürich, Zürich

Richardson, A., E. Ampt and A. Meyburg (1995) *Survey Methods for Transport Planning*, Eucalyptus Press, Melbourne.

Schmiedel, R. (1978) *Methoden zur Analyse periodischer Komponenten von Zeitreihen*, Institut für Städtebau und Landesplanung, Universität Karlsruhe.

Webber, M.J. (1979) Urban Spatial Structure: An Information Theoretic Approach, Bericht an das Social Sciences and Humanities Research Council (Canada), **Projekt 410-77**, Department of Geography, McMaster University, Hamilton, Ontario.

Appendix A Expansion

Table 12 Comparison of trip dimensions: Mobi*drive* vs. recent one-day diary studies in Halle and Karlsruhe (weekdays only)

Dimension	Halle		Karlsruhe	
Category	1998 survey	Mobi*drive*[1]	1992 survey	Mobi*drive*[1]
Modal shares (trip level)[2]				
Car driver	25.9	32.0	33	32.3
Walking	30.8	31.0	23	22.3
Cycling	9.1	8.6	17	16.6
Local public transport	22.3	13.9	16	15.2
Car passenger	4.2	13.2	11	12.2
Average trip length by mode[2] [km]				
Car driver	19.3	12.1	10.5	12.2
Walking	1.1	1.2	0.9	0.9
Cycling	*2.5*	2.6	2.6	2.2
Local public transport	5.6	6.0	6.8	9.9
Car passenger	17.5	13.0	10.2	16.1
All modes	9.2	7.5	6.3	8.2
Average trip duration by mode[2] [min]				
Car driver	28.3	21.5	20	19.1
Walking	17.0	17.7	14	14.3
Cycling	14.0	15.0	14	10.7
Local public transport	30.0	23.8	31	30.6
Car passenger	31.1	23.1	19	22.6
All modes	25.0	21.3	19	18.8
Number of trips by mode[2] [/Mobile Person]				
Car driver	0.91	1.11	1.23	1.31
Walking	1.08	1.09	0.86	0.90
Cycling	0.32	0.30	0.64	0.67
Local public transport	0.78	0.48	0.60	0.64
Car passenger	0.15	0.46	0.41	0.50
Sum of all modes	3.50	3.54	3.75	4.05

1 It was possible to reweight the data to match the comparison surveys with respect to age and gender, pretest data excluded

2 Excluding modes with minor shares

Table 13 Comparison of share of trip purposes: Mobi*drive* vs. recent one-day diary studies in Halle and Karlsruhe (weekdays only)

Trip purpose	Halle		Karlsruhe	
Shares [%]	1998 survey	Mobi*drive*[1]	1992 survey	Mobi*drive*[1]
Return home	40.5	39.4	--	--
Leisure	7.6	19.7	33	33.4
Household maintenance	--	--	32	35.0
Shopping/Services	22.0	10.4	--	--
Work	11.8	9.2	18	18.4
Education	5.4	5.0	9	7.0
Work-related	4.2	1.7	--	--
Other	8.5	4.6	8	6.1

[1] It was possible to reweight the data to match the comparison surveys with respect to age and gender, pretest data excluded

Table 14 Expansion factors Karlsruhe

Age	Socialdata 1991		Mobi*drive*		Expansion factors	
	Male [%]	Female [%]	Male [%]	Female [%]	Male [%]	Female [%]
under 18	7.62	7.32	11.32	6.29	0.6728	1.16396
18-24	6.08	5.11	2.52	6.29	2.4110	0.8121
25-44	16.88	15.14	13.21	13.84	1.2778	1.0942
45-64	12.03	12.62	18.24	17.61	0.6596	0.7164
over 65	5.69	11.51	5.03	5.66	1.1320	2.0344
All	48.30	51.70	50.32	49.69		

Table 15 Expansion factors Halle

Age	Socialdata 1991		Mobi*drive*		Expansion factors	
	Male [%]	Female [%]	Male [%]	Female [%]	Male [%]	Female [%]
under 18	8.89	8.66	10.13	10.13	0.8779	0.8551
18-24	4.54	3.86	3.16	3.8	1.4375	1.0162
25-34	7.41	8.09	5.7	6.33	1.3002	1.2778
35-44	5.59	5.90	8.23	12.03	0.6797	0.4902
45-54	6.50	6.94	10.76	6.33	0.6043	1.096
55-64	9.13	8.30	8.23	8.23	1.1097	1.0082
over 65	5.74	10.44	3.16	3.8	1.8157	2.7466
all	47.81	52.19	50.32	49.69		

Appendix B Structure of the data sets

Table 16 explains the contents of the data set, while Table 17 gives the number of observations in each.

Table 16 Content of the data sets

File name	Unit	Comment/Source
HH_SUM;	Households	Household questionnaire
V_SUM	Vehicles	Vehicle questionnaire
P_SUM	Persons	Person questionnaire
VAL_SUM	Attitudes/values	Attitudes and values instruments
S_SUM	Stages	Known stage details generated from trip diary
T_SUM	Trips	Trips including information about previous and following trip
J_SUM	Journeys	Journeys generated from the reported trips (summaries of trip-level data)
DWLD_SUM	Long-distance journey days	Days with long-distance journeys to locations outside the study areas
ACT_SUM	Activities	Activities based on trip information including some trip information
PDX_SUM	Person days	Summary of each day reported (e.g. trip making, activity participation)
PWX_SUM	Person weeks	Summary of each week during which the person reported
HHDX_SUM	Household days	Summary of each day for each reporting household
HHWX_SUM	Household weeks	Summary of each week for each reporting household
D_IM_SUM	Immobile days	Immobile days from trip diary

Annotation:

The Mobi*drive* project consortium only provides the base files

- HH_SUM;
- V_SUM
- P_SUM
- VAL_SUM
- T_SUM
- D_IM_SUM
- DWLD_SUM

for puiblic usage/analysis. See Data Format Guide, Part B for a comprehensive description of the particular files. For details of accessing the data please contact schoenfelder@ivt.baug.ethz.ch.

Table 17 Size of the data sets (number of records)

File name	Contents	*Pre-test*	Main study	
		Karlsruhe	Halle	Karlsruhe
HH	Households	23	68	71
V	Vehicles	72	168	254
P	Persons	44	158	159
VAL	Attitudes and values	--	129	134
S	Stages (without imputation)	9346	30549	38152
T	Trips	6741	20992	24540
J	Journeys	2801	9323	9664
D_W_LDJ	Long-distance journey days	113	214	329
ACT	Activities	6785	21150	24699
PDX	Person days[1]	1725	6378	6257
PWX	Person weeks	264	946	949
HHDX	Household days	961	2851	2967
HHWX	Household weeks	138	408	426
D_IM	Immobile days	100	593	267
	Missing days	10	44	92

[1] Person day file contains the immobile days

Appendix C Mobi*drive* Database: Data implementation and correction strategy

Create frame / socio-demographic data files

Read hh	Reads household data from raw data; File created: hh

Read p	Reads person data from raw data; File: p

Read v	Read vehicles data from raw data; File: v

- Manual corrections

Correct pretest hh59	Correct household 59 in Pretest data base (one totally miscoded week in HH 59 data sets)

- Check for inplausible data, create file hh_sum (consisting of the data from Karlsruhe, Halle, Pretest

Correct hh_hal_ka	Check consistency of parking place and distances

- Check for inplausible data, create file p_sum (consisting of the data from Karlsruhe, Halle, Pretest

Correct hh_hal_p	Re-code apprentice as working instead of further education Check consistency of statements concerning working Check consistency of statements concerning further education Check consistency of statements concerning fixed commitments Manual corrections

- Check for inplausible data, create file v_sum (consisting of the data from Karlsruhe, Halle, Pretest

Correct hh_hal_v	Manual corrections Spelling of user name

- Check for inplausible data resulting from checks concerning connected files (Halle)

Logic_ha	Manual corrections e.g. licence and age

- Check for inplausible data resulting from checks concerning connected files (Karlsruhe)

Logic_ka	Manual corrections e.g. licence and age

Trip file and trip file based data sets

- Check ACCESS data base for correct data field structure (numeric and character)
- Export ACCESS data base to Dbase
- Check Dbase data for missing times and further possible export errors
- SAS: Import Dbase file to trips.sd2 (intermediate trip file, no “real” processing)
- Identify persons resp. trips which are to be excluded (after negotiating with project partners)

- Create departure and arrival times

Create times	Extracts correct times from raw data; File: times

- Manual correction of times and trips (especially trip duration; correct last export mistakes)

Correct times and trips	Manual corrections

Correct times and trips2	Correct wrong sums of trip duration

- Identify further long distance journeys

Assign ldj code	Detects long distance trips over 100km and categorises; File: trips

- Identify and categorise “open” leisure and other purpose categories (Assigning citymobil categories)
- Identify other modes of transport

- Extract long trips to and from long distance journey episodes

Check for long distance trips	Extracts further days with long distance journeys / days with trips to and from ldj episodes (only one trip on the day); ➔ File: depretka

- Create trip file (t) ➔ base for all further files

Read t	Reads trip data from (quasi) raw data trips and times; File: t

- Some manual corrections on trip file

Correct hh150	Correct household no. 150 in Karlsruhe data base (d_o_s resp. week miscoded in HH 150 raw data); File changed: t_ka

Correct citymobil halle	Additional (re-)coding of City:mobil trip purposes; File changed: t_hal

Correct t_mm_b_s 1104 sts	Corrects wrong trip main modes (main modes tend be to missing if only access and egress modes are stated); File changed: t

Simple correction of speeds	Assigns correct distances and speed; File: t

- Check for inplausible data, create file t_sum (consisting of the data from Karlsruhe, Halle, Pretest

Correct hh_hal_t	Manual corrections after consistency check (licence and mode, status and purpose)

- Create stage file

Read s	Reads stages from trips.sd2; File: s

- Create day mode and activity chain

Create daily chains	Creates daily mode and activity chains from trip data for person days; File: chain; File: chain

- Create immobile days file

Create d_im	Extracts immobile days from (quasi) raw data; File: d_imm

- Create long distance journeys file

Create ldj	Creates day with long distance journey data set (only days stated in raw data); File: d_w_ldj

- Manual corrections in day files

Correct ldj	Manual correction of long distance journeys data set (handle ambiguous statements concerning immobility, journeys and mobility); File changed: dwldj, d_im

- Create activity file

Create activities	Creates activity data set from trip file; File: act

- Manual corrections in activity files

Correct times after midnight	Corrects wrong times in activity and also trip file (t); Files changed: act, t

Check for zero duration act	Checks for activities with durations of zero and correct times in act.sd2 and t.sd2; Files changed: act, t

- Create journey file (aggregate information from trip and activity data)

Create journeys	Creates journey data set from trip (t) and activity (act) files; File: j

Create pd	Creates person day data set from t, act and d_imm file; File pd (contains immobile days also); File: pd

Create pw	Creates person week data set from pd file; File: pw

Correct d_im	Manual correction of immobile days data base; File changed: d_imm

Correct main mode	Corrects main modes in j, pd and pw data sets (more complex algorithm used); Files changed: j, pd, pw

Merge dwldj depret	Adds depret.. to dwldj; File changed: dwldj

- Household files, trip data based

Create hhd	Creates household day data set from person days; File: hhd

Create hhw	Creates household week data set from hhd; File: hhw

Appendix D Imputation procedure and files

Imputations were performed in order to obtain as complete as possible data sets. Besides, biases resulting from item non response should be minimised. The imputations were implemented by the software package Solas 2.0. The missing data imputation in the household, person and vehicle file were implemented by the single imputation technique "Hot deck" according to following rules: In case of more than one matching respondent, the imputed value was taken randomly from the matching respondents, in case where no matching respond could be found no values were imputed and other variables were chosen. The order of imputation and resulting new calculations (in cases of variables that are connected to the imputed ones) are listed in the files impute_p_sum, impute_hh_sum and impute_v_sum as well as chosen variables to find matching respondents.

Table 18 Imputation in file HH_SUM

Imputed Variable	Reference/Sort Variable
HH_INC	CITYCODE N_O_HHM N_O_PV ;
N_O_TR	HH_INC
N_O_V	N_O_PV + N_O_CYC + N_O_MCY + N_O_MP + N_O_MC + N_O_TR
N_O_MV	N_O_PV + N_O_MCY + N_O_MP + N_O_MC + N_O_TR
N_O_VEH	N_O_PV + N_O_TR
F_CSNC	CITYCODE CS_NCOM N_O_LIHH
N_O_G	N_O_MV
C_O_G1/2/3	CITYCODE HH_INC K_O_G1/2/3
D_T_G1/2/3	CITYCODE K_O_G1/2/3
K_O_G2/3	CITYCODE N_O_G
C_O_OS1/2/3	CITYCODE HH_INC K_O_OS1/2/3
D_T_OS1/2/3	CITYCODE K_O_OS1/2/3
K_O_OS2/3	CITYCODE N_O_OS
N_O_PP	N_O_G + N_O_OS
D_T_BS	CITYCODE LOC_HH N_O_PV
D_T_LRT	CITYCODE LOC_HH N_O_PV
D_T_HR	CITYCODE LOC_HH N_O_PV
S_O_ACC	CITYCODE RENTED HH_INC
K_O_ACC	CITYCODE RENTED S_O_ACC HH_INC
C_O_ACC	CITYCODE K_O_ACC RENTED HH_INC
K_RENTED	DURCH CITYCODE RENTED K_O_ACC HH_INC
S_O_GAR	CITYCODE GARDEN K_O_ACC HH_INC
Y_O_MO	CITYCODE LOC_HH K_O_ACC
D_O_RES	Y_O_MO-1999

Table 19 Imputation in file P_SUM

Imputet Variable	Reference/Sort Variable
N_O_J	CITYCODE STATUS AGE
N_O_WP	N_O_J AGE PARENT
N_WH	N_O_J WORKING AGE
Y_1J/2J/3J	N_O_J PARENT EDUC
D_O_1J/2J/3J	D_O_1J/2J/3J=1999-Y_1J/2J/3J
N_O_CH	N_O_C STATUS PARENT
Y_1C/2C/3C	N_O_C PARENT EDUC
D_O_1C/2C/3C	D_O_1C/2C/3C =1999-Y_1C/2C/3C
N_O_FCH	N_O_FC STATUS PARENT
Y_1FC/2FC/3FC	N_O_FC (PARENT) AGE
D_O_1FC	D_O_1FC=1999-Y_1FC/2FC/3FC
K_S_L	SEASON_L LICENCE
A_S_L	SEASON_L LICENCE

Table 20 Imputation in file V_SUM

Imputed Variable	Reference/Sort Variable
POWER	CITYCODE VEH_T HH_INC
CCM	CITYCODE VEH_T POWER
Y_O_P	CITYCODE VEH_T HH_INC
FUEL	CITYCODE POWER
KM	CITYCODE VEH_T Y_O_P N_O_LIHH
KM12MON	CITYCODE VEH_T N_O_LIHH
OWNER_T	CITYCODE VEH_T N_O_LIHH
PARK_T	CITYCODE VEH_T HH_INC
PARK_D	CITYCODE VEH_T PARK_T

For the imputation of the attitude and value instrument data a slightly different imputation procedure was chosen – keeping the Hot Deck method, though. In order to obtain a simple but conclusive reference variable for the missing values in the attitude instruments, the participants were classified by their response behaviour. A classification index was calculated by performing a cluster analysis using the statistical software SPSS (K-Means Cluster, no updating of cluster centroids, pairwise exclusion of missing values). To keep the classification simple only five groups were made up.

The value scale data was imputed analogous to the method described only differing in the way of generating the Hot Deck reference index. Due to the fact that within the value scale the answer category "Don't know" was offered, a two-stage classification process had to be applied which led to two independent reference variables for Hot Deck. Those two independent figures cover the response behaviour concerning the "Don't know" case (3 clusters/groups) and the general response rate described above (again 5 groups). Keeping in mind the small Mobi*drive* sample and the small amount of missing values in general (see Axhausen *et al.*, 2002 for detailed figures), this relatively unorthodox classification and imputation method was considered as sufficient.

Appendix E Figures

Annotation: The figures presented here are based on the data available in 1999.

First trips

Fig. 1: Frequencies of all respondents‘ first trip in the same interval within one week (Mon – Fri, one hour intervals)

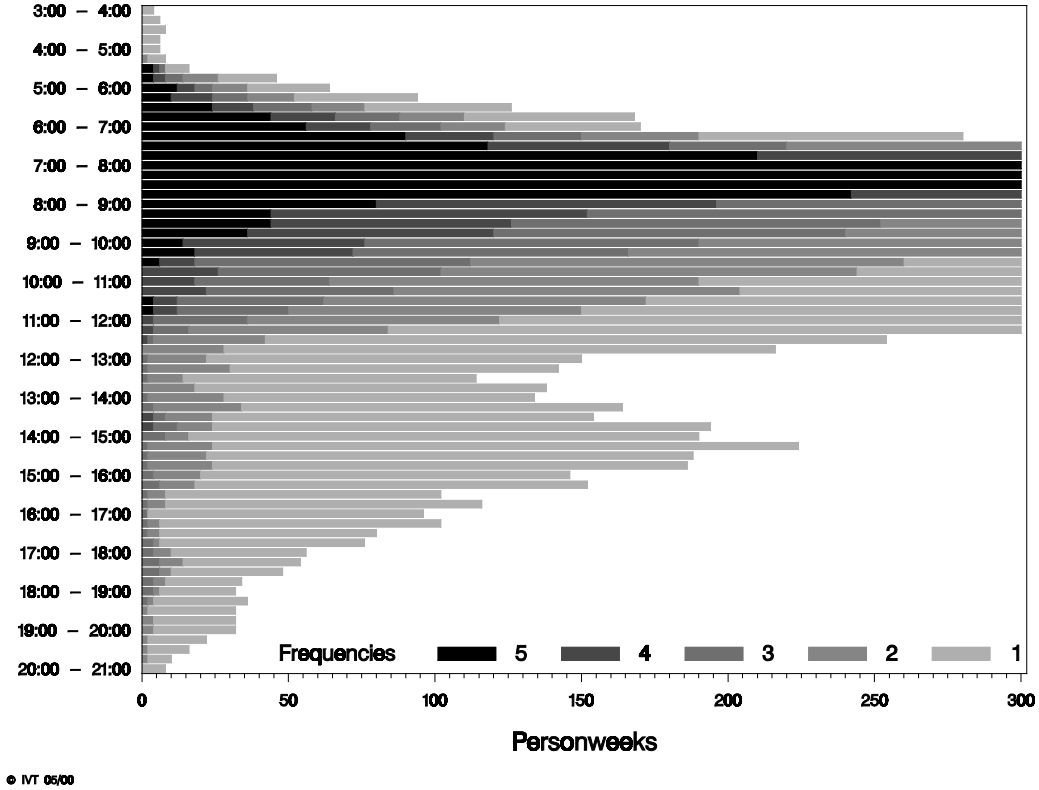


Fig. 2: Frequencies of pupils‘ first trip in the same interval within one week (Mon – Fri, one hour intervals)

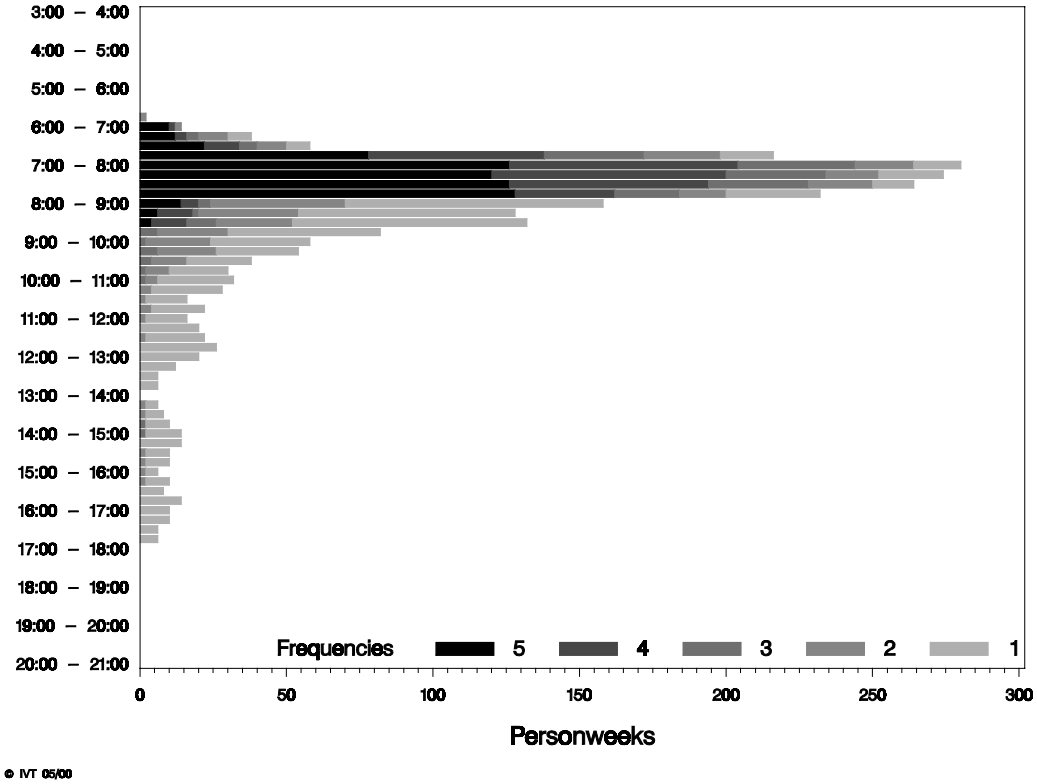


Fig. 3: Frequencies of students‘ first trip in the same interval within one week (Mon – Fri, one hour intervals)

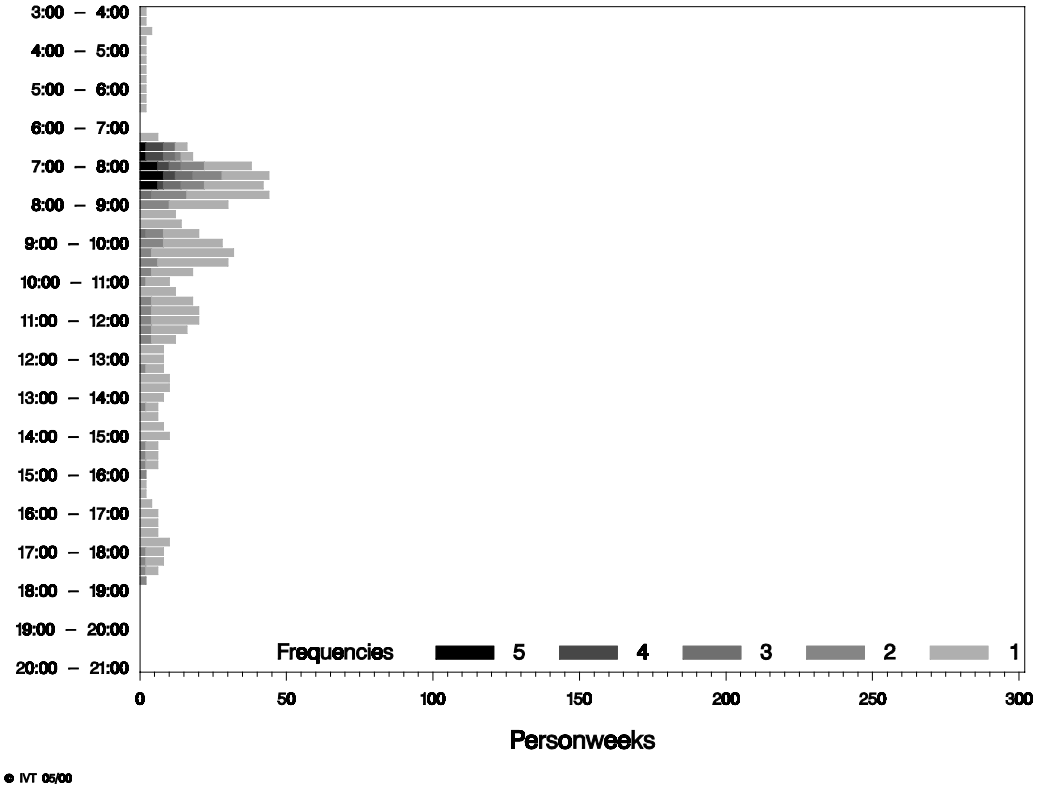


Fig. 4: Frequencies of apprentences‘ first trip in the same interval within one week (Mon – Fri, one hour intervals)

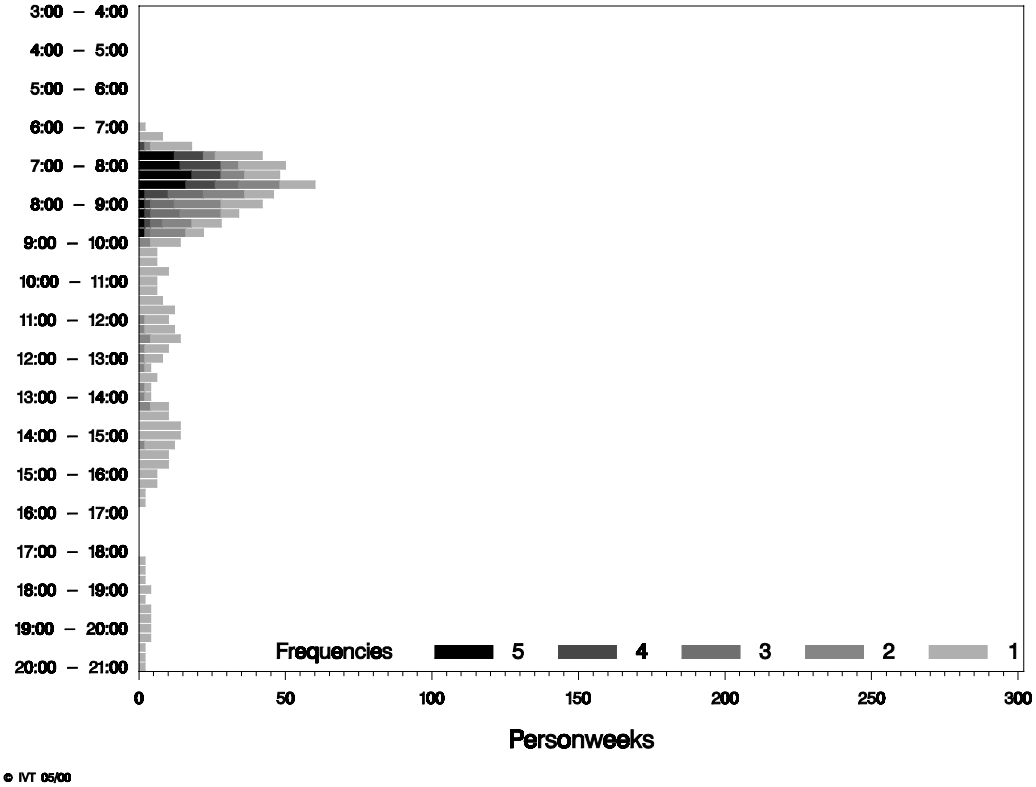


Fig. 5: Frequencies of housemakers‘ first trip in the same interval within one week (Mon – Fri, one hour intervals)

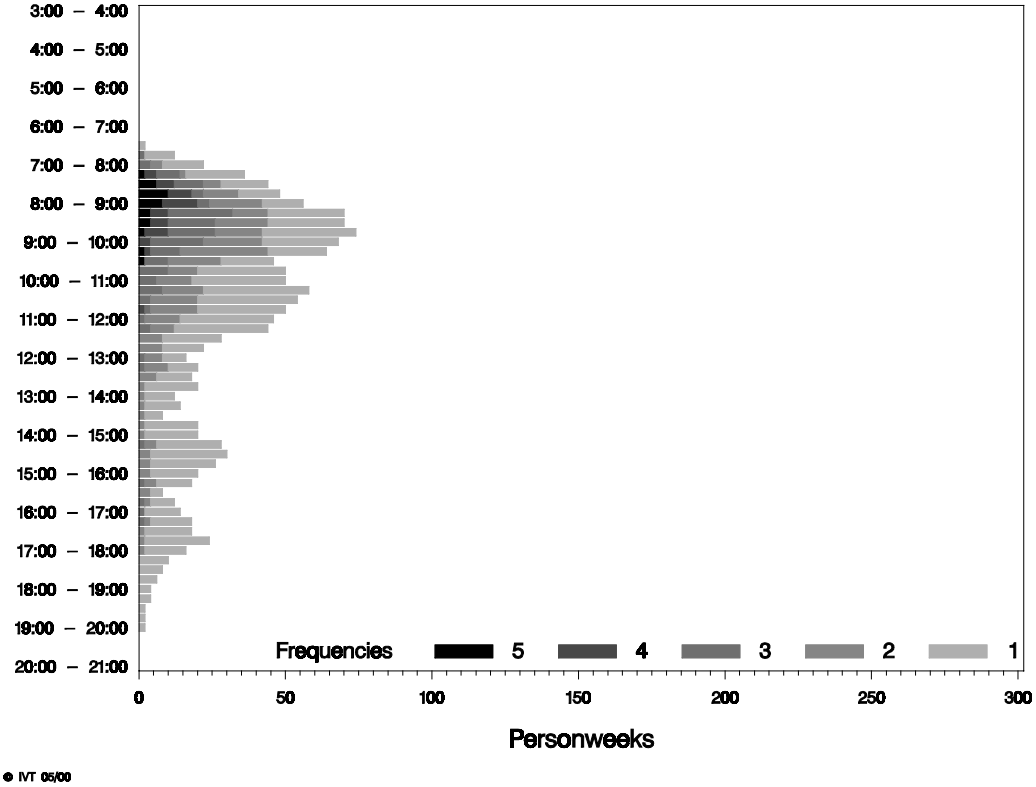


Fig. 6: Frequencies of Retirees‘ first trip in the same interval within one week (Mon – Fri, one hour intervals)

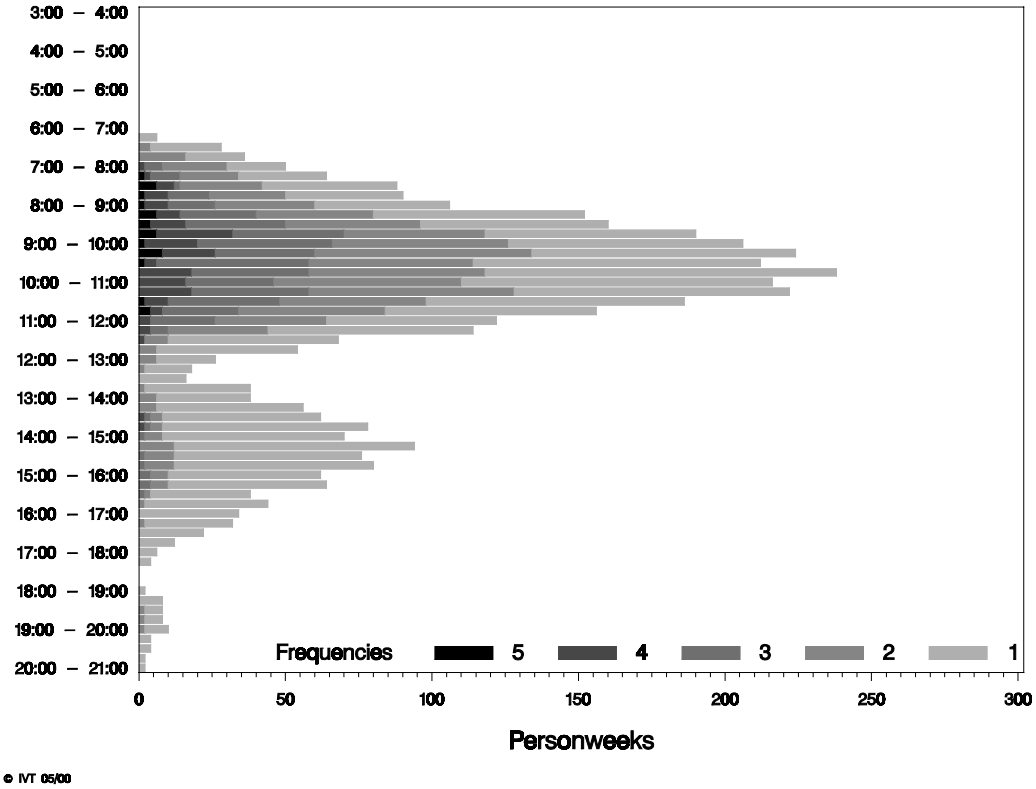


Fig. 7: Frequencies of unemployed persons‘ first trip in the same interval within one week (Mon – Fri, one hour intervals)

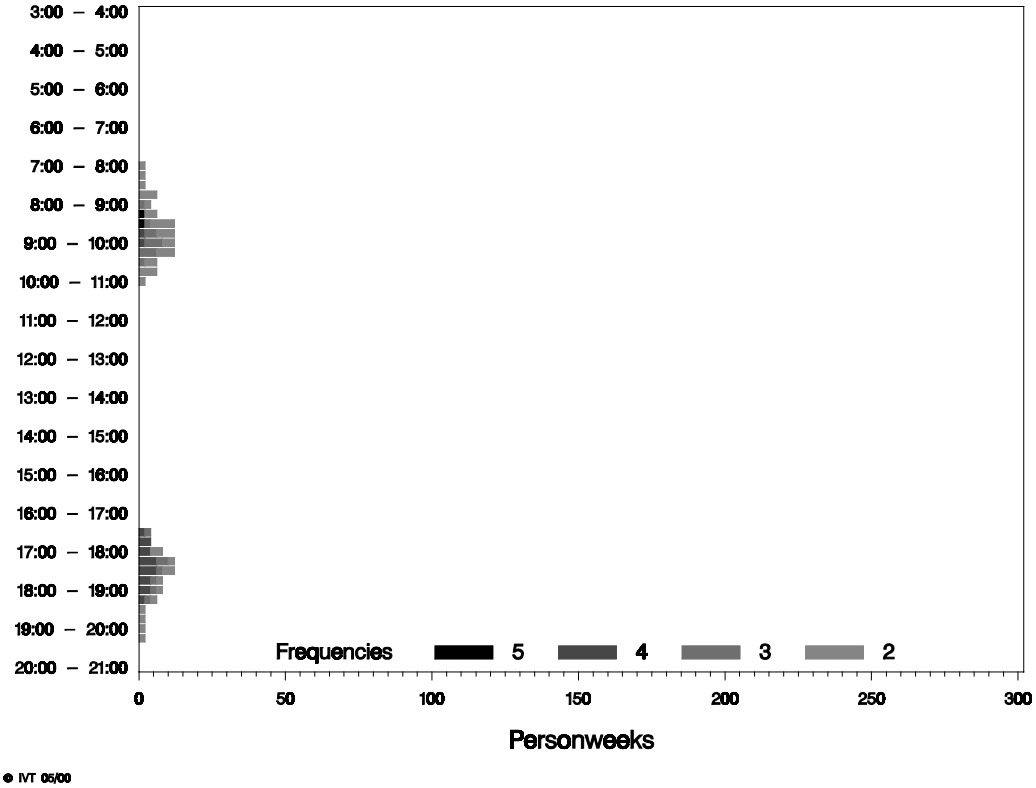


Fig. 8: Frequencies of parttime employees‘ first trip in the same interval within one week (Mon – Fri, one hour intervals)

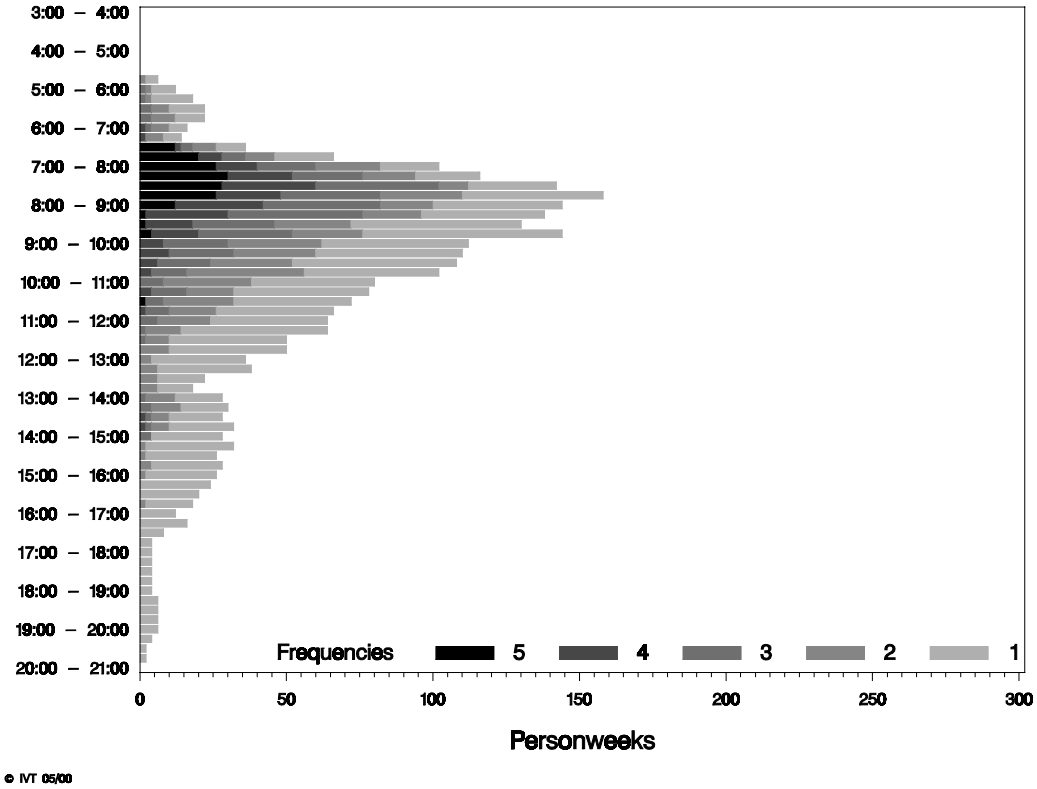


Fig. 9: Frequencies of fulltime employees‘ first trip in the same interval within one week (Mon – Fri, one hour intervals)

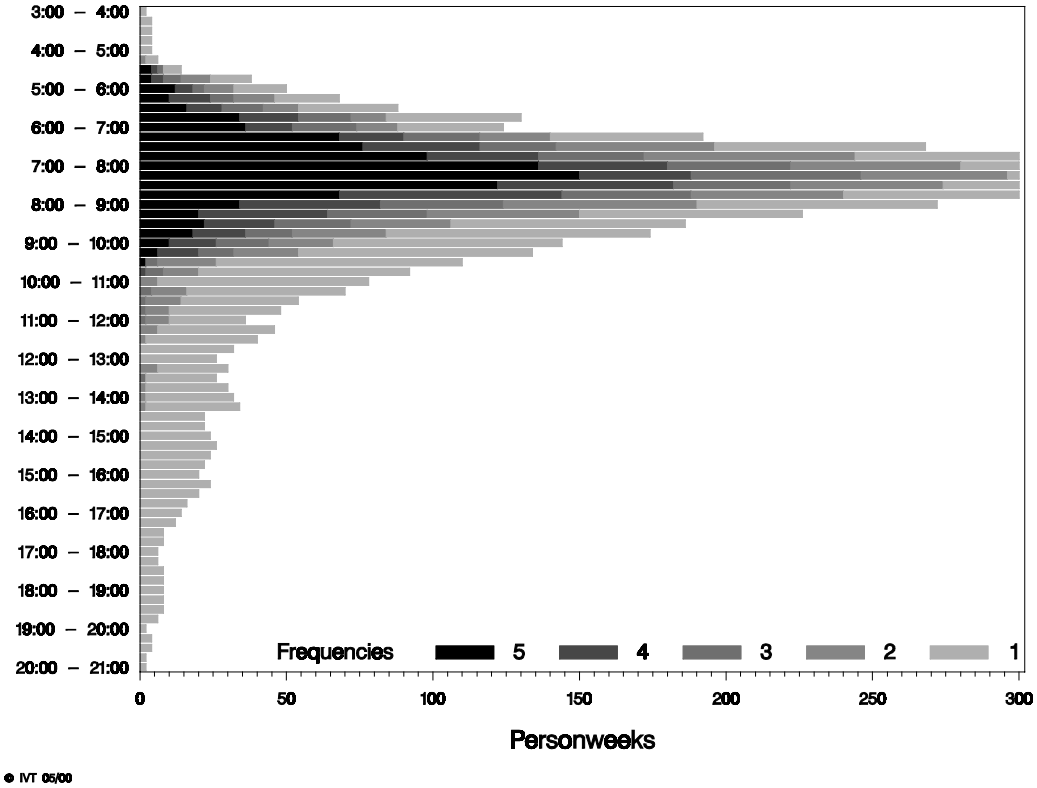
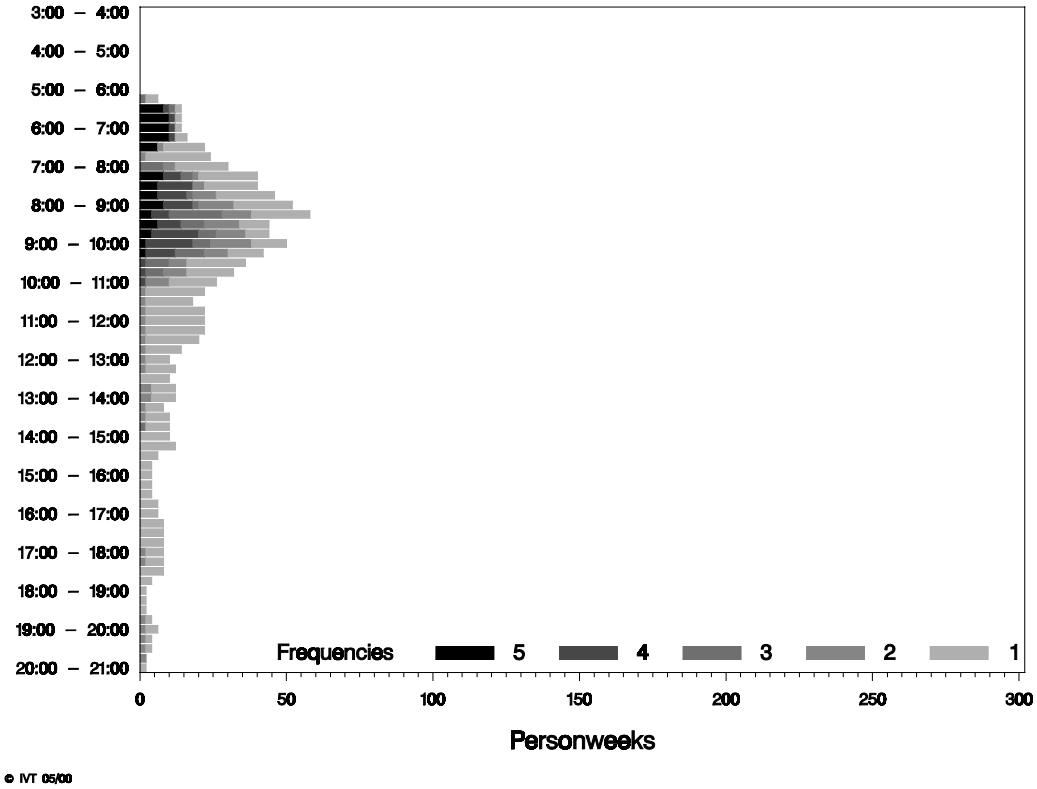


Fig. 10: Frequencies of selfemployed persons‘ first trip in the same interval within one week (Mon – Fri, one hour intervals)



Activities

Fig. 11: Week day activity engagement by time of all respondents (30 minute intervals)

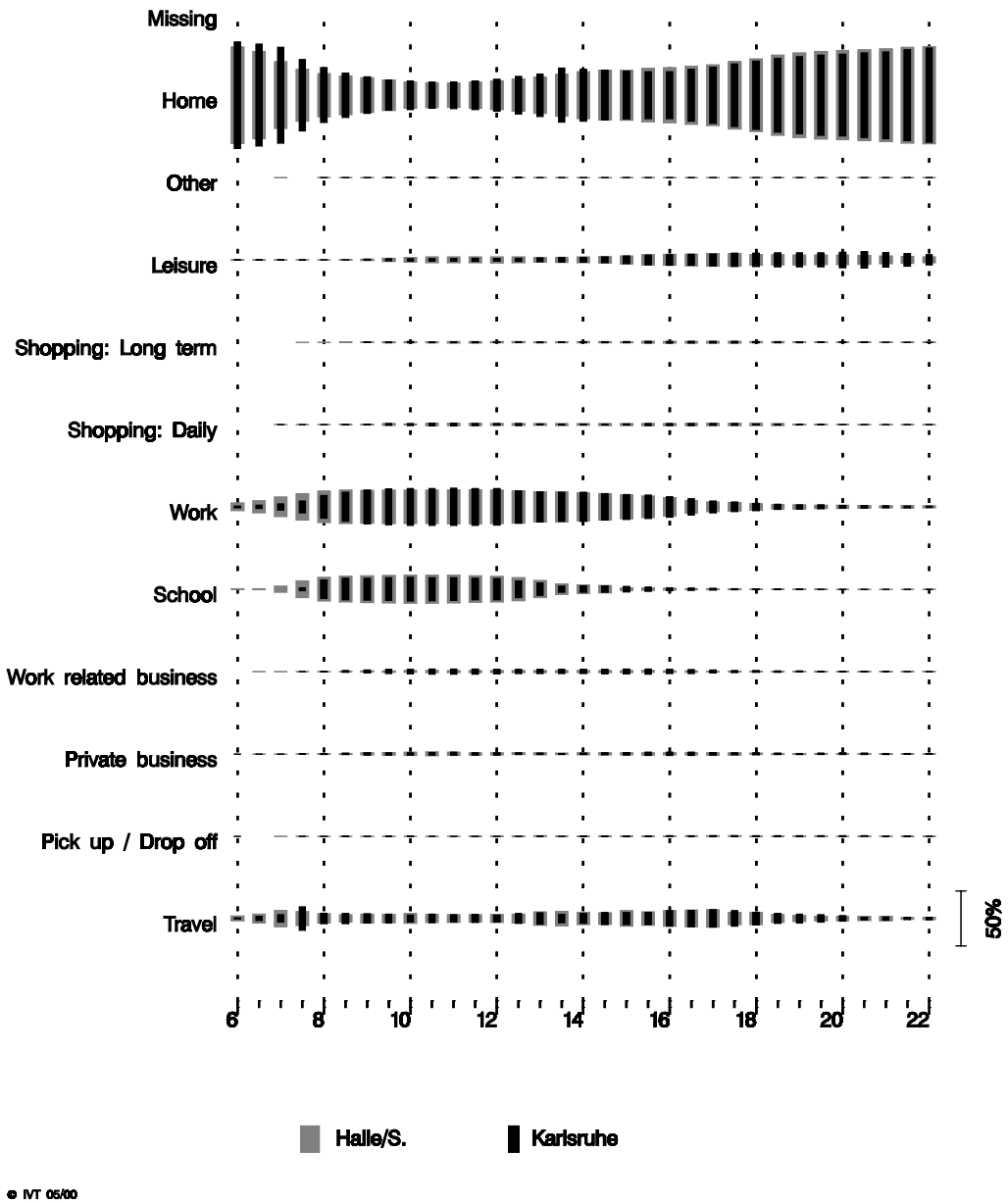


Fig. 12: Week day activity engagement by time of pupils
(30 minute intervals)

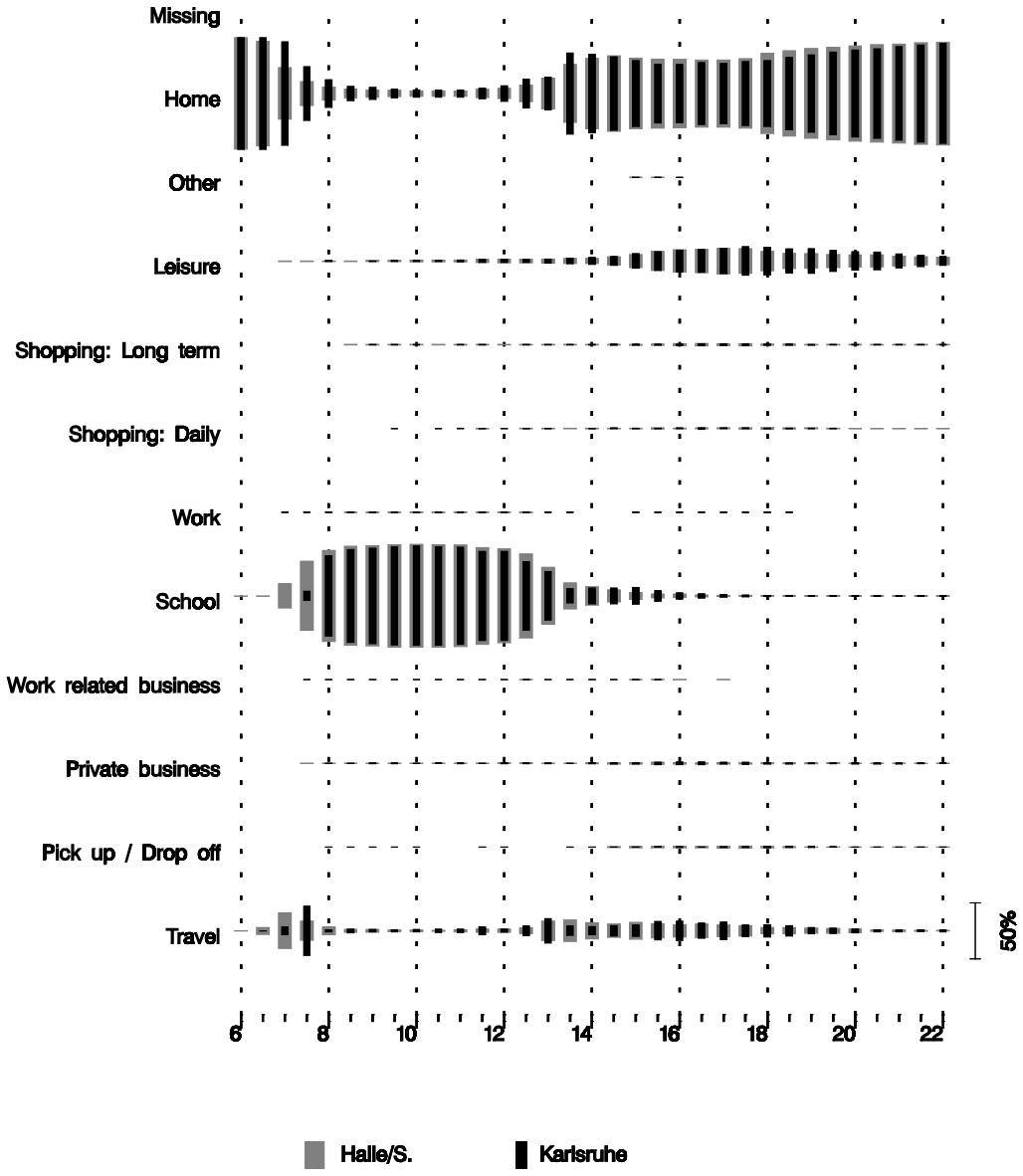


Fig. 13: Week day activity engagement by time of students (30 minute intervals)

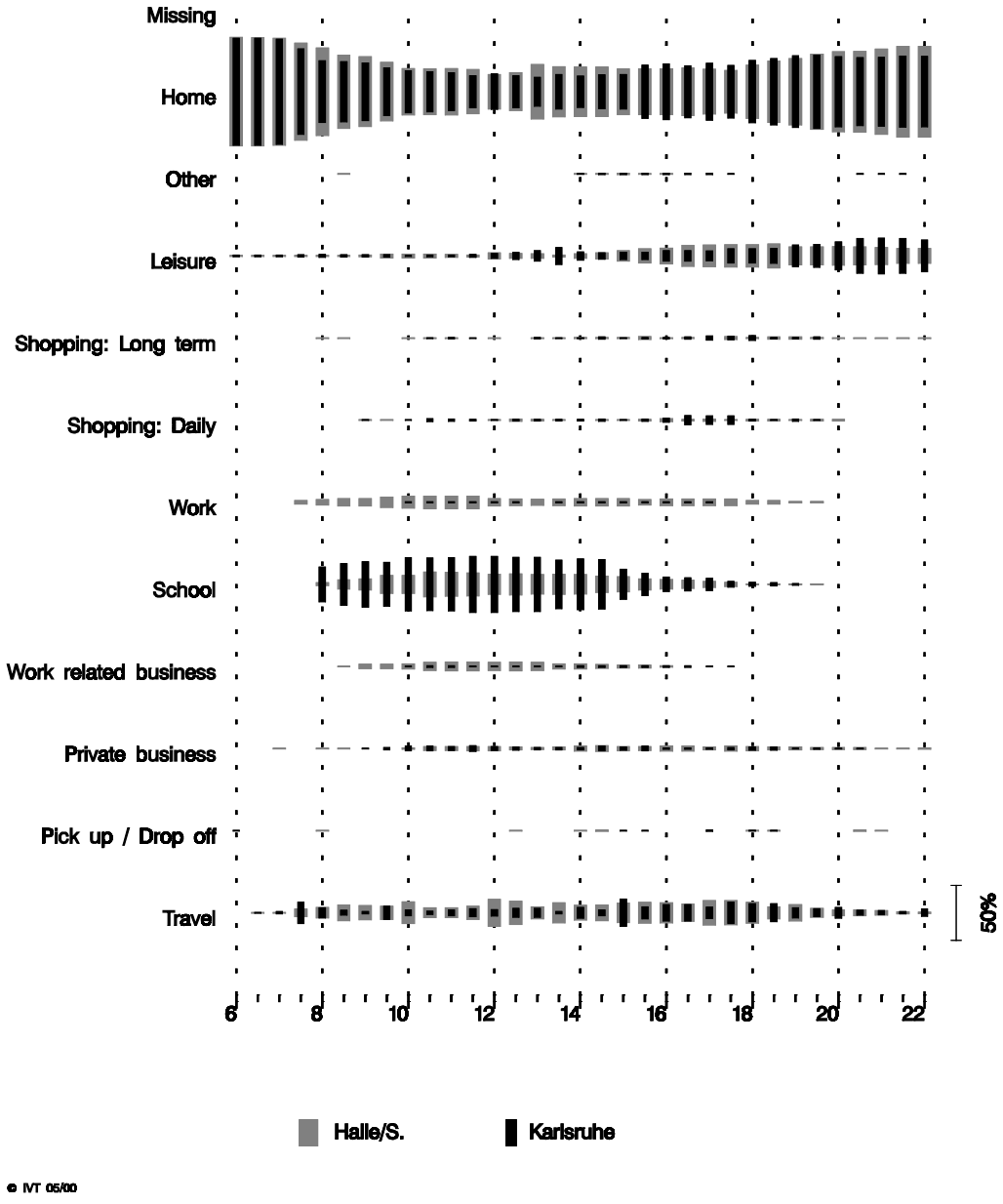


Fig. 14: Week day activity engagement by time of apprentences (30 minute intervals)

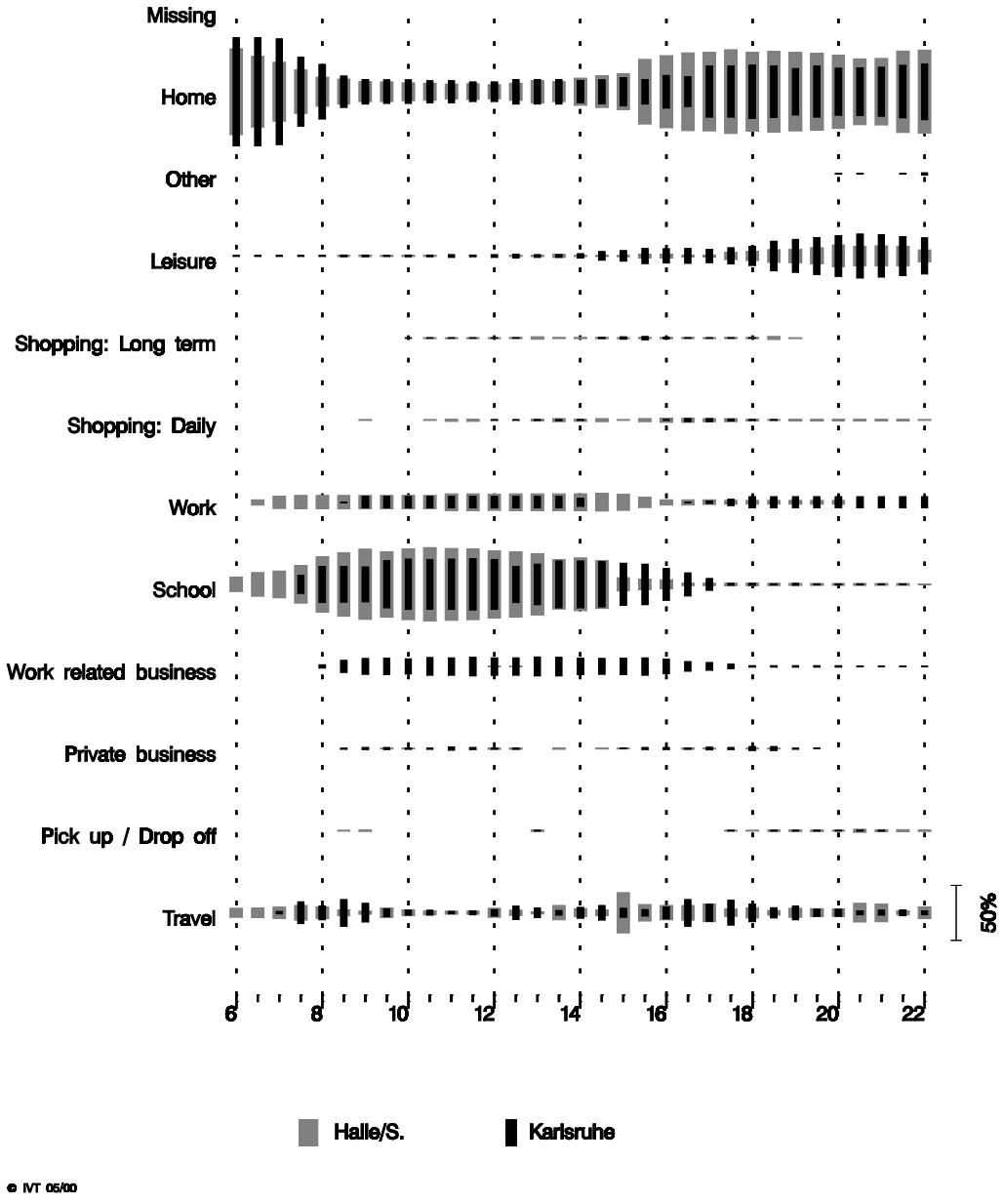


Fig. 15: Week day activity engagement by time of housemakers (30 minute intervals)

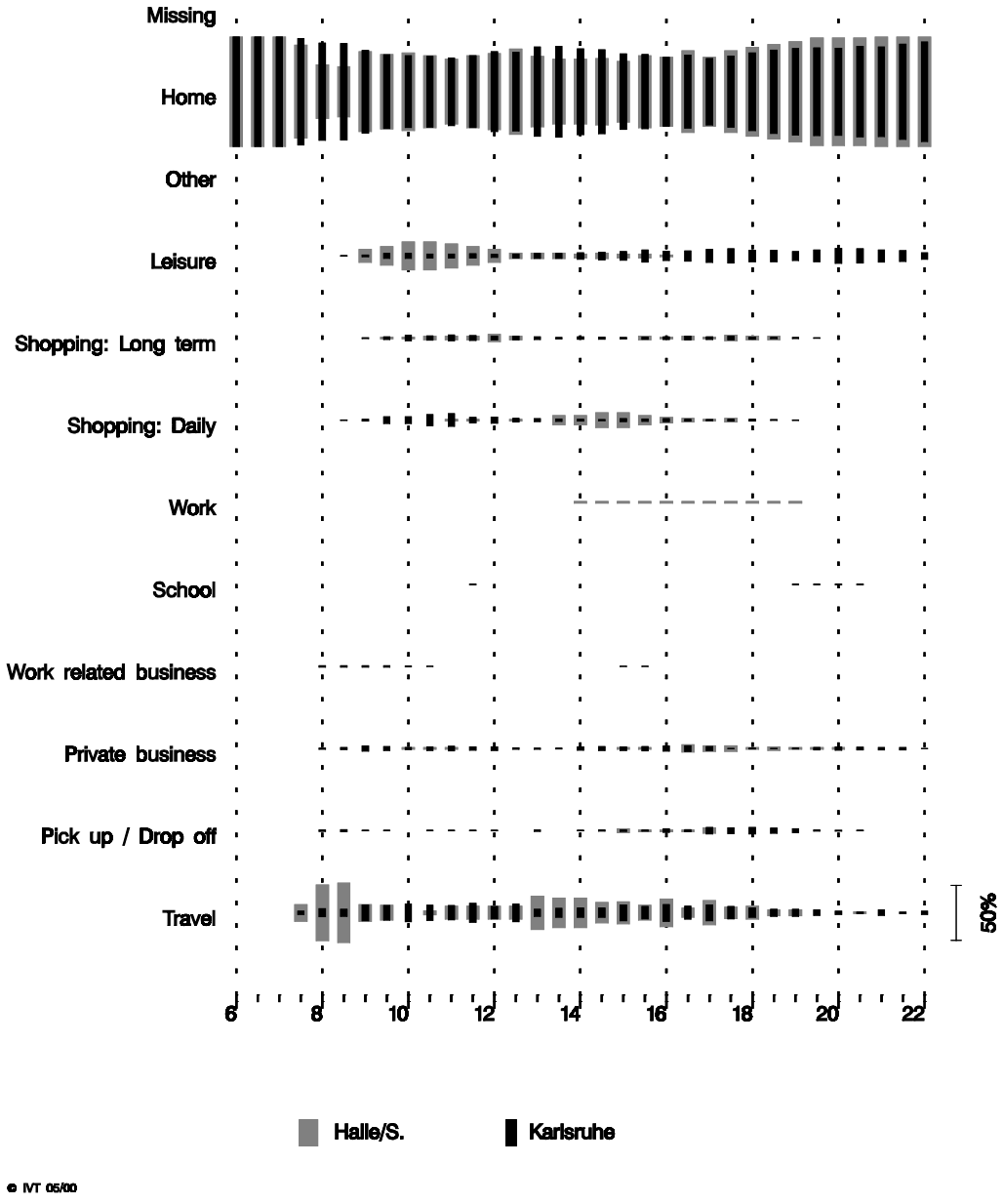


Fig. 16: Week day activity engagement by time of retirees
(30 minute intervals)

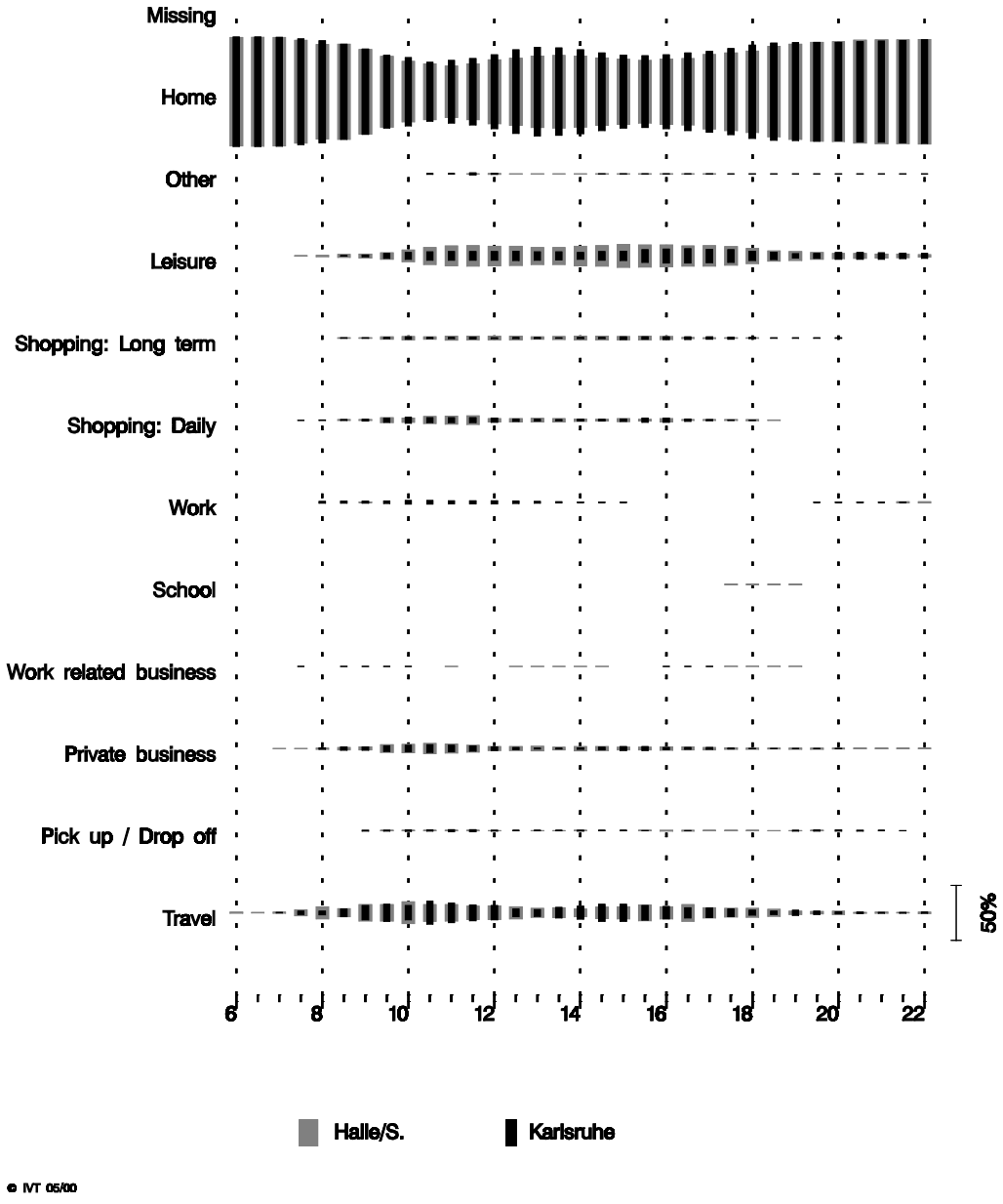


Fig. 17: Week day activity engagement by time of unemployed persons (30 minute intervals)

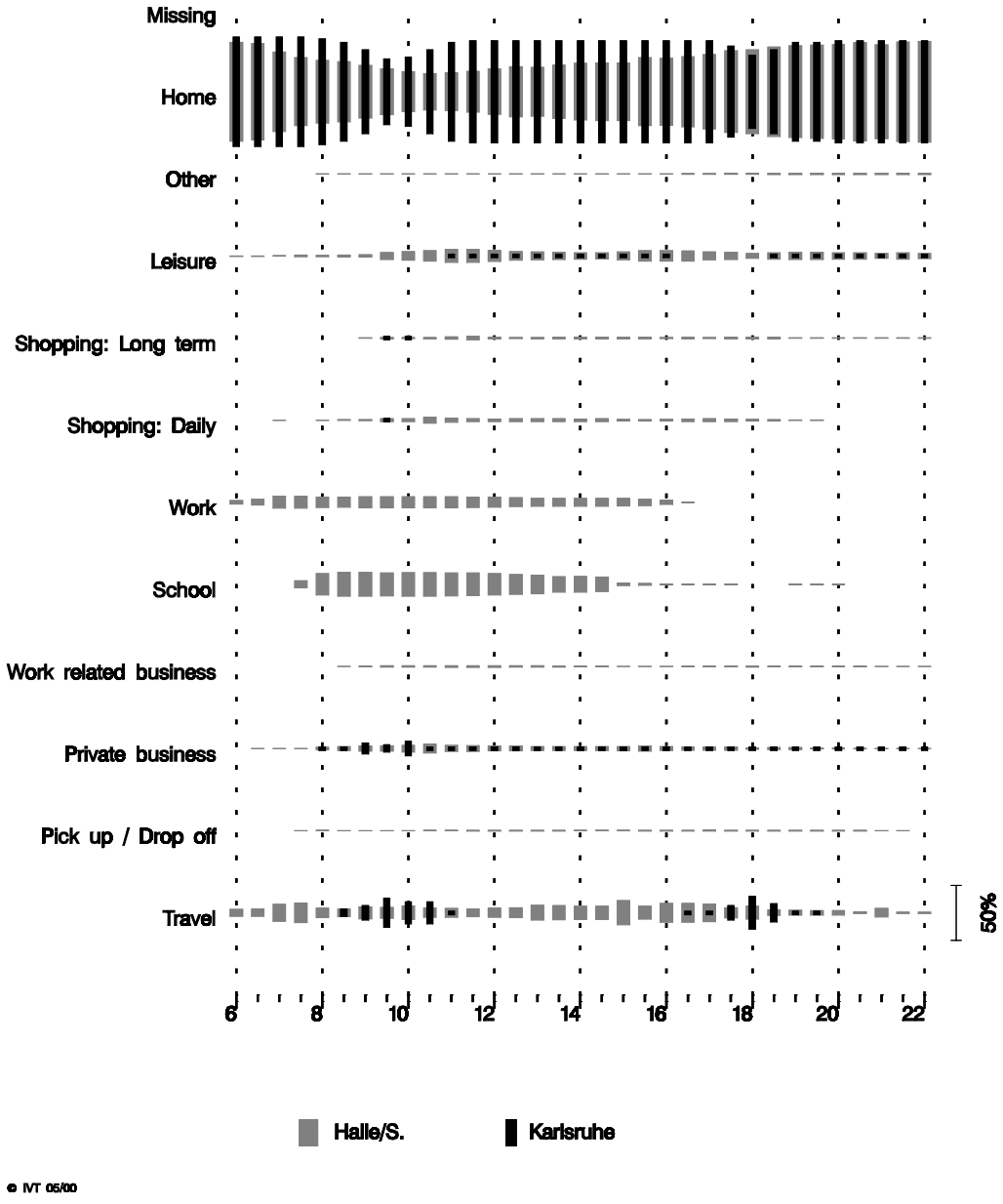


Fig. 18: Week day activity engagement by time of parttime employed persons (30 minute intervals)

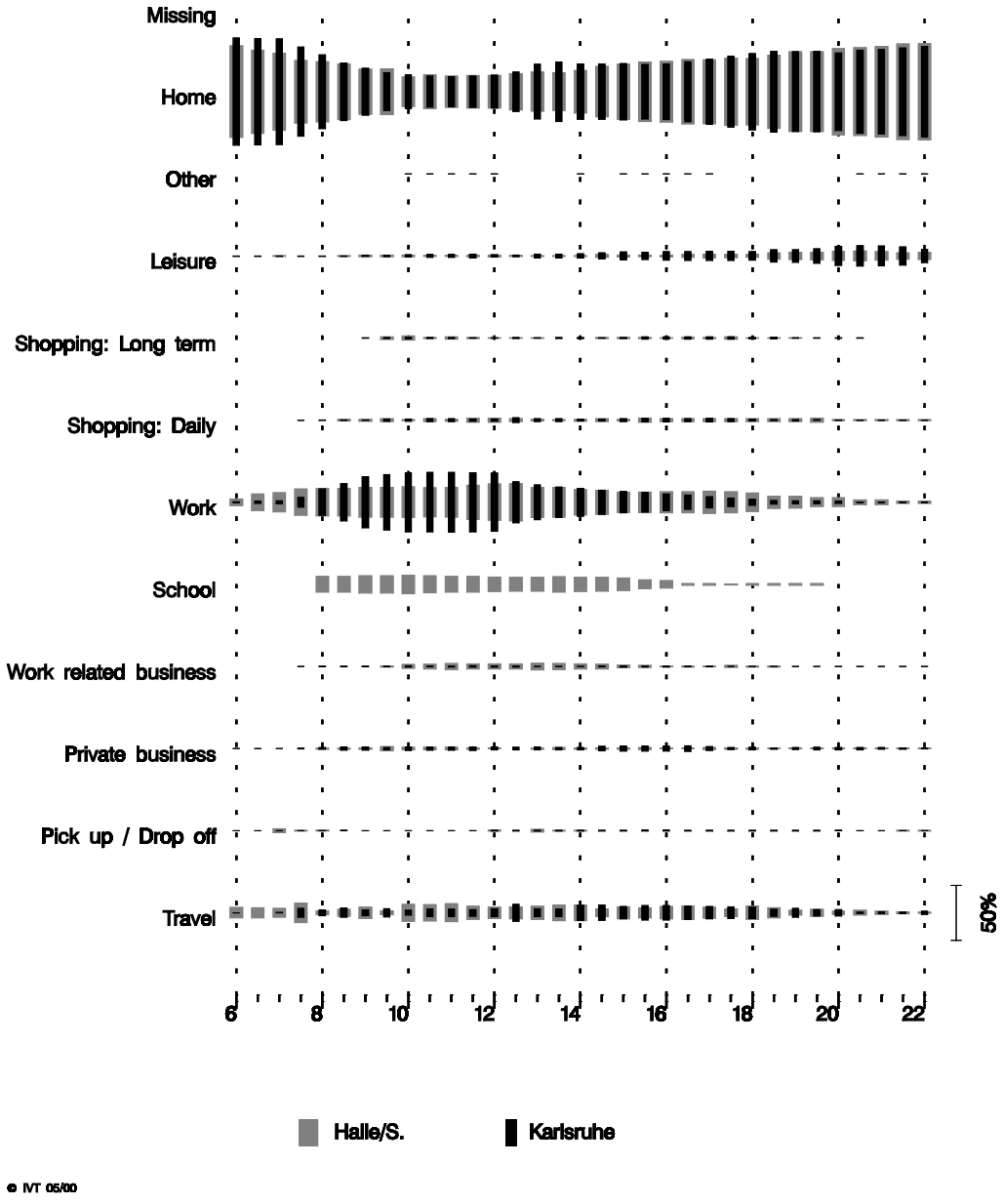


Fig. 19: Week day activity engagement by time of fulltime employed persons (30 minute intervals)

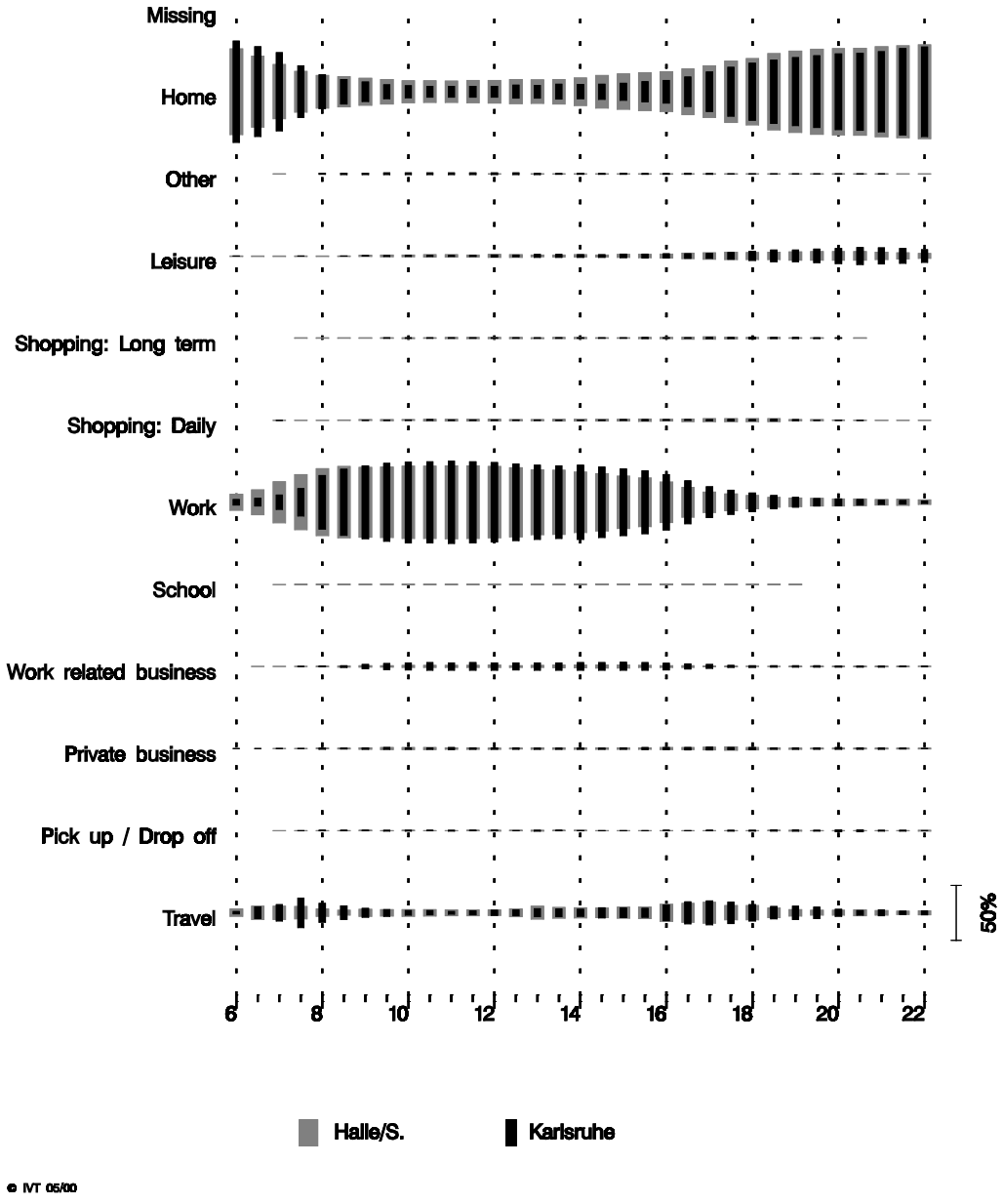


Fig. 20: Week day activity engagement by time of selfemployed persons (30 minute intervals)

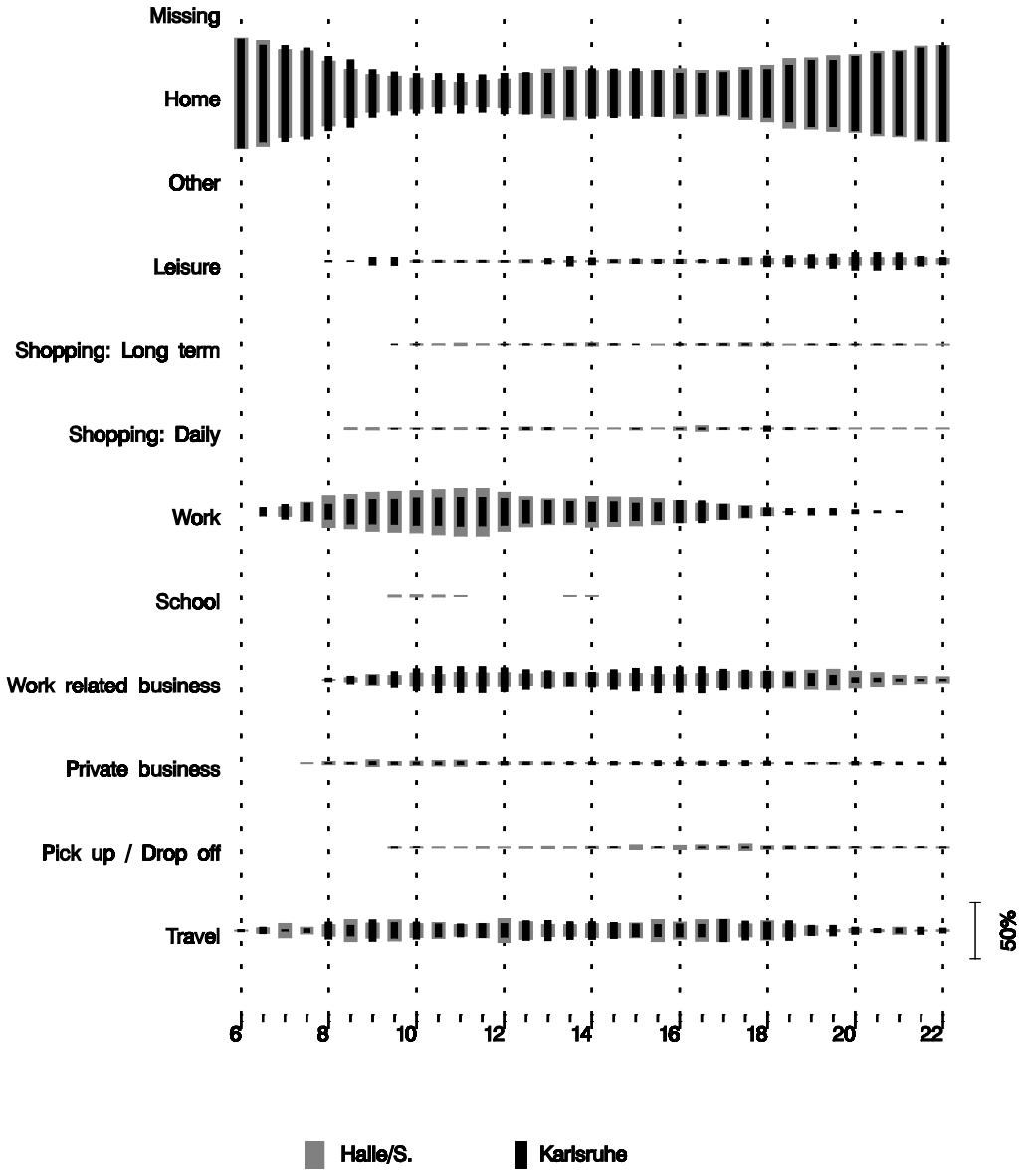


Fig. 21: Weekend day activity engagement by time of all respondents (30 minute intervals)

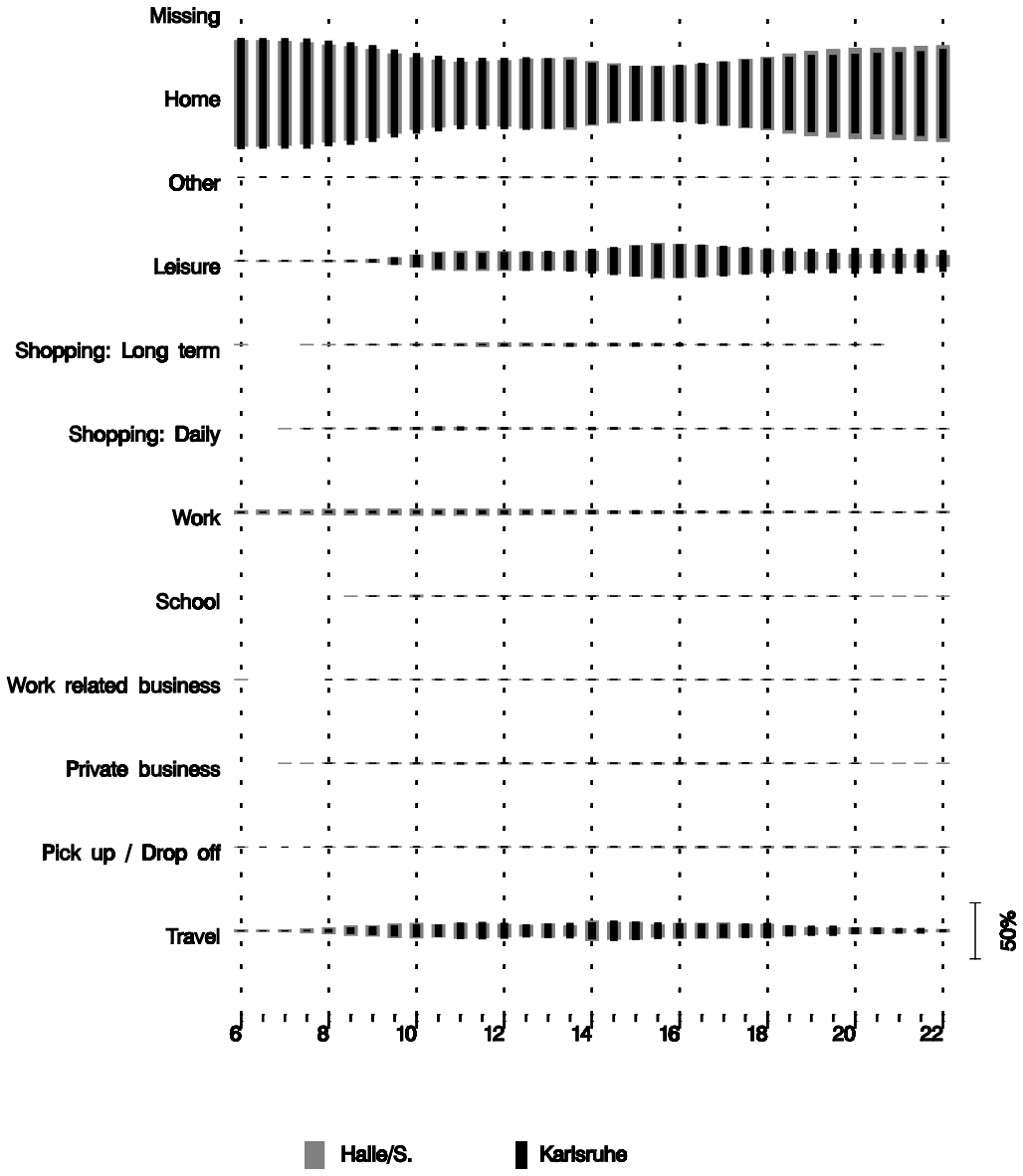


Fig. 22: Weekend day activity engagement by time of pupils (30 minute intervals)

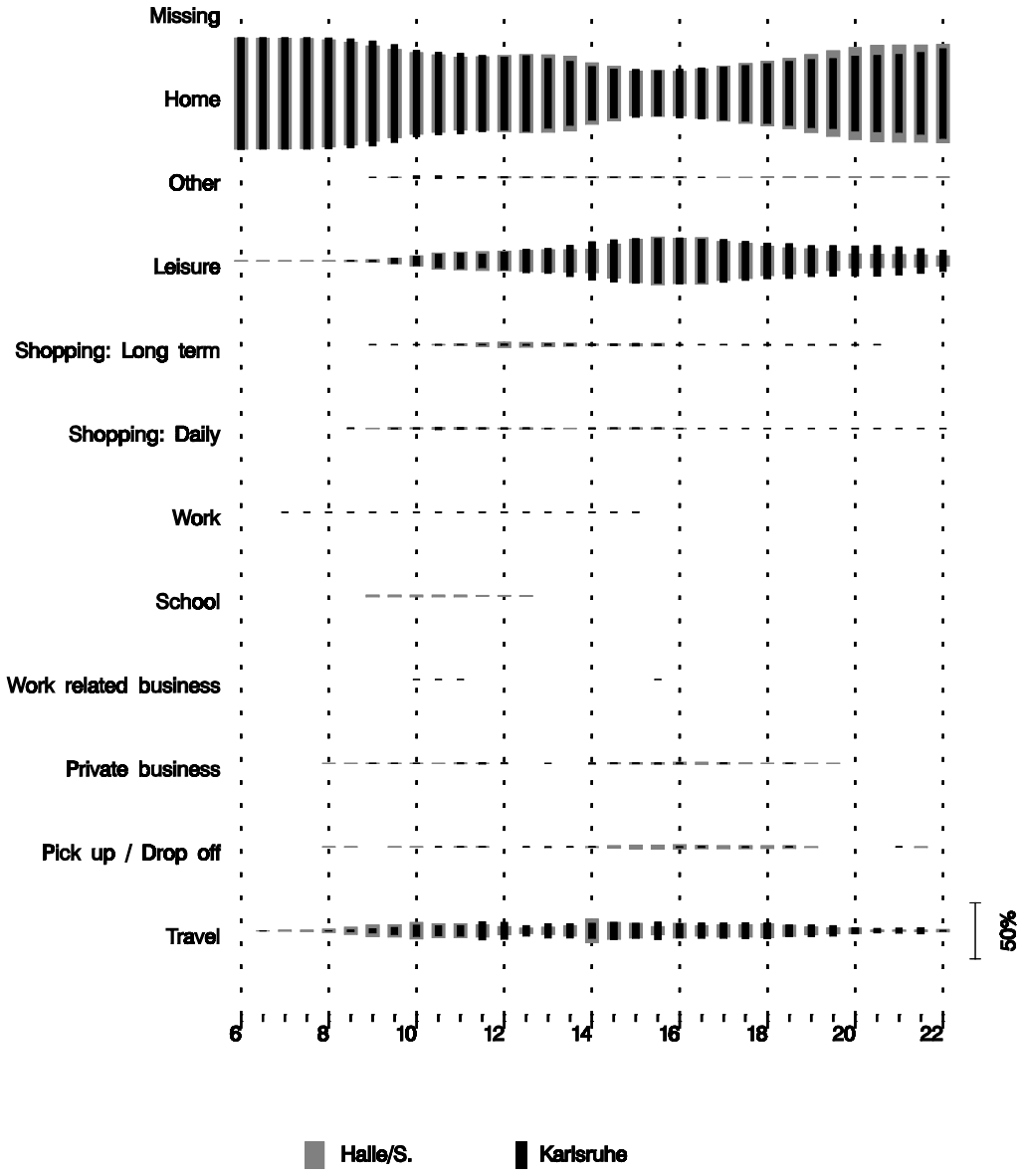


Fig. 23: Weekend day activity engagement by time of students (30 minute intervals)

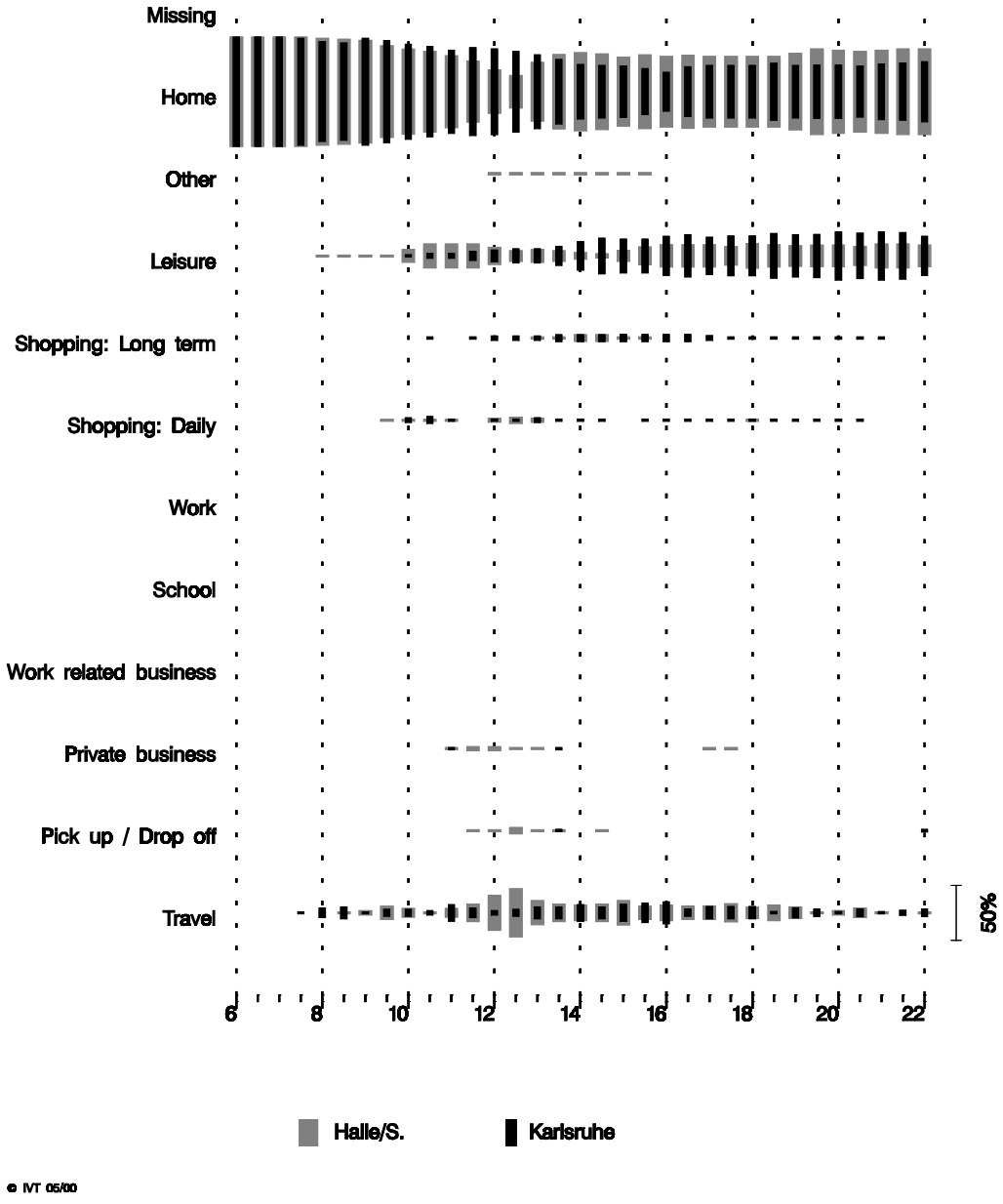


Fig. 24: Weekend day activity engagement by time of apprentences (30 minute intervals)

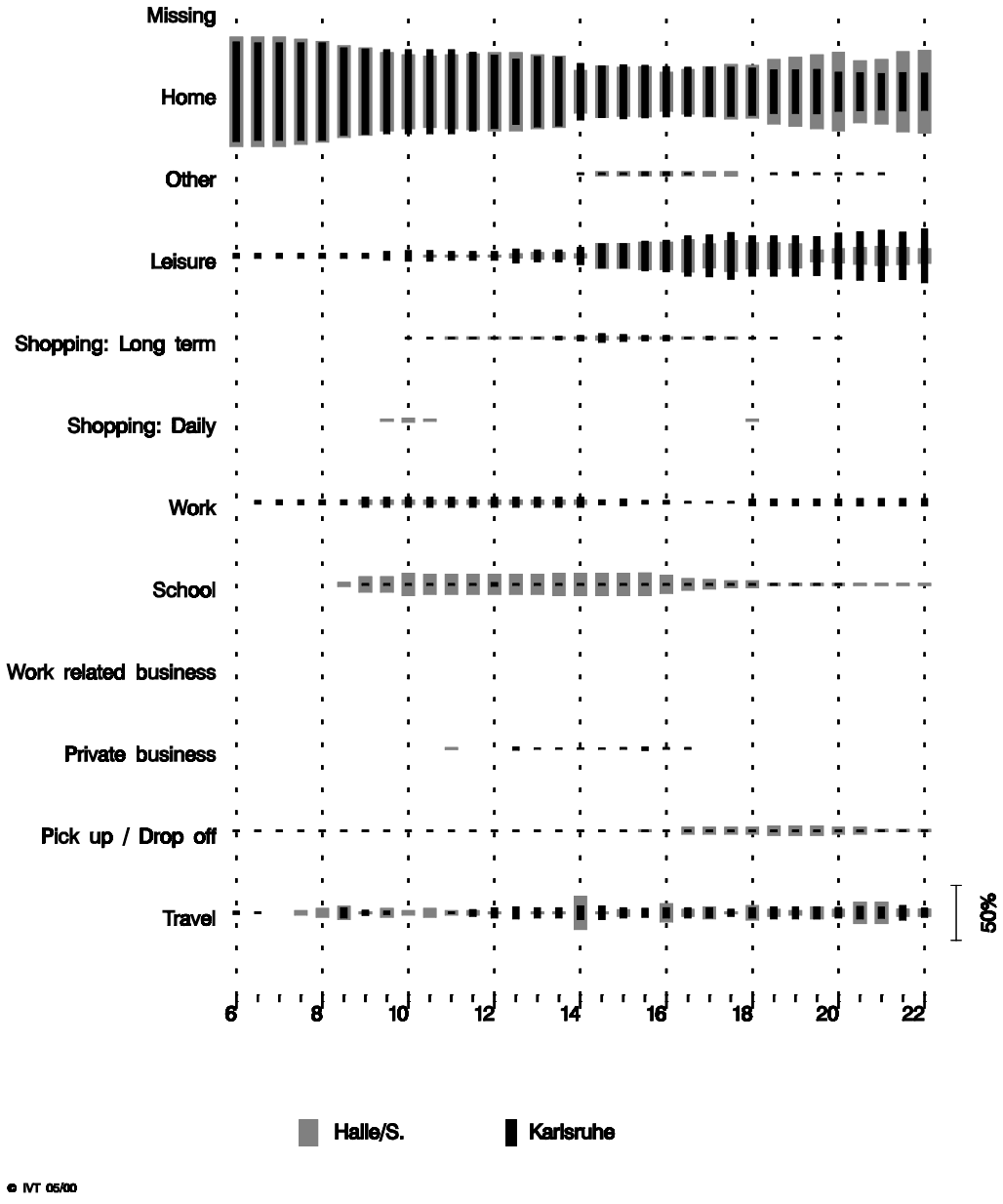


Fig. 25: Weekend day activity engagement by time of housemakers (30 minute intervals)

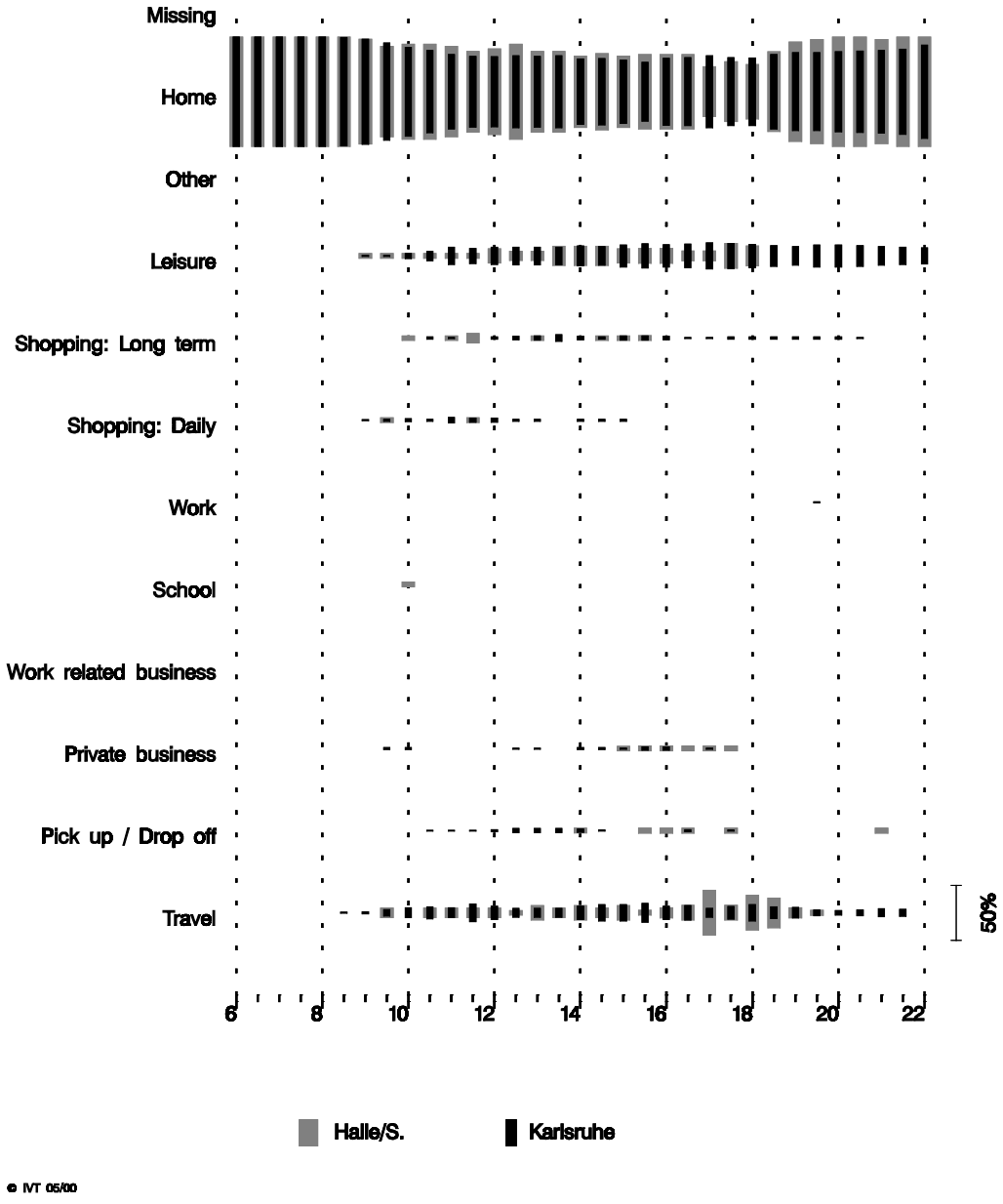


Fig. 26: Weekend day activity engagement by time of retirees (30 minute intervals)

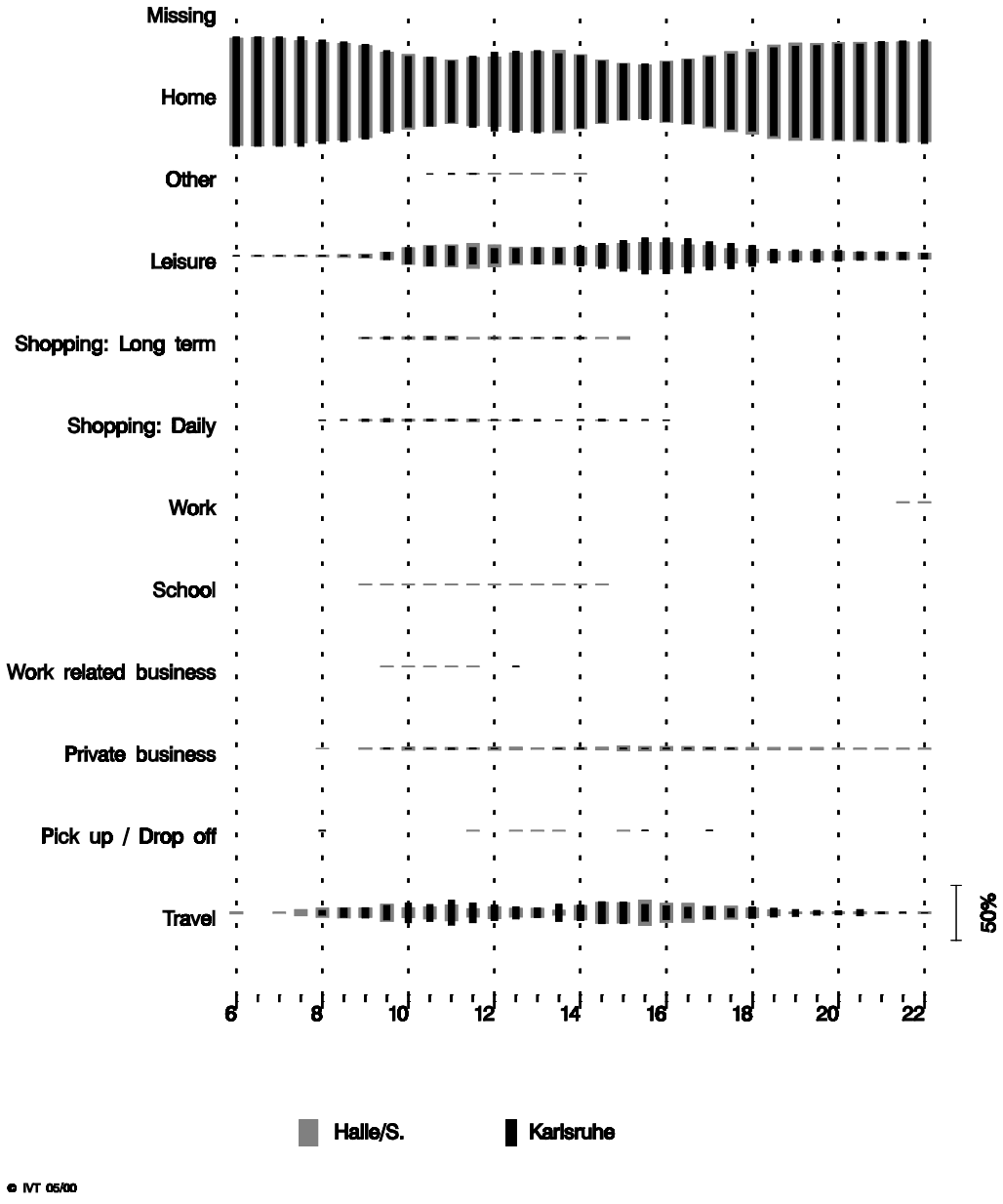


Fig. 27: Weekend day activity engagement by time of unemployed persons (30 minute intervals)

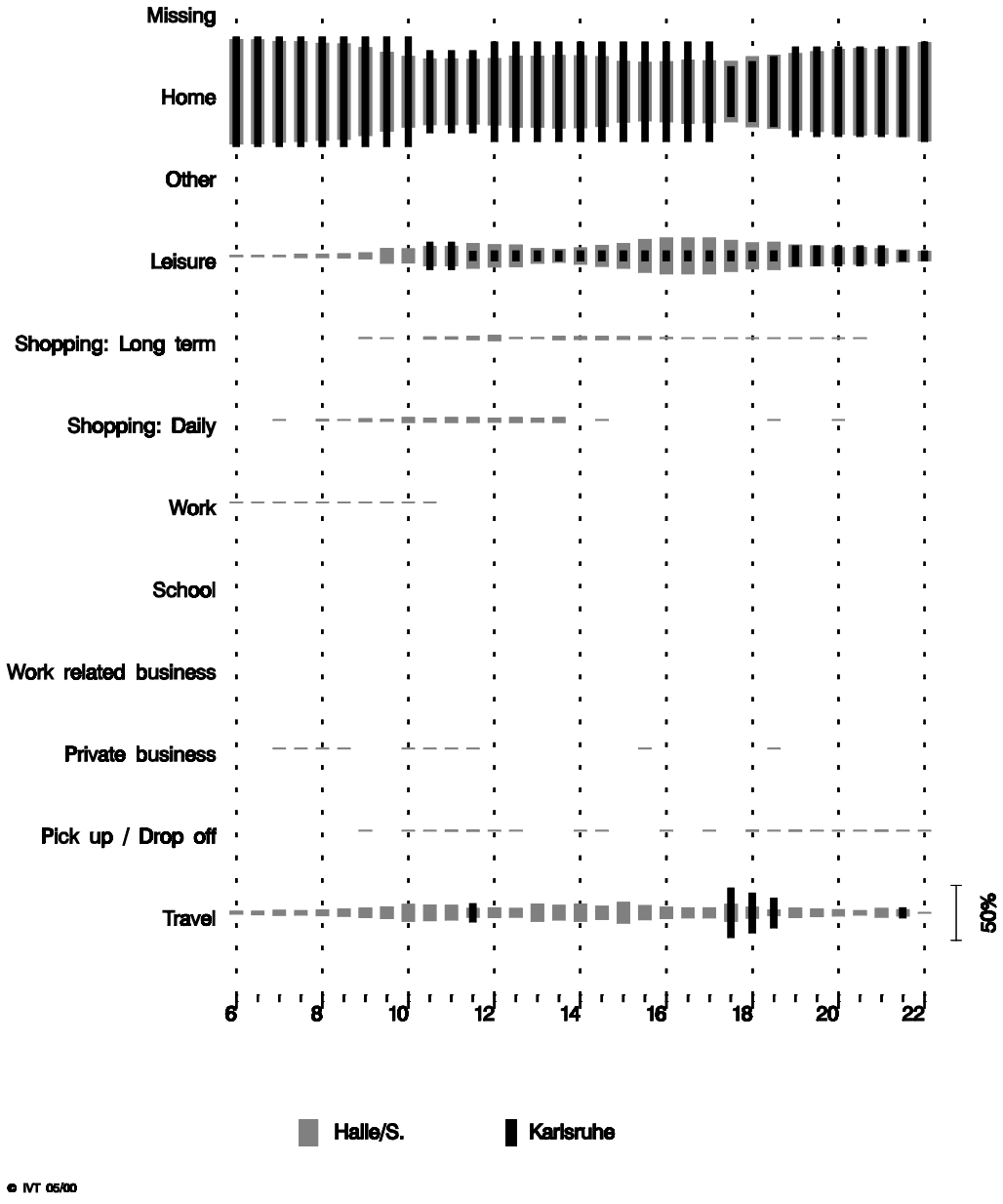


Fig. 28: Weekend day activity engagement by time of parttime employed persons (30 minute intervals)

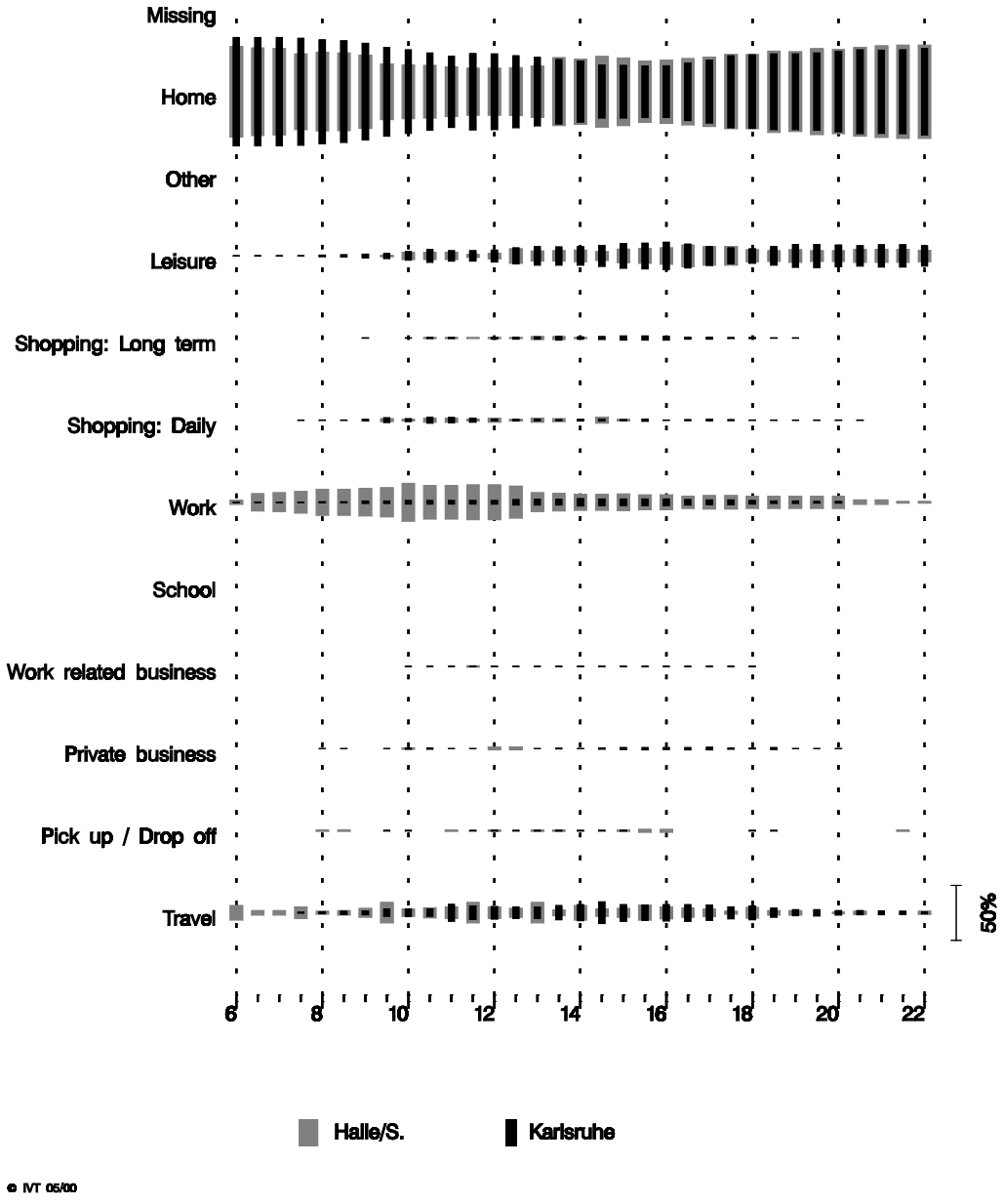


Fig. 29: Weekend day activity engagement by time of fulltime employed persons (30 minute intervals)

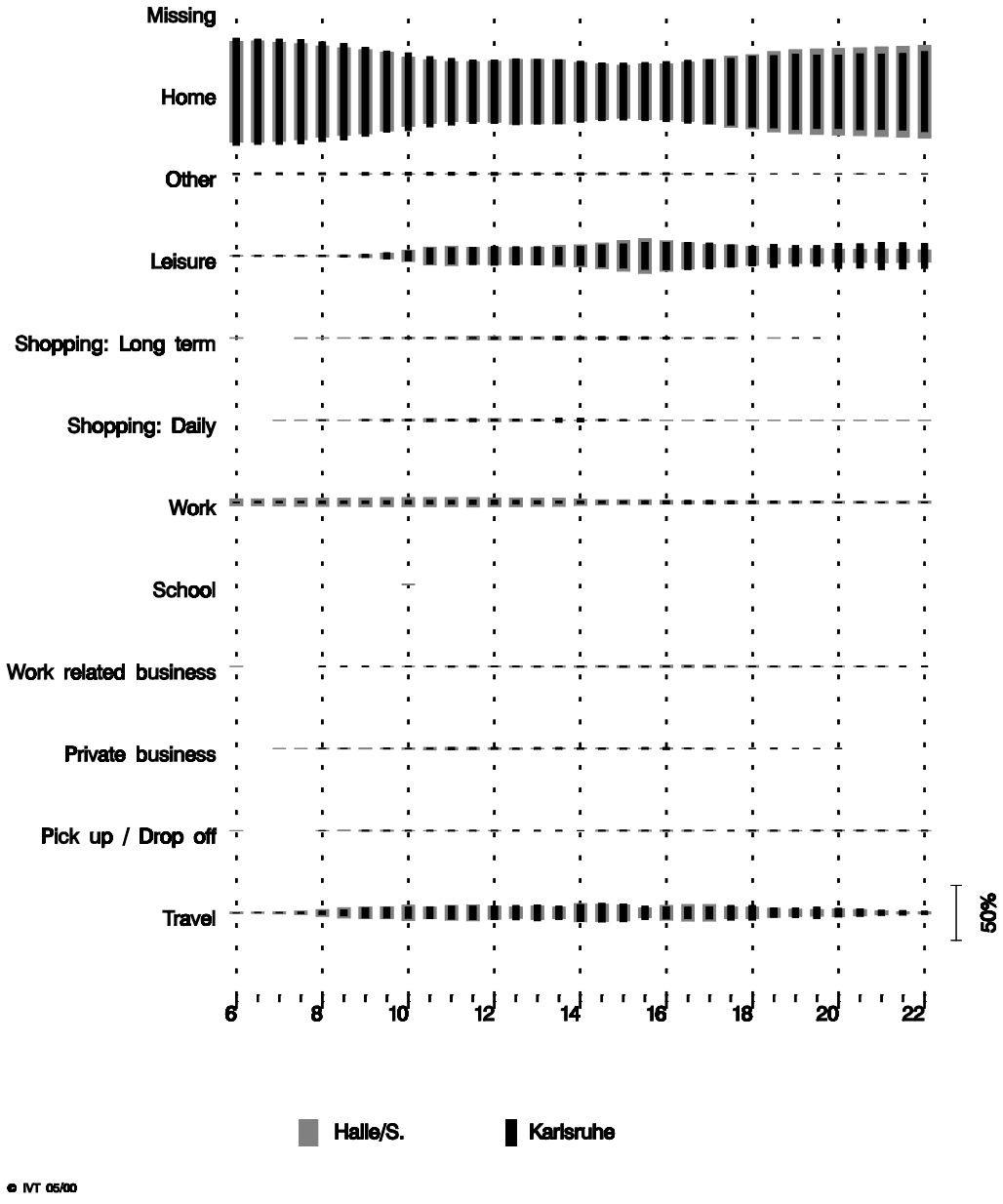


Fig. 30: Weekend day activity engagement by time of selfemployed persons (30 minute intervals)

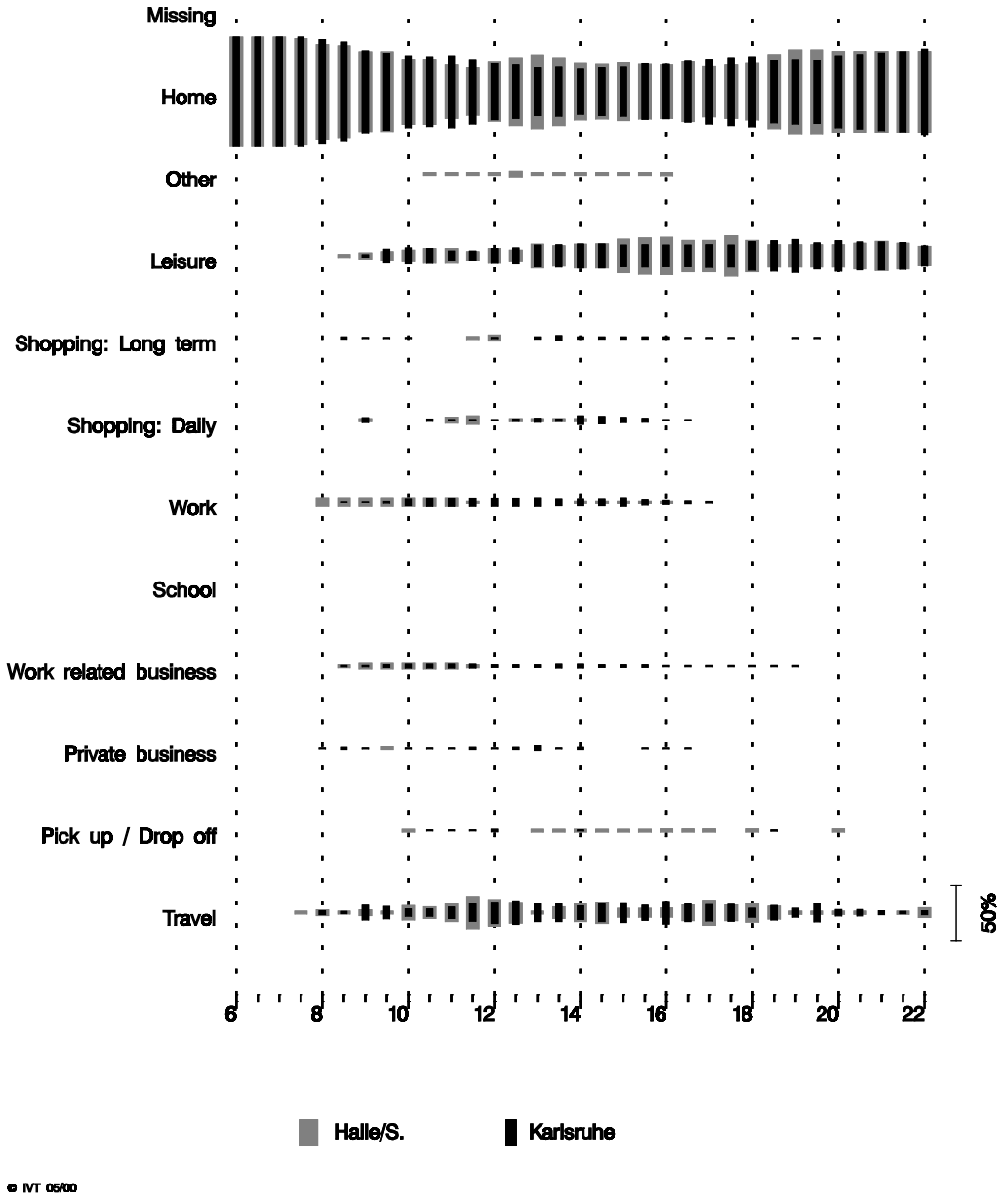


Fig. 31: Week activity engagement by time of all respondents (3 hour intervals)

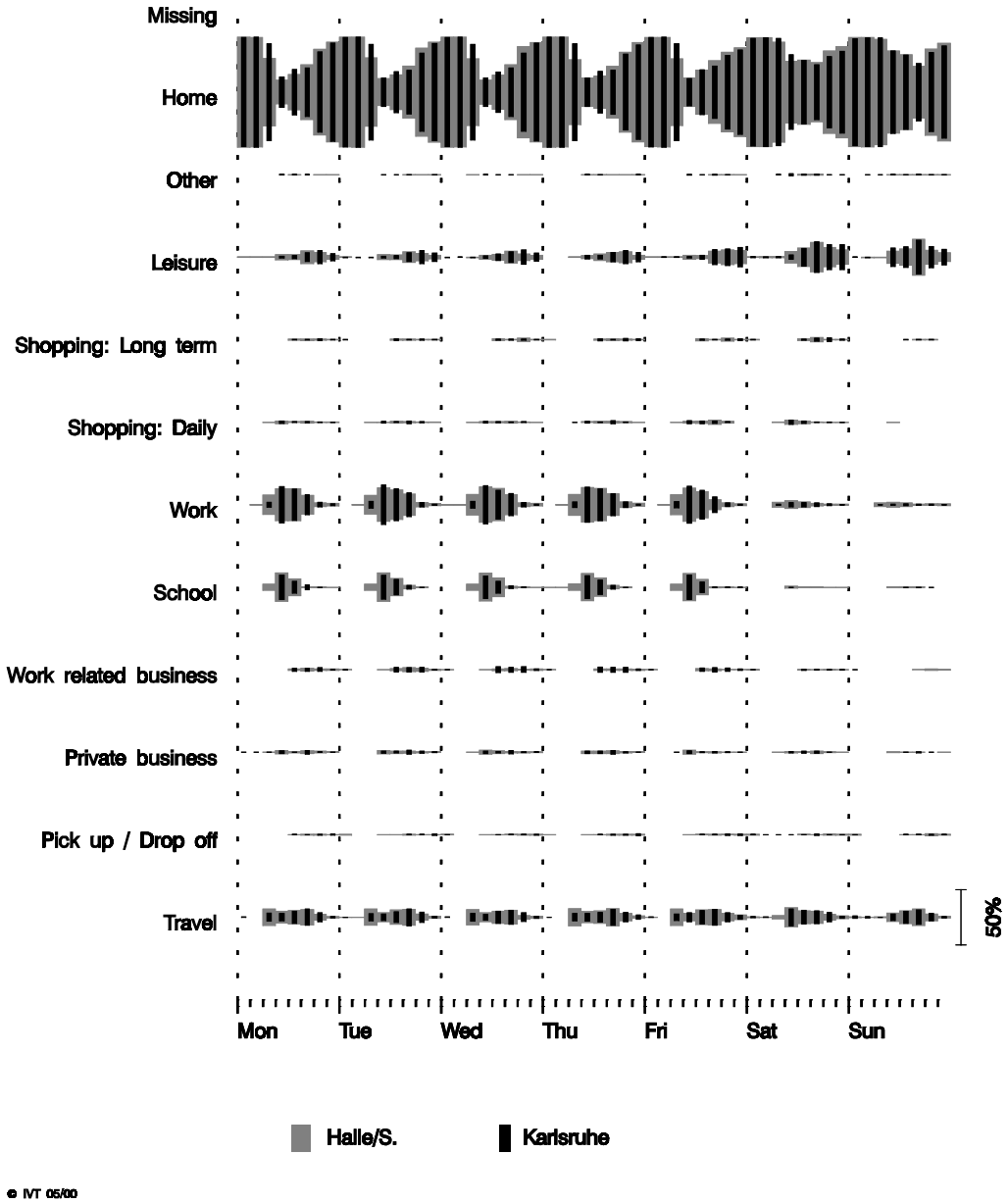


Fig. 32: Week activity engagement by time of pupils
(3 hour intervals)

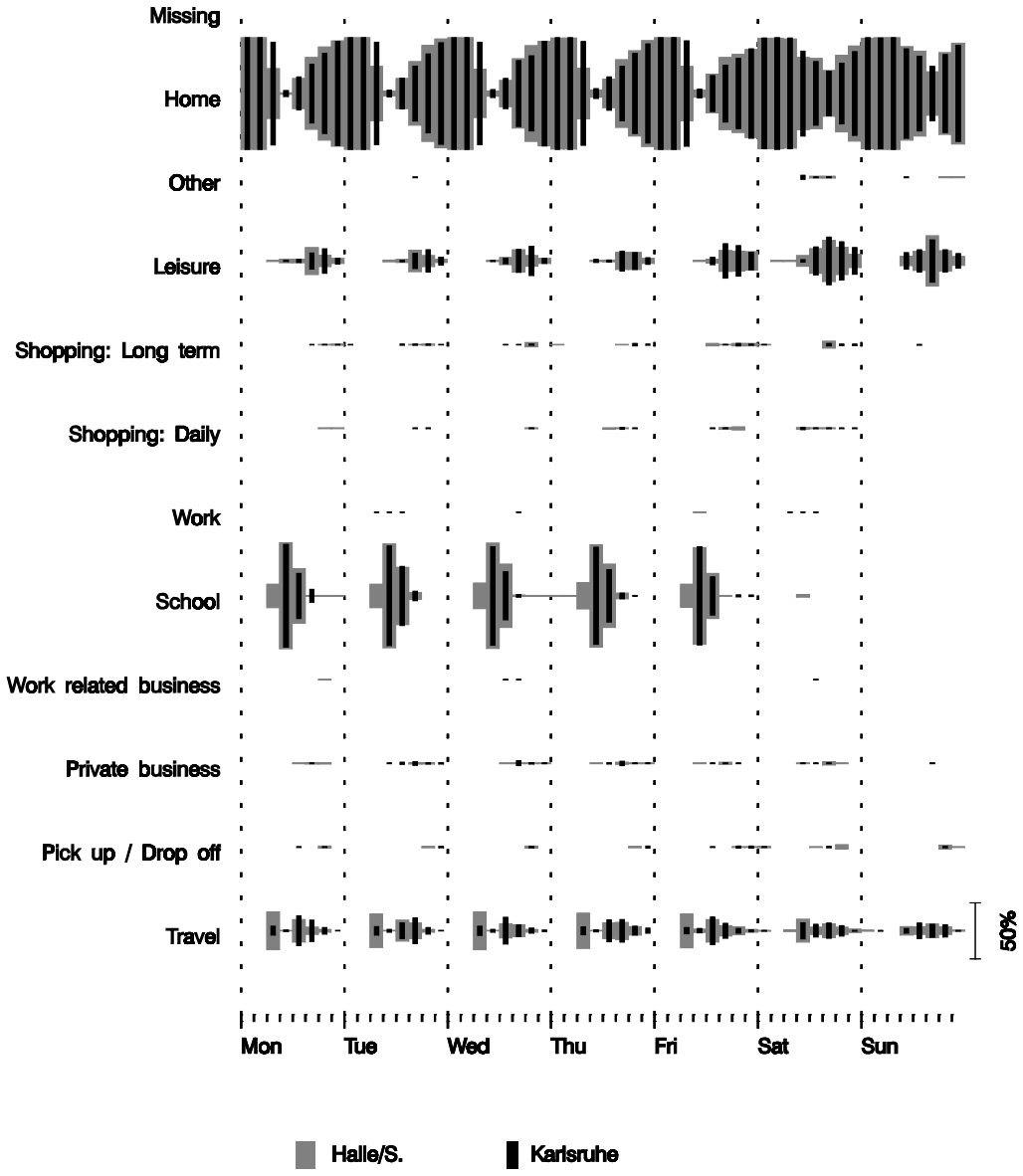


Fig. 33: Week activity engagement by time of students (3 hour intervals)

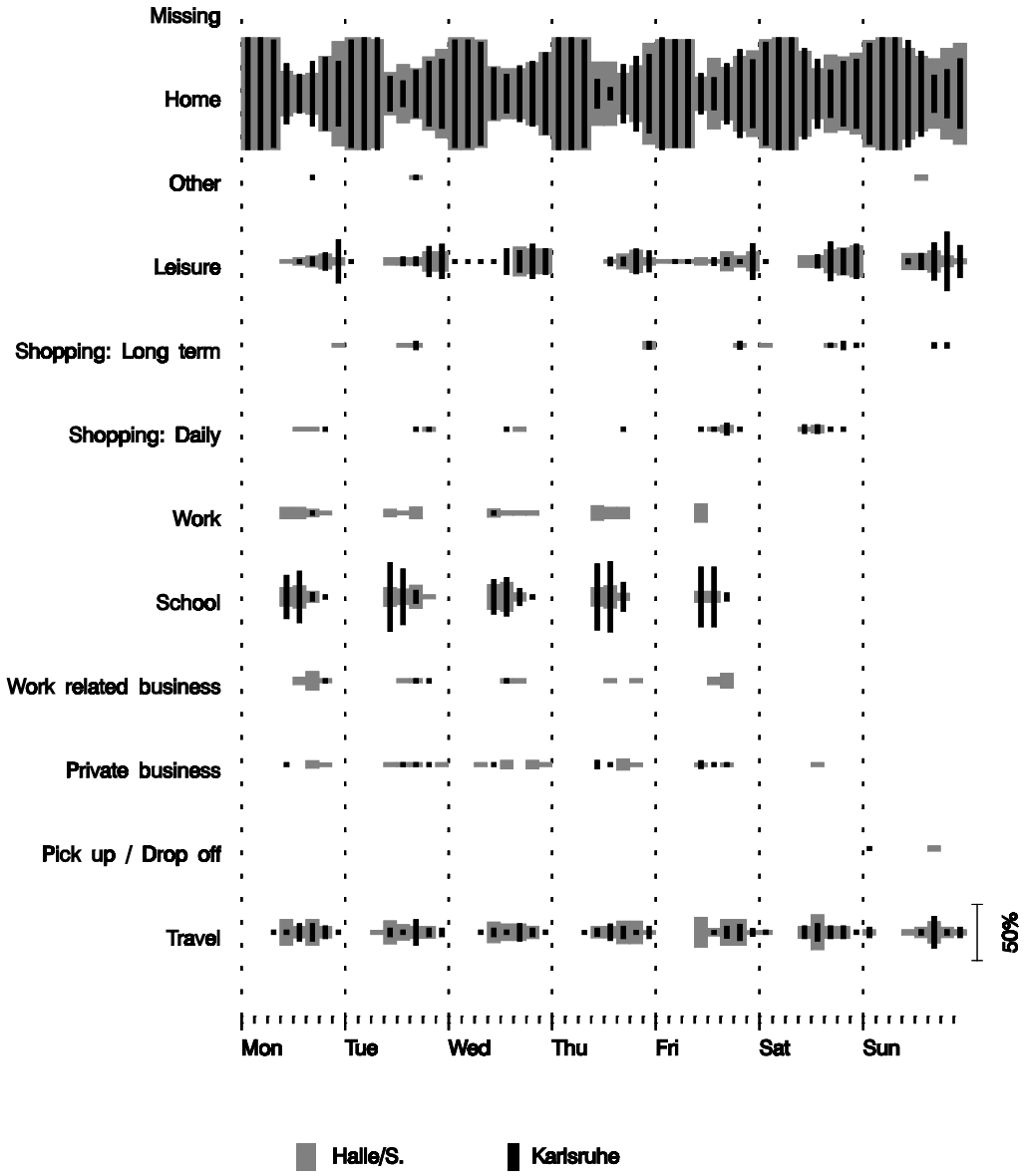


Fig. 34: Week activity engagement by time of apprentences
(3 hour intervals)

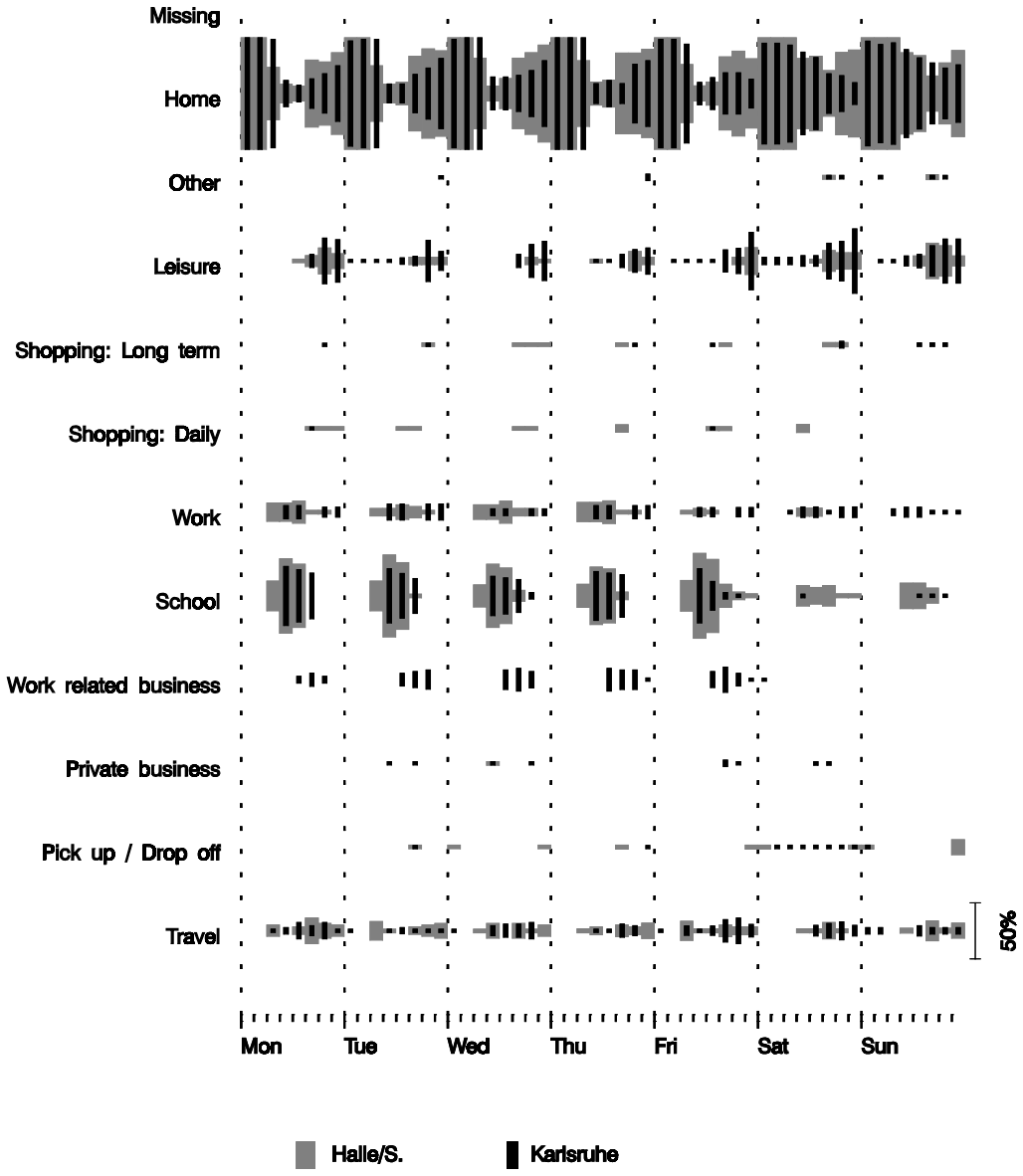


Fig. 35: Week activity engagement by time of housemakers (3 hour intervals)

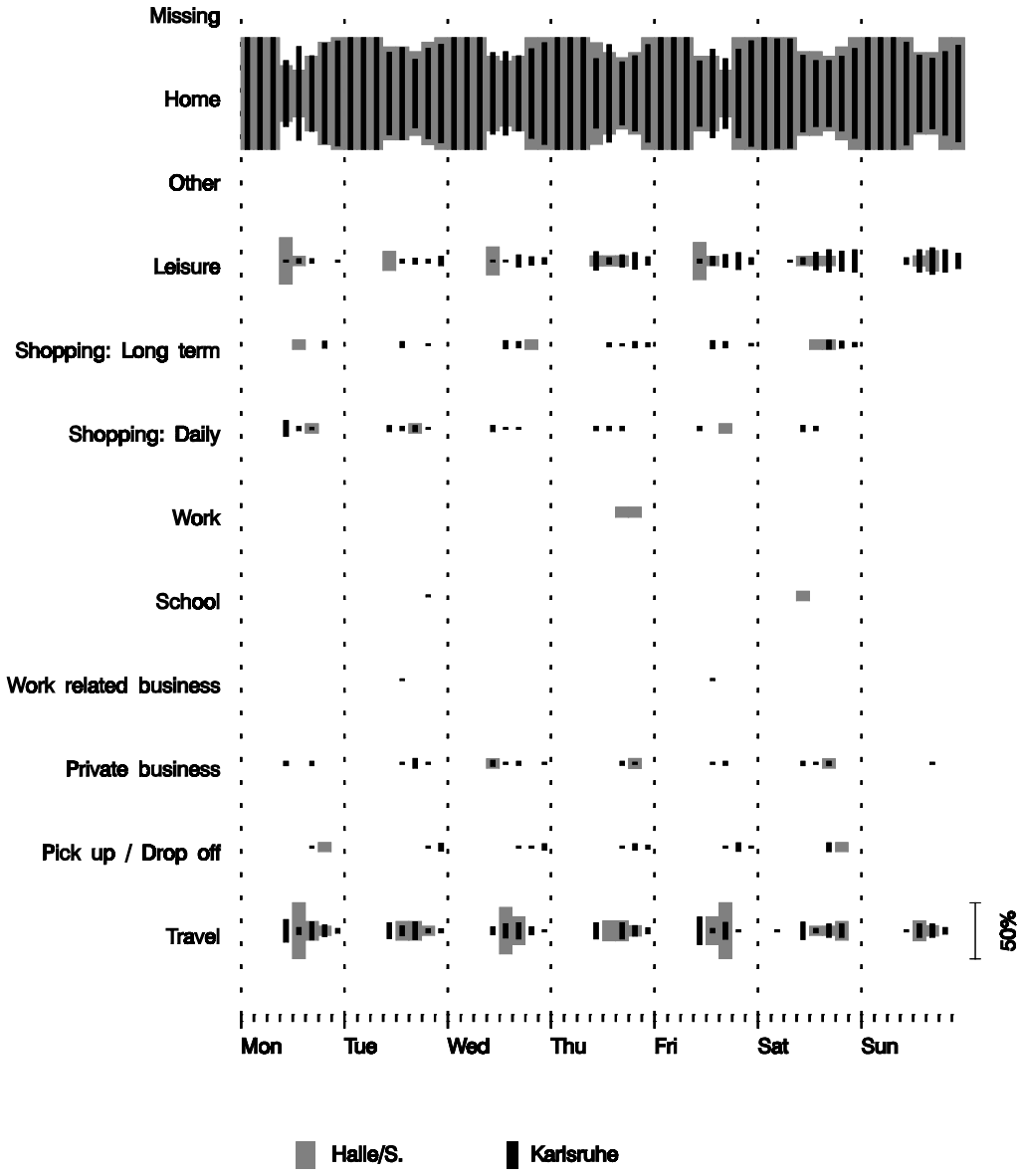


Fig. 36: Week activity engagement by time of retirees
(3 hour intervals)

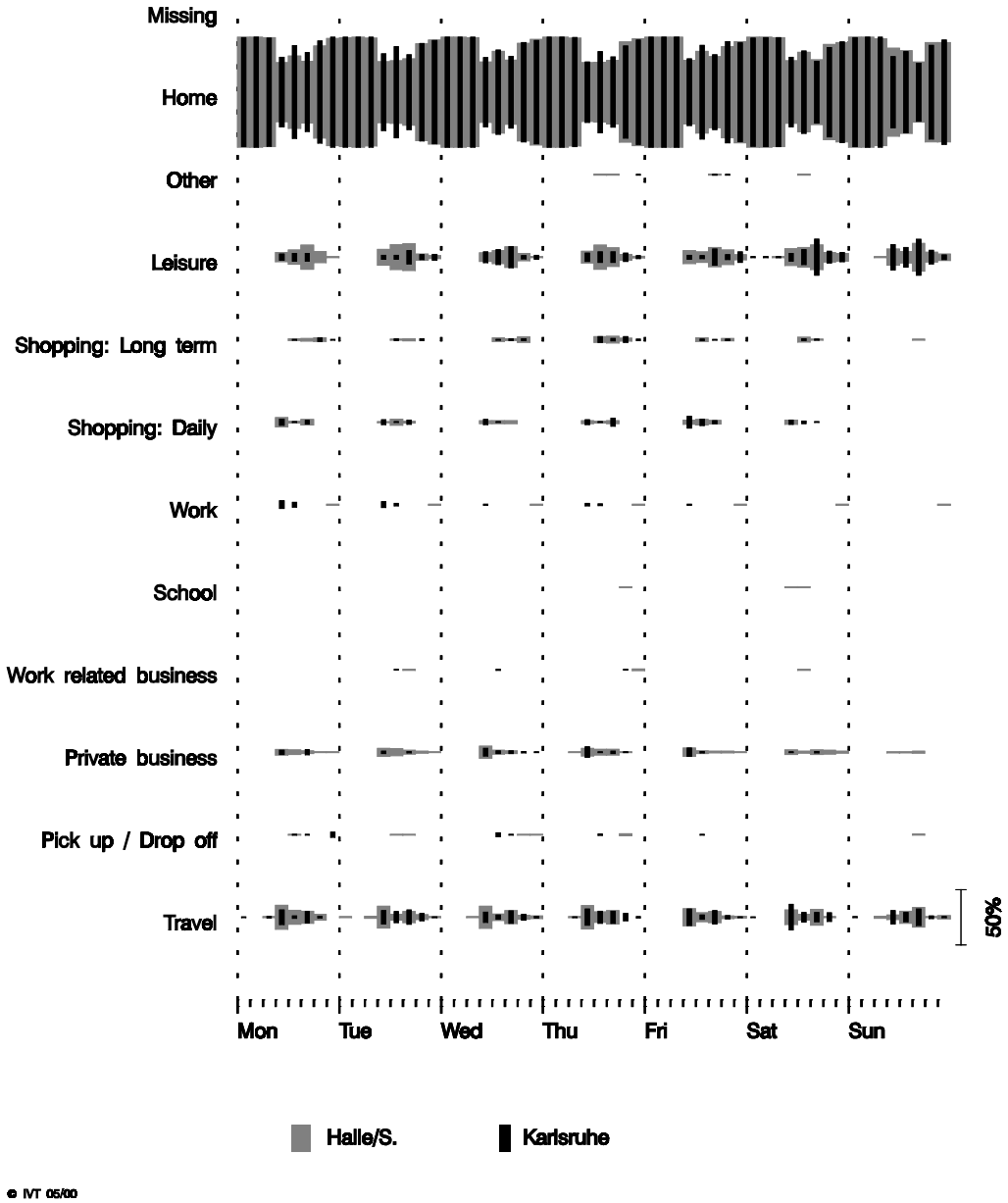


Fig. 37: Week activity engagement by time of unemployed persons (3 hour intervals)

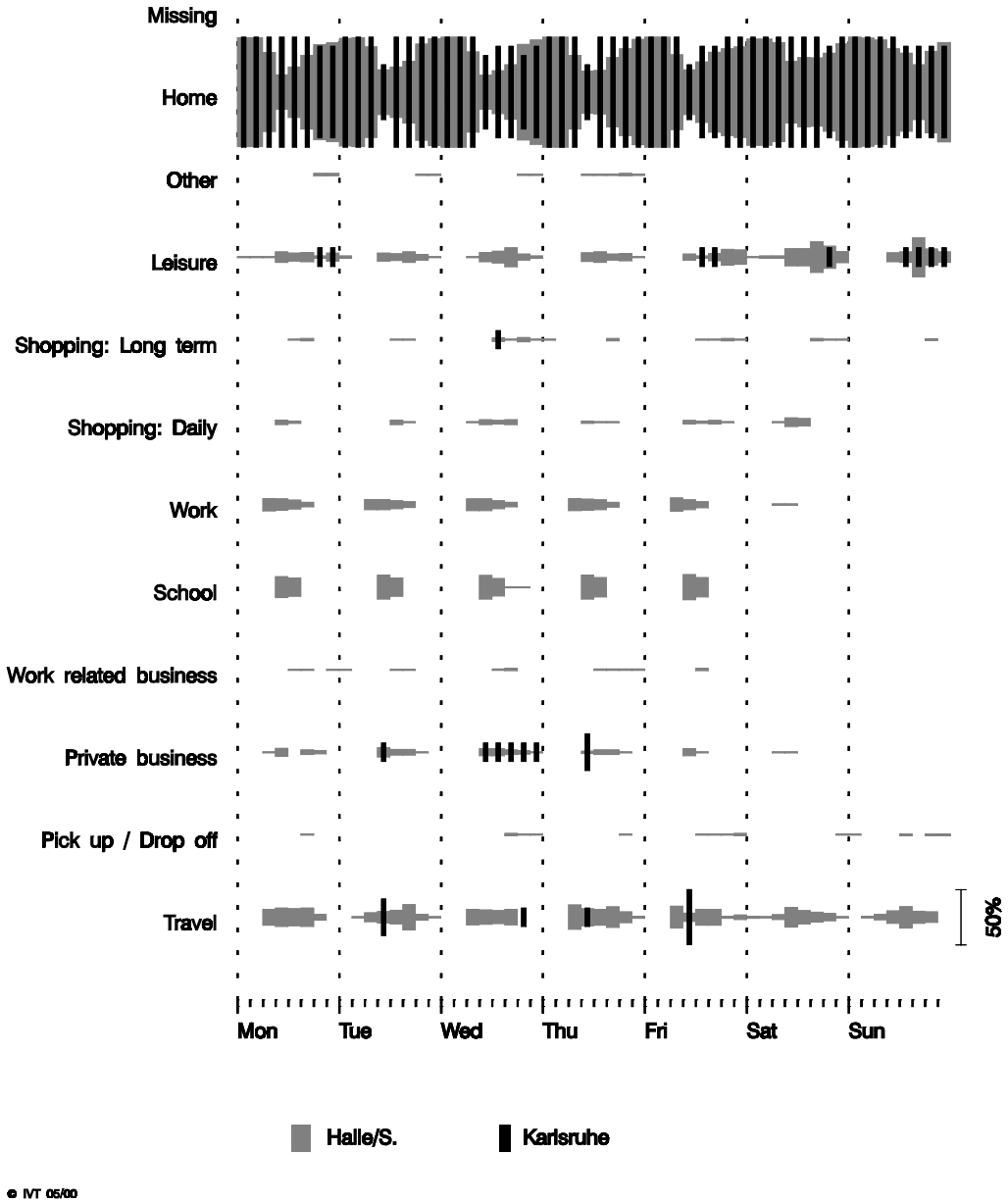


Fig. 38: Week activity engagement by time of parttime employed persons (3 hour intervals)

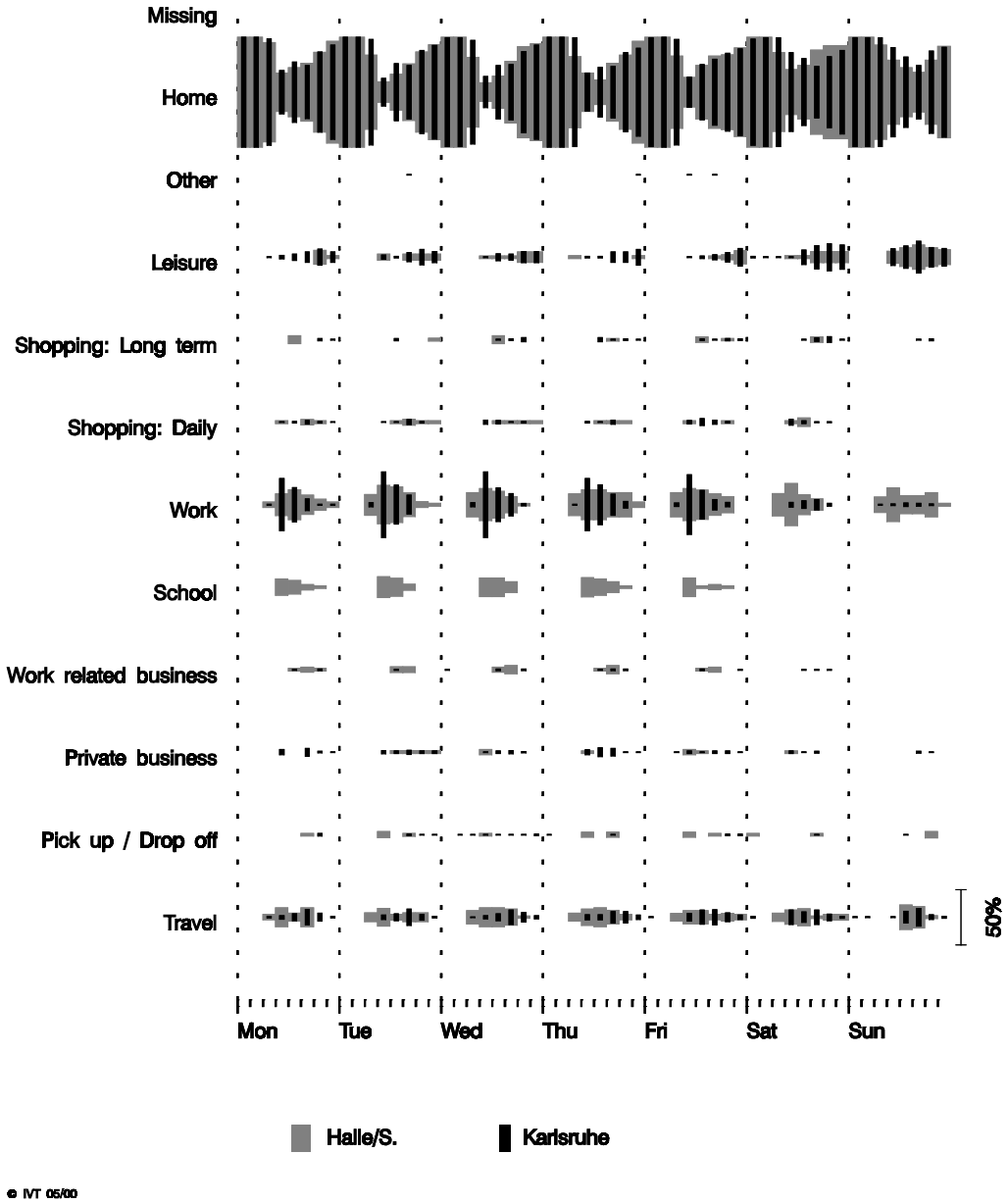


Fig. 39: Week activity engagement by time of fulltime employed persons (3 hour intervals)

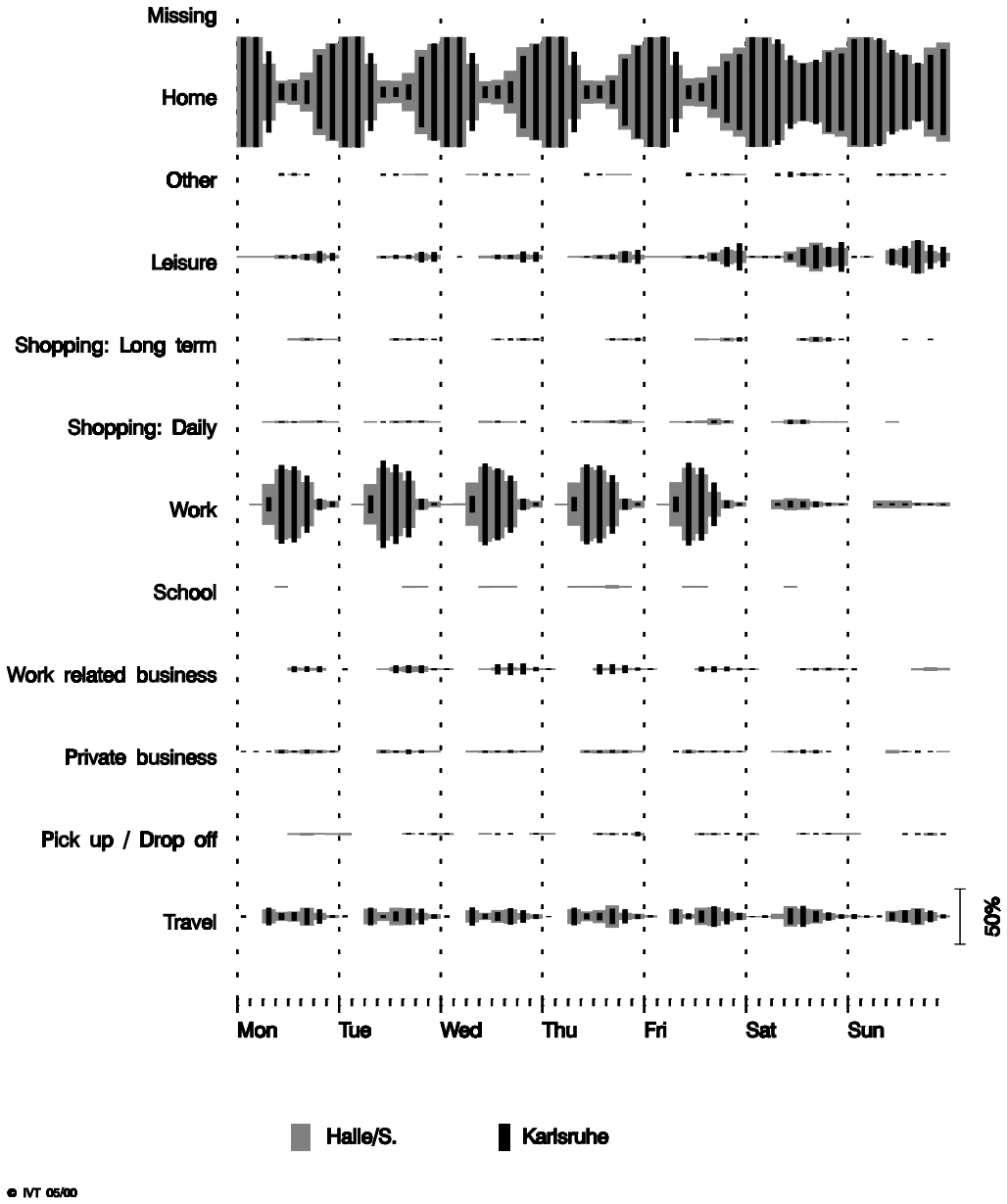


Fig. 40: Week activity engagement by time of selfemployed persons (3 hour intervals)

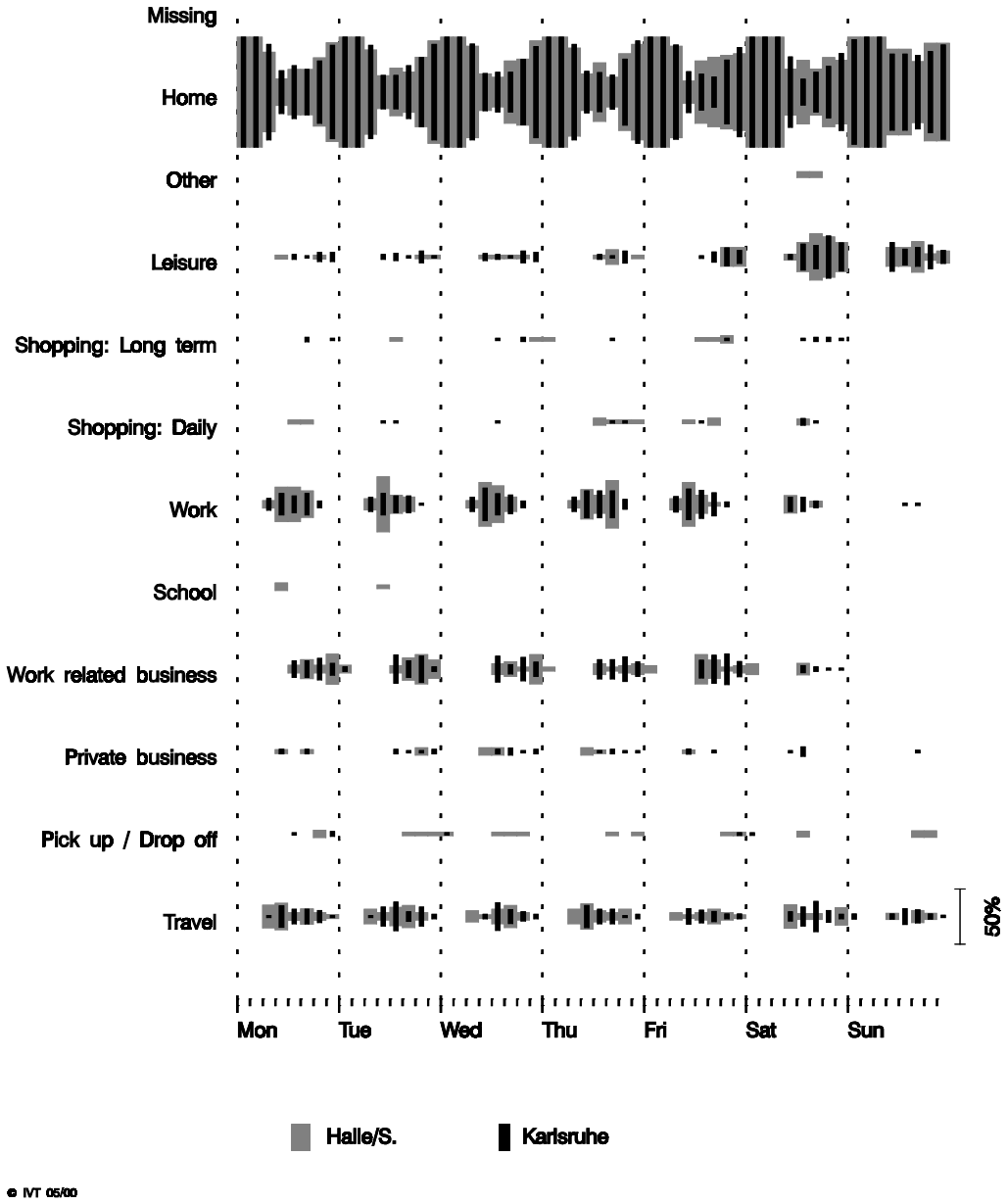


Fig. 41: Survey period activity engagement by time of all respondents (3 hour intervals)

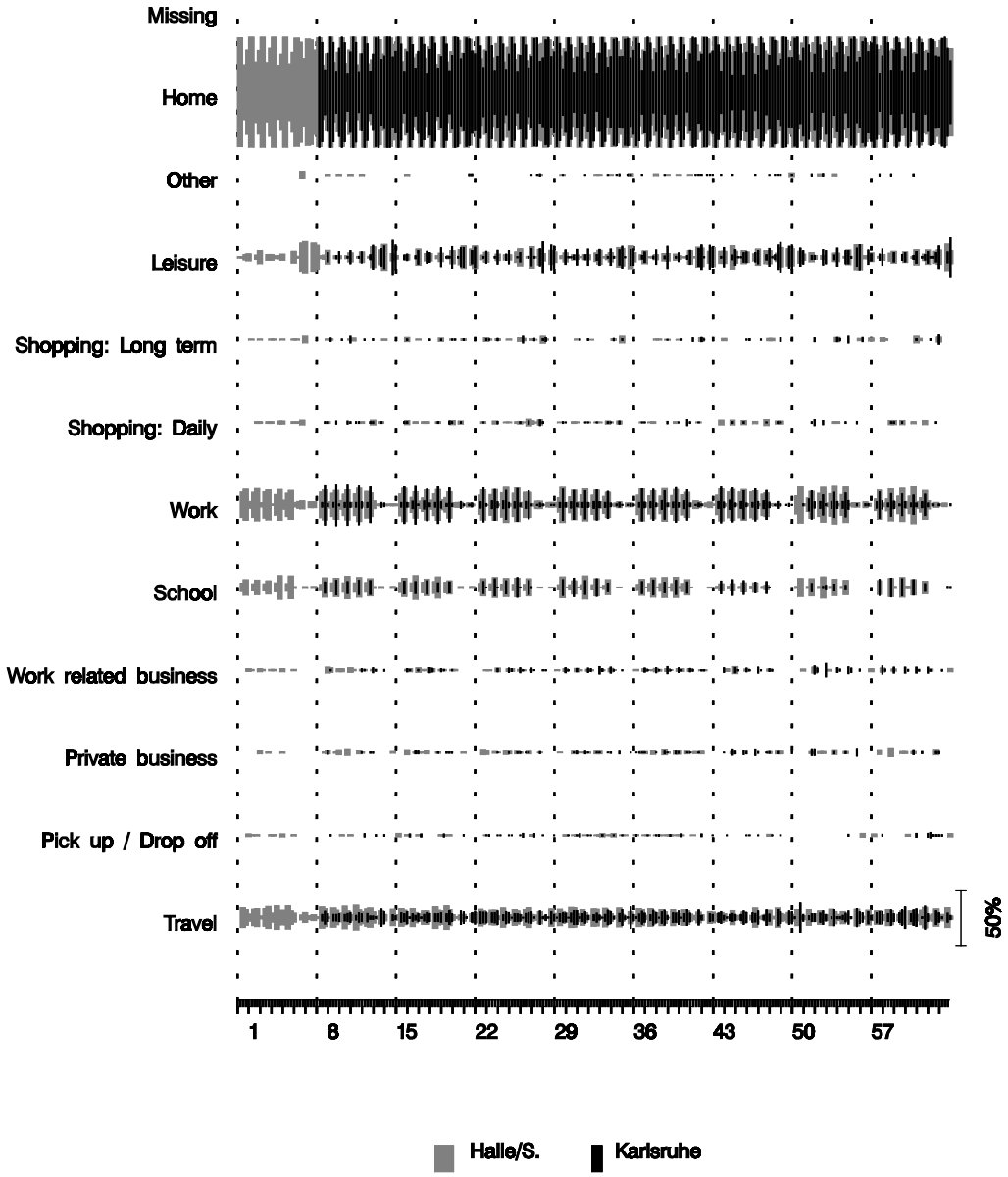


Fig. 42: Survey period activity engagement by time of pupils (3 hour intervals)

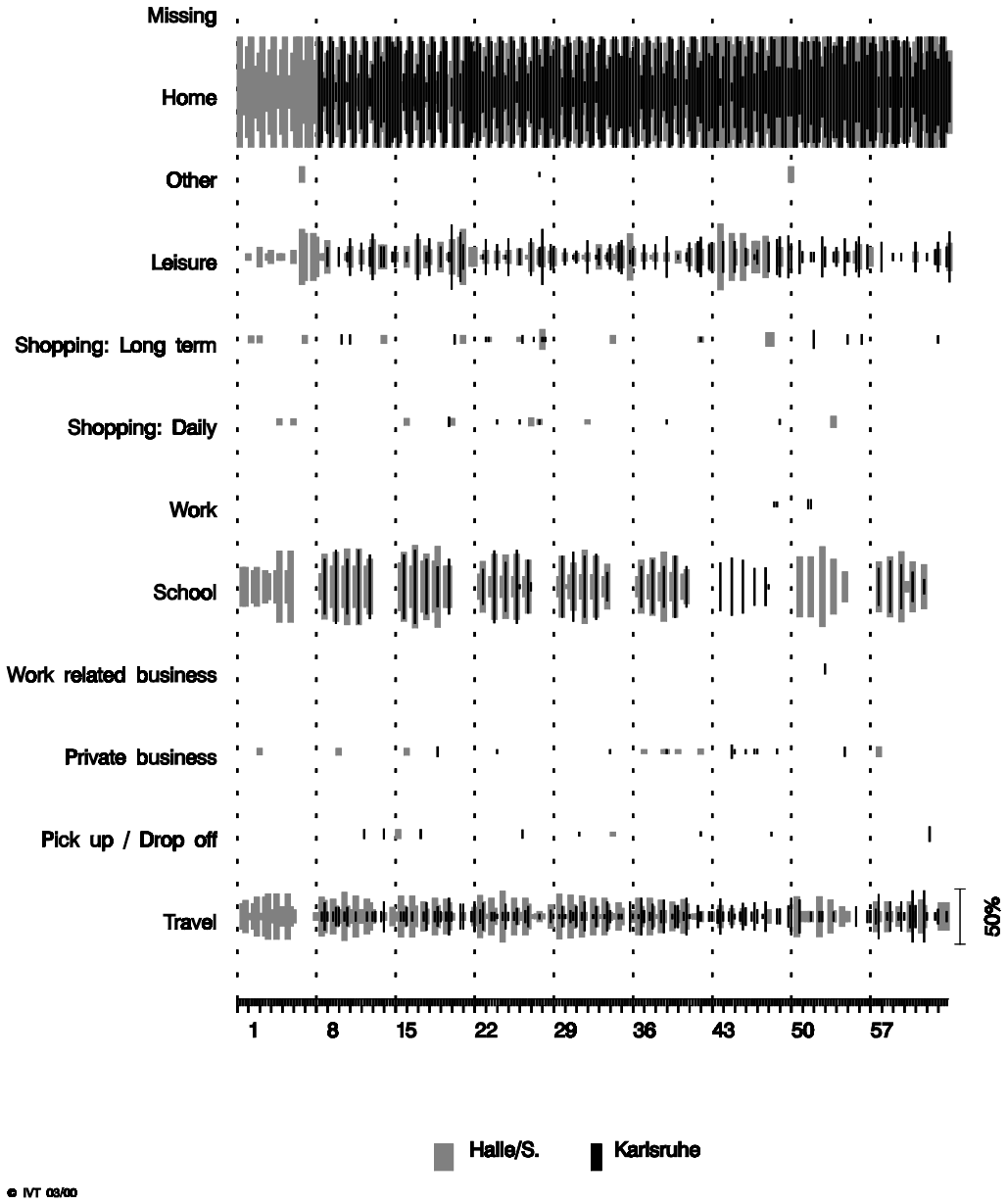


Fig. 43: Survey period activity engagement by time of students (3 hour intervals)

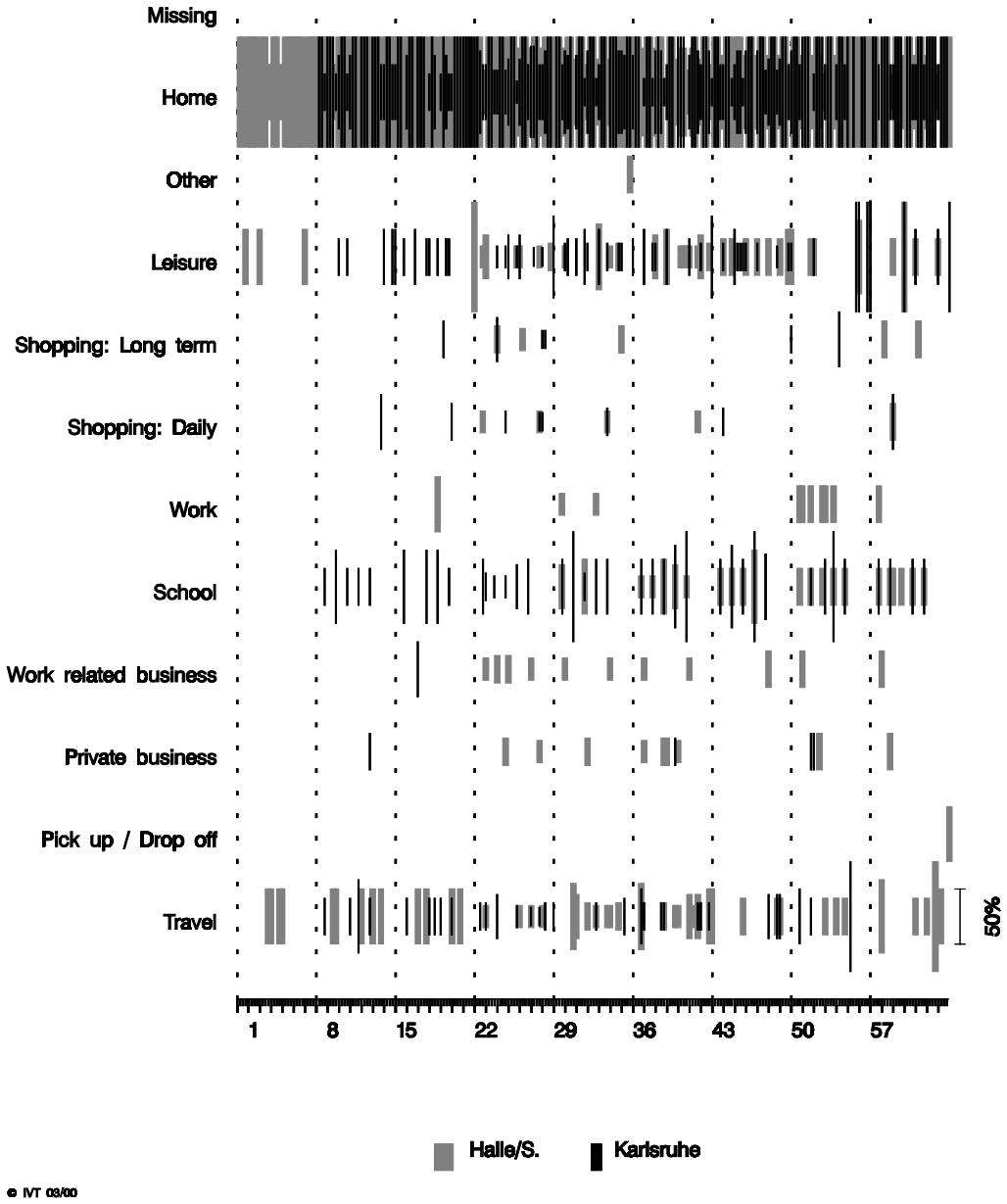


Fig. 44: Survey period activity engagement by time of apprentences (3 hour intervals)

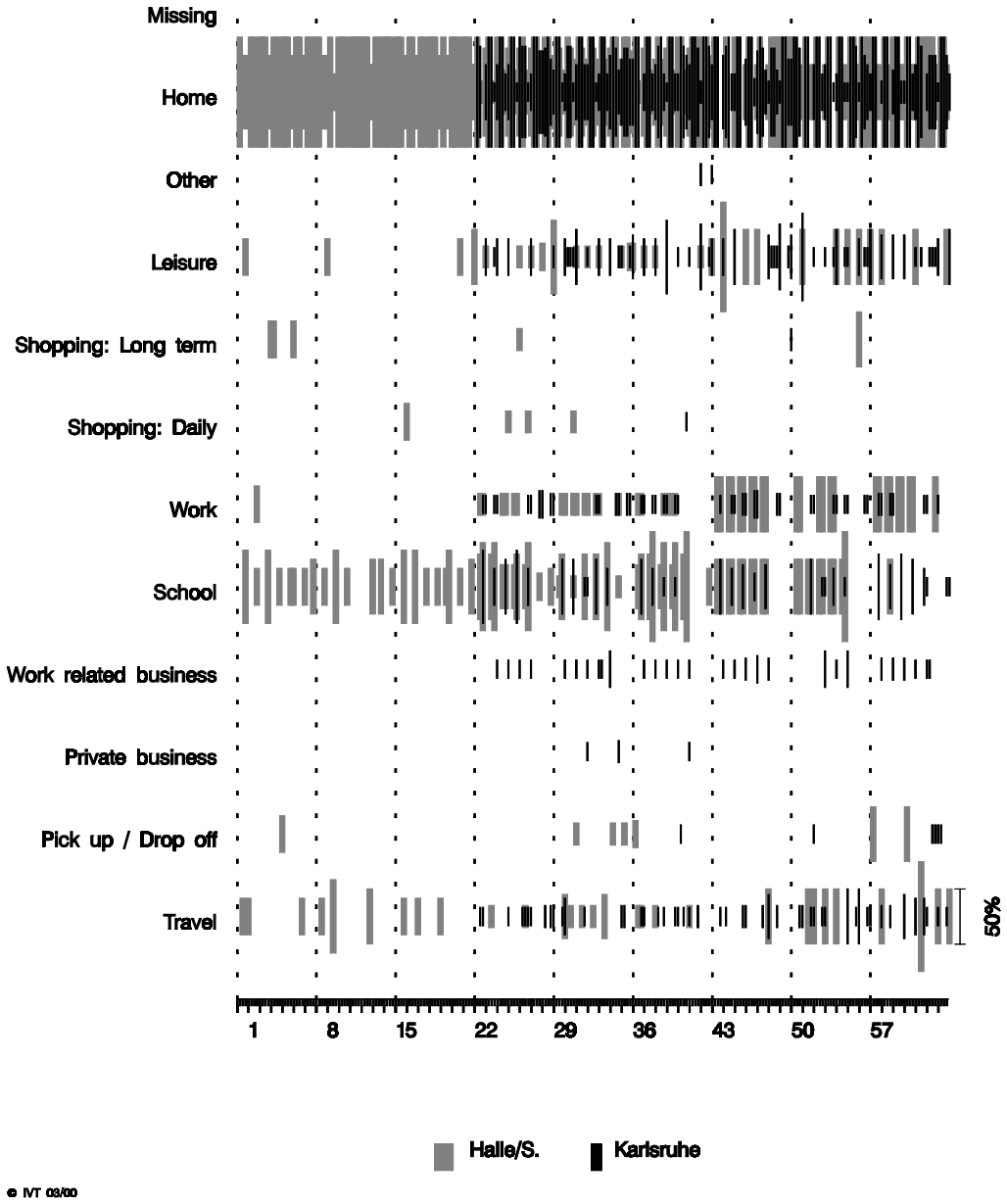


Fig. 45: Survey period activity engagement by time of housemakers (3 hour intervals)

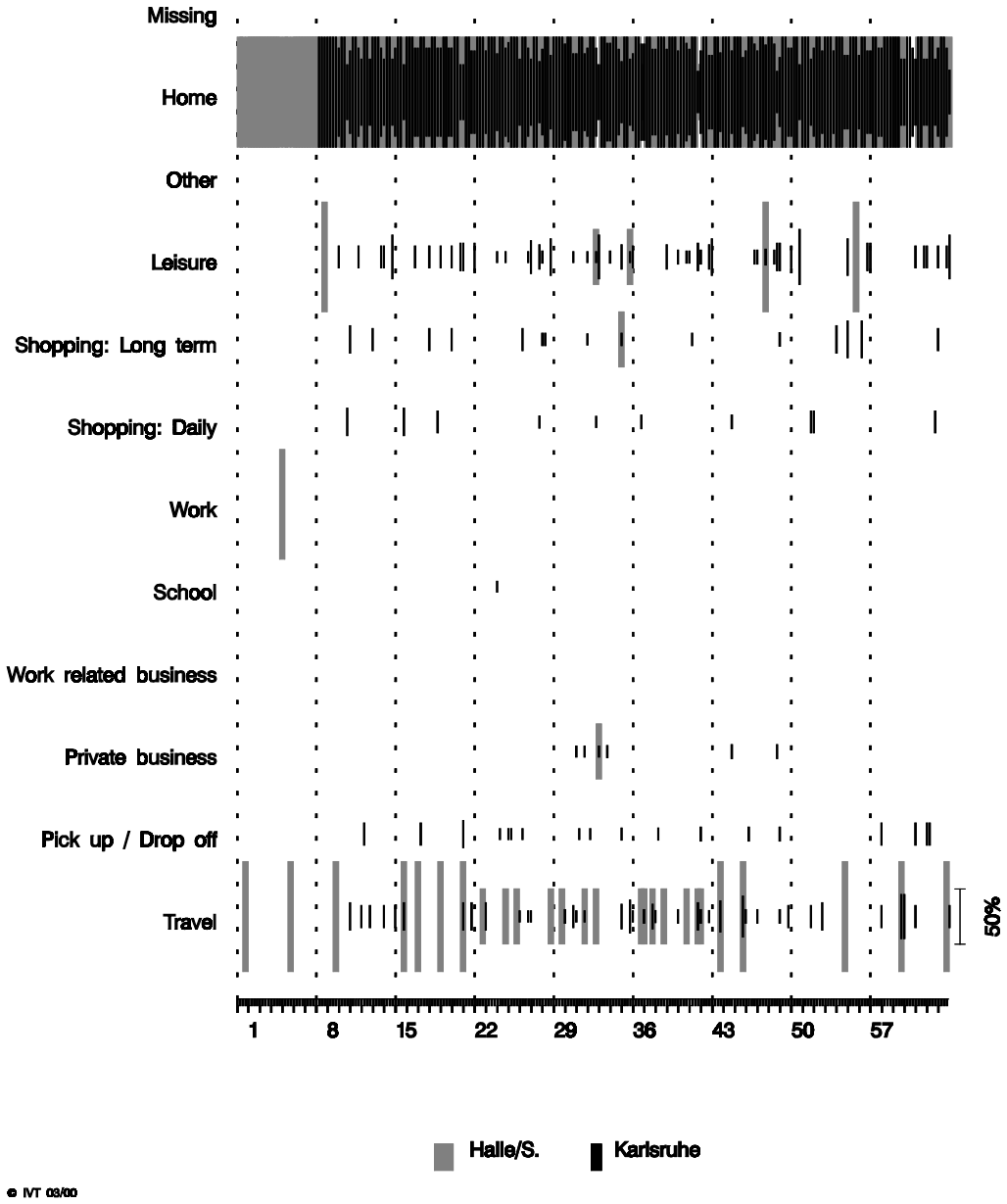


Fig. 46: Survey period activity engagement by time of retirees (3 hour intervals)

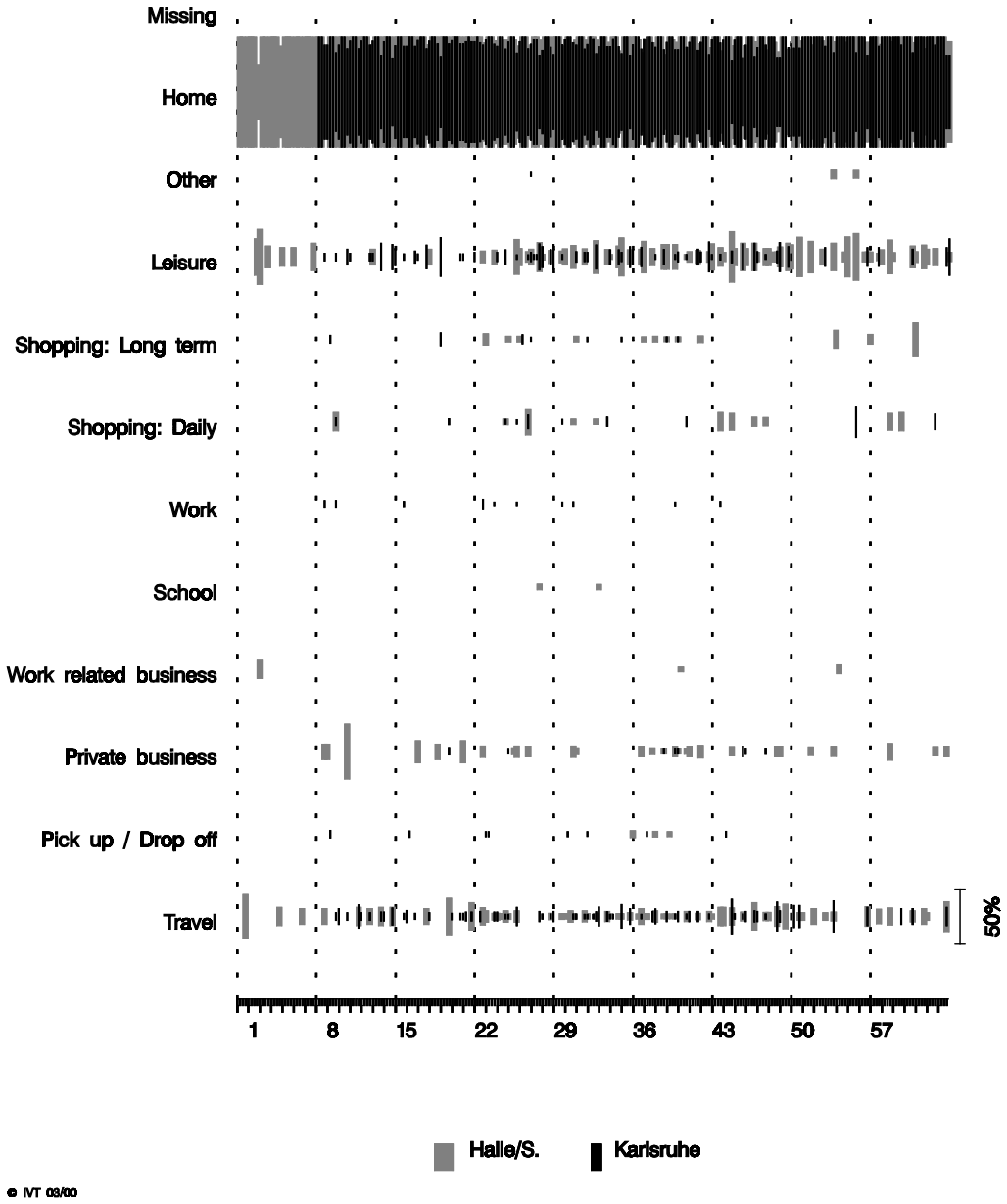


Fig. 47: Survey period activity engagement by time of unemployed persons (3 hour intervals)

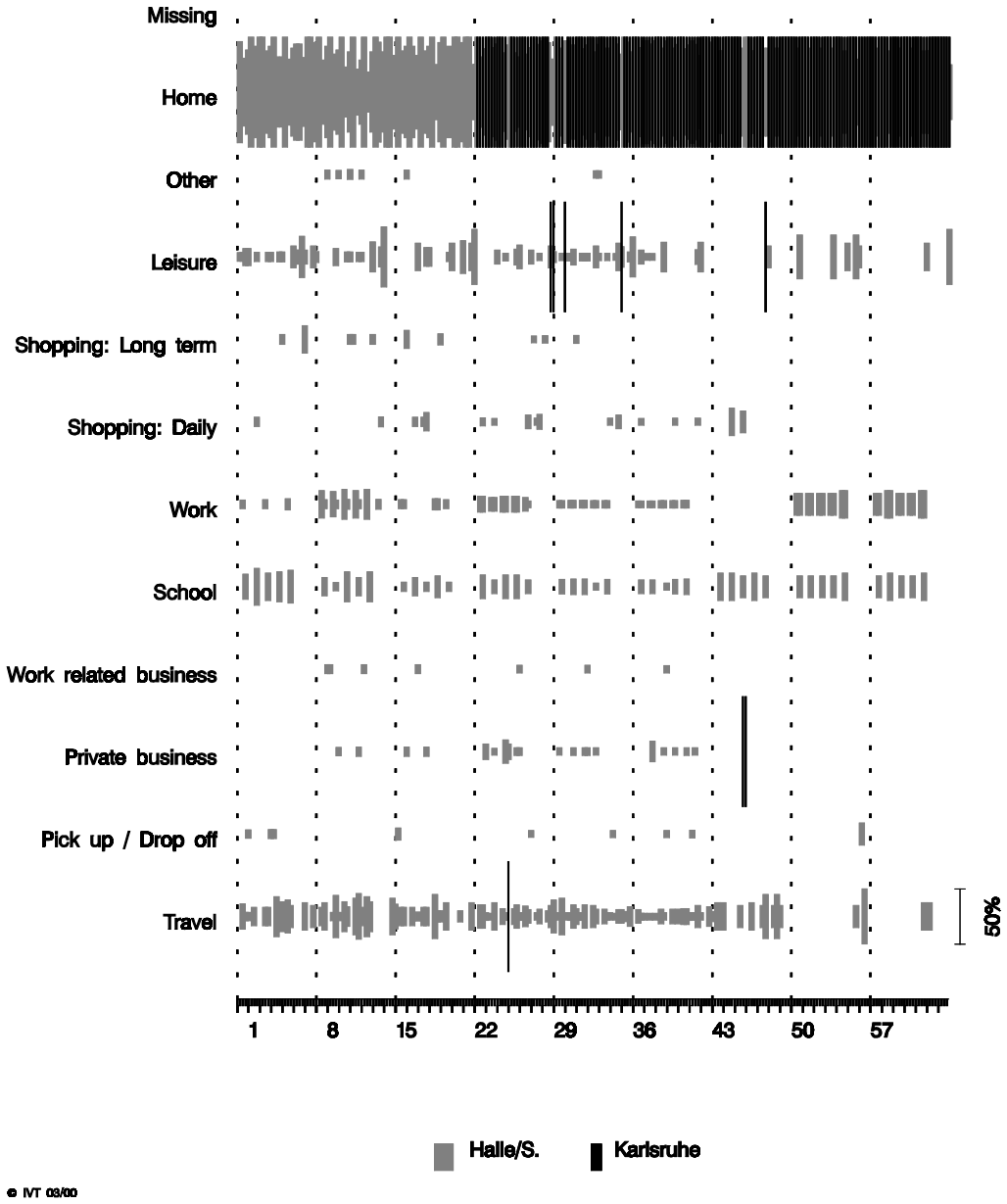


Fig. 48: Survey period activity engagement by time of parttime employed persons (3 hour intervals)

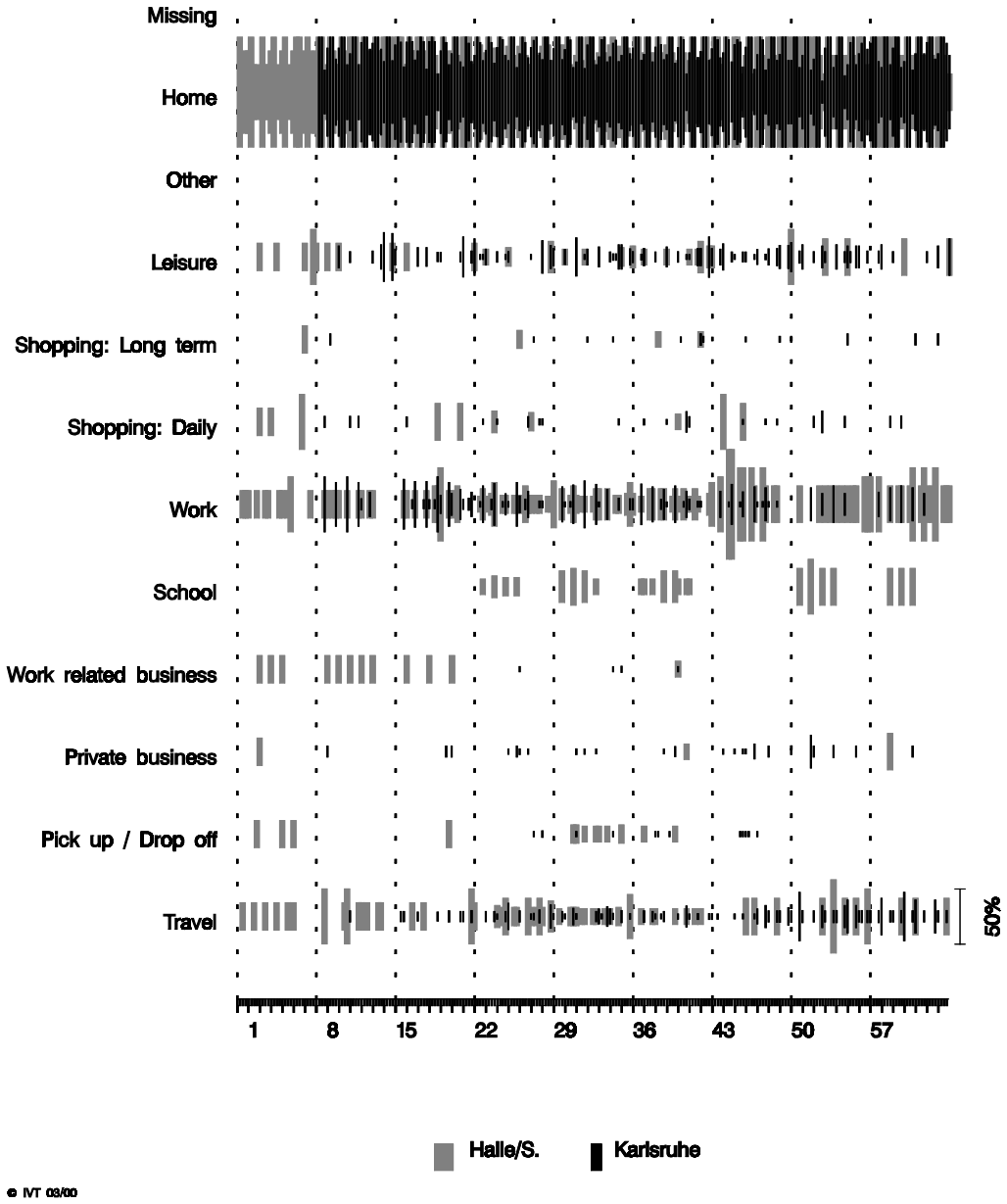


Fig. 49: Survey period activity engagement by time of fulltime employed persons (3 hour intervals)

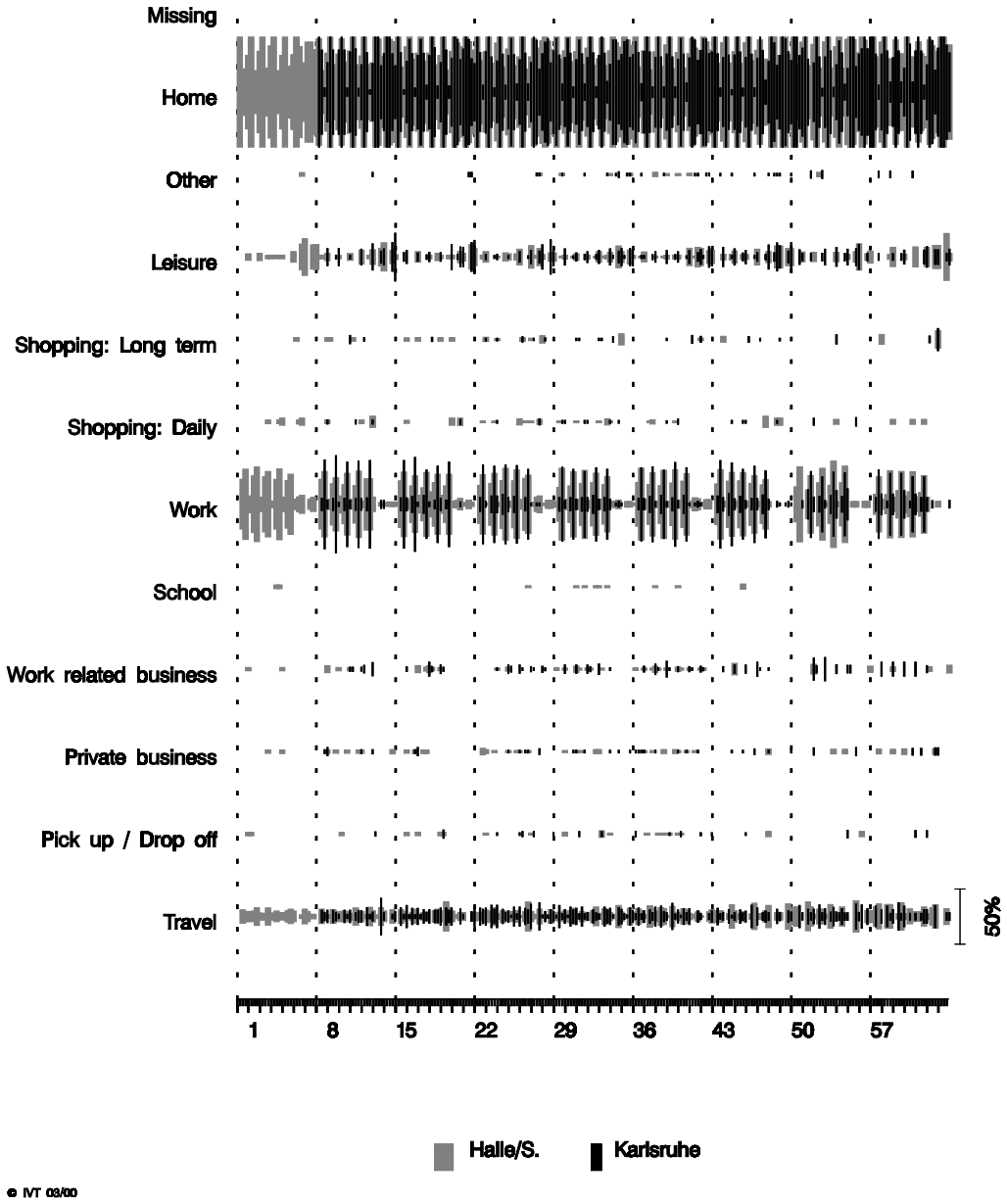
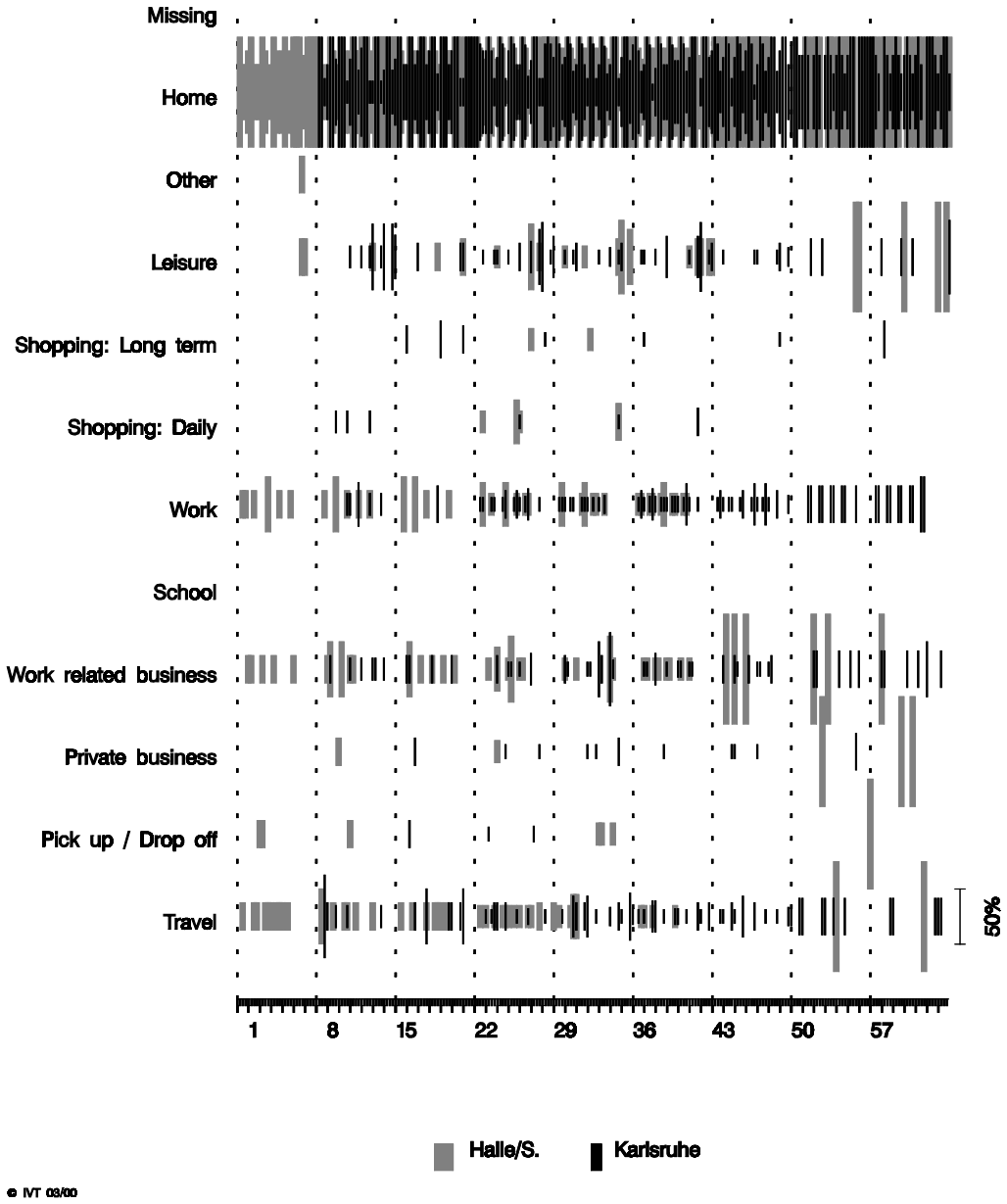


Fig. 50: Survey period activity engagement by time of selfemployed persons (3 hour intervals)



Die *Arbeitsberichte Verkehrs- und Raumplanung* dienen der schnellen Verbreitung der Ergebnisse der Arbeit der Mitarbeitenden und Gäste des Instituts. Die Verantwortung für Inhalt und Gestaltung liegt alleine bei den Autor/innen.

The *Working Papers Traffic and Spatial Planning* are intended for the quick dissamination of the results of the members and guests of the Institut. Their content is the sole responsibility of the authors.

Eine vollständige Liste der Berichte kann vom Institut angefordert werden:

A complete catalog of the papers can be obtained from:

IVT
ETH Hönggerberg
CH - 8093 Zurich

Telephon:	+41 1 633 31 05
Telefax:	+41 1 633 10 57
E-Mail:	hotz@ivt.baug.ethz.ch
WWW:	www.ivt.baug.ethz.ch

Der Katalog kann auch abgerufen werden unter:

The catalog can also be obtained from:

http://www.ivt.baug.ethz.ch/veroeffent_arbeitsbericht.html