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CHANGES IN TRAVEL MODE CHOICE: THE IMPACT OF PERIOD, COHORT, AND LIFE-COURSE EFFECTS

A comprehensive approach

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PD Dr. Joachim Scheiner
Technische Universität Dortmund
Fakultät Raumplanung
Fachgebiet Verkehrswesen und Verkehrsplanung
D-44221 Dortmund
Tel 0231/755-4822
Fax 0231/755-2269
joachim.scheiner@tu-dortmund.de

Changes in travel mode choice: the impact of period, cohort, and life-course effects
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Zusammenfassung: Dieses Arbeitspapier untersucht Veränderungen der individuellen Verkehrsmittelwahl von einem Jahr zum nächsten. Es stützt sich auf drei unterschiedliche Forschungsstränge: Veränderungen des Verkehrsverhaltens, Mobilitätsbiografien und Kohortenanalysen. Als Datengrundlage dient das Deutsche Mobilitätspanel 1994-2008, in dem Haushalte und ihre Mitglieder drei mal in drei aufeinander folgenden Jahren ihre Wege über eine Woche hinweg berichten. Die berichteten Veränderungen werden in Regressionsanalysen auf den Einfluss von Schlüsselereignissen im Lebenslauf, Kohorteneffekten und Periodeneffekten untersucht. Dabei werden soziodemografische und räumliche Variablen kontrolliert. Da aufgrund der Panelstruktur der Daten die Unabhängigkeit der Beobachtungen nicht gegeben ist, wird ein cluster-robuster Regressionsansatz gewählt. OLS-Regressionen werden zum Vergleich ebenfalls geschätzt. Die Ergebnisse zeigen die Robustheit der OLS-Regressionen, denn je zwei Modelle mit dem gleichen Set an Variablen sind für die beiden Schätzmethoden extrem ähnlich. Inhaltlich zeigen die Ergebnisse, dass sich hinter der Stabilität der Verkehrsmittelwahl im Aggregat 'unter der Oberfläche' viel verändert, ausgelöst durch Veränderungen im Lebenslauf, individuelle und haushaltsbezogene soziodemografische Merkmale, und den räumlichen Kontext. Die Veränderungen, die durch Schlüsselereignisse im Lebenslauf ausgelöst werden, stützen den Ansatz der Mobilitätsbiografien. Allerdings legen verschiedene signifikante Effekte von Zustandsvariablen nahe, dass die Verkehrsmittelwahl sich auch ohne solche Schlüsselereignisse verändern kann. Das Arbeitspapier dient der Vorbereitung von geschlechtsspezifischen Analysen von Veränderungen des Verkehrsverhaltens.

Summary: This paper studies changes in people's travel mode choice from one year to the next. It is informed by three distinct discourses: travel behaviour change, the mobility biographies approach, and cohort analysis. The data used is the German Mobility Panel (GMP) 1994 to 2008 in which households and their members are asked three times in three subsequent years to report the trips they made over a week. The changes reported are regressed to key events over the life course, cohort effects and period effects, while various sociodemographic and spatial attributes are controlled. Due to the non-independent nature of panel observation, a cluster robust regression approach is used. OLS regressions are estimated for comparison. The results suggest considerable robustness of OLS regression, as each two models including the same set of variables are extremely similar, no matter which estimation method has been used. The findings suggest that behind the aggregate stability in travel mode choice over time there is much change 'under the surface', induced by life course changes, individual and household sociodemographic, and spatial context. The changes found induced by life course related key events favour the notion of mobility biographies. However, various significant effects of baseline variables suggest that mode choice may change even without any key event. The paper serves the preparation of gendered analysis of travel behaviour changes.

1 Introduction

Changes in individual travel behaviour have become a major field of research in transportation studies in recent years (Ampt, 2003, Cao et al., 2007b; Ker, 2008). Such changes may occur on a day-to-day basis (Pendyala, 2003) or in the longer term. In the latter case they have been linked to people's life courses and conceptualised as being triggered by key events in an individual's mobility biography (Lanzendorf, 2003; Scheiner, 2003). However, behavioural changes in the long term may not just be part of individual mobility biographies, but also of collective cohort and/or period related changes, in which individual life courses are embedded.

This paper studies changes in people's travel mode choice from one year to the next. The data used is the German Mobility Panel (GMP) 1994 to 2008 in which households and their members are asked three times in three subsequent years to report the trips they made over a week. The changes reported are regressed to key events over the life course, cohort effects and period effects, while various sociodemographic and spatial attributes are controlled.

This research is informed by three distinct discourses: behavioural change, the mobility biographies approach, and cohort analysis. In the next section the state of the research is introduced. Subsequently, the data and the methodology are described, followed by the results. The paper finishes with an outlook to further research.

2 Travel behaviour change – state of the research

Travel behaviour change has long been (relatively) neglected in research, even though time geography recognised the usefulness of the life path concept for travel studies as early as the 1970s (Hägerstrand, 1975). In an early study on the dynamics of travel behaviour, Clarke et al. (1982) distinguished between three levels of dynamics: first, short-term microdynamics, capturing people's 24 h daily activity/travel choices (see for an overview on day-to-day variability of travel Pendyala, 2003); second, macrodynamic modifiers, addressing behavioural responses to transitions and trigger events over a period of some years; third, macrodynamic processes over a

lifespan which are related to aging, life-cycle stages and cohort membership.

More recently, a first line of research has emerged in this context that investigates travel behaviour changes triggered by temporary interventions which aim either to break habits and make choices more deliberate, or to change actual behaviour, or both. Studies are typically either based on awareness raising concepts, e.g. by making participants reflect their travel schedules or by providing information on alternatives to the car (Garvill et al., 2003; Kenyon and Lyons, 2003), or on the provision of free public transport (PT) tickets to drivers (Fujii and Kitamura, 2003), or both (Bamberg et al., 2003). One notable study examined a somewhat different form of intervention: the temporary closure of a major road in Japan. Fujii et al. (2001) found that this event raised awareness for alternatives to the car. In a follow-up survey Fujii and Gärling (2003) found that those who changed from driving to PT during the road closure continued one year later to use PT more frequently than those who did not swap.

Studying behavioural changes is key to effective travel demand management as it may help clarify the triggers that make individuals re-evaluate their habits and possibly change their behaviour. In addition, such studies can help identify the population groups that are most resistant to change in order to effectively target others who are less resistant.

Such structural interventions may well be understood as key events in an individual's life. The focus in the related research is, however, not so much on life course related events, but on the effects of policy measures or other incentives on travel.

A second strand of research in this context is the mobility biography approach. This perspective focuses on changes in travel behaviour that are associated with key events and/or 'biographical processes' over the life course (Lanzendorf, 2003; Scheiner, 2003; Van der Waerden et al., 2003; Klöckner, 2004; Axhausen et al., 2006; Harms, 2007; Scheiner, 2007)[1]. Key events that have been identified as transport relevant in these studies can be categorised into three life domains:

- household and family biography: leaving the parental home, formation of a household with a partner/founding a family, birth of children, divorce, children moving out (Goodwin, 1989; Zwerts et al., 2007, Lanzendorf 2010);
- employment biography: commencement of job training or university entry, entry into the labour market (Harms, 2007), change of job or education, income changes (Dargay, 2001; Dargay and Hanly, 2007), retirement (Ottmann, 2007);
- residential biography: residential move and associated changes in spatial context (Holz-Rau, 2000; Bagley and Mokhtarian, 2002; Krizek, 2003; Stanbridge et al., 2004; Scheiner, 2005a and 2005b; Axhausen et al., 2006; Dargay and Hanly, 2007; Cao et al., 2007a; Aditjandra et al., 2009).

Some commentators treat gaining a driving license or the purchase or disposal of a car as key events that may affect mobility biographies. However, a note on causality is warranted here. As these key events imply pre-decisions that can be interpreted as a form of 'self-commitment' with respect to travel mode choice (Simma and Axhausen, 2001) they may be regarded as parts of the mobility biography rather than as determinants.

Processes of learning and ageing may not always be induced by temporally fixed key events, but also by experience gathered over a longer period. For instance, there is ongoing debate in transport psychology and sociology about the effect of socialisation in childhood and adolescence on adult travel behaviour (Baslington, 2007; Klöpper and Weber, 2007). Travel behaviour may be partially shaped by learning processes through which behaviour is transferred from parents, school or other key institutions to children, and this behaviour may then be continued in later life. Haustein et al. (2009) recently established some empirical evidence for this. A second example for such longer-term processes is the distinction made between the 'young old' and the 'old old' in gerontology (Rosenbloom and Ståhl, 2002). Becoming an 'old old' does not necessarily involve a distinct biographical key event (although it may be induced by a key event, such as an accident or the decease of the partner).

It has to be emphasised that the life domains, key events and experiences must not be considered in isolation. For instance, residential relocations often correspond with events in employment and household biographies, such as household formation, birth of a child or workplace change (Dieleman and Mulder, 2002). When examining the effects of changes in residential location on car purchase it is therefore necessary to closely consider related changes in the household context.

The mobility biography approach is individualist in nature, and thus tends to neglect generation specifics in biographies (for an exception see Heinickel and Dienel, 2006). For instance, out-migration and long-distance commuting are not just individual, but generation specific experiences shared among East German adults who have been part of the labour force after the German reunification in 1990. An-

[1] For an overview on biographical (or life course) approaches in sociology and psychology see Elder (1994) and Mortimer and Shanahan (2006), for biographical approaches in the field of residential relocation and migration see Pryor (1979), Clark and Withers (1999), Stovel and Bolan (2004) and Kulu (2008), for an application to tourism and long-distance travel see Frändberg (2008).

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other example is the experience of being pioneers in Mediterranean tourism destinations in the 1950s and 1960s among then young Germans families. Such collective patterns should result in cohort specific elements in mobility biographies, e.g. in cohort specific car use (Thakuriah et al., 2010).

What is more, individualist approaches tend to neglect structural circumstances that operate over and above changing circumstances on the individual level. Such structural circumstances may include changing transport prices, the introduction of new and/or faster modes (high-speed trains, aeroplanes), or welfare changes over time. Such trends should result in period-specific effects in travel.

Longitudinal studies allow for the distinction of age/life course, period, and cohort effects. It is not possible to control for all these effects simultaneously in empirical studies, as the simultaneous inclusion of age, cohort and year of observation in, say, a regression model, would result in perfect multicollinearity (e.g., information on age and cohort allows a conclusion to be made on year of observation) (Glenn, 2006). However, age per se is not an impact factor for travel behaviour, but rather a proxy for other changes that are related to age, e.g. household changes, employment changes, or declining health. Thus, one may well dispense with age as a determinant of travel as soon as other, presumably more accurate impact factors are considered.

This is where the life course events used in this paper come into play. Not only are these events assumed to be more closely related to behavioural change than age. Using life course events also serves to avoid multicollinearity with cohort and period effects.

The analysis in this paper is based on the following hypotheses:

Period effects: I expect a slight increase in car use and a decline in walking and PT use until 1999. In subsequent years, car use has been observed to stagnate or even slightly decline, while PT use has increased (BMVBS, 2010). Thus, I expect little change in car use over the period 2000 to 2008, while PT use should increase.

Cohort effects: the trends described as period effects may vary by cohort. We do not know much in detail about such variation, but recent research suggests that car use may decline particularly among young adults (Kuhnimhof et al., 2011). As the period of observation is limited to 1994-2008 and thus does not cover a person's full lifespan, cohort effects may reflect age effects to a certain extent. I thus expect car use to increase in the younger cohorts who are just about to enter the labour force, but decrease in the older cohorts. In order to detect age v. cohort effects, models including age, but excluding cohort are estimated for comparison.

Key events: Some studies on the effects of key events work with specific target groups, such as movers (Scheiner, 2009) or young parents (Lanzendorf, 2010) without considering control groups. In this study I work with panel data which are not limited to a certain target group. This permits to test the effects of life course events not just in terms of the significance of change over time, but also in terms of significance against those individuals who do not experience this event and who, thus, serve as a control group. No significant change is expected for the latter. All significant effects of life course events on mode choice change provide evidence that life course changes induce *more* change in travel mode choice than what would happen anyway. The changes are expected to differ by type of event, and they are specified below (section 3.5).

3 Methodology

3.1 Data

The data used is the German Mobility Panel (GMP) 1994 to 2008[2]. The GMP is a household survey with the sample organised in overlapping waves. Every household is surveyed three times over a period of three consecutive years (Chlond and Kuhnimhof, 2005). A trip diary is used to collect information on trips over a whole week from all household members aged ten years or over. Sociodemographic attributes for the household and its members are collected as well as spatial context attributes at the residence and at the household members' places of work or education.

Changes observed from one year to the next may be due to the random character of the report periods. However, given the relatively long report period of a week, this should not be a serious concern. The results reported by Schad et al. (2001) indicate a high degree of stability in travel mode use over a week. Changes observed from one year to the next may thus be considered relatively reliable.

An important limitation is the lack of information on personal income, as is typically the case in travel surveys. Even information on household income has only been available since 2002. Income is thus excluded from the analysis, rendering it impossible to investigate the effect of income changes on mode choice.

Coding multiple life course events results in missing values in many cases (see appendix 3 for data processing procedures). As life course events are rela-

[2] The GMP is conducted by the University of Karlsruhe on behalf of the Federal Ministry of Transport, Building and Urban Development (BMVBS). The data are provided for research use by the Clearingstelle Verkehr (www.clearingstelle-verkehr.de).

tively rare events in an individual's life, I assume no event in cases of uncertainty. The coefficients estimated are thus based on changes among those for whom an event is relatively certain, while some of those for whom no event is assumed may in fact have experienced an event. However, missing values are to a large extent due to unemployed individuals with missing information on access to the workplace. Coding these cases as not having experienced a change in access does not yield a problem.

Changes in mode choice among those falsely coded as having experienced no event may be expected to take various directions rather than being biased systematically into a particular direction. Thus, the coefficients estimated should be unbiased. However, the level of significance may be underestimated due to variance inflation among those falsely coded as having experienced no event.

The regression models are based on a sample of 11,235 out of a total of 23,520 individual weeks of report for whom complete information (other than that discussed above) is available.

3.2 Analysis approach

While most mobility biography studies to date have focused on a particular life event, this paper uses regression modelling to detect effects of a comprehensive set of life course events, cohort and period effects on travel mode choice. Descriptive analysis of selected life course events that turned out significant in regression are presented as well. As the paper serves the preparation of gender analysis, the descriptive tables are categorised by gender. I do not include interaction terms with gender in the regression analysis as this results in an extremely large number of explanatory variables. Rather the results presented here are used to select appropriate variables plus interaction terms with gender for further investigation in forthcoming papers.

The panel nature of the data results in non-independent (clustered) observations, thus violating a most basic assumption of statistical analysis. The use of OLS regression with such data may result in underestimation of standard errors because the amount of independent information available is inflated. The significance of parameters may therefore be overestimated (Hedeker et al., 1994). The parameter estimations themselves should be unbiased. Although it is standard practice in transport studies to ignore cluster structures in data that emerge from observing multiple trips made by one person, or from multiple persons living within the same household, the problem of non-independence is likely to be even more marked in repeat observations of the same individuals.

There are two basic ways of treating panel data in regression: employ either a random effects model or cluster-robust estimation based on pooled data. The former has the disadvantage that it assumes constant correlation between successive observations of the same unit. In contrast, clustered regression with pooled data allows for arbitrary correlation. The estimates are less efficient, and, similar to OLS, the standard errors may be too small when the number of clusters is finite (Wooldridge, 2003; Nichols and Schaffer, 2007). However, the cluster-robust standard error estimator converges to the true standard error as the number of clusters (not the number of observations) approaches infinity (Kézdi, 2004; Nichols and Schaffer, 2007). Given the relatively large sample and cluster number, neither of these issues should raise serious concern.

Hence, I use a pooled data approach and account for clustering by using a robust estimation method controlling for autocorrelation within subjects emerging from the temporal order (sequence) of records. As the analysis is at the person level, this means that the correlation matrix of within-subject dependencies is estimated as part of the model. The SPSS procedure GEE (generalised estimating equations) is used for the analysis.

Concerning model specification (see Garson, 2010 for details), I use the autoregressive correlation type, because the temporal order of within-subject measurements means that values at a given point in time are a function of prior values plus error term. I work with continuous dependent variables, assuming normal distribution with untransformed variables ('identity link' in SPSS). A graphical inspection reveals that this assumption holds true which is not surprising as behavioural change from one year to the next is scattered around zero. There is no reason to test for a certain sequential order of model predictors, which technically means SPSS analysis type 3 is chosen.

Unlike OLS regression, there is no determination coefficient available for cluster robust regression. SPSS reports a quasi likelihood under independence criterion (QIC) which is an extension of the Akaike Information Criterion (AIC) for repeated measures (Garson, 2010). It is available in a corrected form (QICC) that penalises model complexity and small sample size. QICC works in a 'the smaller the better' form. I report this for the final models as well as for the intercept models. However, there is no formal test of significance in model improvement available.

For comparison I estimate OLS regressions. The results are documented in appendix 2 (cluster robust regressions in appendix 1). OLS regressions are known to be relatively robust against mild violations of assumptions. A comparison of the cluster-robust regressions with the OLS regressions shows different levels of significance in some cases, but generally the two modelling approaches yield very similar results both for the signs and the magnitudes of the coefficient estimations. There are no cases of significant effects changing their sign, supporting the robustness of the findings. Anyway, the results for OLS

regression models presented here should be interpreted with care.

3.3 Dependent variables

In this paper changes in travel mode choice from one year to the next on the person level are studied. Individuals' mode shares for car as a driver, car as a passenger, public transport, bicycle and walking are used. The variables are computed in two ways, taking the difference between the value in the year of interest and the year before, respectively:

- in proportions of trips made by the respective mode among all trips a person reported to have made over a week of report in the respective survey year
- in mean trip frequencies per day over the week of report.

The difference between shares and frequencies as regards content are, firstly, that mode specific trip frequencies (trip rates) only partly reflect mode choice while also depending on an individual's total trip rate or 'level of mobility'. Modal split shares on the other hand reflect an individual's relative propensity to choose a particular mode, given his/her trip rate. Secondly, modal split shares are a less accurate measure of transport social, environmental or economic effects, as they do not reflect a certain level of travel generation.

3.4 Explanatory variables I – baseline values of sociodemographics and spatial context

Various state and change variables in sociodemographics and spatial context at the residence and at the place of work or education are considered as explanatory variables. For the sake of brevity we use the term 'place of work' in the following to include both place of work or education. Change variables reflect life course events (see next section). State variables reflect the baseline value observed in the year prior to change. All sociodemographic and spatial context variables are in Table 1 and Table 2 along with their descriptive statistics.

I use self-reported car availability rather than a more objective measure such as the number of cars per driver in the household, as the former explains a considerably higher share of variance. Using the latter variable yields effects with the same signs and relative magnitudes (i.e. stronger effects for an increase than for a decrease in car availability), but with considerably lower absolute magnitudes. It should be noted that car availability is endogeneous to sociodemographics (Salomon and Ben-Akiva, 1983; Scheiner and Holz-Rau, 2007; Van Acker and Witlox, 2010), which may result in biased estimations.

Concerning household structure, a dummy is included for couples as opposed to single households, plus the number of children in three age brackets. Using counts rather than dummies for children assumes that the number of children increases the complexity of daily life, resulting in increased car dependency. The age of the youngest child is another typical measure to capture this issue, but is not available in the data.

With respect to cohort effects, I consider cohort plus cohort squared divided by 100 in order to capture non-linear effects. Those born in 1900 (aged 94 in 1994) are coded as cohort zero while the younger cohorts are assigned larger values (i.e. those born in 1901 are coded as cohort one).

To capture period effects, year of survey (1994 equals zero) is considered, plus an interaction term of year multiplied by a dummy taking the value one for years from 2000, and zero for years to 1999, as mode choice trends in the aggregate tended to change from this year.

For comparison I ran models including age plus age squared divided by 100, excluding cohort. These models turned out virtually identical to those including cohort in terms of overall coefficients and model fit. However, age effects turned out just significant only for PT use, while cohort was strongly significant for car use as a driver and public transport use. Thus, cohort is used for further analysis.

Finally, I include the baseline value of use of the respective mode under study in the year prior to change. The baseline value may be expected to show particularly marked negative effects on change (Krizek, 2003), i.e. those with a high level of use of a particular mode may be expected to reduce it more than those who hardly use it anyway.

3.5 Explanatory variables II – life course events

A rather comprehensive range of life course events is considered. These are coded as dummies taking the value one for individuals who experienced a particular event, and zero for those who did not. Separate dummies for changes in opposite directions permit the detection of asymmetrical effects. It should be noted that some events are experienced only be relatively few individuals, which may result in non-significance even when associated changes in mode choice are relatively pronounced. The rarest event in the data is the start of apprenticeship, which is experienced by 73 respondents (0.6%) (Table 2). Brief variable descriptions for the life course events under study are given in Table 3, along with their hypothesised effects on mode choice. I do not expect all life course events to have significant effects on travel mode choice.

	type*	min	max	mean	standard deviation
Dependent variables					
Change in share of trips made...					
... by car as a driver	C	-100	100	0.10	21.7
... by car as a passenger	C	-100	100	-0.16	17.1
... by PT	C	-100	92	-0.06	13.4
... on foot	C	-100	100	-0.14	18.2
... by bicycle	C	-100	100	0.26	14.5
Change in number of trips per day made...					
... by car as a driver	C	-6.71	6.69	-0.02	1.05
... by car as a passenger	C	-3.71	3.34	-0.01	0.58
... by PT	C	-3.14	3.33	-0.01	0.41
... on foot	C	-6.57	4.75	-0.01	0.75
... by bicycle	C	-5.14	5.24	0.01	0.56
Explanatory variables					
Gender, household, family biography					
No. of children in household (< 10 yrs)	B	0	4	0.28	0.63
No. of children in household (10-13 yrs)	B	0	3	0.17	0.44
No. of children in household (14-17 yrs)	B	0	3	0.18	0.44
Spatial context at residence, residential moves					
Urbanity (Variety of facilities in neighbourhood accessible on foot)	B	0	5	3.07	1.41
PT quality in neighbourhood (variety of different systems accessible on foot)	B	0	5	2.45	1.07
Change in urbanity	C	-5	5	-0.02	1.11
Change in PT quality	C	-3	3	0.00	0.71
Cohort and period					
Cohort (94 yrs in 1994 = 0)	B	5	96	54.80	18.17
Cohort, squared, div. by 100	B	0.25	92.2	33.33	20.71
Year of survey (1994 = 0)	B	0	13	6.99	3.59
Year of survey * dummy '2000 or later' (interaction)	B	0	13	5.87	4.80
Baseline values of mode choice					
Share of trips made...					
... by car as a driver	B	0	1	0.44	0.36
... by car as a passenger	B	0	1	0.15	0.20
... by PT	B	0	1	0.09	0.19
... on foot	B	0	1	0.22	0.23
... by bicycle	B	0	1	0.10	0.19
Number of trips per day made...					
... by car as a driver	B	0	10.8	1.65	1.56
... by car as a passenger	B	0	10.4	0.49	0.63
... by PT	B	0	4.4	0.29	0.58
... on foot	B	0	9.4	0.79	0.90
... by bicycle	B	0	7.4	0.36	0.76

Table 1: Continuous variables used in regression: definitions and descriptive statistics
* B = baseline variable; C = change variable.

	type*	per cent 'yes'
Gender, household, family biography		
Gender female	B	52.5%
Living with partner	B	75.9%
Birth of a child	C	2.0%
Household foundation with partner	C	2.0%
Separation from partner	C	1.5%
Move out of child	C	2.1%
Social status, employment and educational biography		
Full-time employed (reference)	B	34.9%
Part-time employed	B	14.0%
Apprenticeship, trainee, in education	B	13.7%
Not employed	B	37.4%
Education level	B	
Elementary school qualification ...without apprenticeship or no qualification	B	14.3%
...plus apprenticeship	B	25.5%
Secondary school qualification level I	B	28.7%
University entrace qualification or higher (reference)	B	31.5%
Start of apprenticeship	C	0.6%
Completion of school or apprenticeship	C	6.1%
Entry into labour market	C	3.7%
Change in workplace	C	7.0%
Leaving labour market (no retirement)	C	2.2%
Retirement	C	2.8%
Access to place of work (or education) and associated changes		
Walking distance from PT stop to place of work or education is 10 minutes or more	B	12.9%
PT connection to place of work	B	
Good connection (reference)	B	64.2%
Poor connection	B	18.4%
No connection	B	17.5%
Parking situation at place of work	B	
Good / more good than difficult (reference)	B	86.0%
Difficult	B	7.5%
Very difficult	B	6.5%
Walking distance from PT stop to place of work gets...	C	
... much longer	C	1.0%
... somewhat longer	C	3.5%
... much shorter	C	1.0%
... somewhat shorter	C	3.5%
PT connection to place of work gets...	C	
... worse	C	7.3%
... much worse	C	2.7%
... better	C	7.1%
... much better	C	2.6%
Parking situation at place of work gets...	C	
... worse	C	6.2%
... much worse	C	1.7%
... better	C	5.8%
... much better	C	2.0%
License ownership and car availability, and associated changes		
Driving license holding	B	79.7%
Achievement of driving license	C	2.3%
Loss of driving license	C	1.2%
Car availability	B	
Not available (reference)	B	29.4%
Occasionally / after agreement	B	11.9%
Regularly	B	58.7%
Increase in car availability	C	5.9%
Loss in car availability	C	5.3%
Spatial context at residence, relocation		
Municipality with < 20,000 inh (reference)	B	41.6%
Municipality with 20,000-100,000 inh	B	27.5%
Municipality with 100,000-500,000 inh	B	17.2%
Municipality with > 500,000 inh	B	13.8%
Central residential location within city	B	15.3%
Move to centre	C	2.9%
Move to periphery	C	2.8%
Move to larger municipality	C	0.9%
Move to smaller municipality	C	1.0%
n		11,236

Table 2: Dummy variables used in regression: definitions and descriptive statistics
All variables are coded as yes=1, no=0.
* B = baseline variable; C = change variable.

Key event	Variable description	Hypothesised effect on… Car use	PT use	NMT use
Household biography				
Leaving the parental home	Impossible to model, as the parent household rather than the descendant household would be traced further	0	0	0
Formation of a household with the partner	Household type change from single household or single parent to couple or family (for construction of household types see appendix 3)	0	0	0
Birth of a child	Increase in number of children aged 10 or less	+	–	+
Divorce	Household type change from couple or family to single or single parent	0–	0+	0+
Move-out of child	Decrease in household size plus household type change from family to family or couple or from single parent to single parent or single household	0–	0	0
Employment biography				
Commencement of job training or university entry	Change from employment or unemployment to job training, apprenticeship, school or university	–	+	0
Entry into the labour market	Change from non-employment job training, apprenticeship, school or university to employment	+	–	–
Change of job or education	Self-reported change	0+	0–	0–
Entry into non-employment	Change from employment or non-employment (but no retirement)	–	0+	+
Change in access to place of work or education	Walking distance from PT stop to workplace (for details see appendix 3):			
	Increase	+	–	0–
	Decrease	–	+	0+
	PT system quality			
	Increase	–	+	0+
	Decrease	+	–	0–
	Parking places at workplace			
	Increase	+	–	0–
	Decrease	–	+	0+
Retirement	Change into retirement or change from employment or education to non-employment for those aged 60 or over	–	0+	+
Spatial mobility				
Change in driver's license holding	Change in self-reported license possession			
	Gain	+	–	–
	Loss	–	+	+
Change in car availability	Change in self-reported car availability on a three-point scale (not available, occasionally/ after agreement, regularly); strong decrease is a change from category 3 to 1, and vice versa			
	Increase	+	–	–
	Decrease	–	+	+
Residential move	Move to inner city	–	+	+
	Move to periphery	+	–	–
	Move to larger municipality	–	+	+
	Move to smaller municipality	+	–	–
	(for details see appendix 3)			
Spatial change at residence (associated with move or change in place)	Increase in urbanity	–	0+	+
	Increase in PT quality	–	+	0+
	(for details see appendix 3)			
Entry into 'old age'	Assumed to be non-significant, as 'old age' does not imply a fix age threshold	–	0	+

Table 3: Life course events in regression: definitions and hypothesised effects
NMT: non-motorised transport. PT: public transport.

4 Results

4.1 Descriptive analysis

In the following some descriptive statistics of mode choice change associated with life course events are presented. The events are selected based on their significance in regression. I focus on mode specific daily trip frequencies. As expected, those who did not experience a key event over the year under study, show little change in mode choice (Table 4). To facilitate interpretation, the table also includes state variables of trip frequencies for the total sample.

The birth of a child is associated with both more driving and more walking, which both confirms expectations, as babies not just need to be driven, but also to be walked. These changes are accompanied by a decrease in the use of all other modes, most of all the bicycle. The changes are strongly gendered, and they mainly refer to women, whereas for men a child's birth does not seem to have that much of an effect on mode choice, except that their cycling and PT use declines.

The formation of a household with one's partner has been hypothesised to result in little change in mode choice. However, this event turns out to result in fewer trips made as a car driver and more cycling. Taking gender into account suggests some kind of change in driving workshare. While men drive less and make more trips as passengers after household formation, it is the other way round for women.

With respect to employment biography events, entry into the labour market is associated with more driving (particularly for men) and less walking. While men appear to change their mode choice from walking, cycling or using PT exclusively towards driving when commencing a job, women seem to change from walking to driving or using PT.

Retirement is associated with moderate changes. Even total trip frequencies (sum of all modes) do not appear to change. However, categorising by gender reveals that total trip frequencies increase for men, but decrease for women after retiring. The number of cycling trips increases for both genders. Men also walk more, while women walk less, drive less and make fewer trips as car passengers.

With respect to access to the workplace, changes in the quality of the PT connection yield only very moderate effects. Changes in walking distance from the nearest stop to work have more distinct effects. Apparently, the stop should be reasonably close to the workplace in order to make people change their mode.

A decrease in walking distance from the PT stop to work does not only result in increasing PT use, but also in more cycling and walking. This suggests that the changes in egress time (walking distance from the stop) are not so much due to changes in the PT system, but rather in the location of work. In any case, decreasing walking distances are associated with considerably less driving (the more so, as the figures presented include all trips, rather than just commute trips), particularly among women. On the other hand, strongly increasing walking distances (from less than 10 minutes to more than 20 minutes) are associated with more driving, particularly among men.

Relatively pronounced effects can also be seen for changes in the parking situation at the workplace, as long as these changes are substantial. When the parking situation gets much more difficult, people (particularly men) drive less. Instead, men use cars more often as passengers, or they cycle, while women tend to use PT more often. When the parking situation gets much easier, people (particularly women) drive more, and they less frequently use PT as well as cars as passengers, and they walk less.

Gaining a driving license is a key event for most individuals. Similar to car purchase or disposal, it is not just an impact factor for travel mode choice, but it may be endogeneous to mode choice. Young people may not just drive because they have gained a license, but may be eager to get licensed, because they want to drive.

This said, gaining a driving license is strongly positively associated with driving, and negatively with riding in a car as a passenger, using PT, and cycling. All these associations are more pronounced for men than for women. The effects of losing one's license are less marked. The observation that women even drive more than before after having lost their license is likely to be due to false report.

Similar to changes in license holding, changes in car availability show the expected effects on mode choice. The frequency of driving increases with the level of car availability, and for all other modes it is the other way round. The effects of car disposal on driving outbalance the effects on all other modes taken together. Thus, the disposal of a car seems to be associated with a general decrease in travel. This may be due to the mobility the car provides (Marottoli et al., 2000) or to other changes associated with car disposal, e.g. loss in physical capabilities or other aspects of health (Scheiner, 2006b). When car availability changes strongly (from 'no' to 'regularly' or vice versa) the effects are stronger for women than for men, suggesting that car use is more closely related to car availability for women than for men.

Changes in urbanity show relatively moderate outcomes despite some significant effects in regression. Hence, they are not included in the descriptives table. There is no evidence for asymmetrical effects.

After moving residence to a more remote location, mode choice among women shifts from car passenger to car driver. People also tend to walk less (again, this is particularly true for women) and cycle somewhat more after moving to the periphery. Moving into the opposite direction, i.e. to inner city neighbourhoods, yields weaker effects.

		car (driver)	car (pass)	public transport	on foot	bicycle	n
Household biography							
Birth of a child	M	-0.02	0.02	-0.10	0.00	-0.08	120
	F	0.13	-0.18	-0.05	0.20	-0.26	130
	All	0.05	-0.08	-0.07	0.10	-0.17	250
Household formation with partner	M	-0.24	0.07	-0.01	-0.04	0.11	125
	F	0.05	-0.07	0.00	-0.01	0.07	115
	All	-0.11	0.01	0.00	-0.03	0.09	240
Employment biography							
Entry into the labour market	M	0.24	-0.02	-0.10	-0.10	-0.10	178
	F	0.12	-0.06	0.10	-0.16	0.04	260
	All	0.17	-0.04	0.01	-0.14	-0.02	438
Retirement	M	-0.01	0.01	0.01	0.09	0.07	130
	F	-0.06	-0.07	0.05	-0.09	0.06	209
	All	-0.04	-0.04	0.04	-0.03	0.07	339
Access to the place of work / education							
Walking distance from PT stop to work							
Strong decrease	M	-0.01	0.13	0.08	0.16	0.01	56
	F	-0.29	-0.10	0.20	0.11	0.18	60
	All	-0.14	0.03	0.14	0.14	0.09	116
Decrease	M	-0.01	0.08	0.05	-0.06	0.01	223
	F	-0.12	-0.07	0.02	0.05	0.01	212
	All	-0.06	0.01	0.04	-0.01	0.01	435
Increase	M	-0.06	0.09	0.01	-0.05	-0.04	210
	F	-0.01	-0.13	0.01	-0.11	0.03	206
	All	-0.03	-0.02	0.01	-0.08	-0.01	416
Strong increase	M	0.21	-0.02	-0.10	-0.12	0.04	63
	F	0.10	-0.01	-0.20	-0.07	-0.06	66
	All	0.16	-0.01	-0.14	-0.10	0.00	129
Parking situation at place of work gets...							
...much more difficult	M	-0.24	0.10	-0.02	0.05	0.11	108
	F	-0.12	-0.04	0.14	-0.04	-0.08	93
	All	-0.19	0.04	0.05	0.01	0.02	201
...more difficult	M	0.03	0.10	0.01	-0.04	-0.02	390
	F	0.00	-0.10	0.05	0.00	-0.02	348
	All	0.02	0.01	0.02	-0.02	-0.02	738
...easier	M	-0.10	0.05	-0.02	-0.03	-0.04	357
	F	0.05	-0.11	0.00	0.00	0.06	337
	All	-0.03	-0.03	-0.01	-0.02	0.01	694
...much easier	M	0.10	0.06	-0.20	-0.06	0.05	121
	F	0.34	-0.23	-0.16	-0.24	-0.02	113
	All	0.21	-0.08	-0.18	-0.14	0.02	234
Car availability							
Strong decrease	M	-0.18	0.05	0.07	-0.04	-0.02	101
	F	-0.27	0.03	0.06	0.07	-0.02	103
	All	-0.23	0.04	0.06	0.02	-0.02	204
Decrease	M	-0.37	0.07	0.03	-0.01	0.04	202

	F	-0.11	-0.03	0.05	0.03	0.01	237
	All	-0.24	0.02	0.04	0.01	0.03	439
Increase	M	0.32	-0.10	-0.12	-0.05	-0.04	218
	F	0.27	-0.11	-0.07	-0.05	-0.07	297
	All	0.29	-0.10	-0.09	-0.05	-0.06	515
Strong increase	M	0.08	-0.07	0.02	0.01	0.04	100
	F	0.25	-0.11	-0.06	-0.12	0.00	98
	All	0.16	-0.09	-0.02	-0.05	0.02	198
Driving license holdership							
Loss	M	-0.06	0.11	0.12	-0.01	-0.05	63
	F	0.21	-0.03	0.00	-0.27	0.06	82
	All	0.10	0.03	0.05	-0.16	0.02	145
Gain	M	0.85	-0.22	-0.21	-0.04	-0.21	130
	F	0.56	-0.04	-0.06	-0.06	-0.12	151
	All	0.70	-0.12	-0.13	-0.05	-0.16	281
Residential move							
Move to the inner city	M	0.05	-0.06	-0.02	-0.07	-0.02	155
	F	0.00	-0.01	0.06	0.00	-0.08	188
	All	0.02	-0.03	0.03	-0.03	-0.05	343
Move to the periphery	M	-0.01	0.01	-0.02	-0.05	0.04	155
	F	0.17	-0.13	0.00	-0.23	0.07	180
	All	0.08	-0.06	-0.01	-0.14	0.06	335
Reference groups							
None of the key events studied in	M	-0.04	-0.01	0.01	-0.06	0.03	954
regression occurred	F	-0.02	0.00	0.01	-0.02	-0.01	1,096
	All	-0.03	0.00	0.01	-0.04	0.01	2,050
Total sample	M	-0.03	-0.01	-0.01	-0.02	0.00	5,738
	F	0.01	-0.02	0.00	-0.02	0.00	6,382
	All	-0.01	-0.01	0.00	-0.02	0.00	12,120
State variables (daily trip frequencies)	M	1.86	0.32	0.30	0.72	0.38	5,745
Total sample	F	1.19	0.62	0.36	0.91	0.36	6,390
	All	1.50	0.47	0.33	0.82	0.36	12,135

Table 4: Changes in mode choice (mean trip frequencies per day) after experiencing various life course events, categorised by gender
M: male, F: female.

4.2 Multivariate analysis

Subsequently the results of multiple regressions are described. The results tables are in appendix 1 (cluster robust regressions) and appendix 2 (OLS regressions) due to their size. The results from cluster robust estimations and standard OLS estimations are extremely similar, pointing towards the robustness of OLS regressins against violations of assumptions. The magnitudes of the coefficients tend to be slightly smaller in cluster robust regressions (the sum of the absolut values of all coefficients is about 10% smaller in most cluster robust regressions, compared to the respective OLS model), and the coefficients slightly tend to lose significance in cluster robust regressions. The R^2 values in OLS regressions range from 14% to 25%, which is a good to satisfactory level for travel behaviour models on the individual level. What is more, each two models estimating the share of or the trip rate for a specific mode are very similar. Further interpretation focuses on cluster robust regressions of mode specific trip rates (Table 6), except where noted.

4.2.1 Baseline variables effects

Perhaps surprisingly, there are a number of baseline variables that significantly affect changes in mode choice. The number of children in the household positively affects driving. This holds both for children aged 10 or younger and children aged 14-17. Being female is associated with a decrease in driving and an increase in trip-making as a car passenger. Women also tend to increase their frequency of walking. Living as a couple is associated with decreasing walking and driving frequencies, and increasing trip-making as a car passenger. Employment status is significant to a certain extent, most pronounced in terms of a decrease in driving for those who are still in education. Those with low

education levels tend to decrease both their driving and walking, and those with medium education levels tend to decrease their cycling.

While these sociodemographic associations are generally in line with what one would expect for travel mode choice variables at a given point in time, the interpretation of their effects on changes in mode choice is less obvious. We do not yet know about, say, why couples decrease their driving from one year to the next more than those living without a partner. Apparently there are changes in mode choice over the life course of individuals that are associated with particular life situations but not necessarily with certain key events.

Similarly, access to the workplace has some significant effects. A poor PT connection is associated with declining PT use, and a difficult parking situation at the workplace leads to significantly reduced driving and more PT use. Again, while these observations are in line with expections for mode choice, there is no obvious reason to expect, for instance, a decline in car use when the parking situation has already been difficult in the baseline year. Perhaps these effects reflect learning processes over time. They may be considered relatively strong (particularly the effect of a very difficult parking situation on changes in driving), the more so, as the effects on all trips are under study here, rather than just the commute.

Driving license holdership and car availability both have significant effects on changes in mode choice. License holders and car owners tend to increase their driving frequency more than others. For license holding, this is at the expense of using a car as a passenger, while for car ownership it is at the expense of using PT, walking and cycling.

Municipality size also has some significant effects. The positive effect of living in a large city on PT use, and the negative effect on driving are most pronounced. On a more micro-spatial level, urbanity and central locations are associated with increasing walking and (somewhat) decreased car use, while PT quality positively affects PT use and cycling. Again, these effects of spatial context may reflect learning processes. Individuals living in cities, and particularly those living in inner-city neighbourhoods, may be more adaptive to increasing fuel prices or other changes, as they have more alternatives in mode choice available.

Cohort effects are only minor, but yet significant. Cohort is positively associated with driving and negatively with PT use. That is to say, subsequent cohorts drive more and use PT less than their predecessors. The effects of 'cohort squared' - negative (not significant) on driving and positive on PT use – suggest that the cohort specific changes are smoothing over time. According to the estimations the maximum of driving would be reached in the generation of those born in 2020[3], and the minimum of PT use in the generation of those born in 1983. However, as noted above, one should keep in mind that cohort reflects age effects to some extent here. Thus, these estimations are very likely not valid.

The year of survey is not significant in any case. There is no evidence for a non-linear trend, reflecting the end of growth in car travel around the year 2000.

Finally, there are strong negative effects of baseline values in mode use, suggesting that increases in the use of a particular mode are relatively weak among those who already used this mode frequently in the baseline year. For instance, each additional percent in driving results in 0.296 percent more reduction in driving (Table 5).

4.2.2 Change variables effects – life course events

Changes in behaviour may be expected not so much as an outcome of life situations per se than of changing life situations triggered, e.g., by key events. In total, however, the effects of such key events are limited. OLS regressions of changes in mode specific trip frequencies based exclusively on key events yield variance explanation rates of less than 2% for any given travel mode. On the other hand, variance explanation of models including only sociodemographic and spatial baseline explanatory variables is even worse, suggesting that there is little systematic change in mode choice over time when key events do not occur.

Anyway, there are several significant and notable effects. To begin with household biography, the birth of a child results in decreasing car use as a passenger, PT use, and cycling, while walking increases. Interestingly, driving does not increase. Founding a household with one's partner leads to increasing car use as a passenger, pointing towards shared trips. Separation from one's partner results in making more PT trips, but the effect is significant only in the OLS regression. A child moving out of the household yields somewhat more PT use among the other household members, but the effect is significant only for the percentage of trips (Table 5), while it just fails to reach significance in the trip frequency model.

Entering the labour market results in more driving and and decreasing shares of trips made as a car passenger, on foot or by bicycle. These effects may be caused by tigher time budgets and that tend to be associated with entering the workforce.

[3] The maximum of the cohort function of driving frequency change is $Y_{max} = 0.917/(2*0.00382) = 120.03$.

Graduating in school or completing an apprenticeship, starting an apprenticeship, and changing the workplace yield no significant effects.

Leaving the labour market (without retiring) results in more walking and less PT use. Retirement has no significant effects on mode specific trip frequencies, but in terms of modal split (Table 5) it is associated with less driving, more walking (just fails to reach significance) and cycling.

Concerning access to the workplace, there are some notable observations.

First, a change in the walking distance from the nearest PT stop to work has only two significant effects: walking frequency drops when walking distance increases considerably, and vice versa. The effect on walking frequency rather than on frequency of PT use suggests that this may not be due to changes in PT supply, but to workplace relocations and associated changes in spatial context. Modal split shows more significant effects (Table 5), most pronounced being the drop in driving share when walking distance from the nearest PT stop gets considerably shorter, and vice versa.

Second, the PT connection to work yields no significant effects, except that a decrease in PT quality leads to less walking and cycling. Again, this suggests that the effects may be due to workplace relocations rather than changes in PT supply.

Third, the parking situation at the workplace has more pronounced effects. When parking gets considerably more difficult, respondents drive less and use PT more often (just fails to reach significance). Conversely, when parking gets considerably easier, respondents drive more, use PT less frequently and walk less frequently.

As expected, gaining a license has a strongly positive effect on driving, but negative effects on using the car as a passenger, using PT, and cycling. The effects of losing one's license are notably weaker, except for PT use, which increases significantly.

Similarly, changes in car availability strongly affect the use of all modes (cycling is only significant when modal shares are studied). The effects on driving are very strong and outbalance all other modes taken together. This suggests that a decline in car availabiliy is associated with generally decreased levels of travel, and vice versa. However, endogeneity of car availability may be at play here. Hence, having a car available may perhaps not be a cause for, but an outcome of enhanced mobility levels.

Car availability was measured here as reported by a respondent. Interestingly, this measure yields stronger effects on mode choice changes than changes in the number of cars a household owns. This suggests that self-reported availability of a car does not only reflect car purchase (or disposal), but also reallocations of the car(s) a household owns within the household.

Residential relocations show very limited effects. Moving to the periphery is associated with a drop in walking. On a more small-scale level, increasing urbanity leads to more walking, while the shares (but not the frequencies) of car use as a driver or passenger decrease (Table 5).

5 Conclusions

This paper has investigated changes in travel mode choice from one year to the next using descriptive statistics and multiple regressions. Due to the clustered nature of the data, a cluster robust estimation methodology has been used, and it has been complemented by and compared with standard OLS regression. The results suggest considerable robustness of OLS regression, as each two models including the same set of variables are extremely similar, no matter which estimation method has been used.

The results show that behind the aggregate stability in travel mode choice over time there is much change 'under the surface', induced by life course changes, individual and household sociodemographic, and spatial context. The changes found induced by life course related key events favour the notion of mobility biographies. However, in total key events seem to be relatively loosely associated with changes in travel mode choice.

Three reasons may be offered for interpretation. Firstly, the period of observation is relatively short. Changes in travel mode choice induced by certain key events may be delayed (Dargay, 2001). For instance, after household formation of two adults each owning their own cars, the decision to keep only one car may be postponed until one of the two cars is depreciated, rather than dispose one of the vehicles immediately. Secondly, mode choice is known to involve strongly habitual elements (Gärling and Axhausen, 2003). These may prevent people to change their behaviour even when certain conditions of life change. Thirdly, low levels of variance explanation suggest high levels of freedom in mode choice. The satisfactory variance explanation rates achieved in total are mainly due to the baseline values in behaviour. From a statistical perspective, mode choice behaviour may seem arbitrary and random, but those choosing a particular mode are likely to have good reasons for doing so. In a welfare society such as Germany with a high level of car ownership, the level of structural determination in mode choice is very low (Scheiner, 2006a).

Besides the effects of key events, various significant effects of baseline variables have been found which suggest that mode choice may change even without any key event. On the other hand, variance explanation of models including only sociodemographic and spatial baseline explanatory variables is ex-

tremely low. Hence, there seems to be little systematic change in mode choice over time when key events do not occur, again supporting the notion of habitual mode choice.

As noted above, this paper serves the preparation of gendered analysis of travel behaviour changes. Considering the significant effects in regression as well as the gender differences observed in descriptive statistics, the following key events appear worthwhile to be considered in such analysis: the birth of a child; household formation with a partner; entry into the labour market; changing the workplace; leaving the labour market; retirement; change in access to the workplace (particularly walking distance from the nearest PT stop, and parking situation at the workplace); change in license holdership; change in car availability; residential move and associated changes in urbanity and/or location within the municipality.

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Appendix 1: cluster robust regressions

		Car (driver)			Car (passenger)			Public transport			On foot			Bicycle		
		B	Exp (B)	Sig.	B	Exp (B)	Sig.	B	Exp (B)	Sig.	B	Exp (B)	Sig.	B	Exp (B)	Sig.
Intercept		2.2	1.02	0.28	6.5	1.07	0.00	9.2	1.10	0.00	12.3	1.13	0.00	0.5	1.00	0.73
Gender, household, family biography																
Gender female	B	-3.4	0.97	0.00	3.8	1.04	0.00	0.1	1.00	0.84	0.9	1.01	0.00	-0.3	1.00	0.24
No. of children in household (< 10 yrs)	B	0.6	1.01	0.06	-0.8	0.99	0.00	-0.2	1.00	0.16	-0.2	1.00	0.41	0.5	1.00	0.03
No. of children in household (10-13 yrs)	B	-0.5	0.99	0.20	-0.6	0.99	0.06	0.1	1.00	0.65	-0.1	1.00	0.82	0.9	1.01	0.01
No. of children in household (14-17 yrs)	B	1.6	1.02	0.00	0.1	1.00	0.71	-0.5	1.00	0.13	-1.0	0.99	0.00	-0.6	0.99	0.04
Living with partner	B	-0.6	0.99	0.14	2.8	1.03	0.00	-0.3	1.00	0.22	-1.2	0.99	0.00	0.0	1.00	0.92
Birth of a child	C	0.1	1.00	0.93	-1.6	0.98	0.11	-1.4	0.99	0.05	4.8	1.05	0.00	-2.4	0.98	0.01
Household foundation with partner	C	-2.5	0.98	0.06	3.0	1.03	0.00	0.2	1.00	0.81	-1.6	0.98	0.09	1.0	1.01	0.27
Separation from partner	C	-1.0	0.99	0.55	-1.3	0.99	0.26	1.1	1.01	0.31	1.0	1.01	0.47	0.3	1.00	0.79
Move out of child	C	-2.6	0.97	0.06	0.0	1.00	0.99	1.5	1.02	0.04	0.5	1.01	0.60	0.3	1.00	0.80
Social status, employment and educational biography																
Employment (reference: full-time)	B															
Part-time employed	B	-0.6	0.99	0.34	-0.4	1.00	0.38	-0.2	1.00	0.46	0.3	1.00	0.59	0.6	1.01	0.10
Apprenticeship, trainee, in education	B	-2.0	0.98	0.08	0.9	1.01	0.26	-0.1	1.00	0.86	0.2	1.00	0.83	0.5	1.01	0.46
Not employed	B	-1.0	0.99	0.12	0.8	1.01	0.09	-1.3	0.99	0.00	1.4	1.01	0.02	0.6	1.01	0.17
Education level (reference: university entrace qualification or higher)	B															
Elementary school qualification without ...apprenticeship or no qualification	B	-1.0	0.99	0.18	1.0	1.01	0.13	0.5	1.00	0.37	-0.8	0.99	0.22	0.5	1.00	0.38
...plus apprenticeship	B	1.1	1.01	0.03	0.6	1.01	0.07	-0.5	1.00	0.07	0.0	1.00	0.95	-0.7	0.99	0.01
Secondary school qualification level I	B	1.1	1.01	0.02	0.0	1.00	0.98	-0.2	1.00	0.30	0.1	1.00	0.80	-0.7	0.99	0.01
Start of apprenticeship	C	-0.9	0.99	0.79	1.4	1.01	0.52	2.3	1.02	0.35	-0.8	0.99	0.68	-1.5	0.99	0.33
Completion of school or apprenticeship	C	-0.6	0.99	0.43	0.1	1.00	0.88	-0.1	1.00	0.91	1.0	1.01	0.16	-0.3	1.00	0.56
Entry into labour market	C	5.8	1.06	0.00	-1.8	0.98	0.04	0.2	1.00	0.78	-2.5	0.98	0.01	-1.8	0.98	0.01
Change in workplace	C	1.2	1.01	0.16	-0.3	1.00	0.54	0.1	1.00	0.90	-0.9	0.99	0.15	0.3	1.00	0.54
Leaving labour market (no retirement)	C	-1.1	0.99	0.46	0.8	1.01	0.43	-2.0	0.98	0.00	3.5	1.04	0.00	-0.6	0.99	0.46
Retirement	C	-2.9	0.97	0.02	-0.1	1.00	0.88	-0.5	0.99	0.44	2.0	1.02	0.06	1.6	1.02	0.05

(continued)															
Access to place of work or education and associated changes															
Walking distance from PT stop to work															
10 minutes or more	B	0.9	1.01	0.20	-0.4	1.00	0.39	-0.2	1.00	0.67	-0.3	1.00	0.64	-0.1	1.00	0.84
PT connection (reference: good)	B														
Poor connection	B	1.2	1.01	0.05	0.3	1.00	0.51	-0.8	0.99	0.04	-0.1	1.00	0.75	-0.3	1.00	0.33
No connection	B	1.7	1.02	0.01	-0.1	1.00	0.77	-1.4	0.99	0.00	-0.4	1.00	0.46	0.0	1.00	0.97
Parking situation at work (reference: good or more good than difficult)	B														
Difficult	B	-1.4	0.99	0.05	-0.3	1.00	0.54	1.4	1.01	0.01	0.0	1.00	0.95	0.1	1.00	0.81
Very difficult	B	-2.1	0.98	0.01	0.5	1.01	0.34	2.1	1.02	0.00	-0.3	1.00	0.62	-0.2	1.00	0.67
Walking distance from PT stop...	C														
... increases considerably	C	4.0	1.04	0.03	-0.2	1.00	0.89	-2.2	0.98	0.18	-0.5	1.00	0.69	-0.5	1.00	0.65
... increases somewhat	C	0.6	1.01	0.58	-1.0	0.99	0.21	1.9	1.02	0.02	-1.0	0.99	0.20	0.0	1.00	0.97
... decreases considerably	C	-7.8	0.93	0.00	1.3	1.01	0.36	3.3	1.03	0.05	2.0	1.02	0.17	1.1	1.01	0.43
... decreases somewhat	C	-1.8	0.98	0.13	0.7	1.01	0.46	1.6	1.02	0.07	-0.7	0.99	0.43	-0.1	1.00	0.89
PT connection to work gets...	C														
... worse	C	0.5	1.00	0.54	1.3	1.01	0.03	0.5	1.00	0.33	-1.2	0.99	0.02	-1.0	0.99	0.03
... much worse	C	-0.5	0.99	0.60	0.6	1.01	0.47	-0.6	0.99	0.47	0.3	1.00	0.77	0.5	1.00	0.55
... better	C	-0.2	1.00	0.80	0.3	1.00	0.62	-0.8	0.99	0.09	0.2	1.00	0.69	0.5	1.01	0.25
... much better	C	-0.9	0.99	0.48	-0.5	1.00	0.58	0.5	1.00	0.40	1.2	1.01	0.21	-0.4	1.00	0.60
Parking situation gets...	C														
... worse	C	-0.1	1.00	0.92	0.2	1.00	0.77	1.0	1.01	0.07	-0.6	0.99	0.30	-0.3	1.00	0.55
... much worse	C	-2.5	0.98	0.12	0.3	1.00	0.80	1.9	1.02	0.11	0.6	1.01	0.54	-0.3	1.00	0.77
... better	C	1.1	1.01	0.20	0.0	1.00	0.98	-1.4	0.99	0.00	0.2	1.00	0.80	0.4	1.00	0.50
... much better	C	4.2	1.04	0.01	1.1	1.01	0.36	-4.3	0.96	0.00	-1.8	0.98	0.11	1.3	1.01	0.17
License holding and car availability and associated changes															
Driving license holding	B	4.6	1.05	0.00	-3.8	0.96	0.00	-0.3	1.00	0.61	-2.1	0.98	0.00	0.6	1.01	0.33
Achievement of driving license	C	18.0	1.20	0.00	-6.5	0.94	0.00	-4.6	0.95	0.00	-4.4	0.96	0.00	-3.0	0.97	0.00
Loss of driving license	C	-3.1	0.97	0.11	2.1	1.02	0.14	1.7	1.02	0.10	0.4	1.00	0.80	-0.7	0.99	0.54
Car availability (reference: no)	B														
Occasionally / after agreement	B	2.4	1.02	0.00	1.7	1.02	0.00	-1.7	0.98	0.00	-0.7	0.99	0.28	-1.4	0.99	0.02
Regularly	B	9.5	1.10	0.00	-0.3	1.00	0.51	-3.5	0.97	0.00	-2.8	0.97	0.00	-2.3	0.98	0.00
Increase in car availability	C	8.3	1.09	0.00	-1.6	0.98	0.03	-2.8	0.97	0.00	-2.4	0.98	0.00	-1.1	0.99	0.09

(continued)															
Loss in car availability	C	-7.5	0.93	0.00	2.0	1.02	0.00	2.1	1.02	0.00	2.3	1.02	0.00	1.2	1.01	0.02
Spatial context at residence, relocation															
Municipality size category (reference: < 20,000 inh)	B														
20,000-100,000 inh	B	0.4	1.00	0.33	0.8	1.01	0.02	-0.3	1.00	0.20	-1.1	0.99	0.00	0.2	1.00	0.55
100,000-500,000 inh	B	-0.2	1.00	0.66	-0.1	1.00	0.88	0.6	1.01	0.08	0.3	1.00	0.48	-0.6	0.99	0.08
> 500,000 inh	B	-0.7	0.99	0.19	-0.9	0.99	0.05	2.7	1.03	0.00	-0.9	0.99	0.07	-0.4	1.00	0.31
Central residential location within city	B	-1.1	0.99	0.04	-1.1	0.99	0.01	-0.6	0.99	0.15	3.6	1.04	0.00	-0.8	0.99	0.07
Urbanity (Variety of facilities in neighbourhood accessible on foot)	B	-0.9	0.99	0.00	-0.3	1.00	0.01	-0.1	1.00	0.08	0.8	1.01	0.00	0.4	1.00	0.00
PT quality in neighbourhood (variety of different systems accessible on foot)	B	-0.7	0.99	0.00	-0.1	1.00	0.66	0.3	1.00	0.03	0.1	1.00	0.48	0.3	1.00	0.04
Move to centre	C	0.8	1.01	0.52	-0.2	1.00	0.81	1.1	1.01	0.15	-0.9	0.99	0.35	-1.0	0.99	0.28
Move to periphery	C	1.8	1.02	0.11	0.7	1.01	0.39	0.2	1.00	0.79	-4.5	0.96	0.00	1.7	1.02	0.08
Move to larger municipality	C	-2.7	0.97	0.21	0.8	1.01	0.61	0.6	1.01	0.66	0.4	1.00	0.82	0.4	1.00	0.80
Move to smaller municipality	C	0.4	1.00	0.83	-0.1	1.00	0.95	2.1	1.02	0.12	-1.6	0.98	0.28	-0.1	1.00	0.94
Change in urbanity	C	-0.4	1.00	0.03	-0.3	1.00	0.04	-0.2	1.00	0.16	0.8	1.01	0.00	0.1	1.00	0.33
Change in PT quality	C	-0.1	1.00	0.71	-0.3	1.00	0.21	0.3	1.00	0.14	0.1	1.00	0.71	0.0	1.00	0.85
Cohort and period															
Cohort (94 yrs in 1994 = 0)	B	0.3	1.00	0.00	0.0	1.00	0.62	-0.2	1.00	0.00	-0.1	1.00	0.11	0.0	1.00	0.47
Cohort, squared, div. by 100	B	-0.2	1.00	0.02	0.0	1.00	0.92	0.2	1.00	0.00	0.0	1.00	0.47	0.0	1.00	0.42
Year of survey (1994 = 0)	B	-0.3	1.00	0.12	0.2	1.00	0.23	-0.1	1.00	0.64	0.0	1.00	0.97	0.2	1.00	0.15
Year of survey * 2000 or later	B	0.1	1.00	0.59	-0.1	1.00	0.15	0.1	1.00	0.30	0.1	1.00	0.51	-0.1	1.00	0.37
Baseline value of mode choice															
Share of trips made by mode under study	B	-29.6	0.74	0.00	-37.3	0.69	0.00	-27.3	0.76	0.00	-33.1	0.72	0.00	-21.7	0.81	0.00
(Scale)		379.8			233.0			149.4			266.8			183.4		
QICC		529			332			203			374			239		
QICC (intercept model)		550			386			293			424			331		
n (observations)		11,236			11,236			11,236			11,236			11,236		
n (individuals)		6,932			6,932			6,932			6,932			6,932		

Table 5: Cluster robust regression models of mode choice (changes in percentages of trips)
Regression coefficients B have been multiplied by 100 for more convenient interpretation. They reflect percentages from 0-100 rather than from 0-1.
B = baseline variable; C = change variable.

		Car (driver)			Car (passenger)			Public transport			On foot			Bicycle		
		B	Exp (B)	Sig.	B	Exp (B)	Sig.	B	Exp (B)	Sig.	B	Exp (B)	Sig.	B	Exp (B)	Sig.
Intercept		-0.01	0.99	0.88	0.06	1.06	0.29	0.24	1.28	0.00	0.22	1.24	0.00	0.03	1.03	0.59
Gender, household, family biography																
Gender female	B	-0.12	0.89	0.00	0.14	1.16	0.00	0.00	1.00	0.83	0.03	1.03	0.03	-0.01	0.99	0.38
No. of children in household (< 10 yrs)	B	0.07	1.07	0.00	-0.01	0.99	0.09	0.00	1.00	0.63	0.01	1.02	0.17	0.02	1.02	0.01
No. of children in household (10-13 yrs)	B	-0.01	0.99	0.58	-0.01	0.99	0.25	0.01	1.01	0.51	0.00	1.00	0.88	0.03	1.03	0.03
No. of children in household (14-17 yrs)	B	0.10	1.11	0.00	0.02	1.02	0.07	-0.01	0.99	0.37	-0.04	0.96	0.01	-0.01	0.99	0.36
Living with partner	B	-0.05	0.96	0.02	0.08	1.09	0.00	-0.02	0.98	0.02	-0.06	0.94	0.00	0.00	1.00	0.80
Birth of a child	C	-0.03	0.97	0.71	-0.08	0.92	0.03	-0.04	0.96	0.07	0.14	1.15	0.01	-0.12	0.88	0.00
Household foundation with partner	C	-0.08	0.92	0.26	0.13	1.14	0.00	0.01	1.02	0.53	-0.04	0.96	0.41	0.04	1.04	0.15
Separation from partner	C	-0.07	0.94	0.36	-0.03	0.97	0.39	0.05	1.05	0.14	0.06	1.06	0.29	-0.01	0.99	0.78
Move out of child	C	-0.10	0.90	0.11	-0.03	0.97	0.31	0.04	1.04	0.06	-0.01	0.99	0.71	0.05	1.05	0.29
Social status, employment and educational biography																
Employment (reference: full-time)	B															
Part-time employed	B	0.06	1.06	0.07	-0.01	0.99	0.53	0.00	1.00	0.74	0.04	1.04	0.07	0.03	1.03	0.09
Apprenticeship, trainee, in education	B	-0.17	0.84	0.00	0.05	1.05	0.11	0.01	1.01	0.64	0.05	1.05	0.19	0.00	1.00	0.95
Not employed	B	-0.01	0.99	0.71	0.02	1.02	0.24	-0.04	0.97	0.01	0.04	1.05	0.06	0.01	1.01	0.40
Education level (reference: university entrace qualification or higher)	B															
Elementary school qualification without ...apprenticeship or no qualification	B	-0.09	0.91	0.01	0.01	1.01	0.54	0.01	1.01	0.59	-0.07	0.94	0.01	0.01	1.01	0.76
...plus apprenticeship	B	-0.03	0.97	0.19	0.02	1.02	0.08	-0.01	0.99	0.08	-0.03	0.97	0.07	-0.04	0.96	0.00
Secondary school qualification level I	B	0.01	1.01	0.79	-0.01	0.99	0.46	-0.01	0.99	0.22	-0.02	0.98	0.24	-0.04	0.96	0.00
Start of apprenticeship	C	-0.14	0.87	0.38	0.06	1.07	0.40	0.03	1.03	0.66	-0.07	0.93	0.40	-0.02	0.98	0.84
Completion of school or apprenticeship	C	0.00	1.00	0.94	0.01	1.01	0.50	-0.01	0.99	0.56	0.01	1.01	0.73	-0.02	0.98	0.40
Entry into labour market	C	0.25	1.29	0.00	-0.03	0.97	0.27	0.01	1.01	0.73	-0.07	0.93	0.10	-0.03	0.97	0.31
Change in workplace	C	0.01	1.01	0.84	-0.02	0.98	0.29	0.01	1.01	0.76	-0.04	0.96	0.13	0.01	1.01	0.79
Leaving labour market (no retirement)	C	0.04	1.05	0.61	0.01	1.01	0.82	-0.07	0.93	0.00	0.12	1.13	0.02	-0.05	0.96	0.16
Retirement	C	-0.06	0.95	0.29	0.00	1.00	0.99	-0.01	0.99	0.67	0.05	1.05	0.22	0.06	1.06	0.07
Access to place of work or education and associated changes																
Walking distance from PT stop to work 10 minutes or more	B	-0.02	0.98	0.59	-0.04	0.96	0.02	-0.01	0.99	0.30	-0.03	0.97	0.20	-0.01	0.99	0.41

(continued)																
PT connection (reference: good)	B															
Poor connection	B	0.03	1.03	0.38	0.00	1.00	0.90	-0.02	0.98	0.04	-0.02	0.98	0.30	-0.02	0.98	0.28
No connection	B	0.03	1.03	0.34	-0.01	0.99	0.58	-0.05	0.95	0.00	-0.02	0.98	0.40	0.00	1.00	0.93
Parking situation at work (reference: good or more good than difficult)	B															
Difficult	B	-0.05	0.95	0.18	0.00	1.00	0.97	0.05	1.05	0.00	-0.01	0.99	0.78	0.00	1.00	0.99
Very difficult	B	-0.11	0.89	0.00	0.00	1.00	0.99	0.06	1.07	0.00	-0.01	0.99	0.68	0.00	1.00	0.92
Walking distance from PT stop gets...	C															
... much longer	C	0.05	1.05	0.58	-0.01	0.99	0.78	-0.08	0.93	0.06	-0.13	0.88	0.00	-0.05	0.95	0.12
... somewhat longer	C	-0.02	0.98	0.68	-0.05	0.95	0.07	0.03	1.03	0.15	-0.05	0.95	0.10	-0.02	0.98	0.48
... much shorter	C	-0.15	0.86	0.11	0.05	1.05	0.33	0.10	1.11	0.07	0.14	1.15	0.05	0.11	1.12	0.08
... somewhat shorter	C	-0.06	0.94	0.32	0.02	1.02	0.41	0.06	1.06	0.02	-0.01	0.99	0.75	0.00	1.00	0.98
PT connection gets...	C															
... worse	C	0.02	1.02	0.66	0.04	1.04	0.05	0.01	1.01	0.57	-0.06	0.94	0.01	-0.04	0.96	0.03
... much worse	C	0.04	1.04	0.53	0.03	1.03	0.36	-0.02	0.98	0.38	0.03	1.03	0.51	0.01	1.01	0.84
... better	C	-0.02	0.98	0.58	0.00	1.00	0.81	-0.02	0.98	0.29	-0.01	0.99	0.82	0.01	1.01	0.46
... much better	C	0.04	1.04	0.55	-0.04	0.96	0.14	0.01	1.01	0.49	0.02	1.02	0.59	-0.02	0.98	0.54
Parking situation gets...	C															
... worse	C	0.01	1.01	0.82	0.00	1.00	0.83	0.02	1.02	0.31	-0.04	0.96	0.12	-0.01	0.99	0.60
... much worse	C	-0.19	0.83	0.01	-0.01	0.99	0.71	0.07	1.07	0.06	0.02	1.02	0.59	0.00	1.00	0.99
... better	C	0.07	1.07	0.12	0.01	1.01	0.63	-0.05	0.95	0.00	0.00	1.00	0.95	0.01	1.01	0.60
... much better	C	0.18	1.19	0.04	0.03	1.03	0.43	-0.13	0.87	0.00	-0.11	0.90	0.03	0.01	1.01	0.71
License holding and car availability and associated changes																
Driving license holding	B	0.15	1.16	0.00	-0.12	0.89	0.00	-0.03	0.97	0.17	-0.05	0.95	0.07	0.02	1.02	0.36
Achievement of driving license	C	0.72	2.06	0.00	-0.15	0.86	0.00	-0.14	0.87	0.00	-0.06	0.94	0.22	-0.11	0.89	0.00
Loss of driving license	C	-0.04	0.97	0.68	0.06	1.06	0.14	0.08	1.08	0.05	0.01	1.01	0.84	0.00	1.00	0.90
Car availability (reference: no)	B															
Occasionally / after agreement	B	0.10	1.10	0.00	0.06	1.07	0.00	-0.05	0.95	0.00	-0.01	0.99	0.59	-0.06	0.94	0.01
Regularly	B	0.41	1.51	0.00	0.02	1.02	0.30	-0.10	0.90	0.00	-0.06	0.94	0.00	-0.08	0.92	0.00
Increase in car availability	C	0.33	1.39	0.00	-0.04	0.96	0.09	-0.09	0.92	0.00	-0.06	0.94	0.04	-0.03	0.97	0.29
Loss in car availability	C	-0.33	0.72	0.00	0.05	1.06	0.02	0.07	1.07	0.00	0.06	1.06	0.05	0.03	1.03	0.17

(continued)																
Spatial context at residence, relocation																
Municipality size category (reference: < 20,000 inh)	B															
20,000-100,000 inh	B	0.01	1.01	0.55	0.03	1.03	0.00	-0.01	0.99	0.30	-0.02	0.98	0.14	0.02	1.02	0.10
100,000-500,000 inh	B	0.00	1.00	0.92	0.00	1.00	0.90	0.03	1.03	0.02	0.01	1.01	0.67	-0.02	0.98	0.09
> 500,000 inh	B	-0.07	0.93	0.01	-0.03	0.97	0.05	0.09	1.09	0.00	-0.04	0.97	0.09	-0.01	0.99	0.45
Central residential location within city	B	-0.03	0.97	0.19	-0.04	0.96	0.00	-0.01	0.99	0.52	0.12	1.12	0.00	-0.03	0.97	0.07
Urbanity (Variety of facilities in neighbourhood accessible on foot)	B	-0.02	0.98	0.01	-0.01	0.99	0.08	0.00	1.00	0.06	0.04	1.04	0.00	0.01	1.01	0.00
PT quality in neighbourhood (variety of different systems accessible on foot)	B	0.00	1.00	0.65	0.00	1.00	0.49	0.01	1.01	0.01	0.01	1.01	0.16	0.01	1.01	0.01
Move to centre	C	-0.01	0.99	0.83	-0.01	0.99	0.72	0.02	1.02	0.52	-0.07	0.93	0.07	-0.06	0.94	0.08
Move to periphery	C	0.05	1.05	0.34	0.02	1.02	0.40	-0.02	0.98	0.42	-0.17	0.85	0.00	0.07	1.07	0.09
Move to larger municipality	C	-0.18	0.84	0.06	-0.03	0.97	0.57	0.02	1.02	0.68	0.04	1.05	0.62	-0.06	0.94	0.25
Move to smaller municipality	C	-0.02	0.98	0.75	0.01	1.01	0.83	0.07	1.08	0.12	-0.09	0.92	0.11	-0.05	0.95	0.35
Change in urbanity	C	-0.01	0.99	0.12	-0.01	0.99	0.08	0.00	1.00	0.19	0.03	1.03	0.00	0.00	1.00	0.66
Change in PT quality	C	0.00	1.00	0.79	0.00	1.00	0.82	0.01	1.01	0.13	0.01	1.01	0.19	0.01	1.01	0.21
Cohort and period																
Cohort (94 yrs in 1994 = 0)	B	0.01	1.01	0.00	0.00	1.00	0.15	0.00	1.00	0.04	0.00	1.00	0.62	0.00	1.00	0.46
Cohort, squared, div. by 100	B	0.00	1.00	0.19	0.00	1.00	0.27	0.00	1.00	0.02	0.00	1.00	0.41	0.00	1.00	0.51
Year of survey (1994 = 0)	B	0.00	1.00	0.67	0.00	1.00	0.38	0.00	1.00	0.88	0.01	1.01	0.33	0.00	1.00	0.49
Year of survey * 2000 or later	B	-0.01	0.99	0.31	0.00	1.00	0.18	0.00	1.00	0.93	0.00	1.00	0.59	0.00	1.00	0.56
Baseline value of mode choice																
Frequency of trips (by mode under study)	B	-0.32	0.73	0.00	-0.42	0.66	0.00	-0.29	0.75	0.00	-0.34	0.71	0.00	-0.22	0.80	0.00
(Scale)		0.88			0.25			0.14			0.45			0.27		
QICC		9,995			2,933			1,695			5,170			3,198		
QICC (intercept model)		12,410			3,735			1,930			6,308			3,581		
n (observations)		11,236			11,236			11,236			11,236			11,236		
n (individuals)		6,932			6,932			6,932			6,932			6,932		

Table 6: Cluster robust regression models of mode choice (changes in daily trip frequencies)
B = baseline variable; C = change variable.

Appendix 2: OLS regressions

		Car (driver)			Car (passenger)			Public transport			On foot			Bicycle		
		B	Beta	Sig.	B	Beta	Sig.	B	Beta	Sig.	B	Beta	Sig.	B	Beta	Sig.
Intercept		3.98		0.10	8.18		0.00	10.71		0.00	13.76		0.00	0.76		0.65
Gender, household, family biography																
Gender female	B	-4.32	-0.10	0.00	4.54	0.13	0.00	0.10	0.00	0.71	1.06	0.03	0.00	-0.43	-0.01	0.14
No. of children in household (< 10 yrs)	B	0.61	0.02	0.06	-0.94	-0.03	0.00	-0.26	-0.01	0.21	-0.08	0.00	0.78	0.49	0.02	0.03
No. of children in household (10-13 yrs)	B	-0.43	-0.01	0.36	-0.70	-0.02	0.06	-0.10	0.00	0.73	-0.07	0.00	0.85	1.20	0.04	0.00
No. of children in household (14-17 yrs)	B	1.72	0.04	0.00	0.03	0.00	0.93	-0.38	-0.01	0.19	-1.06	-0.03	0.01	-0.59	-0.02	0.06
Living with partner	B	-0.80	-0.02	0.08	3.32	0.08	0.00	-0.47	-0.02	0.10	-1.34	-0.03	0.00	-0.15	0.00	0.64
Birth of a child	C	0.30	0.00	0.82	-1.52	-0.01	0.15	-1.36	-0.01	0.10	4.37	0.03	0.00	-2.28	-0.02	0.01
Household foundation with partner	C	-2.68	-0.02	0.04	3.12	0.03	0.00	0.14	0.00	0.87	-1.74	-0.01	0.12	1.03	0.01	0.26
Separation from partner	C	-1.15	-0.01	0.46	-1.51	-0.01	0.21	1.54	0.01	0.11	0.94	0.01	0.47	0.30	0.00	0.78
Move out of child	C	-2.71	-0.02	0.04	-0.03	0.00	0.97	1.41	0.02	0.08	0.60	0.00	0.58	0.52	0.01	0.57
Social status, employment and educational biography																
Employment (reference: full-time)	B															
Part-time employed	B	-0.62	-0.01	0.33	-0.51	-0.01	0.31	-0.33	-0.01	0.42	0.33	0.01	0.54	0.84	0.02	0.06
Apprenticeship, trainee, in education	B	-2.77	-0.04	0.01	0.95	0.02	0.27	0.31	0.01	0.65	0.12	0.00	0.90	1.07	0.03	0.16
Not employed	B	-1.48	-0.03	0.04	0.83	0.02	0.13	-1.73	-0.06	0.00	1.95	0.05	0.00	0.80	0.03	0.10
Education level (reference: university entrace qualification or higher)	B															
Elementary school qualification without ...apprenticeship or no qualification	B	-1.26	-0.02	0.12	1.26	0.03	0.05	0.47	0.01	0.35	-0.95	-0.02	0.16	0.56	0.01	0.31
...plus apprenticeship	B	1.08	0.02	0.04	0.82	0.02	0.04	-0.40	-0.01	0.22	-0.15	0.00	0.74	-0.91	-0.03	0.01
Secondary school qualification level I	B	1.09	0.02	0.03	0.10	0.00	0.80	-0.17	-0.01	0.59	-0.01	0.00	0.98	-0.88	-0.03	0.01
Start of apprenticeship	C	-0.82	0.00	0.73	2.16	0.01	0.24	2.45	0.01	0.10	-1.42	-0.01	0.47	-2.06	-0.01	0.21
Completion of school or apprenticeship	C	-0.80	-0.01	0.31	-0.21	0.00	0.73	-0.10	0.00	0.84	1.28	0.02	0.05	-0.08	0.00	0.88
Entry into labour market	C	5.88	0.05	0.00	-1.56	-0.02	0.06	0.42	0.01	0.53	-2.84	-0.03	0.00	-2.00	-0.03	0.01
Change in workplace	C	0.98	0.01	0.20	-0.44	-0.01	0.46	0.43	0.01	0.37	-0.88	-0.01	0.17	0.27	0.00	0.61
Leaving labour market (no retirement)	C	-0.89	-0.01	0.49	0.55	0.00	0.59	-2.33	-0.03	0.00	3.81	0.03	0.00	-0.50	0.00	0.58
Retirement	C	-3.01	-0.02	0.01	-0.36	0.00	0.69	-0.36	0.00	0.62	2.28	0.02	0.02	1.61	0.02	0.04

(continued)															
Access to place of work or education and associated changes															
Walking distance from PT stop to work															
10 minutes or more	B	0.82	0.01	0.25	-0.48	-0.01	0.39	-0.20	-0.01	0.66	-0.22	0.00	0.71	0.12	0.00	0.81
PT connection to work (reference: good)	B														
Poor connection	B	1.71	0.03	0.01	0.13	0.00	0.79	-0.85	-0.02	0.03	-0.23	0.00	0.66	-0.54	-0.01	0.20
No connection	B	1.79	0.03	0.01	-0.18	0.00	0.73	-1.78	-0.05	0.00	-0.37	-0.01	0.50	0.44	0.01	0.33
Parking situation at work (reference: good or more good than difficult)	B														
Difficult	B	-1.73	-0.02	0.02	-0.27	0.00	0.65	1.60	0.03	0.00	0.11	0.00	0.87	0.14	0.00	0.79
Very difficult	B	-2.51	-0.03	0.00	0.53	0.01	0.42	2.21	0.04	0.00	-0.14	0.00	0.84	-0.27	0.00	0.64
Walking distance from PT stop...	C														
... increases considerably	C	3.83	0.02	0.04	0.03	0.00	0.98	-3.04	-0.02	0.01	-0.35	0.00	0.82	0.07	0.00	0.96
... increases somewhat	C	0.49	0.00	0.63	-0.69	-0.01	0.39	1.83	0.03	0.00	-1.03	-0.01	0.23	-0.05	0.00	0.95
... decreases considerably	C	-7.81	-0.04	0.00	1.40	0.01	0.36	3.64	0.03	0.00	2.12	0.01	0.20	0.69	0.00	0.61
... decreases somewhat	C	-1.47	-0.01	0.21	0.67	0.01	0.47	1.57	0.02	0.03	-0.83	-0.01	0.40	-0.21	0.00	0.80
PT connection gets...	C														
... worse	C	0.62	0.01	0.41	1.32	0.02	0.02	0.12	0.00	0.79	-1.33	-0.02	0.04	-0.82	-0.01	0.12
... much worse	C	-0.32	0.00	0.79	0.65	0.01	0.48	-0.97	-0.01	0.19	0.57	0.01	0.56	0.17	0.00	0.84
... better	C	-0.20	0.00	0.80	0.41	0.01	0.51	-0.62	-0.01	0.21	0.16	0.00	0.81	0.37	0.01	0.50
... much better	C	-0.36	0.00	0.77	-0.64	-0.01	0.51	0.52	0.01	0.50	1.17	0.01	0.26	-0.77	-0.01	0.37
Parking situation gets...	C														
... worse	C	0.20	0.00	0.80	0.07	0.00	0.91	0.90	0.02	0.07	-0.54	-0.01	0.42	-0.46	-0.01	0.40
... much worse	C	-2.21	-0.01	0.13	0.36	0.00	0.75	1.79	0.02	0.05	0.34	0.00	0.78	-0.25	0.00	0.81
... better	C	1.27	0.01	0.13	-0.11	0.00	0.86	-1.40	-0.02	0.01	0.14	0.00	0.84	0.40	0.01	0.49
... much better	C	4.34	0.03	0.00	1.10	0.01	0.33	-4.63	-0.05	0.00	-1.89	-0.01	0.12	1.69	0.02	0.09
License holding and car availability and associated changes															
Driving license holding	B	6.08	0.11	0.00	-4.12	-0.10	0.00	-0.66	-0.02	0.18	-2.62	-0.06	0.00	0.42	0.01	0.45
Achievement of driving license	C	18.75	0.13	0.00	-6.75	-0.06	0.00	-4.74	-0.05	0.00	-4.56	-0.04	0.00	-3.17	-0.03	0.00
Loss of driving license	C	-2.55	-0.01	0.13	2.12	0.01	0.11	1.86	0.02	0.08	0.10	0.00	0.95	-0.94	-0.01	0.42
Car availability (reference: no)	B														
Occasionally / after agreement	B	2.85	0.04	0.00	1.76	0.03	0.00	-2.06	-0.05	0.00	-0.87	-0.02	0.20	-1.31	-0.03	0.02
Regularly	B	11.52	0.26	0.00	-0.64	-0.02	0.22	-4.30	-0.16	0.00	-3.25	-0.09	0.00	-2.70	-0.09	0.00
Increase in car availability	C	8.91	0.10	0.00	-1.83	-0.03	0.01	-2.92	-0.05	0.00	-2.53	-0.03	0.00	-1.15	-0.02	0.06

(continued)																
Loss in car availability	C	-7.66	-0.08	0.00	2.02	0.03	0.00	2.18	0.04	0.00	2.40	0.03	0.00	1.10	0.02	0.06
Spatial context at residence, relocation																
Municipality size category (reference: < 20,000 inh)	B															
20,000-100,000 inh	B	0.38	0.01	0.42	0.86	0.02	0.02	-0.32	-0.01	0.28	-1.25	-0.03	0.00	0.35	0.01	0.29
100,000-500,000 inh	B	-0.34	-0.01	0.56	-0.11	0.00	0.81	0.82	0.02	0.03	0.29	0.01	0.56	-0.64	-0.02	0.12
> 500,000 inh	B	-1.17	-0.02	0.09	-1.11	-0.02	0.04	3.40	0.09	0.00	-0.92	-0.02	0.11	-0.49	-0.01	0.30
Central residential location within city	B	-1.56	-0.03	0.02	-1.22	-0.03	0.02	-0.39	-0.01	0.34	3.93	0.08	0.00	-0.75	-0.02	0.10
Urbanity (Variety of facilities in neighbourhood accessible on foot)	B	-1.06	-0.07	0.00	-0.38	-0.03	0.00	-0.18	-0.02	0.06	0.94	0.07	0.00	0.58	0.06	0.00
PT quality in neighbourhood (variety of different systems accessible on foot)	B	-0.87	-0.04	0.00	-0.07	0.00	0.69	0.39	0.03	0.01	0.16	0.01	0.41	0.33	0.02	0.04
Move to centre	C	0.98	0.01	0.38	-0.14	0.00	0.88	0.58	0.01	0.41	-0.73	-0.01	0.44	-0.84	-0.01	0.28
Move to periphery	C	1.84	0.01	0.14	0.80	0.01	0.41	0.10	0.00	0.90	-4.45	-0.04	0.00	1.67	0.02	0.05
Move to larger municipality	C	-3.09	-0.01	0.12	1.10	0.01	0.48	0.49	0.00	0.69	-0.19	0.00	0.91	1.15	0.01	0.40
Move to smaller municipality	C	0.36	0.00	0.85	0.19	0.00	0.90	1.79	0.01	0.12	-1.76	-0.01	0.25	0.29	0.00	0.82
Change in urbanity	C	-0.48	-0.02	0.01	-0.37	-0.02	0.01	-0.20	-0.02	0.08	0.84	0.05	0.00	0.21	0.02	0.10
Change in PT quality	C	-0.13	0.00	0.66	-0.24	-0.01	0.28	0.32	0.02	0.08	0.04	0.00	0.85	0.03	0.00	0.90
Cohort and period																
Cohort (94 yrs in 1994 = 0)	B	0.29	0.25	0.00	-0.06	-0.06	0.34	-0.18	-0.25	0.00	-0.11	-0.11	0.11	0.04	0.06	0.43
Cohort, squared, div. by 100	B	-0.19	-0.18	0.01	0.03	0.04	0.59	0.18	0.28	0.00	0.04	0.05	0.50	-0.05	-0.07	0.38
Year of survey (1994 = 0)	B	-0.28	-0.05	0.11	0.17	0.04	0.23	-0.01	0.00	0.94	-0.01	0.00	0.92	0.12	0.03	0.33
Year of survey * 2000 or later	B	0.05	0.01	0.71	-0.15	-0.04	0.14	0.07	0.02	0.41	0.08	0.02	0.46	-0.04	-0.01	0.66
Baseline value of mode choice																
Share of trips made by mode under study	B	-36.91	-0.61	0.00	-43.77	-0.51	0.00	-34.53	-0.49	0.00	-38.99	-0.50	0.00	-29.62	-0.39	0.00
R^2 adj		19.8			21.1			17.1			19.9			14.0		
n		11,235			11,235			11,235			11,235			11,235		

Table 7: OLS regression models of mode choice (changes in percentages of trips)
Regression coefficients B have been multiplied by 100 for more convenient interpretation. They reflect percentages from 0-100 rather than from 0-1.
B = baseline variable; C = change variable.

		Car (driver)			Car (passenger)			Public transport			On foot			Bicycle		
		B	Beta	Sig.	B	Beta	Sig.	B	Beta	Sig.	B	Beta	Sig.	B	Beta	Sig.
Intercept		0.01		0.92	0.08		0.21	0.28		0.00	0.23		0.01	0.01		0.84
Gender, household, family biography																
Gender female	B	-0.15	-0.07	0.00	0.17	0.15	0.00	0.00	0.00	0.65	0.03	0.02	0.02	-0.01	-0.01	0.25
No. of children in household (< 10 yrs)	B	0.08	0.05	0.00	-0.02	-0.02	0.04	0.00	0.00	0.66	0.02	0.02	0.07	0.02	0.03	0.01
No. of children in household (10-13 yrs)	B	0.00	0.00	0.91	-0.02	-0.01	0.18	0.00	0.00	0.95	0.00	0.00	0.81	0.04	0.03	0.00
No. of children in household (14-17 yrs)	B	0.11	0.05	0.00	0.02	0.02	0.10	-0.01	-0.01	0.44	-0.04	-0.02	0.02	-0.01	-0.01	0.52
Living with partner	B	-0.05	-0.02	0.01	0.10	0.08	0.00	-0.02	-0.03	0.01	-0.07	-0.04	0.00	-0.01	-0.01	0.58
Birth of a child	C	-0.02	0.00	0.78	-0.07	-0.02	0.04	-0.04	-0.01	0.09	0.13	0.02	0.01	-0.12	-0.03	0.00
Household foundation with partner	C	-0.08	-0.01	0.23	0.14	0.03	0.00	0.02	0.01	0.52	-0.04	-0.01	0.41	0.04	0.01	0.21
Separation from partner	C	-0.06	-0.01	0.40	-0.04	-0.01	0.33	0.06	0.02	0.03	0.06	0.01	0.29	-0.02	0.00	0.66
Move out of child	C	-0.12	-0.02	0.06	-0.03	-0.01	0.30	0.04	0.01	0.09	-0.01	0.00	0.81	0.05	0.01	0.14
Social status, employment and educational biography																
Employment (reference: full-time)	B															
Part-time employed	B	0.07	0.02	0.03	-0.01	-0.01	0.56	-0.01	0.00	0.64	0.04	0.02	0.05	0.04	0.02	0.03
Apprenticeship, trainee, in education	B	-0.21	-0.07	0.00	0.05	0.03	0.06	0.03	0.02	0.16	0.05	0.02	0.18	0.02	0.01	0.41
Not employed	B	-0.03	-0.01	0.43	0.02	0.02	0.25	-0.05	-0.06	0.00	0.06	0.04	0.01	0.02	0.02	0.22
Education level (reference: university entrace qualification or higher)	B															
Elementary school qualification without ...apprenticeship or no qualification	B	-0.12	-0.04	0.00	0.02	0.01	0.36	0.00	0.00	0.76	-0.07	-0.03	0.01	0.00	0.00	0.86
...plus apprenticeship	B	-0.04	-0.02	0.10	0.02	0.02	0.08	-0.02	-0.02	0.11	-0.04	-0.02	0.05	-0.05	-0.04	0.00
Secondary school qualification level I	B	0.00	0.00	0.83	-0.01	0.00	0.65	-0.01	-0.01	0.37	-0.02	-0.01	0.16	-0.05	-0.04	0.00
Start of apprenticeship	C	-0.13	-0.01	0.25	0.09	0.01	0.12	0.03	0.01	0.52	-0.08	-0.01	0.32	-0.04	-0.01	0.54
Completion of school or apprenticeship	C	-0.01	0.00	0.78	0.01	0.00	0.67	-0.01	-0.01	0.50	0.02	0.01	0.43	-0.01	0.00	0.76
Entry into labour market	C	0.26	0.05	0.00	-0.03	-0.01	0.24	0.01	0.00	0.61	-0.08	-0.02	0.02	-0.04	-0.01	0.17
Change in workplace	C	0.00	0.00	0.99	-0.02	-0.01	0.29	0.01	0.01	0.32	-0.03	-0.01	0.19	0.01	0.00	0.77
Leaving labour market (no retirement)	C	0.05	0.01	0.46	0.00	0.00	0.98	-0.08	-0.03	0.00	0.13	0.03	0.00	-0.04	-0.01	0.20
Retirement	C	-0.06	-0.01	0.28	-0.01	0.00	0.72	0.00	0.00	0.95	0.05	0.01	0.22	0.05	0.01	0.12
Access to place of work or education and associated changes																
Walking distance from PT stop to work 10 minutes or more	B	-0.02	-0.01	0.56	-0.04	-0.03	0.02	-0.02	-0.01	0.25	-0.03	-0.01	0.27	0.00	0.00	0.80

(continued)																
PT connection (reference: good)	B															
Poor connection	B	0.05	0.02	0.12	-0.01	-0.01	0.61	-0.03	-0.03	0.01	-0.02	-0.01	0.24	-0.02	-0.02	0.18
No connection	B	0.03	0.01	0.27	-0.01	-0.01	0.51	-0.06	-0.06	0.00	-0.02	-0.01	0.39	0.02	0.01	0.36
Parking situation at work (reference: good or more good than difficult)	B															
Difficult	B	-0.06	-0.01	0.13	0.00	0.00	0.88	0.06	0.04	0.00	0.00	0.00	0.91	0.00	0.00	0.90
Very difficult	B	-0.13	-0.03	0.00	-0.01	0.00	0.68	0.07	0.04	0.00	-0.01	0.00	0.72	0.00	0.00	0.97
Walking distance from PT stop...	C															
... increases considerably	C	0.04	0.00	0.68	0.00	0.00	0.92	-0.09	-0.02	0.01	-0.12	-0.02	0.06	-0.03	-0.01	0.50
... increases somewhat	C	-0.02	0.00	0.64	-0.04	-0.01	0.14	0.03	0.01	0.14	-0.06	-0.01	0.10	-0.02	-0.01	0.54
... decreases considerably	C	-0.18	-0.02	0.06	0.04	0.01	0.39	0.10	0.02	0.01	0.14	0.02	0.05	0.10	0.02	0.06
... decreases somewhat	C	-0.04	-0.01	0.49	0.02	0.01	0.43	0.06	0.03	0.01	-0.02	0.00	0.70	-0.01	0.00	0.73
PT connection gets...	C															
... worse	C	0.03	0.01	0.44	0.04	0.02	0.02	0.00	0.00	0.91	-0.06	-0.02	0.02	-0.03	-0.02	0.10
... much worse	C	0.05	0.01	0.39	0.03	0.01	0.35	-0.03	-0.01	0.13	0.04	0.01	0.33	-0.01	0.00	0.79
... better	C	-0.02	0.00	0.68	0.01	0.00	0.65	-0.01	-0.01	0.47	-0.01	0.00	0.74	0.00	0.00	0.82
... much better	C	0.06	0.01	0.31	-0.05	-0.01	0.12	0.01	0.00	0.61	0.02	0.00	0.59	-0.03	-0.01	0.34
Parking situation gets...	C															
... worse	C	0.02	0.01	0.56	0.00	0.00	0.98	0.01	0.01	0.34	-0.04	-0.01	0.17	-0.01	-0.01	0.52
... much worse	C	-0.18	-0.02	0.01	-0.02	0.00	0.64	0.07	0.02	0.02	0.01	0.00	0.86	0.00	0.00	0.91
... better	C	0.07	0.01	0.10	0.01	0.00	0.79	-0.05	-0.03	0.00	0.00	0.00	0.93	0.01	0.00	0.61
... much better	C	0.19	0.03	0.01	0.04	0.01	0.26	-0.14	-0.05	0.00	-0.11	-0.02	0.03	0.02	0.01	0.52
License holding and car availability and associated changes																
Driving license holding	B	0.20	0.08	0.00	-0.12	-0.08	0.00	-0.03	-0.03	0.04	-0.05	-0.03	0.05	0.02	0.01	0.42
Achievement of driving license	C	0.74	0.11	0.00	-0.15	-0.04	0.00	-0.14	-0.05	0.00	-0.06	-0.01	0.17	-0.11	-0.03	0.00
Loss of driving license	C	-0.01	0.00	0.93	0.07	0.01	0.12	0.08	0.02	0.01	0.01	0.00	0.80	-0.01	0.00	0.79
Car availability (reference: no)	B															
Occasionally / after agreement	B	0.11	0.03	0.00	0.07	0.04	0.00	-0.06	-0.05	0.00	-0.02	-0.01	0.49	-0.05	-0.03	0.01
Regularly	B	0.48	0.22	0.00	0.01	0.01	0.65	-0.13	-0.15	0.00	-0.07	-0.05	0.00	-0.09	-0.08	0.00
Increase in car availability	C	0.35	0.08	0.00	-0.05	-0.02	0.04	-0.09	-0.05	0.00	-0.07	-0.02	0.03	-0.03	-0.01	0.24
Loss in car availability	C	-0.34	-0.07	0.00	0.06	0.02	0.01	0.07	0.04	0.00	0.05	0.02	0.06	0.02	0.01	0.31

(continued)																
Spatial context at residence, relocation																
Municipality size category (reference: < 20,000 inh)	B															
20,000-100,000 inh	B	0.02	0.01	0.48	0.04	0.03	0.00	-0.01	-0.01	0.35	-0.03	-0.02	0.11	0.03	0.02	0.04
100,000-500,000 inh	B	0.00	0.00	0.92	0.00	0.00	0.83	0.03	0.03	0.00	0.01	0.00	0.65	-0.02	-0.02	0.15
> 500,000 inh	B	-0.09	-0.03	0.01	-0.03	-0.02	0.05	0.11	0.09	0.00	-0.04	-0.02	0.12	-0.01	-0.01	0.45
Central residential location within city	B	-0.05	-0.02	0.13	-0.05	-0.03	0.00	0.00	0.00	0.91	0.12	0.06	0.00	-0.03	-0.02	0.13
Urbanity (Variety of facilities in neighbourhood accessible on foot)	B	-0.02	-0.03	0.00	-0.01	-0.02	0.08	-0.01	-0.02	0.06	0.04	0.08	0.00	0.02	0.05	0.00
PT quality in neighbourhood (variety of different systems accessible on foot)	B	-0.01	-0.01	0.33	0.00	0.01	0.57	0.01	0.03	0.00	0.01	0.02	0.15	0.02	0.03	0.01
Move to centre	C	-0.01	0.00	0.81	-0.01	0.00	0.75	0.01	0.00	0.79	-0.06	-0.01	0.10	-0.06	-0.02	0.04
Move to periphery	C	0.05	0.01	0.42	0.03	0.01	0.28	-0.03	-0.01	0.26	-0.17	-0.04	0.00	0.07	0.02	0.03
Move to larger municipality	C	-0.19	-0.02	0.05	-0.01	0.00	0.77	0.02	0.00	0.56	0.02	0.00	0.71	-0.03	0.00	0.60
Move to smaller municipality	C	-0.02	0.00	0.84	0.02	0.00	0.62	0.08	0.02	0.03	-0.08	-0.01	0.20	-0.03	-0.01	0.51
Change in urbanity	C	-0.01	-0.02	0.10	-0.01	-0.02	0.04	-0.01	-0.01	0.12	0.03	0.04	0.00	0.01	0.01	0.26
Change in PT quality	C	0.00	0.00	0.79	0.00	0.00	0.75	0.01	0.02	0.08	0.01	0.01	0.28	0.01	0.01	0.21
Cohort and period																
Cohort (94 yrs in 1994 = 0)	B	0.01	0.20	0.00	0.00	0.08	0.26	0.00	-0.14	0.04	0.00	0.04	0.51	0.00	0.07	0.32
Cohort, squared, div. by 100	B	-0.01	-0.11	0.15	0.00	-0.05	0.47	0.00	0.17	0.02	0.00	-0.07	0.35	0.00	-0.07	0.34
Year of survey (1994 = 0)	B	0.00	-0.01	0.77	0.00	0.02	0.52	0.00	0.01	0.62	0.01	0.03	0.34	0.00	0.02	0.61
Year of survey * 2000 or later	B	-0.01	-0.04	0.21	0.00	-0.03	0.25	0.00	0.00	0.90	0.00	-0.02	0.59	0.00	-0.01	0.73
Baseline value of mode choice																
Frequency of trips (by mode under study)	B	-0.39	-0.58	0.00	-0.50	-0.55	0.00	-0.36	-0.51	0.00	-0.39	-0.48	0.00	-0.30	-0.40	0.00
R^2 adj		20.7			25.1			19.0			19.9			14.7		
n		11,235			11,235			11,235			11,235			11,235		

Table 8: OLS regression models of mode choice (changes in daily trip frequencies)
B = baseline variable; C = change variable.

Appendix 3: data processing

Changes in household structure – determination of household type

The determination of changes in the household structure requires to determine household type. In common with most other travel surveys, the MOP data do not include direct information on household type. Household type has to be reconstructed from the household members' number, sex and age.

I distinguish between single (one person) households, couples without children, families, single parents, and other households. Those households are defined as families that have one or more children below the age of 18, as well as households with three or more adults if the age difference between the second oldest and the third oldest household member is more than 18 years, and the third oldest household member is younger than 30 years of age. In such cases the household is assumed to be a family with an adult child.

Similarly, households with two or more adults are identified as single parents with adult children if the age difference between the oldest and the second oldest household member is more than 18 years, and the second oldest household member is younger than 30 years of age. Otherwise, households with two adults are coded as couples. Households with three or more adults that do not match these conditions are classified as 'other households'.

In few cases of complex households – e.g. when grandparents or other persons live in the household – this procedure does not permit a clear decision about which household members are assumed to be partners. These households were inspected individually, and the couples were detected by age and sex combination of the household members.

False coding may occur anyway. Imagine a patchwork family composed of a 49-year-old man, his 25-year-old second wife, the 24-year-old husband's son, and the 3-year-old wife's daughter. This household would be classified as a young family with a grandfather living in the household. The 25-year-old woman and the 24-year-old man would be classified as a couple. Cases such as this are likely to be very rare, however. Note also that all those identified as couples may be flat-mates rather than couples in reality.

Residential moves and changes in spatial context at the residence

Changes in travel mode choice after a residential move are dependent on changes in spatial context associated with the move, while the move per se may not be particularly relevant. Such changes in spatial context mainly depend on the direction of the move (e.g., to a central v. remote location). Changes in spatial context may also be due to changes in urban structure or transport systems characteristics at the residence location.

The data include various variables of spatial context in the neighbourhood. These include access within walking distance to PT systems and to various facilities. This information is used to calculate two variables that reflect the quality of the PT supply and the degree of urbanity at the residence, i.e. here: the variety of neighbourhood facilities. Both variables are based on the number of 'yes'-counts of PT systems or facilities accessible on foot. From the counts changes from one year to the next are computed.

- PT quality: bus, tram, underground, regional train (S-Bahn), train (ranging from 0 to 5)
- urbanity: groceries, other shopping facilities, restaurants/pubs, evening leisure facilities (cinema, theatre, concerts...), sports facilities (ranging from 0 to 5).

The data also include information on municipality size category and residence location within the municipality. Four change dummies are constructed from this information:

- Move to periphery, move to centre. Such moves reflect location changes within the municipality as reported by the respondents (from a central to a remote location or vice versa). This information is only available for medium sized towns and cities. Small towns and villages are coded as remote.
- Move to larger municipality, move to smaller municipality. These dummies are calculated from six municipality size categories.

Changes in access to the place of work or education

The data include various measures of access to the place of work or education. This information is transformed into the following variables. Generally, an improvement by at least two categories is coded as 'much better' or 'considerable improvement', and vice versa.

- PT connection is measured in five categories: speedy direct connection; one transfer required; slow direct connection; more than one transfer required; no PT connection available. The two answer categories 'speedy direct connection' and 'one transfer required' are associated to very similar PT modal split shares (ca 30 percent for job plus education trips; 22 percent for just job trips). The same is true for the two categories 'slow direct connection' and 'more than one transfer required' (ca 18 percent for job plus education trips; 10 percent for just job trips).

The PT share in job plus education trips is only 1 percent for job plus education trips among respondents who report having no PT connection to work/education available. Hence, the answers are summarised into three categories: 'good' means there is a speedy direct connection, or one transfer is required. 'Poor' means there is a direct connection, or more than one transfer is required. The third category is 'no PT connection available'. These three categories are used as baseline values, and they are used to compute dummy variables of change (PT connection to work/education gets better, much better, worse, or much worse).

- Walking distance from the nearest PT stop to work or education is recorded in three categories: < 10, 10-20, > 20 minutes. Dummy variables of change are computed the same way as for the PT connection, indicating that the walking distance increases considerably, increases somewhat, decreases considerably, or decreases somewhat. Only one dummy is used as a baseline value, indicating whether the walking distance is less than 10 minutes or not. At this threshold travel mode choice changes considerably.

- The parking situation at the workplace is recorded in four categories: very difficult; difficult; more good than difficult; good. Again, dummy variables of change are computed: parking situation gets better, much better, worse, or much worse. With respect to baseline values, the categories 'more good than difficult' and 'good' are associated with similar travel mode choice distributions. Hence, they are summarised into one reference category. The categories 'very difficult' and 'difficult' are treated as separate dummies.