

Interdependencies between turning points in life and long-term mobility decisions

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Abstract Turning points in life include important personal and familial events as well as changes in the places of residence, education and employment. The latter usually involve alterations in the spatial distribution of activities and, hence, in the activity space, thereby also influencing the daily travel behavior. In this context, the ownership of mobility tools, such as cars and different public transport season tickets, also plays an important role, since people commit themselves to particular travel behaviors as they trade large one-time costs for a low marginal cost at the time of usage. At the same time, decisions concerning mobility tool ownership have lasting effects, as have the decisions concerning location choices. A longitudinal perspective on the dynamics of these long-term mobility decisions is available from people's life courses, which link different dimensions of life together. In order to study these dynamics and the influence of turning points in life, a longitudinal survey covering the 20 year period from 1985 to 2004 was carried out at the beginning of 2005 in a stratified sample of municipalities in the Zurich region, Switzerland. The paper describes the data collection and then presents results which show that there exist strong interdependencies between the various turning points and long-term mobility decisions during the life course, as events occur to a great extent simultaneously. Persons tend to aim for compensation between the different dimensions of life.

Keywords Turning points · Residential and occupational behavior · Mobility tool ownership · Life course · Retrospective survey

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Introduction

Daily travel behavior is strongly influenced by the location of the places of residence, education and employment. After changes in these spatial structures, e.g., due to moves or changes in occupation, people inevitably show a travel behavior that is different from the travel behavior before these relocations occurred, as usually changes in the spatial distribution of activities and, hence, in the activity space are implied, influencing trip distances, routing, timing and frequency (Chapin 1965, 1974; Hägerstrand 1970; Scheiner 2006). At the same time, the availability as well as the quality and quantity of the available transport systems change. In turn, the decisions about the ownership and usage of the various mobility tools are influenced, as they provide access to the different transport systems and determine the marginal costs of usage. In this context, the question arises, to what extent the availability of mobility tools already affects the residential and occupational decisions of people, particularly with regard to so-called self-selection processes (Cao et al. 2006; Prillwitz et al. 2006).

These long-term mobility decisions form turning points in life. Further important turning points include personal and familial events, such as changes in education and employment as well as family formation (partnership, marriage), expansion (birth of children), contraction (maturation of children) and dissolution (break-up, divorce, death of a partner or spouse). These events have lasting effects, since corresponding changes involve substantial amounts of resources (costs, time, etc.). Therefore, it is necessary to analyze their dynamics over longer periods of time. A longitudinal perspective on the relationships between spatial mobility and mobility tool ownership is available from people's life courses, which link different dimensions of life together. Besides personal and familial history, locations of residence, education and employment as well as the ownership of various mobility tools can be taken into account. These life course dimensions are usually not independent from one another. Events in one area are frequently connected to changes in other areas. Decisions are rarely made in isolation and choice behavior is often context dependent (Verhoeven et al. 2005). At the same time, this longitudinal approach provides the possibility to observe developments over time, as behavior is influenced by time, and to identify state dependencies (Hensher 1998; Hollingworth and Miller 1996; Lanzendorf 2003; Verhoeven et al. 2005; Wagner 1990). The life course perspective enables the integration of the temporal dimension and dynamics into the analyses of long-term mobility in a comprehensive way (Elder 2000).

Analyzing people's life courses can contribute to the understanding of their reactions to changes occurring in their personal and familial life, within their household as well as in the spatial structures (Simm and Axhausen 2003). For instance, one can analyze how a move affects mobility tool ownership and, therefore, travel behavior, since mobility tool ownership can be used as a proxy for the actual travel behavior (Prillwitz et al. 2006; Simm and Axhausen 2003). Through the ownership of mobility tools people commit themselves to particular travel behaviors as they trade large one-time costs for a low marginal cost at the time of usage.

Turning points during the life course play a central role, when formulating transport policies which are designed to influence people's behavior, as they reconsider and reflect their decisions and choices only in the cases where the situation is very different from the usual context (Gorr 1997; Jones et al. 1983; Lanzendorf 2003). Thereby, questions regarding how, when and why such changes might happen are of large interest for policy makers and planners. From the incorporation of temporal effects, besides spatial effects,

into the analyses of long-term mobility, a better assessment of the impact of policies and other interventions on travel behavior is expected (Lanzendorf 2006).

Life course

The life course itself can be regarded as a contextual system (Mayer 1990). A person's past affects his or her present, and his or her present affects his or her future (Ryder 1965). Individuals seek coherence and continuity. So, an individual's life course and the successive events that constitute it are not random, but patterned.

The structure of the life course is described with trajectories and transitions (Elder 2000). As intermediary concept, the life course is seen as a sequence of events (Elder 2000; Sackmann and Wingens 2001). In this context, it is worthwhile to understand an event as well as the history leading up to its occurrence, since past behavior is strongly correlated to present behavior (Box-Steffensmeier and Jones 2004). A further advantage regarding the investigation and improved understanding and modeling of the dynamic aspects is the provision of more accurate and coherent forecasts of the future (Lanzendorf 2003).

These dynamic effects can not be captured with cross-sectional data (Dargay 2001). The analyses of turning points in life and long-term mobility decisions require corresponding longitudinal data that describe people's life courses. Solely this kind of data enables the investigation of continuity and change over time (Ryder 1965).

Data

Essentially, there are two ways of collecting such longitudinal data. The most obvious and well-recognized method is to conduct a panel survey, in which the same sample of persons is asked about their respective current situation at several points in time to build up a series of observations. Data collected this way are very reliable, since events are observed as they happen and, hence, inaccuracies due to memory loss are reduced (Diekmann 1995; Lanzendorf 2003; Zumkeller et al. 2006). However, panel surveys are difficult and expensive to carry out as well as rather effort and time consuming, due to the long durations required for data collection (Scott and Alwin 1998). Normally, it takes several years before it is possible to analyze long-term effects (Lanzendorf 2003). The second method approximating a panel survey is to use a retrospective approach that relies on individual's recall capacity and, hence, is subject to the limitations of the human memory. With increasing amounts of time elapsed since an event, the amount of information retained decreases in a logarithmic relationship (Brückner 1994; Hollingworth and Miller 1996; Lanzendorf 2004). People tend to remember major events, such as residential moves or personal and familial events, so-called turning points in life, better. Therefore, those can be used as support for the memory by further linking different dimensions of life together and in doing so placing single events into a larger context (Brückner 1990). Experiences from Hollingworth and Miller (1996) showed that a retrospective survey proved to be a favorable alternative to a panel survey. They tested it as a tool for collecting longitudinal data on residential mobility and found that people's ability to recall prior residential mobility decisions and housing details is generally good. Brückner (1994), Klein and Fischer-Kerli (2000), Lanzendorf (2004) and Peters (1988) also argue that a retrospective approach is feasible and suitable for important events of the life course that respondents are able to remember well. However, Verhoeven (2010) found that people have substantial

difficulties to recall aspects of their daily travel behavior, such as mode choice, timing, etc., in retrospect. These short-term mobility decisions tend to vary more frequently, and are therefore rather hard to collect over longer periods of time. Asking instead for the 'usual' travel behavior proved problematic too, due to confusion amongst respondents about what 'usual' means, thus lowering the quality of the data noticeably, particularly with respect to elements with relatively high levels of short-term intra-personal variability (Behrens and Del Mistro 2008). So in the present study, the respondents are asked to indicate the 'mostly used mode of transport' for the commuting trip, which represents a more general and clearer aspect of the daily travel behavior. Overall, retrospective data are easier, cheaper and faster to obtain than panel data (Gärling and Axhausen 2003). Retrospective surveys allow for observing longer time spans than usually are feasible with panel surveys, whereas panel data are able to cover a broader range and more detailed information.

In order to collect longitudinal data concerning turning points and long-term mobility decisions during the life course, a retrospective survey covering the 20 year period from 1985 to 2004 was carried out at the beginning of the year 2005 in a stratified sample of municipalities in the Zurich region, Switzerland. The stratification was based on a spatial and transport related classification of the municipalities, which was developed by the Federal Office for Spatial Development (2002). In this context, all Swiss municipalities are assigned to five different types. The first type covers the main centers. These are the core cities with more than 100,000 inhabitants and more than 50,000 workplaces. Types 2 and 3 comprise middle centers and ancillary centers of the main centers with and without access to the national railway network, respectively. Access is thereby defined as fast trains running at least every hour. The municipalities of the inner and outer agglomerations form the fourth type. The last type consists of the rural areas.

The survey was conducted using a written self-completion questionnaire which was sent out by mail. One reason for choosing this procedure was due to the relative complexity of the survey. In this way, respondents had more time, quiet and privacy when answering the questionnaire, remembering and recollecting their past, possibly looking up documents, if necessary. In addition, it is less demanding to obtain a larger sample, as expenses and costs tend to be in general lower in comparison to face-to-face and telephone interviews (Diekmann 1995). However, it is not possible to offer immediate assistance to the respondents, in the case that problems with understanding and filling in the questionnaire occur.

The questionnaire consisted of two parts, a household form and a person form. The household form asked for the current address, a short description of all persons living in the household and the household income. In the person form, socio-demographic and socio-economic characteristics of the respondents were collected. The essential part of this form was a multidimensional life course calendar, providing a visual reconstruction of the past. So a plain and compressed picture of the respondents' own life comprising several dimensions is developed which is also interesting and motivating for them to recover. Linking the various aspects together supports their recollection, as associations are formed (Brückner 1990; Freedman et al. 1988). At the same time, the graphic representation of the life course increases the quality and accuracy of the data, since inconsistencies in the timing of events between different dimensions become easier to detect. Furthermore, the life course calendar permits a comfortable handling of the complexity of the information and a rather straightforward recording of relatively detailed sequences of events in comparison to the conventional question-response format. Besides, it is a very flexible survey instrument (Bird et al. 2000).

The calendar itself is a matrix with a horizontal time axis for the observed time period from 1985 to 2004 with semi-annual precision. The 6-month-intervals are chosen, because this time unit is small enough to ascertain the sequence and relation of events (Freedman et al. 1988). But at the same time, it is necessary to consider the amount of detail as well as accuracy and time distinctiveness with which respondents are able to remember. Bird et al. (2000) made the experience that specifications on a semi-annual basis are feasible without larger difficulties. Along the other axis of the calendar, the different items of the retrospective survey are arranged vertically. For the 20 year period, information about turning points, such as important events of the personal and familial history, the household size as well as data on moves and corresponding places of residence was collected. In the case that several moves took place within a half-year period, the most important place of residence was to be specified. Furthermore, the respondents were asked to indicate their changing ownership of cars and different public transport season tickets, such as national and regional tickets as well as half-fare discount tickets. Data on the places of education and employment, on the main mode of transport for the commuting trip as well as on the personal income were collected for the period from 1985 to 2004. Figure 1 illustrates an example of the multidimensional life course calendar, showing a person which left the parents' house in the year 1986, then lived 2 years alone and then moved together with a partner in a new accommodation. In 1989 the couple married and subsequently had two children. Accordingly, the stated household size changes. There is also a connection to the ownership of the different mobility tools visible.

The questionnaire was sent out by mail to 3,600 households. Each household received, besides one household form, two person forms that were to be filled in by persons aged 18 years and older. The response rate amounted to only 23.1 %, which is primarily due to the relative length and complexity of the questionnaire (Axhausen 2007). Overall, 780 household forms and 1,166 person forms are available for further statistical analyses.

Results

Over time, the occurrence of important personal and familial events, such as the move out of the parents' house, the birth of persons in the household, partnerships and marriages as well as break-ups and divorces, is fairly constant, with shares ranging between 0 and 2 % per year. In contrast, alterations in residence, education and employment occur noticeably more frequently, e.g., with about 15 % of all the persons moving within each year. Concerning the changes in mobility tool ownership, only about 3 % of the respondents vary their mobility tool ownership each year. In about one-third of all cases, respondents acquire a car, whereas only 10 % are related to the abandonment of a car. To a lesser extent and in a more balanced way, this also applies to the various public transport season tickets, pointing to a slightly weaker commitment to public transport.

Figure 2 shows the occurrence of important turning points during the life course, based on 5 year intervals. Due to the fact that the respondents are of different age during the observed time period from 1985 to 2004, the number of cases within each interval varies. The turning points considered include personal and familial events, changes in the places of residence, education and employment as well as changes in car availability and public transport season ticket ownership. Most personal and familial events occur rather early in life, consistent with the literature (Aufhauser 1995; Birg and Flöthmann 1992; Wagner 1990). The move out of the parents' house primarily takes place at the age between 15 and 20 years. The birth of persons in the household shows a maximum at the beginning,

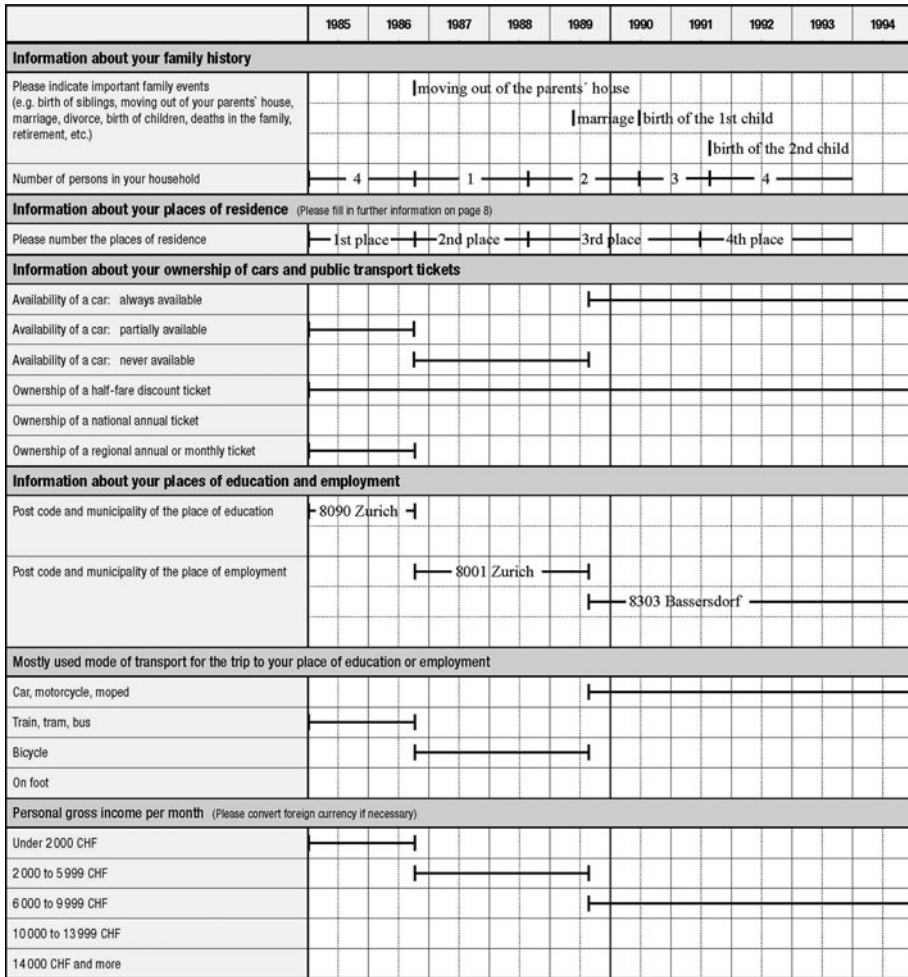


Fig. 1 Example of the multidimensional life course calendar

covering the respondents' own birth as well as the birth of siblings. Between the ages of 20 and 30 years, again a higher number of children are born, followed by a gradual decrease afterwards. The share for the formation of partnerships and marriages is highest for persons aged from 15 to 30 years. Break-ups and divorces show overall a relatively flat graph with values not exceeding 1 %, peaking in the early forties. Concerning the changes in the place of residence, most moves occur between the ages of 20 and 35 years, with a maximum of about 15 %. Afterwards the share of moves gradually decreases. This supports findings of Birg and Flöthmann (1992), Wagner (1990), and others. For the changes in the place of employment, the curve is very similar, however, at a lower level. Between the ages of 60 and 65 years, the influence of retirement becomes visible. Variations in education occur, concurrent with the expectations, earlier during the life course. This share reaches a maximum for persons aged from 15 to 20 years. In comparison to the spatial changes, the shape of the curves regarding mobility tool ownership is overall very similar, but the scale

is ranging only up to 5 % instead of up to 20 %, indicating that mobility tool ownership is considerably more stable than the relocation behavior concerning the places of residence, education and employment. For the ownership of always and partially available cars, the two maxima are slightly offset from one another, with always following partially car availability. After the age of 40 years, both curves become flat. There are some persons who give up their car as they get older, but this happens only to a lesser extent. For the national tickets, the share of variations is noticeably lower, with the highest values being surveyed between the ages of 15 and 30 years. Regional tickets behave very similar to the partially available cars, with a maximum for persons aged around 18 years. The half-fare discount tickets show larger variations with increasing age compared to the other mobility tools.

Analyzing the occurrence and non-occurrence of changes within the same year, significant connections between the different types are observed. The strongest links are detected for always and partially available cars as well as among the various public transport season tickets. The changes in residence, education and employment are also considerably related to one another, confirming findings of Rouwendal and van der Vlist (2005), as well as of others.

In the following, binomial logit models are presented for the occurrence or non-occurrence of changes in residence, education and employment as well as of changes in the ownership of the different mobility tools between the years 1985 and 2004. For this time period, observations on a semi-annual basis are included in the data set. Unfortunately, it is not possible to take the direction of the changes into account, i.e., starting or ending education and employment, since the proportion of changes in the data set is not sufficient to be further distinguished. For the explanatory variables used in the models, the difference between after and before each point in time is calculated on a semi-annual basis. Tables 1 and 2 show the results of the various estimated binomial logit models. As measure for the goodness of fit, the adjusted ρ^2 is given. It is calculated as follows

$$\text{Adjusted } \rho^2 = 1 - \frac{L(\max) - K}{L(0)},$$

where $L(0)$ and $L(\max)$ represent the initial and the final log-likelihoods, respectively, and K denotes the number of estimated parameters (Bierlaire 2005). In all models, the adjusted ρ^2 is relatively high. Since the shares for changes occurring and not-occurring are rather unbalanced (e.g., 7 % for moving and 93 % for not-moving), the contribution of the constant term to the log-likelihood $L(\text{constant})$ is also presented, equaling the difference between the final log-likelihoods $L(\max)$ of the two models containing and not containing the constant term. Overall, the explanatory power of the constant term is very low in comparison to the other explanatory variables.

In the context of the model estimation, it is necessary to take into account that each respondent appears several times as observation and, therefore, to control for unobserved characteristics of the individuals. Thus, an error term is added, which allows individuals who are homogeneous in their observed characteristics to be heterogeneous in their response probabilities (Hsiao 2003). Within the model specification, a random parameter is introduced, which is normally distributed across the entire sample, but invariant for each individual. For this parameter, the standard deviation is estimated, while the mean value is set to zero (Bierlaire 2005). In the models, the estimated standard deviations of the individual-specific error term, which takes the panel effect into account, show relatively low values, indicating a slight heterogeneity in the sample.

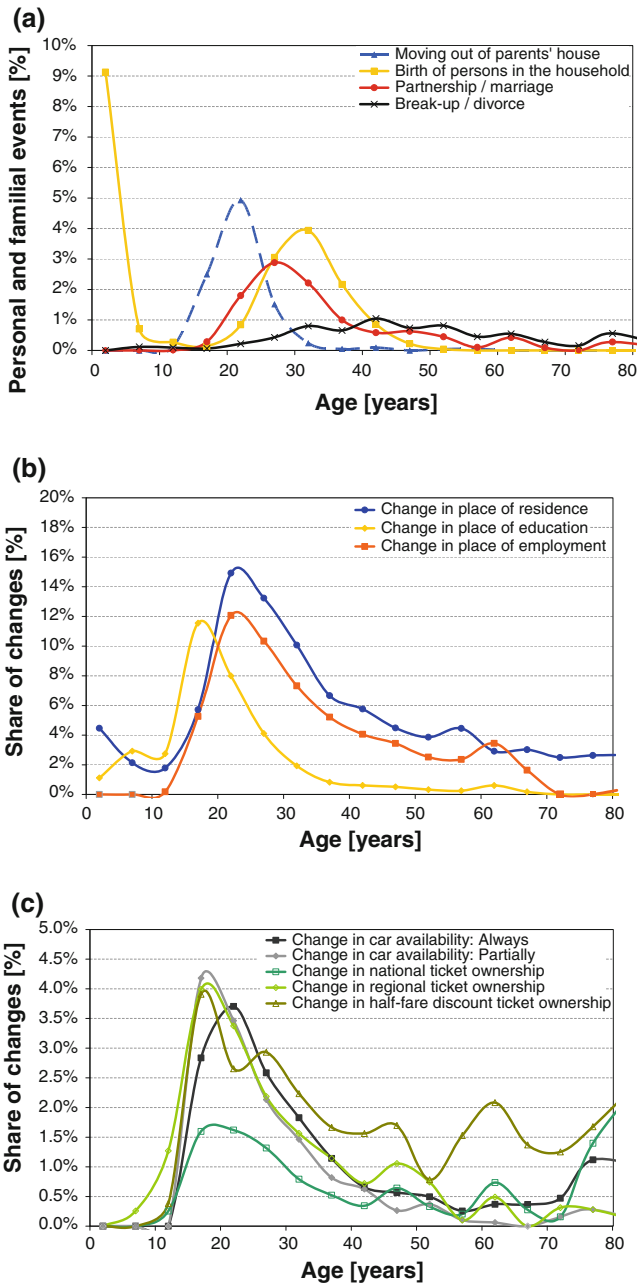


Fig. 2 Turning points and changes in long-term mobility during the life course. **a** Personal and familial events during the life course. **b** Changes in residence, education and employment during the life course. **c** Changes in car availability and public transport season ticket ownership during the life course

Concerning the changes in residence, the probability increases with increasing age until reaching a maximum for persons aged between 25 and 30 years, and after-wards the propensity to move declines. This also applies to the alterations in employment. Changes in

Table 1 Binomial logit models for the changes in residence, education and employment

| Explanatory variable (difference between the after and before status) | Change in residence | Change in education | Change in employment | Change in education and employment |
|---|---------------------|---------------------|----------------------|------------------------------------|
| Age in years | +0.063*** | -0.009 | +0.076*** | +0.022** |
| Age in years squared | -0.001*** | -0.001 | -0.001*** | -0.001*** |
| Gender: male | -0.098** | -0.217** | -0.143** | -0.146** |
| Nationality: Swiss national | -0.071 | +0.492*** | +0.156* | +0.234*** |
| College or university degree | +0.079* | +0.460*** | -0.037 | +0.081 |
| Increase in monthly income in 1,000 CHF | +0.095*** | +0.268*** | +0.023 | -0.046 |
| Increase in monthly income in 1,000 CHF squared | +0.028*** | +0.067*** | +0.161*** | +0.181*** |
| Moving out of parents' house | | +1.648*** | +1.009*** | +1.373*** |
| Birth of a person in the household | +1.636*** | -0.357 | +0.621*** | +0.421*** |
| Increase in number of persons in household | -0.923*** | -0.021 | -0.109*** | -0.044 |
| Increase in number of rooms in accommodation | | +0.013 | +0.045 | +0.018 |
| Increase in degree of rurality (from urban to rural) | +0.021 | +0.252 | +0.006 | +0.068 |
| Increase in population in res. municipality in 1,000 inhabitants | -0.000 | +0.000 | +0.000 | +0.000 |
| Increase in population density in res. municipality in 1,000 inhabitants per square kilometer | -0.006 | +0.136** | -0.029 | +0.059 |
| Change in place of residence from abroad | | +2.003*** | +3.270*** | +3.772*** |
| Change in place of residence to abroad | | +2.262*** | +2.523*** | +3.313*** |
| Increase in purchasing power index in res. region | -0.005 | -0.016 | +0.025** | +0.014 |
| Constant | -3.357*** | -2.783*** | -3.888*** | -2.616*** |
| Standard deviation of the individual-specific random parameter | 0.024 | 0.544*** | 0.537*** | 0.488*** |
| Number of persons | 1045.0 | 1045.0 | 1045.0 | 1045.0 |
| Number of observations | 31695.0 | 31695.0 | 31695.0 | 31695.0 |
| Share of observations with the value zero (%) | 93.3 | 96.7 | 93.9 | 92.2 |
| Share of observations with the value one (%) | 6.7 | 3.3 | 6.1 | 7.8 |

Table 1 continued

| Explanatory variable (difference between the after and before status) | Change in residence | Change in education | Change in employment | Change in education and employment |
|---|---------------------|---------------------|----------------------|------------------------------------|
| $L(0)$ | -21969.3 | -21969.3 | -21969.3 | -21969.3 |
| $L(\max)$ | -7304.0 | -3711.1 | -6328.3 | -7493.1 |
| $L(\text{constant})$ | 269.7 | 78.1 | 208.0 | 136.3 |
| Adjusted ρ^2 | 0.667 | 0.830 | 0.711 | 0.658 |

*** level of significance ≤ 0.01 ; ** level of significance ≤ 0.05 ; * level of significance ≤ 0.10

Table 2 Binomial logit models for the changes in car availability and public transport season ticket ownership

| Explanatory variable (difference between the after and before status) | Change in car availability: always | Change in car availability: partially | Change in national ticket ownership | Change in regional ticket ownership | Change in half-fare discount ticket ownership |
|---|------------------------------------|---------------------------------------|-------------------------------------|-------------------------------------|---|
| Age in years | +0.064** | +0.084** | -0.019 | +0.021 | -0.008 |
| Age in years squared | -0.002*** | -0.002*** | -0.000 | -0.001*** | -0.000 |
| Gender: male | -0.187* | -0.327*** | -0.313** | -0.361*** | -0.277*** |
| Nationality: Swiss national | -0.004 | +0.343** | +1.115*** | +0.023 | +0.454*** |
| College or university degree | +0.021 | +0.276*** | +0.720*** | +0.141 | +0.359*** |
| Increase in distance between place of residence and place of education in 1,000 km | -0.408*** | -0.143 | -0.052 | +0.138 | +0.023 |
| Increase in distance between place of residence and place of employment in 1,000 km | +0.047* | +0.062** | +0.083 | +0.275** | +0.080 |
| Increase in monthly income in 1,000 CHF | +0.261** | +0.337*** | +0.040 | +0.116** | +0.091*** |
| Increase in monthly income in 1,000 CHF squared | +0.007 | -0.005 | +0.033*** | +0.027*** | +0.034*** |
| Moving out of parents' house | +1.600*** | +1.810*** | +1.290*** | +1.382*** | +0.943*** |
| Birth of a person in the household | +0.820*** | +0.772*** | -0.630 | +0.407 | +0.442 |
| Increase in number of persons in household | -0.237*** | -0.142** | -0.074 | -0.043 | -0.168*** |
| Increase in number of rooms in accommodation | +0.058 | +0.048 | +0.083 | +0.115** | -0.000 |
| Increase in degree of rurality (from urban to rural) | -0.224 | -0.314 | +0.205 | -0.267 | +0.205 |
| Increase in population in res. municipality in 1,000 inhabitants | +0.000 | +0.000 | -0.000 | +0.001 | +0.002*** |
| Increase in population density in res. municipality in 1,000 inhabitants per square kilometer | -0.032 | -0.055 | +0.098 | -0.074 | -0.003 |
| Change in place of residence from abroad | +1.485*** | +2.176*** | +1.659** | +1.156* | +2.604*** |
| Change in place of residence to abroad | +0.697 | +1.158 | +1.384 | +1.174 | -34.153 |
| Increase in purchasing power index in res. region | +0.013 | +0.020 | +0.005 | +0.042** | +0.053*** |

Table 2 continued

| Explanatory variable (difference between the after and before status) | Change in car availability: always | Change in car availability: partially | Change in national ticket ownership | Change in regional ticket ownership | Change in half-fare discount ticket ownership |
|---|------------------------------------|---------------------------------------|-------------------------------------|-------------------------------------|---|
| Constant | -4.656*** | -4.831*** | -5.715*** | -3.835*** | -4.174*** |
| Standard deviation of the individual-specific random parameter | 0.174 | 0.401*** | 1.031*** | 0.523*** | 0.206 |
| Number of persons | 1045.0 | 1045.0 | 1045.0 | 1045.0 | 1045.0 |
| Number of observations | 31695.0 | 31695.0 | 31695.0 | 31695.0 | 31695.0 |
| Share of observations with the value zero (%) | 98.6 | 98.5 | 99.1 | 98.3 | 98.0 |
| Share of observations with the value one (%) | 1.4 | 1.5 | 0.9 | 1.7 | 2.0 |
| $L(0)$ | -21969.3 | -21969.3 | -21969.3 | -21969.3 | -21969.3 |
| $L(\max)$ | -2110.0 | -2217.1 | -1555.4 | -2553.1 | -3029.4 |
| $L(\text{constant})$ | 124.9 | 114.7 | 111.4 | 109.0 | 167.8 |
| Adjusted ρ^2 | 0.903 | 0.898 | 0.928 | 0.883 | 0.861 |

*** level of significance ≤ 0.01 ; ** level of significance ≤ 0.05 ; * level of significance ≤ 0.10

education are less likely to happen the older the respondents are. Overall, men show a more stable behavior regarding the spatial changes than women. The occurrence of all changes is accompanied by a rising income. Persons moving out of their parents' house tend to vary the places of education and employment more frequently at the same time. An increase in the household size reduces the propensity to move, unless the increase is due to the birth of a person, in which case the propensity to move rises, the latter being consistent with results by Aufhauser (1995). For respondents moving from or to abroad, the probability of occupational alterations taking place increases. The index of purchasing power in the residential region measures the changes in consumer prices in a country in Euro, making an adjustment for changes in exchange rates (Olsson 2005). This variable is only relevant for variations in the place of employment, having a positive effect.

Concerning the changes in mobility tool ownership, age as well as gender (being male) of the respondents has overall a negative influence on variations in car availability and public transport season ticket ownership. Swiss nationals tend to alter their ownership of mobility tools, with an exception for always available cars, more frequently than foreign nationals. This also applies to persons holding a college or university degree. An increase in the distance between the place of residence and the place of education decreases the probability of changes in car availability happening, whereas a place of employment which is further away is accompanied by more alterations. The monthly income has again a positive effect. The move out of the parents' house results in the occurrence of more changes in the ownership of mobility tools. A growth in household size makes changes in car availability become less likely, while, at the same time, when a person is born in the household, the respective probability rises. A move from or to another country leads, concurrent with the expectations, to more alterations taking place. An increasing index of purchasing power in the residential region has a positive effect, especially for the variations occurring in public transport season ticket ownership.

Overall, turning points in life as well as long-term mobility decisions are considerably connected to one another, this means that changes in the different dimensions of life tend to occur simultaneously. Around 50 % of all spatial changes are related to a change in residence, education and employment within the first year. After that, the shares of the longer delays observed strongly decrease. Concerning the delays until the next variation in mobility tool ownership following a move and a change in occupation, the connection is to some extent weaker. Respondents with always available cars show the most stable behavior. In this group changes after a change in residence, education or employment occur for only about 20 % of the persons within the first year, whereas this share amounts to about 30–35 % for persons with partially available cars. For the national and regional tickets, approximately one-third of all the delays are shorter than 1 year. The changes in half-fare discount ticket ownership show trends comparable to the always available cars. And again, the shares of the longer durations until the next change in mobility tool ownership decrease strongly after the first year. An analogue picture arises for the distribution of these durations after variations in car availability and public transport season ticket ownership. In this context, changes among the different mobility tools are very strongly connected to one another.

Duration models, which are estimated for the delays occurring subsequent to a move or a change in education or employment until the next changes in the ownership of mobility tools, indicate that with increasing age the so-called hazard or probability of transition decreases, especially after reaching the age of 30 years. Men are in general at a lower risk than women. Already having a car at disposal at the point of time when a change in residence, education or employment occurs, decreases the probability of changes in car

availability of the equal level, whereas an always available car increases the hazard for partially available cars, and vice versa. This means that cars are acquired rather than abandoned, supporting findings of Dargay (2001), providing a further indication of the stability of car availability. Among the various public transport season tickets, this relationship between the ownership of the same and another type exists as well. A simultaneous change of the place of residence and the places of education or employment leads to a shorter duration until the next alteration in mobility tool ownership, indicating a stronger effect of such a change. In detail, the corresponding duration models are to be found in Beige (2008) as well as in Beige and Axhausen (2008).

Conclusions

In summary, one can say that there exist strong interdependencies between the various turning points and long-term mobility decisions during the life course. Persons tend to aim for compensation between the different dimensions of life. Changes concerning locations, i.e., the places of residence, education and employment, take place significantly more frequently than changes concerning the ownership of the various mobility tools. At the same time, however, events occur to a great extent simultaneously. As spatial changes take place, the actual travel behavior, using mobility tool ownership as a proxy for this behavior, seems to be reconsidered and altered.

Most personal and familial events occur rather early in life. This also applies to the decisions concerning the long-term mobility. In general, persons between the ages of 15 and 35 years are most mobile, i.e., moving and changing occupation as well as varying the ownership of mobility tools most frequently. Afterwards they become relatively established. Furthermore, male respondents show a more stable behavior than female respondents. Women seem to be more flexible, for instance, making considerable adjustments following the birth of children. Once children are born and live in a household, they have a stabilizing influence on the long-term mobility of this household.

Regarding the design of policy and planning instruments, which seek to change travel behavior, this means that these instruments should aim at the younger generations, as their travel habits and routines are not fully established yet, being consistent with findings by Prillwitz and Lanzendorf (2006), and, therefore, easier to influence.

Additional opportunities to significantly affect travel behavior are provided by the turning points in life, such as important personal and familial events as well as changes in residence, education and employment, as habits and routines are broken or at least weakened, and individuals reconsider their behavior and consciously reflect on their decisions. There exist only short periods of time during an individual's life course in which he or she looks into travel choices (Gorr 1997). The analyses of the life courses show that these events play an important role with respect to the ownership of the various mobility tools. In this context, residential relocations as well as changes in occupation seem to be the most important ones. Therefore, these spatial alterations provide interesting starting points for policies and other interventions aiming at travel behavior change, due to accessibility and transport systems changes (Bamberg 2006). Corresponding instruments could include the provision of information about alternative ways to travel from or to a new place of residence or occupation, the implementation of more successful mobility management and public transport marketing strategies, especially targeting younger people, new residents or people entering education or employment, as well as the supply of temporary free or discounted public transport tickets, free bicycles, etc.

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