


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

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INTERDEPENDENCIES BETWEEN TURNING POINTS IN LIFE AND LONG-TERM MOBILITY DECISIONS

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1 ABSTRACT

2
3 Turning points in life include important personal and familial events as well as changes in the
4 places of residence, education and employment. The latter usually involve alterations in the
5 spatial distribution of activities and, hence, in the activity space, thereby also influencing the
6 daily travel behavior. In this context, the ownership of mobility tools, such as cars and
7 different public transport season tickets, also plays an important role, since people commit
8 themselves to particular travel behaviors as they trade large one-time costs for a low marginal
9 cost at the time of usage. At the same time, decisions concerning mobility tool ownership
10 have lasting effects, as have the decisions concerning location choices. A longitudinal
11 perspective on the dynamics of these long-term mobility decisions is available from people's
12 life courses, which link different dimensions of life together.

13 In order to study these dynamics and the influence of turning points in life, a longi-
14 tudinal survey covering the 20 year period from 1985 to 2004 was carried out at the
15 beginning of 2005 in a stratified sample of municipalities in the Zurich region, Switzerland.
16 The paper describes the data collection and then presents results which show that there exist
17 strong interdependencies between the various turning points and long-term mobility decisions
18 during the life course, as events occur to a great extent simultaneously. Persons tend to aim
19 for compensation between the different dimensions of life.
20

21 INTRODUCTION

22
23 Daily travel behavior is strongly influenced by the location of the places of residence,
24 education and employment. After changes in these spatial structures, e.g., due to moves or
25 changes in occupation, people inevitably show a travel behavior that is different from the
26 travel behavior before these relocations occurred, as usually changes in the spatial distri-
27 bution of activities and, hence, in the activity space are implied, influencing trip distances,
28 routing, timing and frequency (1; 2; 3; 4). At the same time, the availability as well as the
29 quality and quantity of the available transport systems change. In turn, the decisions about the
30 ownership and usage of the various mobility tools are influenced, as they provide access to
31 the different transport systems and determine the marginal costs of usage. In this context, the
32 question arises, to what extent the availability of mobility tools already affects the residential
33 and occupational decisions of people, particularly with regard to so-called self-selection
34 processes (5; 6).

35 These long-term mobility decisions form turning points in life. Further important
36 turning points include personal and familial events, such as changes in education and
37 employment as well as family formation (partnership, marriage), expansion (birth of
38 children), contraction (maturation of children) and dissolution (break-up, divorce, death of a
39 partner or spouse). These events have lasting effects, since corresponding changes involve
40 substantial amounts of resources (costs, time, etc.). Therefore, it is necessary to analyze their
41 dynamics over longer periods of time. A longitudinal perspective on the relationships
42 between spatial mobility and mobility tool ownership is available from people's life courses,
43 which link different dimensions of life together. Besides personal and familial history,
44 locations of residence, education and employment as well as the ownership of various
45 mobility tools can be taken into account. These life course dimensions are usually not in-
46 dependent from one another. Events in one area are frequently connected to changes in other
47 areas. Decisions are rarely made in isolation and choice behavior is often context dependent

48 (7). At the same time, this longitudinal approach provides the possibility to observe develop-
49 ments over time, as behavior is influenced by time, and to identify state dependencies (7; 8;
50 9; 10; 11). The life course perspective enables the integration of the temporal dimension and
51 dynamics into the analyses of long-term mobility in a comprehensive way (12).

52 Analyzing people's life courses can contribute to the understanding of their reactions
53 to changes occurring in their personal and familial life, within their household as well as in
54 the spatial structures (13). For instance, one can analyze how a move affects mobility tool
55 ownership and, therefore, travel behavior, since mobility tool ownership can be used as a
56 proxy for the actual travel behavior (6; 13). Through the ownership of mobility tools people
57 commit themselves to particular travel behaviors as they trade large one-time costs for a low
58 marginal cost at the time of usage.

59 Turning points during the life course play a central role, when formulating transport
60 policies, which are designed to influence people's behavior, as they reconsider and reflect
61 their decisions and choices only in the cases where the situation is very different from the
62 usual context (10; 14; 15). Thereby, questions regarding how, when and why such changes
63 might happen are of large interest for policy makers and planners. From the incorporation of
64 temporal effects, besides spatial effects, into the analyses of long-term mobility, a better
65 assessment of the impact of policies and other interventions on travel behavior is expected
66 (16).

67

68 **LIFE COURSE**

69

70 The life course itself can be regarded as a contextual system (17). A person's past affects his
71 or her present, and his or her present affects his or her future (18). Individuals seek coherence
72 and continuity. So, an individual's life course and the successive events that constitute it are
73 not random, but patterned.

74 The structure of the life course is described with trajectories and transitions (12). As
75 intermediary concept, the life course is seen as a sequence of events (12; 19). In this context,
76 it is worthwhile to understand an event as well as the history leading up to its occurrence,
77 since past behavior is strongly correlated to present behavior (20). A further advantage
78 regarding the investigation and improved understanding and modeling of the dynamic aspects
79 is the provision of more accurate and coherent forecasts of the future (10).

80 These dynamic effects can not be captured with cross-sectional data (21). The
81 analyses of turning points in life and long-term mobility decisions require corresponding
82 longitudinal data that describes people's life courses. Solely this kind of data enables the
83 investigation of continuity and change over time (18).

84

85 **DATA**

86

87 Essentially, there are two ways of collecting such longitudinal data. The most obvious and
88 well-recognized method is to conduct a panel survey, in which the same sample of persons is
89 asked about their respective current situation at several points in time to build up a series of
90 observations. Data collected this way is very reliable, since events are observed, as they
91 happen and, hence, inaccuracies due to memory loss are reduced (10; 22; 23). However,
92 panel surveys are difficult and expensive to carry out as well as rather effort and time
93 consuming, due to the long durations required for data collection (24). Normally, it takes
94 several years before it is possible to analyze long-term effects (10). The second method

95 approximating a panel survey is to use a retrospective approach that relies on individual's
96 recall capacity and, hence, is subject to the limitations of the human memory. With increasing
97 amounts of time elapsed since an event, the amount of information retained decreases in a
98 logarithmic relationship (9; 25). People tend to remember major events, such as residential
99 moves or personal and familial events, so-called turning points in life, better. Therefore, those
100 can be used as support for the memory by further linking different dimensions of life together
101 and in doing so placing single events into a larger context (25). Experiences from Holling-
102 worth and Miller showed that a retrospective survey proved to be a favorable alternative to a
103 panel survey (9). At the same time, retrospective data is easier, cheaper and faster to obtain
104 than panel data (26). Retrospective surveys allow for observing longer time spans than
105 usually are feasible with panel surveys, whereas panel data is able to cover a broader range
106 and more detailed information.

107 In order to collect longitudinal data concerning turning points and long-term mobility
108 decisions during the life course, a retrospective survey covering the 20 year period from 1985
109 to 2004 was carried out at the beginning of the year 2005 in a stratified sample of muni-
110 cipalities in the Zurich region, Switzerland, taking different spatial and transport related
111 municipality types into account (27).

112 The survey was conducted using a written self-completion questionnaire which was
113 sent out by mail. One reason for choosing this procedure was due to the relative complexity
114 of the survey. In this way, respondents had more time, quiet and privacy when answering the
115 questionnaire, remembering and recollecting their past, possibly looking up documents, if
116 necessary. In addition, it is less demanding to obtain a larger sample, as expenses and costs
117 tend to be in general lower in comparison to face-to-face and telephone interviews (22).
118 However, it is not possible to offer immediate assistance to the respondents, in the case that
119 problems with understanding and filling in the questionnaire occur.

120 The questionnaire consisted of two parts, a household form and a person form. The
121 household form asked for the current address, a short description of all persons living in the
122 household and the household income. In the person form, socio-demographic and socio-
123 economic characteristics of the respondents were collected. The essential part of this form
124 was a multidimensional life course calendar, providing a visual reconstruction of the past. So
125 a plain and compressed picture of the respondents' own life comprising several dimensions is
126 developed which is also interesting and motivating for them to recover. Linking the various
127 aspects together supports their recollection, as associations are formed (25; 28). At the same
128 time, the graphic representation of the life course increases the quality and accuracy of the
129 data, since inconsistencies in the timing of events between different dimensions become
130 easier to detect. Furthermore, the life course calendar permits a comfortable handling of the
131 complexity of the information and a rather straightforward recording of relatively detailed
132 sequences of events in comparison to the conventional question-response format. Besides, it
133 is a very flexible survey instrument (29).

134

FIGURE 1 Example of the multidimensional life course calendar

	1985	1986	1987	1988	1989	1990	1991	1992
Information about your family history								
Please indicate important family events (e.g. birth of siblings, moving out of your parents' house, marriage, divorce, birth of children, deaths in the family, retirement, etc.)			moving out of the parents' house			marriage	birth of the 1st child	
							birth of the 2nd child	
Number of persons in your household	4		1		2		3	4
Information about your places of residence (Please fill in further information on page 8)								
Please number the places of residence	1st place		2nd place		3rd place		4th place	
Information about your ownership of cars and public transport tickets								
Availability of a car: always available								
Availability of a car: partially available								
Availability of a car: never available								
Ownership of a half-fare discount ticket								
Ownership of a national annual ticket								
Ownership of a regional annual or monthly ticket								
Information about your places of education and employment								
Post code and municipality of the place of education	8090 Zurich							
Post code and municipality of the place of employment			8001 Zurich			8303 Bassersdorf		
Mostly used mode of transport for the trip to your place of education or employment								
Car, motorcycle, moped								
Train, tram, bus								
Bicycle								
On foot								
Personal gross income per month (Please convert foreign currency if necessary)								
Under 2 000 CHF								
2 000 to 5 999 CHF								
6 000 to 9 999 CHF								
10 000 to 13 999 CHF								
14 000 CHF and more								

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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 six-month-intervals are chosen, because this time unit is small enough to ascertain the sequence and relation of events (28). But at the

139 same time, it is necessary to consider the amount of detail as well as accuracy and time
140 distinctiveness with which respondents are able to remember. Bird, Born and Erzberger made
141 the experience that specifications on a semi-annual basis are feasible without larger diffi-
142 culties (29). Along the other axis of the calendar, the different items of the retrospective
143 survey are arranged vertically. For the 20 year period, information about turning points, such
144 as important events of the personal and familial history, the household size as well as data on
145 moves and corresponding places of residence was collected. Furthermore, the respondents
146 were asked to indicate their changing ownership of cars and different public transport season
147 tickets, such as national and regional tickets as well as half-fare discount tickets. Data on the
148 places of education and employment, on the main mode of transport for the commuting trip
149 as well as on the personal income was collected for the period from 1985 to 2004. FIGURE 1
150 illustrates an example of the multidimensional life course calendar, showing a person which
151 left the parents' house in the year 1986, then lived two years alone and then moved together
152 with a partner in a new accommodation. In 1989 the couple married and subsequently had
153 two children. Accordingly, the stated household size changes. There is also a connection to
154 the ownership of the different mobility tools visible.

155 Verhoeven found that people have substantial difficulties to remember and recall
156 aspects of their daily travel behavior, such as mode choice, timing etc., in retrospect (30).
157 These short-term mobility decisions tend to vary more frequently, and are therefore rather
158 hard to collect over longer periods of time. Asking instead for the 'usual' travel behavior
159 proved problematic, lowering the quality of the data noticeably, particularly with respect to
160 elements with relatively high levels of short-term intra-personal variability (31).

161 The questionnaire was sent out by mail to 3600 households. Each household received,
162 besides one household form, two person forms that were to be filled in by persons aged 18
163 years and older. The response rate amounted to only 23.1%, which is primarily due to the
164 relative length and complexity of the questionnaire (32). Overall, 780 household forms and
165 1166 person forms are available for further statistical analyses.

166

167 **RESULTS**

168

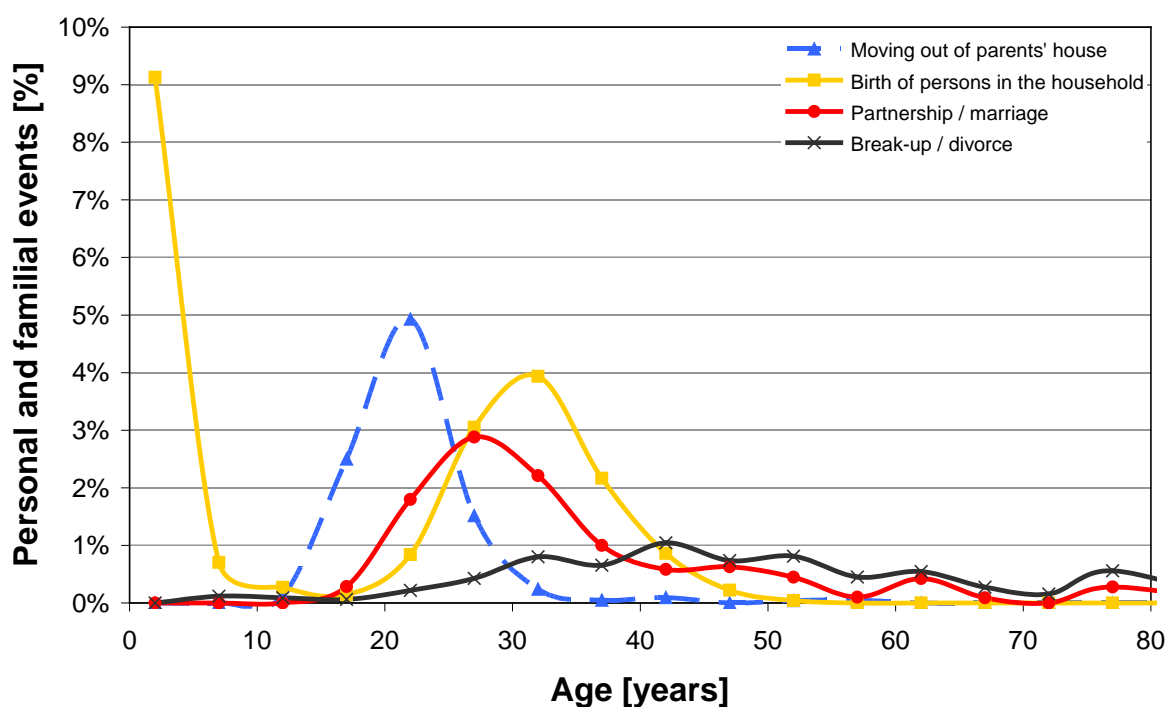
169 Over time, the occurrence of important personal and familial events, such as the move out of
170 the parents' house, the birth of persons in the household, partnerships and marriages as well
171 as break-ups and divorces, is fairly constant, with shares ranging between 0% and 2%. In
172 contrast, alterations in residence, education and employment occur noticeably more
173 frequently, e.g., with about 15% of all the persons moving within each year. Concerning the
174 changes in mobility tool ownership, only about 3% of the respondents vary their mobility tool
175 ownership each year. In about one third of all cases, respondents acquire a car, whereas only
176 10% are related to the abandonment of a car. To a lesser extent and in a more balanced way,
177 this also applies to the various public transport season tickets, pointing to a slightly weaker
178 commitment to public transport.

179 FIGURE 2 shows the occurrence of important turning points during the life course,
180 based on five year intervals. These turning points include personal and familial events,
181 changes in the places of residence, education and employment as well as changes in car
182 availability and public transport season ticket ownership. Most personal and familial events
183 occur rather early in life, consistent with the literature (11; 33; 34). The move out of the
184 parents' house primarily takes place at the age between 15 and 20 years. The birth of persons
185 in the household shows a maximum at the beginning, covering the respondents' own birth as

186 well as the birth of siblings. Between the ages of 20 and 30 years, again a higher number of
 187 children are born, followed by a gradual decrease afterwards. The share for the formation of
 188 partnerships and marriages is highest for persons aged from 15 to 30 years. Break-ups and
 189 divorces show overall a relatively flat graph with values not exceeding 1%, peaking in the
 190 early forties. Concerning the changes in the place of residence, most moves occur between
 191 the ages of 20 and 35 years, with a maximum of about 15%. Afterwards the share of moves
 192 gradually decreases. This supports findings of Birg and Flöthmann, and others (11; 34). For
 193 the changes in the place of employment, the curve is very similar, however, at a lower level.
 194 Between the ages of 60 and 65 years, the influence of retirement becomes visible. Variations
 195 in education occur, concurrent with the expectations, earlier during the life course. This share
 196 reaches a maximum for persons aged from 15 to 20 years. In comparison to the spatial
 197 changes, the shape of the curves regarding mobility tool ownership is overall very similar, but
 198 the scale is ranging only up to 5% instead of up to 20%, indicating that mobility tool owner-
 199 ship is considerably more stable than the relocation behavior concerning the places of
 200 residence, education and employment. For the ownership of always and partially available
 201 cars, the two maxima are slightly offset from one another, with always following partially car
 202 availability. After the age of 40 years, both curves become flat. There are some persons who
 203 give up their car as they get older, but this happens only to a lesser extent. For the national
 204 tickets, the share of variations is noticeably lower, with the highest values being surveyed
 205 between the ages of 15 and 30 years. Regional tickets behave very similar to the partially
 206 available cars, with a maximum for persons aged around 18 years. The half-fare discount
 207 tickets show larger variations with increasing age compared to the other mobility tools.
 208

FIGURE 2 Turning points and changes in long-term mobility during the life course

Personal and familial events during the life course

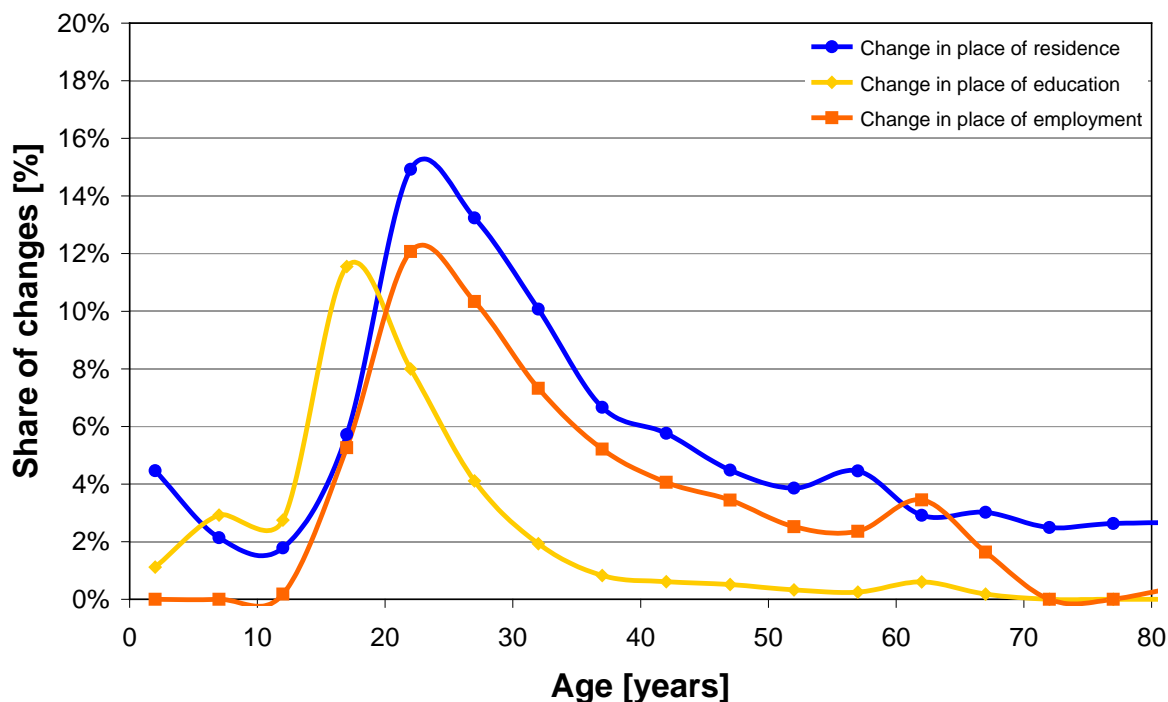


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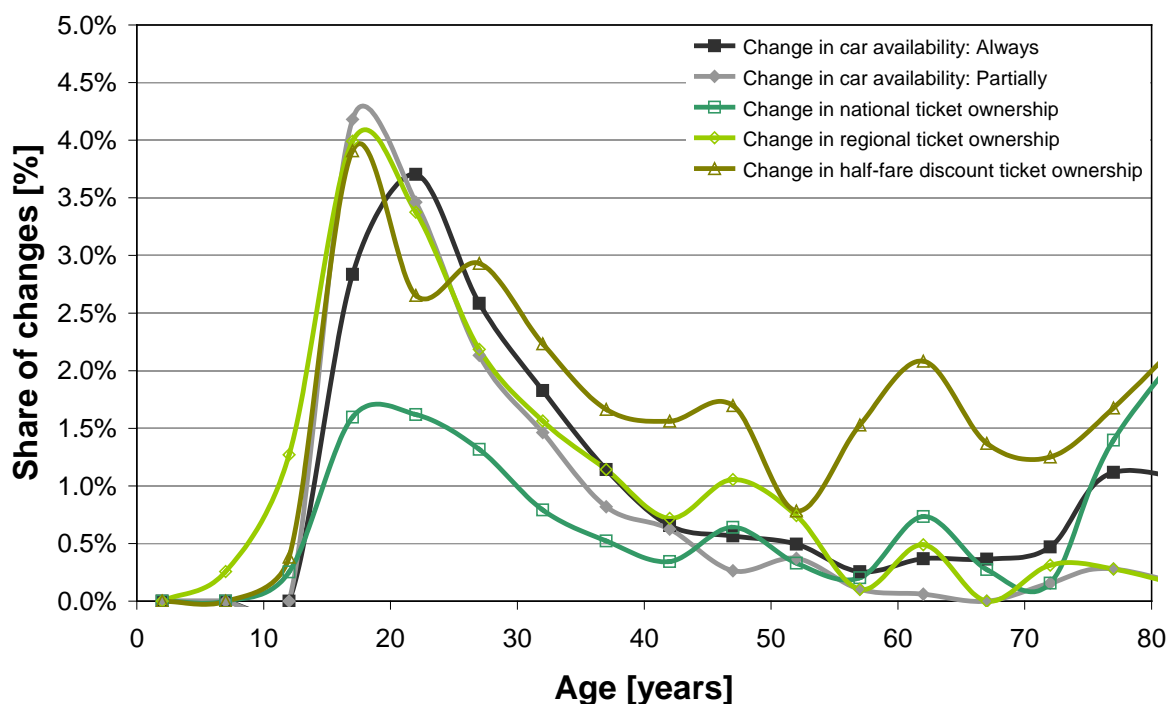
FIGURE 2 is continued ...

211 *FIGURE 2 continued ...*

Changes in residence, education and employment during the life course



Changes in car availability and public transport season ticket ownership during the life course



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Analyzing the occurrence and non-occurrence of changes within the same year, significant connections between the different types are observed. The strongest links are

215 detected for always and partially available cars as well as among the various public transport
 216 season tickets. The changes in residence, education and employment are also considerably
 217 related to one another, confirming findings of Rouwendal and van der Vlist, as well as of
 218 others (35).

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

$$229 \quad \rho^2 = 1 - \frac{L(\max) - K}{L(0)},$$

230 where $L(0)$ and $L(\max)$ represent the initial and the final log-likelihoods, respectively, and K
 231 denotes the number of estimated parameters (36). In all models, the adjusted ρ^2 is relatively
 232 high.

233 In the context of the model estimation, it is necessary to take into account that each
 234 respondent appears several times as observation and, therefore, to control for unobserved
 235 characteristics of the individuals. Thus, an error term is added, which allows individuals who
 236 are homogeneous in their observed characteristics to be heterogeneous in their response
 237 probabilities (37). Within the model specification, a random parameter is introduced, which is
 238 normally distributed across the entire sample, but invariant for each individual. For this
 239 parameter, the standard deviation is estimated, while the mean value is set to zero (36). In the
 240 models, the estimated standard deviations of the individual-specific error term, which takes
 241 the panel effect into account, show relatively low values, indicating a slight heterogeneity in
 242 the sample. The sign of the random parameter is not relevant.

243 Concerning the changes in residence, the probability increases with increasing age
 244 until reaching a maximum for persons aged between 25 and 30 years, and afterwards the
 245 propensity to move declines. This also applies to the alterations in employment. Changes in
 246 education are less likely to happen the older the respondents are. Overall, men show a more
 247 stable behavior regarding the spatial changes than women. The occurrence of all changes is
 248 accompanied by a rising income. Persons moving out of their parents' house tend to vary the
 249 places of education and employment more frequently at the same time. The birth of a person
 250 in the household leads to a higher propensity to move as well as to alter employment,
 251 confirming results by Aufhauser (33). An increase in the household size influences moving in
 252 a negative way, whereas an increase in the accommodation size is related to more changes
 253 occurring. For respondents moving abroad, the probability of alterations taking place is
 254 reduced, contrary to the expectations. This is related to the specification of the corresponding
 255 influencing variable, which further distinguishes the direction of the moves. In this context,
 256 the share of persons moving to Switzerland is more than twice as high as the share of persons
 257 moving from Switzerland, due to the fact that the retrospective survey was carried out in
 258 Switzerland, thereby overemphasizing the negative section of the variable. The index of
 259 purchasing power in the residential region measures the changes in consumer prices in a

260 country in Euro, making an adjustment for changes in exchange rates (38). This variable is
 261 only relevant for variations in the place of employment, having a positive effect.
 262

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

Explanatory variable	Change in residence	Change in education	Change in employment	Change in education and employment
<i>(Difference between the after and before status)</i>				
Age in years	+ 0.059 *	- 0.009	+ 0.076 *	+ 0.023 *
Age in years squared	- 0.001 *	- 0.001	- 0.001 *	- 0.001 *
Gender: Male	- 0.100 *	- 0.212 *	- 0.151 *	- 0.145 *
Nationality: Swiss national	- 0.011	+ 0.447 *	+ 0.107	+ 0.193 *
College or university degree	+ 0.060	+ 0.479 *	- 0.016	+ 0.102 *
Increase in distance between place of residence and place of education in 1000 kilometers	- 0.114	- 0.238 *	- 0.089	- 0.177
Increase in distance between place of residence and place of employment in 1000 kilometers	- 0.068	+ 0.496 *	- 0.046	- 0.043
Increase in monthly income in 1000 CHF	+ 0.089 *	+ 0.268 *	+ 0.017	- 0.050
Increase in monthly income in 1000 CHF squared	+ 0.027 *	+ 0.067 *	+ 0.163 *	+ 0.183 *
Moving out of parents' house		+ 1.640 *	+ 1.018 *	+ 1.358 *
Birth of a person in the household	+ 1.977 *	- 0.379	+ 0.588 *	+ 0.392 *
Increase in number of persons in household	- 1.406 *	- 0.017	- 0.104 *	- 0.041
Increase in number of rooms in accommodation	+ 0.599 *	+ 0.007	+ 0.038	+ 0.009
Increase in degree of urbanization (from urban to rural)	- 0.180	+ 0.324 *	+ 0.081	+ 0.147
Increase in population in res. municipality in 1000 inhabitants	+ 0.013	+ 0.000	+ 0.001	+ 0.001
Increase in population density in res. municipality in 1000 inhabitants per square kilometer	+ 0.001 *	+ 0.185 *	- 0.004	+ 0.096
Change in place of residence from or to abroad considering the direction of the move (-1 = from abroad and +1 = to abroad)	- 3.161 *	- 0.926 *	- 1.989 *	- 1.741 *
Increase in purchasing power index in res. region	+ 0.001	- 0.013	+ 0.028 *	+ 0.017 *
Constant	- 3.408 *	- 2.761 *	- 3.826 *	- 2.593 *
Individual-specific random parameter	- 0.018	+ 0.558 *	- 0.537 *	- 0.493 *
Number of persons	1045	1045	1045	1045
Number of observations	31695	31695	31695	31695
ρ^2 (adjusted)	0.675	0.830	0.709	0.655

* Level of significance ≤ 0.10

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

Explanatory variable	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
<i>(Difference between the after and before status)</i>					
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 *	- 0.364 *	- 0.277 *
Nationality: Swiss national	+ 0.030	+ 0.289 *	+ 0.731 *	+ 0.149	+ 0.358 *
College or university degree	- 0.019	+ 0.315 *	+ 1.076 *	+ 0.004	+ 0.457 *
Increase in distance between place of residence and place of education in 1000 kilometers	- 0.413 *	- 0.155	- 0.068	+ 0.105	+ 0.031
Increase in distance between place of residence and place of employment in 1000 kilometers	+ 0.051 *	+ 0.066 *	+ 0.087	+ 0.277 *	+ 0.080
Increase in monthly income in 1000 CHF	+ 0.257 *	+ 0.335 *	+ 0.041	+ 0.118 *	+ 0.089 *
Increase in monthly income in 1000 CHF squared	+ 0.008	- 0.004	+ 0.034 *	+ 0.028 *	+ 0.034 *
Moving out of parents' house	+ 1.597 *	+ 1.815 *	+ 1.293 *	+ 1.392 *	+ 0.947 *
Birth of a person in the household	+ 0.816 *	+ 0.759 *	- 0.641	+ 0.398	+ 0.445
Increase in number of persons in household	- 0.242 *	- 0.141 *	- 0.075	- 0.045	- 0.169 *
Increase in number of rooms in accommodation	+ 0.061	+ 0.048	+ 0.089	+ 0.120 *	- 0.002
Increase in degree of urbanization (from urban to rural)	- 0.203	- 0.325	+ 0.293	- 0.245	+ 0.171
Increase in population in res. municipality in 1000 inhabitants	+ 0.001	+ 0.000	- 0.000	+ 0.001	+ 0.001 *
Increase in population density in res. municipality in 1000 inhabitants per square kilometer	- 0.025	- 0.051	+ 0.166	- 0.079	+ 0.002
Change in place of residence from or to abroad considering the direction of the move (-1 = from abroad and +1 = to abroad)	- 1.132 *	- 1.753 *	- 0.929	- 0.397	- 2.658 *
Increase in purchasing power index in res. region	+ 0.014	+ 0.023	+ 0.006	+ 0.046 *	+ 0.053 *
Constant	- 4.645 *	- 4.817 *	- 5.681 *	- 3.827 *	- 4.175 *
Individual-specific random parameter	+ 0.188	- 0.422 *	- 1.032 *	- 0.528 *	- 0.202
Number of persons	1045	1045	1045	1045	1045
Number of observations	31695	31695	31695	31695	31695
ρ^2 (adjusted)	0.903	0.898	0.928	0.883	0.861

* Level of significance ≤ 0.10 264
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Concerning the changes in mobility tool ownership, age as well as gender 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 more frequently than foreign nationals. This also applies to persons holding a college or university degree, except for always available cars. 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

272 by more alterations. The monthly income has again a positive effect. The move out of the
273 parents' house results in the occurrence of more changes in the ownership of mobility tools.
274 When a person is born in the household, changes in car availability become more likely,
275 while, at the same time, a growth in household size reduces the respective probability. A
276 move from or to another country leads, contrary to the expectations, to less alterations taking
277 place. An increasing index of purchasing power in the residential region has a positive effect,
278 especially for the variations occurring in public transport season ticket ownership.

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

295 Duration models, which are estimated for the delays occurring subsequent to a move
296 or a change in education or employment until the next changes in the ownership of mobility
297 tools, indicate that with increasing age the so-called hazard or probability of transition
298 decreases, especially after reaching the age of 30 years. Men are in general at a lower risk
299 than women. Already having a car at disposal at the point of time, when a change in
300 residence, education or employment occurs, decreases the probability of changes in car
301 availability of the equal level, whereas an always available car increases the hazard for
302 partially available cars, and vice versa. This means that cars are acquired rather than
303 abandoned, confirming findings of Dargay, providing a further indication of the stability of
304 car availability (21). Among the various public transport season tickets, this relationship
305 between the ownership of the same and another type exists as well. A simultaneous change of
306 the place of residence and the places of education or employment leads to a shorter duration
307 until the next alteration in mobility tool ownership, indicating a stronger effect of such a
308 change (39).

309

310 **CONCLUSIONS**

311

312 In summary, one can say that there exist strong interdependencies between the various
313 turning points and long-term mobility decisions during the life course. Persons tend to aim
314 for compensation between the different dimensions of life. Changes concerning locations,
315 i.e., the places of residence, education and employment, take place significantly more
316 frequently than changes concerning the ownership of the various mobility tools. At the same
317 time, however, events occur to a great extent simultaneously. As spatial changes take place,

318 the actual travel behavior, using mobility tool ownership as a proxy for this behavior, seems
319 to be reconsidered and altered.

320 Most personal and familial events occur rather early in life. This also applies to the
321 decisions concerning the long-term mobility. In general, persons between the ages of 15 and
322 35 years are most mobile, i.e., moving and changing occupation as well as varying the
323 ownership of mobility tools most frequently. Afterwards they become relatively established.
324 Furthermore, male respondents show a more stable behavior than female respondents.
325 Women seem to be more flexible, for instance, making considerable adjustments following
326 the birth of children. Once children are born and live in a household, they have a stabilizing
327 influence on the long-term mobility of this household.

328 Regarding the design of policy and planning instruments, which seek to change travel
329 behavior, this means that these instruments should aim at the younger generations, as their
330 travel habits and routines are not fully established yet, confirming findings by Prillwitz and
331 Lanzendorf, and, therefore, easier to influence (40).

332 Additional opportunities to significantly affect travel behavior are provided by the
333 turning points in life, such as important personal and familial events as well as changes in
334 residence, education and employment, as habits and routines are broken or at least weakened,
335 and individuals reconsider their behavior and consciously reflect their decisions. There exist
336 only short periods of time during an individual's life course in which he or she looks into
337 travel choices (14). The analyses of the life courses show that these events play an important
338 role with respect to the ownership of the various mobility tools. In this context, residential
339 relocations as well as changes in occupation seem to be the most important ones. Therefore,
340 these spatial alterations provide interesting starting points for policies and other interventions
341 aiming at travel behavior change, due to accessibility and transport systems changes (41).
342 Corresponding instruments could include the provision of information about alternative ways
343 to travel from or to a new place of residence or occupation, the implementation of more
344 successful mobility management and public transport marketing strategies, especially
345 targeting younger people, new residents or people entering education or employment, as well
346 as the supply of temporary free or discounted public transport tickets, free bicycles, etc.
347

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