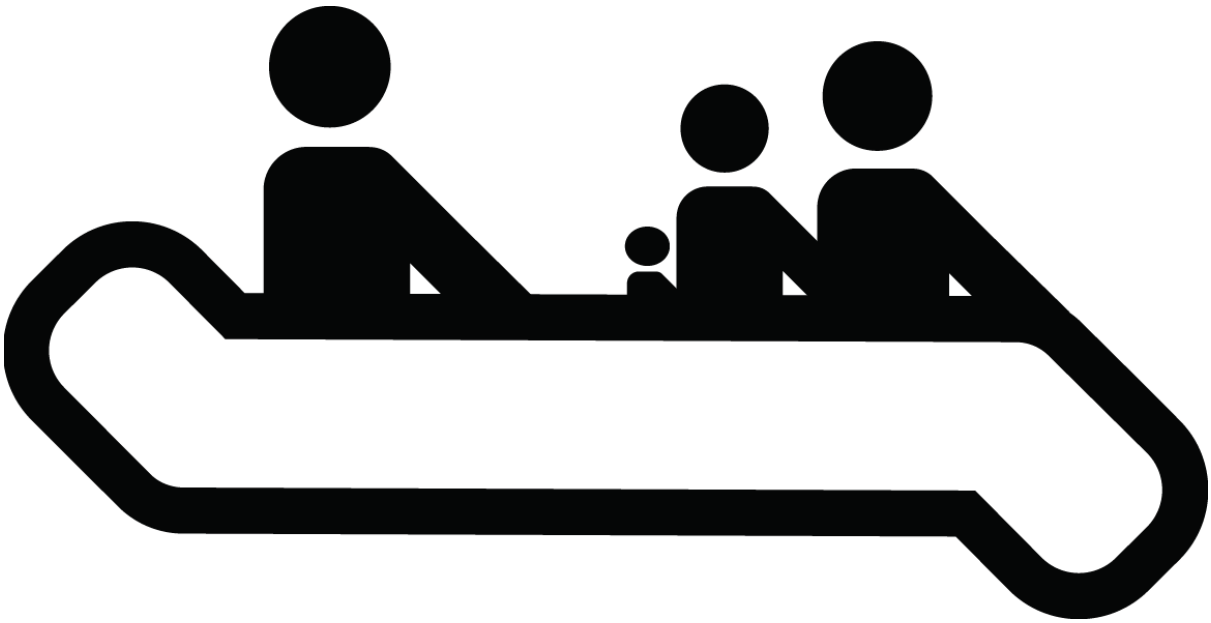

Post-Car World: Survey Methods and Response Behavior in the Pre-Test

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Abstract

The investigation of temporal rhythms in activity scheduling, the reshaping in time organisation and mobility tool ownership in combination with improvements in communication and transportation technology play a key role in understanding travel behaviour in a world with restricted car ownership and usage. The empirical basis of this comprehensive three-stage survey is a two-week travel diary that is required to obtain the reference values for the later stated choice and stated adaptation tasks. This paper provides first detailed information about the survey design, recruitment and pre-test fieldwork of this study. An initial investigation of the data and its quality attributes, descriptions of the sampling structure and response behavior are presented. Due to the high response burden and complexity of tasks, this quality check is crucial for improving the later recruitment and survey process.

A high incentive level leads to a significantly higher participation rate, but the net-effect on completing the survey is zero: Once recruited, higher incentives even lead to positive drop-out effects. Certain socio-demographic characteristics are consistently overrepresented for the participation and drop-out groups: Season tickets ownership strongly affects participation and completion of the survey, while motorized vehicle ownership positively affects drop-out probability. Findings suggest saliency effects, where response behavior seems to be heavily influenced by the respondents' interest in the *Post-Car World* topic. While general fatigue effects could not be revealed in this pre-test study, public transport users exhibit a stabler reporting behavior over time than non-public transport users.

Keywords

Long-duration surveys, stated preference, response burden, participation choice, fatigue effects

1 Introduction

The investigation of temporal rhythms in activity scheduling, the reshaping in time organization and mobility tool ownership in combination with improvements in communication and transportation technology play a key role in understanding travel behavior in a world with restricted car ownership and usage. The main research question addressed by the *Post-Car World* project (team B1) is to what degree individuals would be substituting time allocation and distinct activities after experiencing large changes in generalized transport costs (Weis, 2012) and how they would react regarding their longer-term ownership in mobility tools (e.g. Erath and Axhausen (2010); Le Vine et al. (2011)), assessing suppressed demand effects from an activity-based perspective. One goal is to combine different established survey approaches, starting with a multi-day reporting period of individual travel behavior and activity scheduling (e.g. Axhausen et al. (2002); Löchl et al. (2005)), including attitudinal (Axhausen et al., 2002) and psychometric scales (Rieser-Schüssler and Axhausen, 2012) as well as stated preference methods (e.g. Weis et al. (2012); Axhausen et al. (2014); Fröhlich et al. (2012)), where each part will be integrated in a superordinate modeling framework: How do changes in generalized costs interact with the underlying rhythms of daily life for respondents' distinct attitudinal and personal characteristics? To what degree adaptations in daily scheduling, travel and activity behavior are undertaken by experiencing these changes in the short- and long-run?

This paper provides first information about the survey process and fieldwork of this comprehensive study. Pre-test data are collected for a sample of 33 households (51 respondents) from Zurich city and suburban regions, trying to cover the relevant range of life cycle positions, mobility tool ownership and household types. The survey is conducted in three main steps: 1) Together with detailed information about the households' socio-economic, vehicle ownership and personal characteristics, the empirical basis is a two-week travel diary that is required to explore the use of virtual internet-based interactions, the planning style and to obtain the reference values for the later 2) stated choice and 3) stated adaptation experiments, using an updated version of the *MobiDrive* protocol (Axhausen et al., 2002). In consideration of the sample size, longer reporting period, high response burden and complexity of the survey, the investigation of the data quality, sampling structure and response behavior requires special attentiveness (e.g. Axhausen et al. (2002); Axhausen et al. (2007); Groves et al. (2000)). Results in this paper mainly cover these issues and descriptive data analyses for the recruitment and screening process, sampling structure, response and participation likelihood, fatigue and drop-out effects are conducted. Understanding the respondents' motivation and self-selection to participate in the study play a key role for improving the later recruitment and survey process.

The structure of the paper is organized as follows: Section 2 describes the methods used in

each stage of the survey and discusses potential problems observed in the pre-test. Section 3 provides a detailed overview of the recruitment process, conducting a meta data analysis based on previous IVT studies and estimating participation choice models to investigate the effect of different incentive levels and socio-economic characteristics on participation and drop-out incidence. In addition, descriptive figures of the recruited sample's behavior are compared with data from the Mikrozensus 2010 (Swiss Federal Statistical Office, 2010), a weighted, representative sample of the Swiss population, revealing possible differences in socio-economic, mobility related and personal characteristics. Data are tested for the presence of reporting fatigue and exogenous behavioral influences, where trends in lower numbers of trips or mobile days in the travel diary may indicate decreasing commitment over time. Section 4 provides a discussion of results, some concluding remarks and further topics, and gives a short outlook for the upcoming main survey in May 2015.

2 Survey Methods

The survey process is organized in three stages (see Fig. 1). If the households agreed for participation during the telephonic recruitment interviews in December 2014[1], the questionnaires for stage I (empirical basis) were sent to the households in the beginning of January 2015. Stage II questionnaires (stated choice and attitudinal questionnaires) were sent the 3rd of March 2015. The second stage of the pre-test is still ongoing: 29 out of 33 households (reference date: 7th of April 2015) have already sent back the questionnaires and are willing to conduct the personal interviews (stage III), where the first one took place the 7th of April 2015.

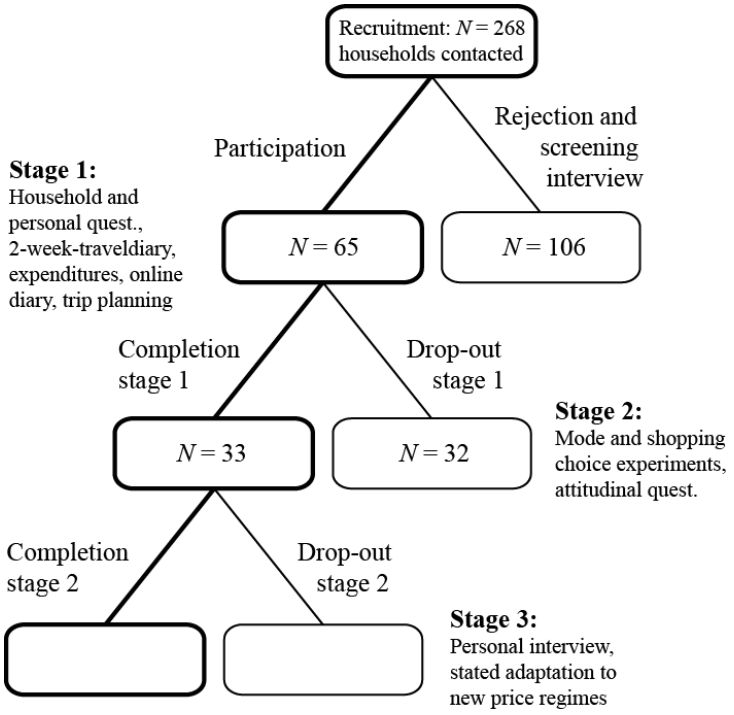
2.1 Stage I: Empirical Basis

The empirical basis is an enriched two-week travel diary that is required to explore the individual patterns in daily travel behavior, the use of non-physical and Internet-based interactions, the planning style and to obtain the reference trips / days for the later stated choice (stage II) and stated adaptation (stage III) tasks. The design of the travel diary (see Appendix A.1) is based on the well-tested *Mobidrive* protocol (Axhausen et al. (2002); Löchl et al. (2005)): For each conducted trip, respondents were asked to state the day of the week, starting and arrival times, exact starting and destination addresses, chosen modes, trip purpose, accompanying persons[2], presence of dogs, travel and activity costs. Data are organized in a longitudinal panel structure,

[1] Details about the recruitment process are discussed in Section 3.

[2] Many respondents were confused about the description of an accompanying person and often included themselves in the counting. This issue will be made more clear for the main survey.

Figure 1: Survey procedure and participation rates in the pre-test.



where each new trip follows its predecessor. It implicitly reveals information about activity durations for nine different activity types / trip purposes: (1) Home activity, (2) accompanying trip, (3) work or education, (4) short and (5) long-run purchase, (6) service or attendance, (7) business trip, (8) leisure and (9) other activity.[3] The use of non-physical and Internet-based interactions are captured in a separate questionnaire (see Appendix A.1), asking for E-shopping, entertainment, banking, communication and social network activities, including daily duration and expenditures for each of those categories. In addition, there are detailed household and personal questionnaires, mobility tool and season ticket ownership as well as short- and long-term expenditure questionnaires providing a rich variety of socio-economic, mobility-related and consumption data. Table 1 gives a short overview of the survey questionnaires used, including a point-score for the response burden (see also Axhausen and Weis (2009), for a detailed description of their calculation).[4]

[3]One problem that has been observed in the pre-test is that some respondents chose multiple activities for a given trip, especially in the version where activity costs are integrated in the travel diary. Therefore, for the main survey, the version with separate activity expenditure sheets is favored.

[4]Note: Point-scores for the travel and planning diary are based on an average of 22 trips within a one-week period. Respondents could report maximally 40 trips per week.

Table 1: PCW survey questionnaires and response burden scores in stage I.

Questionnaire	Type	Comments	Avg. score
1. Household	Socio-economic variables	Address, type of living, income, etc.	55
2. Vehicles	Vehicle characteristics	Type, fuel consumption, parking	30
3. Person	Socio-economic variables	Age, sex, education, mobility tools	75
4. Travel diary	Daily travel behavior	Addresses, modes, purpose, etc.	1930
5. Trip planning	Planning task for 2nd week	Addresses, modes, purpose	320
6. Online diary	Non-physical interactions	E-shopping, entertainment, other	590
7. SR Expenditures	Daily expenditures	Shopping, food, leisure, etc.	140
8. LR expenditures	Long-run expenditures	Housing, communication, insurance	160
	Stage I questionnaires		Total: 3300

2.2 Stage II: Stated Choice and Attitudinal Questionnaires

Five weeks after the end of the two-week reporting period, stage II questionnaires were sent to the remaining 33 households (51 respondents). To construct the stated choice questionnaires, it has been put a high effort into the creation of the experimental designs, selecting the attributes and the coding of the personalized choice set generation based on RP reference values from the first stage of the survey. In this section, the travel time and cost structures are presented, highlighting the pivot design approach to help the respondents to identify better with the individually tailored, more realistic and intuitive choice scenarios. In addition, the respondents were asked to state their attitudes towards existing, new and innovative mobility tools (Axhausen et al., 2002) as well as hypothetical modes (autonomous cars, moving pathways, etc.), evaluating their acceptance and opinion towards different means of transport. Also, an extended version of the Big-Five personality questionnaire (Satow, 2012) is included, trying to reveal the main features of respondents' personality traits and clustering different groups with respect to their travel and activity behavior in the later modeling process (e.g. Johansson et al. (2006); Rieser-Schüssler and Axhausen (2012)). Table 2 gives a short overview of the questionnaires used, again including a point-score for the response burden.

Table 2: PCW survey questionnaires and response burden scores in stage II.

Questionnaire	Type	# Choice Sets	Avg. score
1. Mode choice	Stated choice	8	190
2. ICT ordering choice	Stated choice	8	120
3. Attitudinal	Attitudes and psychometric scales	-	375
	Stage II questionnaires		Total: 685

2.2.1 Mode Choice Experiment

Respondents' preferences towards different transportation modes - slow modes, carsharing, carpooling, taxi and public transport, but excluding private cars - are asked in a mode choice experiment following a pivot design approach: Reference trips are routed with the agent-based transport simulation software MATSim to calculate the shortest path travel times (*SPTT*), related (in-vehicle) distances (*IVD*) and other attributes for both the chosen and unchosen alternatives (i.e. for walk, bike, car and public transport). Most attribute levels are calculated as percentage changes relative to these reference values according to the experimental designs. Trip purposes for the mode choice experiment focus on commuting (23 %), shopping (32 %) and leisure trips (45 %), where respondents were randomly assigned to one of these categories.

The following alternatives, attributes and reference values are considered:

Alternative 1: Slow mode

- **Travel time** walk and bike: Travel time for slow mode m (walk and bike) is calculated based on Dobler (2013), using reference speeds $v_{ref,m}$ for walk (4.8 km / h) and bike (16.2 km / h), accounting for individual i's gender, age and steepness s of the link(s):

$$v_{i,m} = v_{ref,m} * f(i) * f(s) \rightarrow tt_{i,m} = IVD/v_{i,m} \quad (1)$$

Alternative 2: Taxi

- **Travel cost**: The cost structure for taxi is based on the controversial *UberPop* service for Zurich (*www.uber.com/cities/zurich*), constituting about half of the price of current taxis fares:

$$tc_{taxi} = 3 \text{ CHF} + IVD * 1.35 \text{ CHF/km} + SPTT * 0.3 \text{ CHF/min} \quad (2)$$

- **Travel time**: *SPTT* for the MIV route
- **Waiting time**: Percentage of *SPTT* (see Table 4)

Alternative 3: Carpooling passenger

- **Travel cost**: The cost structure for carpooling is based on a cost calculator on *www.mitfahrgelegenheit.ch*, assuming a mark-up of 30 %, two passengers per car and a minimum cost of 2.50 CHF per trip (i.e. the minimum amount for which a car driver is willing to catch up a passenger for a small distance trip). In addition, the driver should be considered as unknown to the respondent and the fuel consumption factor and price per liter are set

according to the following equation:

$$tc_{carpooling} = \min\left[1.3 * IVD * 0.04 \text{ l/km} * 5 \text{ CHF/l} * \frac{1}{2}, 2.5 \text{ CHF}\right] \quad (3)$$

- **Travel time**: Travel time for carpooling is calculated based on the assumption that the driver has imperfect geographical knowledge about the respondent's start and destination locations. A detour factor of 20 % is added to *SPTT* for the MIV route.
- **Access and egress time**: Percentage of *SPTT* (see Table 4)
- **Risk to miss driver**: Probability of missing the driver (see Table 4)

Alternative 4: Free-floating carsharing driver

- **Travel cost**: The cost structure for carsharing is based on the cost calculator on *www.catch-a-car.ch*, a pilot study of free-floating carsharing in the region of Basel, assuming an average reservation time (i.e. access time to next available car) of 7.5 minutes. This leads to a fixed cost component of about 2 CHF per trip:

$$tc_{carsharing} = 2 \text{ CHF} + SPTT * 0.37 \text{ CHF/min} \quad (4)$$

- **Travel time**: Travel time for carsharing is calculated based on the assumption that the driver spends some time to find an accurate parking space. A detour factor of 10 % is added to *SPTT* for the MIV route.
- **Access and egress time**: Percentage of *SPTT* (see Table 4)

Alternative 5: Public transport

- **Travel cost**: The cost structure for public transport is based on the routed distances and average km-prices (Allgemeiner Personentarif, Direkter Verkehr Schweiz, 2014): Respondents that reported any kind of season ticket (Halbtax, GA, ZVV-Netzpass, etc.) are assigned to the public transport cost category "With season ticket", containing the average cost structure for people owning a half fare card (Table 3).
- **Travel time**: The travel time for public transport is based on the door-to-door travel time excluding waiting, transfer, access and egress time
- **Access and egress time**: Sum of access and egress time.
- **Number of transfers**: Based on the route with lowest generalized costs
- **Frequency of service**: The frequency is calculated based on the following four steps:
  (1) Finding connection closest to the departure time
  (2) Searching for alternative connections within $+/-$ 2 hours
  (3) Eliminating alternatives which are more than 30 % slower than (1), or which are "much less direct", i.e. require at least 2 more transfers

Table 3: Travel cost structure for public transport alternative.

In-vehicle trip distance	Without season ticket	With season ticket
< 5 km	0.44 CHF/km	0.22 CHF/km
5 - 14 km	0.41 CHF/km	0.205 CHF/km
15 - 48 km	0.35 CHF/km	0.175 CHF/km
49 - 150 km	0.25 CHF/km	0.125 CHF/km
> 150 km	0.21 CHF/km	0.105 CHF/km
Minimum cost per trip	3.00 CHF	2.20 CHF

(4) Counting remaining connections $n - 1$ and computing the frequency by dividing the time difference between the first and last connection by $n - 1$

Fig. 2 presents the reference value distributions for the core attributes of the mode choice experiment. MIV travel time is essentially the same for carpooling, carsharing and taxi, except for some constant detour factors explained above. As for public transport, the distributions for MIV travel time and travel costs are highly right-skewed, resulting from the fact that most trips are conducted for short distances. E.g. including minimum cost fares for carpooling (2.50 CHF) and public transport (2.20 CHF) results in high peak densities at the respective values.

Table 4 highlights the pivot design approach to create the individual choice situations: Most attribute levels are varied relative to some reference values explained above. *D*-efficient designs were calculated in *Ngene* (e.g. Rose and Bliemer (2009); Quan et al. (2011)) assuming zero priors β_0, where Z are the design matrices for which the standard errors are minimized within a sequential optimization process, Ω is the asymptotic covariance matrix and k is the number of parameters to be estimated:

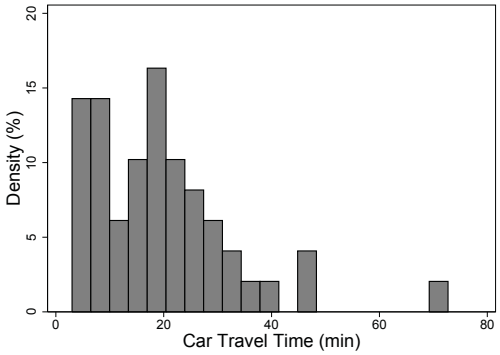
$$\min \left[D_Z - \text{Error} = \det \left(\Omega(Z, \beta_0) \right)^{\frac{1}{k}} \right] \tag{5}$$

Based on the pre-test results and to further improve the efficiency of the standard errors, design priors for the main survey will be updated accordingly.

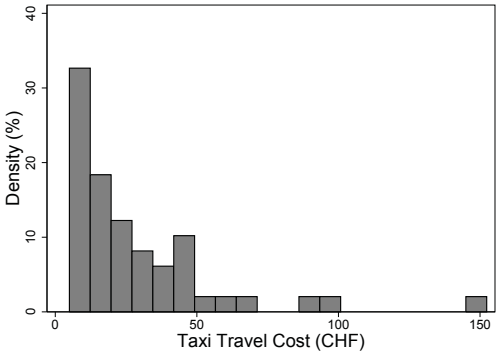
Depending on the traveled distances in the reference trips, having a driving license and chosen modes, participants were assigned to one out of six mode choice experiments including the choice alternatives public transport, taxi, carsharing, carpooling and, for short distances, walk or bike. While respondents without a driving license did not receive carsharing as a choice alternative, trip distances greater than 5 and 15 km excluded walk and bike alternatives, respectively (see Fig. 8 for an example of one mode choice situation presented to a respondent).

Figure 2: Reference value distributions (mode choice experiment).

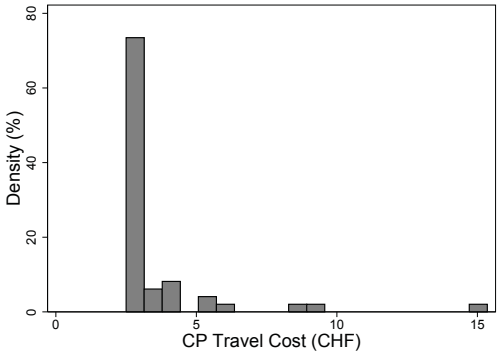
(a) MIV: Travel time



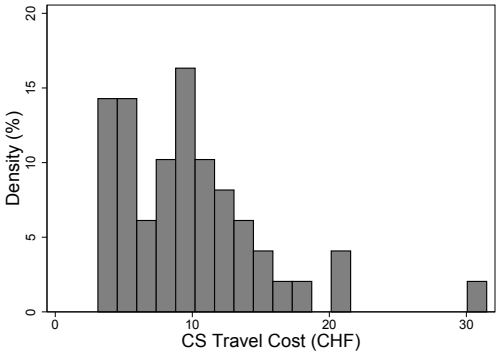
(b) Taxi: Travel cost



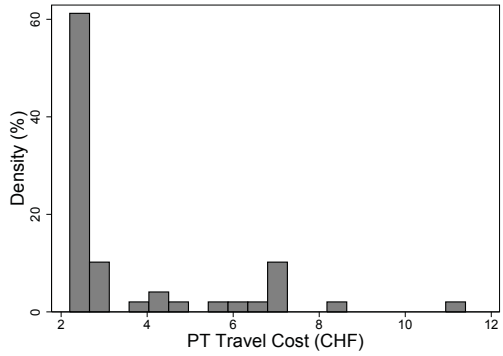
(c) CP: Travel cost



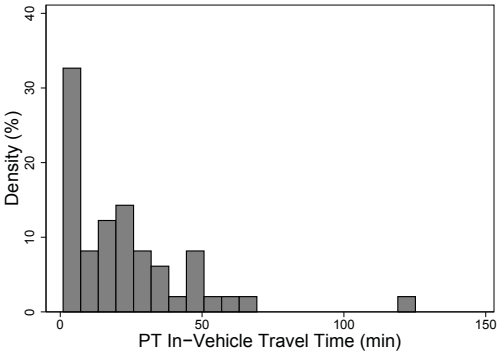
(d) CS: Travel cost



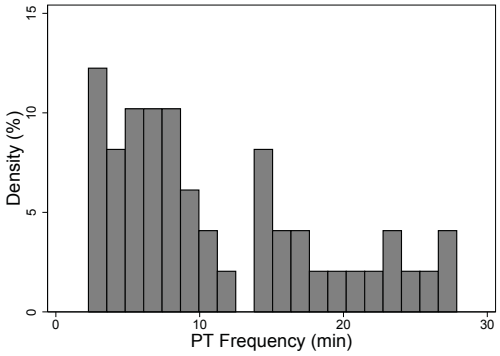
(e) PT: Travel Cost



(f) PT: In-vehicle travel time



(g) PT: Frequency of service



(h) PT: Number of transfers

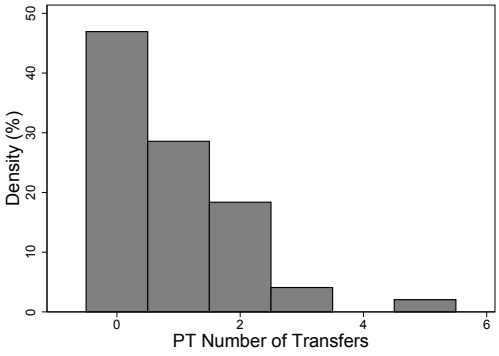


Table 4: Experimental design for mode choice experiment.

Attributes	SM	Taxi	CP	CS	PT	Levels
Travel cost		x	x	x	x	$-20\%, +10\%, +40\%$
Travel time Bike and Walk	x					Fix
In-vehicle travel time MPV		x	x	x		$-15\%, +5\%, +20\%, \geq 2$ min.
In-vehicle travel time PT					x	$-20\%, -5\%, +10\%, \geq 2$ min.
Access and egress time CP and CS			x	x		$15\%, 20\%, 25\%$ of IVTT, ≥ 3 min.
Access and egress time PT					x	$-30\%, -10\%, +10\%, \geq 2$ min.
Waiting time Taxi		x				$10\%, 15\%, 20\%$ of IVTT, ≥ 2 min.
Risk to miss driver			x			$5\%, 10\%, 20\%$
Number of transfers					x	$-1, +/-0, +1, 4 \geq T \geq 0$
Service every ... minutes					x	$-30\%, -10\%, +10\%, \geq 3$ min.

MPV: Motorized public vehicles (taxi, carpooling, carsharing).
CP: Carpooling. CS: Carsharing. PT: Public transport.

2.2.2 ICT Ordering Choice Experiment

A trip making vs. ICT ordering choice experiment requests respondents to trade-off different attributes related to their choice between in-home (online shopping / ordering) and out-of-home (personal procurement) shopping activities, based on previous information obtained from the travel diary. Reference values for travel time and travel cost of the trip making alternative are calculated based on reported shopping trips for either short- or long-run purchases. If a respondent did not report any shopping trip during the two-week survey period, a potential shopping location is chosen offering a high variety of goods and high level of accessibility (e.g. Letzipark Altstetten, Sihlcity, Glattzentrum).[5]

Two different shopping categories are distinguished. Respondents are assigned to one shopping category such that each contains around 50 % of observations:

- Short-run purchases: Daily / weekly shopping (food, drinks, cosmetics, etc.)
- Long-run purchases: Multimedia, HiFi and electronic (household) appliances[6]

Several assumption have been made in the introduction text in order to place the respondents in a preferably homogeneous choice situation. Shopping trips are often chained with other activities, which is ruled out by writing that respondents should imagine a home-based round trip when considering the trip making alternative. To eliminate social motives and shopping trips for leisure purpose (Hsiao, 2009), respondents were told that buying the specific goods is the one and only

[5]The exact adress of the shopping location was not mentioned in the introduction text.
[6]This category exhibits the highest E-shopping market share in Switzerland (Rudolph et al., 2013).

reason of doing this shopping task. To account for this issue, short- and long-run purchases have been explicitly defined as either daily or weekly grocery shopping or as multimedia and electronic household appliances, respectively. Transaction security, information asymmetries and delivery uncertainties are difficult to include as attributes in the choice experiment, though respondents were asked in the attitudinal questionnaire about their perception and feelings of such issues.

The following two alternatives, attributes and reference values are considered for the trip making vs. ICT ordering choice experiment (see also Table 5):

Alternative 1: Ordering

- **Goods basket price**: Based on average shopping expenditures for either short- or long-run needs, respondents are assigned to one out of three reference expenditure categories (short-run purchases: 30 CHF, 60 CHF and 90 CHF; long-run purchases: 70 CHF, 100 CHF and 140 CHF). To increase the variation of offered goods basket prices, reference values are randomly varied by some predefined factors (short-run purchases: Price scaling factors between 0.8 and 3; long-run purchases: Price scaling factors between 1 and 5).
- **Time for ordering**: Based on average shopping duration for either short- or long-run needs, respondents are assigned to one out of three reference shopping duration categories (short-run purchases: 15 min, 30 min and 45 min; long-run purchases: 25 min, 50 min and 70 min). To increase the variation of presented shopping durations, reference values are randomly varied by some predefined factors (short-run purchases: Time scaling factors between 0.8 and 1.4; long-run purchases: Time scaling factors between 1 and 1.6).
- **Delivery cost including duty**: 0 CHF, 5 CHF, 10 CHF and 15 CHF
- **Delivery time**: Short-run purchases: Within one day / 1-2 days / more than 2 days; long-run purchases: 2-4 days / 4-7 days / more than 1 week

Alternative 2: Trip Making

- **Goods basket price**: Same as for the ordering alternative
- **Time for shopping**: Same as for the ordering alternative
- **Travel cost**: Travel costs depend on the chosen mode in the travel diary for one reference shopping trip and comprise both the way to the shop and back home. If the chosen mode was ...
  (1) MIV: Average of CP and CS travel costs (see also Section 2.2.1)
  (2) Public transport: PT travel costs (see also Section 2.2.1)
  The mode for the trip making alternative was not mentioned in the introduction text.
- **Travel time**: Travel times depend on the chosen mode in the travel diary for one reference

shopping trip and only comprise the way to the shop. If the chosen mode was ...
(1) MIV: Average travel time of carsharing and carpooling (see also Section 2.2.1), including an additional detour factor of 5 % assuming that the driver spends some time to find an accurate parking space
(2) Public transport: PT door-to-door travel time

In addition, the environmental variable **Size / weight of the goods basket** is included in the choice experiments, indicating how convenient it is to do a specific shopping task. For short-run purchases, this variable is linked with shopping time and expenditures: Assuming that for a high size / weight of a goods basket, the choice situation refers to weekly shopping, respective shopping time and price scaling factors are chosen to be slightly higher compared to lower size / weight of goods baskets.

Table 5: Experimental design for trip making vs. ICT ordering choice experiment.

Attributes	Ordering	Trip Making	Levels
Goods basket price	x		$-10\%, -5\%, +/-0\%$
Goods basket price		x	$-5\%, +/-0\%, +5\%$
Time for ordering	x		$-20\%, -10\%, +/-0\%$
Time for shopping		x	$-10\%, +/-0\%, +10\%$
Delivery cost and duty	x		0, 5, 10, 15 CHF
Travel cost		x	$-20\%, +10\%, +40\%$
Delivery time SR	x		$<$ 1 day / 1-2 days / $>$ 2 days
Delivery time LR	x		2-4 days / 4-7 day / $>$ 1 week
Travel time		x	$-10\%, +5\%, +20\%, \geq$ 3 min.
Size / weight of the goods basket	x	x	Low / medium / high (same for both alternatives)

SR: Short-run purchases. LR: Long-run purchases.

2.3 Stage III: Stated Adaptation Interview

The main research question addressed by stage III of the survey is to what degree individuals would be substituting time allocation and distinct activities after experiencing large changes in generalized transport costs and how they would react regarding their longer-term ownership in mobility tools[7], assessing suppressed demand effects from an activity-based perspective.

[7]While most of the material is ready for the first main survey, a high effort is put into the creation and coding of the second stated adaptation tool for long-term reactions to changes in mobility costs. The main challenges here are to present sensible cost structures - including fixed and variable costs - to the vehicle owners as well as public transport users: The shown values will depend on the respondents' yearly miles traveled, car and season

Personal interviews start the 7th of April and will take around 30 minutes, including possible adjustments / corrections of stage I and II responses followed by a debriefing of the survey and the payment of the incentive. An overview of the tools and response burden scores for the last stage of the survey are presented in Table 6.

Table 6: PCW survey tools and response burden scores in stage III.

Tool / task	Type	# Choice Scenarios	Avg. score
1. Daily scheduling	Stated adaptation	4	300
2. Mobility tool ownership	Stated adaptation	4	300
3. Adjustments / debriefing	Interview	-	100
	Stage III interviews		Total: 700

The goal is to investigate short- and long-term reactions to increasing transport prices using two Java-based stated adaptation tools. The first tool (Fig. 3) is based on the respondents' busiest days reported in the travel diary, where the interviewers introduce changes to travel costs by predefined factors: MIV (car and motor-bike) alternatives experience the highest increase, from factors of 1.5 up to 8, while the increases in public transport cost range between factors of 1.1 and 1.7 of current prices (Table 7). MPV modes, such as carsharing, taxi and carpooling are integrated as well, using the same reference cost structures as in the stated choice part and increasing them by factors between 1.1 and 2 relative to current prices. In contrast to the successful work of Weis (2012), travel times are not changed systematically and remain constant between choice scenarios. The underlying reasoning for these possible cost environments are outlined to the respondents. The basic assumptions are that future policies, such as road tolls and congestion taxes for MIV are introduced and that fuel prices increase to a possible pain threshold, while MPV and PT modes are subsidized by the government though are still increasing relative to current prices. To account for possible inconsistencies regarding season ticket ownership, the more PT trips a respondent conducts, the higher is the discount in total travel costs: For each additional PT trip, there will be a 10 % discount in the price, assuming the same reference cost structure presented in Table 2. The sum of the daily travel costs is automatically calculated and shown at the bottom of the tool (Fig. 3).

The choice set now contains the whole daily schedule: Respondents can skip or add certain activities, change the modes and activity durations. When changing activity locations (e.g. to a closer shop or leisure activity), an interactive map presenting all current activity locations supports them in their decisions. The interviewers make sure that the respondents are aware of

ticket types. Cost structures will be based on a *TCS* (Touring Club Schweiz) mobility calculator, which has to be adapted and coded in Java for a real-time calculation of household mobility costs.

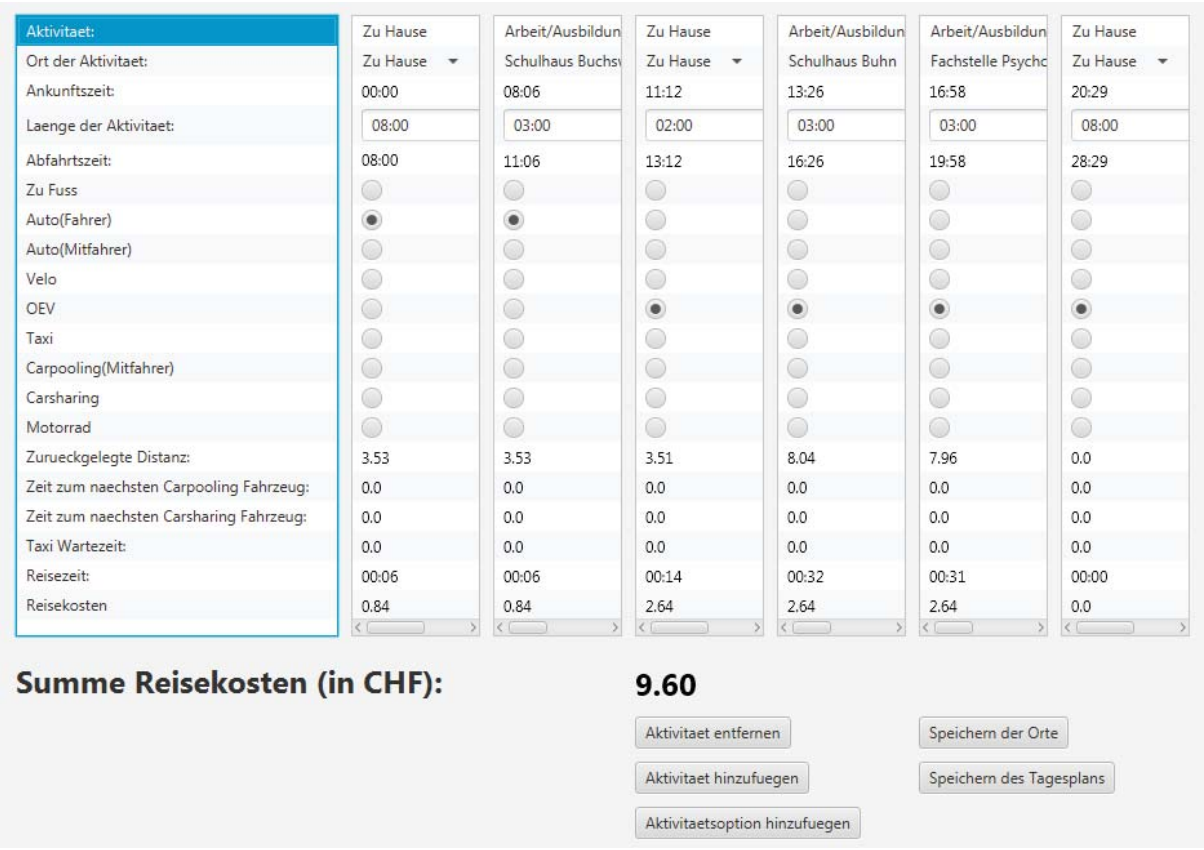
all their possibilities to reorganize the day.

Table 7: Experimental design for stated adaptation interview (tool 1): Price factors relative to current prices for different mobility tools.

Choice situation (*Post-Car World* scenario)	# 1	# 2	# 3	# 4
MIV price factors	1.5	2	4	8
MPV price factors	1.1	1.3	1.5	2
PT price factors	1.1	1.2	1.3	1.7

MPV: Motorized public verhicles (taxi, carpooling, carsharing).
MIV: Motorized individual verhicles (car, motorbike).

Figure 3: Stated adaptation tool 1: Short-term reactions to increasing mobility costs.



3 Recruitment and Response Behavior

This *Post-Car World* survey has been designed referring to many suggestions from the literature (e.g. Dillman (2000); Axhausen et al. (2002); Axhausen et al. (2007); Porter (2004); Galesic and Bosnjak (2009)), trying to account for and reveal potential response rate problems that arise when dealing with long-duration and burdensome studies:

- Medium: Paper-pencil surveys often lead to better response rates. A high effort has been put into the design and structure of the questionnaires. For more complex tasks, personal interviews are conducted.
- Confidentiality: Due the high data sensitivity, respondent were reminded several times about the strict confidentiality of their responses.
- Organization and communication: Apart from a sophisticated recruitment process (well-formulated invitation letters with the ETH logo offering permanent help, followed by the telephonic recruitment and Christmas cards), motivation and help calls have been conducted. A personal relationship between the respondents and the survey project manager has been built up during the survey process.
- Incentives: Four different incentive levels are tested in the pre-test: 50 CHF, 70 CHF, 80 CHF and 100 CHF, offering an amount that is larger than symbolic but smaller than a market-based time compensation rate, even for the highest incentive level: Total time to complete all three stages is estimated to take between 5 and 6 hours.
- Response burden and fatigue effects: Respondents face an approximate response burden score of 4700 points (separately calculated for each stage of the survey; see Section 2 and Axhausen et al. (2002) for more details) for the whole survey, hence the work effort is enormous and not comparable to most previous IVT studies. A problem that might occur with such long-duration studies is that the number of reported items (trips, activities, etc.) or response quality as a whole might decrease over time as respondents get tired of answering.
- Leverage-saliency theory (Groves et al., 2000): The motivation to participate in a survey might be influenced by the respondent's interest in the topic. Especially in long-duration surveys, saliency effects might become more substantial regarding initial participation choice, drop-out and fatigue. This paper shows evidence of a participation bias for distinct socio-economic clusters (Section 3.3), which can be partly explained by the field of research and the topic of the *Post-Car World* study itself.

Testing for some of the above-mentioned issues, a meta-analysis investigating the relationship between response burden and response rates is conducted in Section 3.1. Section 3.2 and Section 3.3 present a detailed analysis of the recruitment process and reveal possible sampling

biases. One goal is to determine an efficient incentive level for the main survey, to improve the later recruitment and survey process and to understand the respondents' motivation to participate. Fatigue effects are tested in Section 3.4 to evaluate if respondents show a declining reporting behavior over the survey period and if incentive levels affect the number of reported trips and activities.

3.1 Meta-Data Analysis

A vague idea of the required sample size, contact and response rate usually helps to plan the budget and fieldwork of a study. While response behavior, survey quality and response burden have been treated in manifold literature (see e.g. Dillman (2000), for a broad discussion about different survey techniques, response burden and response rates), an ex-ante assessment of response rates predicted by the burden has not been a widely discussed topic so far. In this section, the work of Axhausen and Weis (2009) is continued and refined, conducting a meta-analysis based on the assessment of response burden scores - using a predefined scheme for different types of questions and tasks - and response rates for past transportation studies at the IVT. Observations are fitted by an exponential function

$$response_{i,category} = \beta_0 * exp(\beta_1 * \frac{burden_{i,category}}{100}) + \epsilon_{i,category} \quad (6)$$

showing a slightly better *AICc* (for finite sample size corrected Akaike Criterion) than for a linear relationship or other non-linear model specifications. Observations are weighted by sampling probabilities of study i, i.e. by putting less weight on observations with less potential respondents. Fig. 4 shows the relationship between response burden and response rates for three different categories (all coefficients significant at $p < 0.1$; Table 8): On average, no prior incentives and recruitment of the respondents (category 3) exhibits the lowest performance, and more personal interaction (category 2) combined with incentives (category 1 / *Post-Car World*) yields much higher response rates. In all categories, a higher response burden leads to lower response rates, flattening out to the right. As all observations belong to the same field of research, saliency effects across studies are assumed to be minimized.

33 of the initial 65 recruited households completed the first part of the *Post-Car World* survey (response rate stage I = 51 %; see Fig. 4). Although exhibiting a very high response burden of 3300 response burden points for stage I only (4700 points for the whole survey), the predicted response rate is much above the expected trend line, hence speaks in favor of the large recruitment effort. However, the prediction accuracy for such a high score is not reliable and completely out of range (see Fig. 4), and a larger set of observations would help to improve the validity of the survey length versus response trade-off.

Figure 4: Response burden and stage I response rate: Meta-analysis based on previous IVT studies.

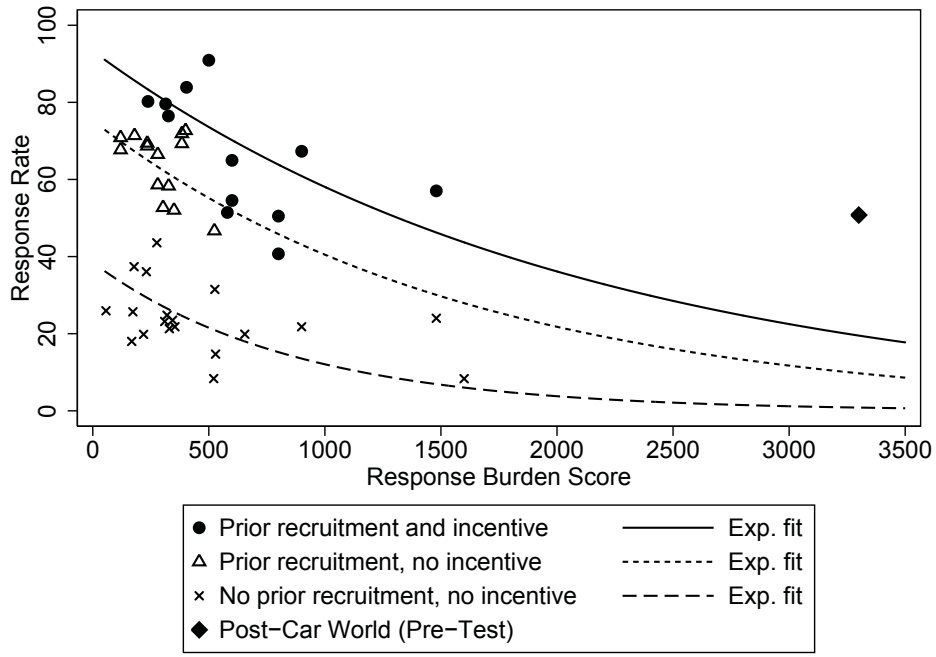


Table 8: Estimation results: Effect of response burden on response rates. Observations are weighted by the number of subjects that each observation represents (= total sample size; participants + drop-outs + non-respondents).

	Category 1	Category 2	Category 3
Incentive	√	√	-
Recruitment	√	-	-
Variable	Coef./(SE)	Coef./(SE)	Coef./(SE)
Constant	93.297***	75.256***	38.462***
	(9.92)	(5.19)	(6.56)
Response burden	-0.047**	-0.062*	-0.116**
	(0.02)	(0.03)	(0.04)
N	13	14	23

Significance levels: *** = 1%, ** = 5% and * = 10%.

Many respondents reported a general discontent regarding the high response burden: While the socio-economic questionnaires and the travel diary (although exhibiting a high response burden) worked well, data quality and response behavior of the trip planning and expenditure questionnaires were suffering. While some of them did not understand the purpose of the trip planning task, others were overwhelmed by calculating their long-run expenditures for the

different categories (communication, housing, education, etc.). To reduce the response burden in the main survey, a natural consequence would be to skip the planning exercise and only ask to complete a one-week travel diary. In general, improving the efficiency of the questionnaires by removing or simplifying burdensome and / or non-urgent questions and tasks should always receive special attention.

3.2 Descriptive Statistics

Descriptive figures of the recruited sample's behavior after stage I (PCW sample: 33 households, 51 respondents) are compared with data from the Mikrozensus 2010 (Swiss Federal Statistical Office, 2010), a weighted, representative sample of the Swiss[8] population (Table 9). While the area of living, the number of vehicles as well as gender of the household members are well represented by the PCW sample, older and larger households (≥ 4 members) with kids, high income and education[9] levels as well as season ticket owners are overrepresented. Although the PCW sample size is small, it indicates already the usual selection problems with many IVT transportation studies (Rieser-Schüssler and Axhausen, 2012): An overrepresented share of high-income, well-educated and public-transport-affine respondents of older age.

An major problem involved the recruitment of all eligible (older than 18 years) household members, simultaneously affecting the age distribution in the PCW sample: Although larger households are overrepresented, mostly fractions (e.g. parents or the addressed household heads) of all eligible household members actually participated in the survey. For the main survey, this has to be ruled out by providing better prior information during the recruitment process.

3.3 Participation Choice

Research has no conclusive suggestions regarding the implementation of incentives (e.g. Dillman (2000) and Porter (2004)). A high incentive is generally assumed to positively influence both participation rate and response quality, but the effects are not always that clear. E.g. Groves et al. (2000) shows that higher incentives lead to lower response rates for respondents with high community involvement. Hence, for the main survey, it is of special interest for the later budgeting and response behavior how the "optimal" incentive should look like. Participation

[8] Note: To compare with the PCW sample, only a subsample of the Mikrozensus is considered, focusing on the canton of Zurich.

[9] I.e. the highest degree in education. Low education: No education, obligatory school, lower commercial school or apprenticeship. Medium education: Grammar school, higher education entrance qualification, proficient diploma or professional school. High education: Higher technical academy, college or university.

Table 9: Descriptive statistics: Mikrozensus 2010 (canton of Zurich) vs. Post-Car World.

Variable	Value	MZ10 (%)	PCW (%)
Household size	1	31.6	9.1
	2	37.4	27.3
	3	12.4	12.1
	≥ 4	18.6	51.5
Household income	< 4'000 CHF	14.9	3.0
	4'000 - 6'000 CHF	17.5	3.0
	6'000 - 8'000 CHF	14.5	24.2
	8'000 - 10'000 CHF	10.6	18.2
	> 10'000 CHF	18.4	36.4
Household type	Single-person household	31.6	9.1
	Couple without kids	33.0	24.2
	Couple with kids	26.6	57.6
	Single-parent household	5.8	3.0
	Living community	3.1	6.1
Area of living	City centre	38.9	27.3
	Agglomeration	54.8	63.6
	Rural	6.3	9.1
Number of cars	0	24.5	30.3
	1	49.1	51.5
	2	21.7	15.2
	> 2	4.6	3.0
Number of bikes	0	30.1	3.0
	1	21.3	6.1
	2	22.2	15.2
	> 2	26.4	75.8
Sex	Female	54.3	54.9
	Male	45.7	45.1
Age	18 - 35 years	20.7	9.8
	36 - 50 years	29.4	29.4
	51 - 65 years	27.4	54.9
	66 - 80 years	22.5	5.9
Education	Low	17.0	19.6
	Medium	56.9	35.3
	High	26.1	45.1
Seasontickets	None	36.4	9.8
	Half-fare card	53.2	62.7
	GA	10.4	27.5
Car availability	Always	74.2	69.4
	Sometimes	18.5	18.4
	Never	7.3	12.2

choice models (A) are estimated based on the screening interviews with recruited and non-recruited households to measure the effects of four different incentive levels - 50, 70, 80 and 100 CHF[10] - and socio-economic characteristics on the willingness to (1) participate in the survey and (2) complete the first part of the survey. Note that *each* participant within a specific household would receive the priorly specified amount of money. Models are estimated for each stage separately (see Fig. 1; stage I: participation vs. non-participation; stage II: completion vs. drop-out). The differences between the Mikrozensus 2010 and the PCW sample mostly coincide with the results of the participation choice models, applying a logistic modeling framework to the likelihood of participation and drop-out: A higher education level and a higher share of season tickets both have a significantly positive effect ($p < 0.01$), increasing initial stage I participation probability by up to 33 percentage points (Table 10). The same for incentives: Offering 100 CHF instead of 50 CHF increases the participation probability by 21 percentage points on average ($p < 0.05$).

While higher incentives as well as a high educational background lead to a significant increase in the initial participation probability, it does not preserve the respondents from drop-out: Offering medium (70 or 80 CHF) or high (100 CHF) incentives leads to a lower probability ($p < 0.1$) that respondents complete stage I of the survey (Table 10), both categories showing net-effects on completion that are probably[11] not significantly different from zero. One explanation might be that when realizing the high response burden, the survey was perceived as work effort rather than a social contribution, and the inhibition threshold to drop-out was lower for such high incentives. In addition, younger ($p < 0.01$) respondents living in the city center ($p < 0.1$) with a higher educational background ($p < 0.05$), a higher share of motorized vehicles in the household ($p < 0.05$) and a lower share of season tickets ($p < 0.1$) also exhibit a higher drop-out probability. While higher educated households generally are more interested in the survey topic, because of time constraints they might choose to drop-out, exhibiting a net-effect on completion that is not significantly different from zero[12]. The mobility-related participation and drop-out pattern is stabbing in the way that car driving respondents probably do not feel involved enough in the *Post-Car World* topic to complete the survey and that public-transport-affine households are highly overrepresented. Results indicate that the motivation to participate in this long-duration survey is partly mediated by the respondents' preferred transport mode.

Table 11 presents a combined modeling approach (B), estimating MNL models with the base category "No initial participation" for the effects of incentives and socio-economic variables on "Completion" and "Initial participation and later drop-out" probabilities. Result underline

[10] Note: To estimate the models, the medium incentive categories (70 CHF and 80 CHF) are pooled, as their effects were never significantly different from each other.

[11] See participation choice model B: Effects are not significant.

[12] Regarding the 2nd MNL model in Table 11 - the model with income data - there is still a positive and significant net-effect though.

Table 10: Participation choice models (A): Stage I (participate in survey) and stage II (complete first part of the survey). Logit models estimating the effects of socio-economic characteristics and incentives on the willingness to participate.

Dep. Var.	Participation		Completion	
Base category	No (N = 106)		No (N = 32)	
Variable	Coef./(SE)	$\frac{dy}{dx}$ /(SE)	Coef./(SE)	$\frac{dy}{dx}$/(SE)
Sex of HH-Head (Male = 1)	0.072	0.017	-0.104	-0.026
	(0.36)	(0.08)	(0.65)	(0.16)
Age of HH-Head	-0.015	-0.003	0.100***	0.025***
	(0.02)	(0.00)	(0.04)	(0.01)
# Household Members	0.241	0.055	0.272	0.068
	(0.16)	(0.04)	(0.24)	(0.06)
City (ZH = 1)	0.498	0.114	-1.644*	-0.411*
	(0.37)	(0.08)	(0.97)	(0.24)
Incentive: 50 CHF	Base	Base	Base	Base
70 CHF or 80 CHF	0.395	0.083	-1.522	-0.340*
	(0.43)	(0.09)	(1.02)	(0.19)
100 CHF	0.924**	0.209**	-1.697	-0.383*
	(0.46)	(0.10)	(1.15)	(0.22)
Education: Low	Base	Base	Base	Base
Medium	1.099**	0.219**	-1.847**	-0.418**
	(0.49)	(0.10)	(0.93)	(0.18)
High	1.535***	0.326***	-1.398	-0.309*
	(0.45)	(0.09)	(0.95)	(0.18)
Share of Seasontickets	1.142**	0.261**	1.331*	0.333*
	(0.46)	(0.11)	(0.74)	(0.19)
Share of Vehicles	0.262	0.060	-2.509**	-0.627**
	(0.41)	(0.09)	(1.06)	(0.26)
N	171	-	65	-
ρ^2	0.15	-	0.28	-
Prob. > χ^2	0.00	-	0.07	-

Significance levels: *** = 1%, ** = 5% and * = 10%.

the findings in Table 9 and Table 10 and directly highlight the net-effects on the outcome of interest: Household size and the share of season tickets have a positive and significant effect on the completion of stage I. Important to note, incentives show no significant effect on completion, while there is a large and positive effect on the drop-out probability for both medium and high incentives! This effect becomes even stronger when additionally controlling for household income. Findings can be interpreted in the following ways:

- Ceteris paribus, the incentive level for the main survey should be set to 50 CHF. This might lead to a lower initial participation probability, but also to a lower drop-out incidence.

Table 11: Participation choice models (B): Full participation vs. ex-ante participation and later drop-out. MNL models estimating the effects of socio-economic characteristics on the willingness to participate.

Base category: Non-participants	Participants Coef./(SE)	Drop-outs Coef./(SE)	Participants Coef./(SE)	Drop-outs Coef./(SE)
Sex of HH-Head (Male = 1)	0.010	0.135	0.230	-0.019
	(0.44)	(0.46)	(0.53)	(0.54)
Age of HH-Head	0.010	-0.049**	-0.006	-0.048*
	(0.02)	(0.02)	(0.02)	(0.03)
# Household Members	0.442**	0.088	0.373*	0.249
	(0.19)	(0.22)	(0.22)	(0.27)
City (ZH = 1)	-0.017	1.157**	-0.160	0.640
	(0.44)	(0.53)	(0.53)	(0.65)
Incentive: 50 CHF	Base	Base	Base	Base
70 CHF or 80 CHF	0.118	0.842	0.125	1.227*
	(0.50)	(0.61)	(0.60)	(0.70)
100 CHF	0.325	1.647**	0.929	2.116***
	(0.60)	(0.66)	(0.68)	(0.78)
Education: Low	Base	Base	Base	Base
Medium	0.153	2.248***	0.104	1.976**
	(0.70)	(0.80)	(0.83)	(0.82)
High	0.891	2.450***	1.325**	2.885***
	(0.55)	(0.77)	(0.67)	(0.87)
Share of Seasontickets	1.676***	0.775	2.033***	0.948
	(0.52)	(0.62)	(0.70)	(0.84)
Share of Vehicles	-0.375	0.920	-0.748	0.530
	(0.54)	(0.63)	(0.62)	(0.73)
Income: < 6'000 CHF			Base	Base
6'000 - 12'000 CHF			1.906*	0.087
			(1.04)	(0.79)
> 12'000 CHF			0.884	-1.158
			(1.20)	(0.92)
$N_{Category}$ (N_{Total})	33 (171)	32 (171)	28 (128)	24 (128)
$AICc$		318		265
ρ^2		0.19		0.24
Prob. > χ^2		0.00		0.00

Significance levels: *** = 1%, ** = 5% and * = 10%.

- If the response burden would be decreased substantially in order to reduce drop-out incidence (and probably increase data quality of the remaining tasks), a higher incentive could make sense for recruiting more households.
- Younger people living in the city are less willing to complete the study. Additional motivation calls to this subgroup might help to improve their response behavior.
- All eligible household members (> 18 years) should agree to participate, otherwise the household will not be permitted for the study. This should also help to improve the age distribution of the PCW sample.
- Saliency effects should be minimized to better address car drivers, hence slightly adapting the invitation letter content and the description of the *Post-Car World* project. In general, the respondents should be better instructed about the different survey questionnaires during the telephonic recruitment process.
- Due to the relatively small sample size, one has to be aware that results should be enjoyed with caution and mainly serve as suggestions for how to "optimally" design the main survey.

3.4 Reported Travel Behavior and Fatigue

A key feature of testing the validity of the longitudinal data structure is to investigate travel and activity behavior over time, checking for possible inconsistencies, decreasing number of trips or other exogenous influences (e.g. Axhausen et al. (2007); Axhausen et al. (2002)). A first investigation of the *Post-Car World* pre-test data focuses on descriptive figures for checking the representativeness of travel behavior and the number of trips and online activities over the reporting period, detecting a possible prevalence of reporting fatigue.

Key mobility figures are found to be representative when compared to the Mikrozensus 2010 for the canton of Zurich subsample (Table 11), and regarding the average number of trips (mobile and all persons) no decreasing commitment over the two reporting weeks has been detected: There is a higher share of mobile person days in the PCW sample, which even is slightly increasing in week 2. Average number of trips per day are only little lower than in the MZ2010, again showing slightly more trips in week 2. Findings indicate no manifestations of reporting fatigue and learning effects seem to be predominating. Regarding the chosen main modes in the MZ2010 and PCW sample, as expected there is a clear tendency of choosing public transport instead of motorized vehicles, while for the other modes, the PCW sample seems to be unbiased (there is a higher share of walking trips in the MZ2010, which may be due to the fact that the MZ2010 is based on its participants' one day travel behavior, probably leading to a higher trip resolution detecting more short-distance trips). Interestingly, even for the relatively small PCW

sample size, the observed trip purpose distribution is extremely close to the MZ2010 subsample, except for the share of leisure activities. Some respondents obviously reported "Other activity, please specify" instead of "Leisure, ...", which, whenever possible, will be recoded in the later data cleaning process.

Table 12: MZ2010 and PCW key mobility figures, chosen main mode and trip purpose distributions.

		MZ2010	PCW Week 1	PCW Week 2
Mobility figures	Share of mobile person days	88.5	93.3	95.1
	Average number of trips (all person days)	3.3	3.1	3.3
	Average number of trips (mobiles days only)	3.8	3.4	3.5
Main mode	Walk	31.1	20.0	20.4
	Bike	5.9	8.2	5.9
	Car or motorbike	43.3	38.2	39.4
	Public transport	18.7	33.0	34.0
	Other	1.0	0.6	0.3
Trip purpose	Return home	36.7	38.7	38.9
	Accompanying trips	3.4	3.6	3.3
	Work / eductation	15.7	16.3	15.5
	Shopping	12.2	10.6	10.7
	Settlements / Transactions	4.1	3.7	4.3
	Business	1.9	2.2	2.5
	Leisure	24.9	19.4	17.8
	Other purpose	1.0	5.4	7.1

Although the length of the 14 days reporting period is still moderate compared to *MobiDrive* (Axhausen et al. (2002); Löchl et al. (2005)), it is still extending most of the Swiss transportation studies. Fig. 5 presents the average (only mobile days) number of trips and the average number of *different* online activities in the PCW sample. For the number of trips, a clear daily pattern is observable, exhibiting significantly less trips on Sundays (day 7 and 14), which is comparable the number of different online activities, though much more pronounced. Fatigue effects seem to be predominated by motivation and learning effects and the number of reported trips even increased in the second week, showing a peak on Saturday, the 24th of January. The number of reported online activities show a weakly negative trend.

OLS regression analyses are conducted, checking if there is a significant deviation from a steady number of reported trips and online activities (Table 13), additionally controlling for the day of week (not reported), incentives and season ticket ownership. Interaction terms of the day of reporting period (time trend) with incentives and season ticket ownership are added, investigating if higher incentives and public-transport-affinity prevents respondents from fatigue effects.

Figure 5: Average number of reported trips and different online activities per day during the two-week reporting period.

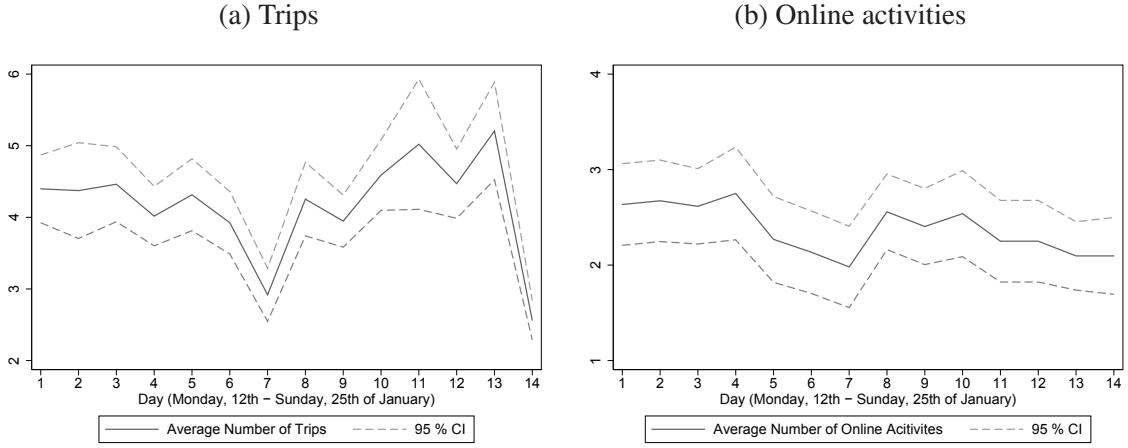


Table 13: Fatigue effects in the number of reported trips and online activities.

Dep. Var.	# Trips per day		# Online activities	
	Coef./(SE)	Coef./(SE)	Coef./(SE)	Coef./(SE)
Time trend (TT)	0.032*	-0.083*	-0.018	-0.027
	(0.02)	(0.05)	(0.01)	(0.05)
Incentive: 50 CHF		Base		Base
70 or 80 CHF		-0.009		0.311
		(0.33)		(0.69)
100 CHF		-0.091		-0.070
		(0.39)		(0.75)
70 or 80 CHF x TT		0.055		-0.032
		(0.05)		(0.04)
100 CHF x TT		0.012		0.020
		(0.04)		(0.04)
Season ticket (Yes = 1)		-0.828**		0.129
		(0.40)		(0.41)
Season ticket x TT		0.094**		-0.033
		(0.04)		(0.03)
N_{Total} (# subjects)	675 (51)	675 (51)	714 (51)	714 (51)
R^2	0.07	0.10	0.02	0.03
Prob. > F	0.00	0.00	0.00	0.02

Constants and day-of-week dummies not reported in the table.

Significance levels: *** = 1%, ** = 5% and * = 10%.

Robust standard errors, clustered by subject-ID.

Regarding the number of reported trips per day, there is a weakly significant ($p < 0.1$) and positive effect, indicating learning effects over the survey period. Results are comparable to (Axhausen et al., 2007), where positive learning rather than negative fatigue effects were predominating. Incentive levels and its interaction with the day of reporting period are all non-significant, indicating that higher incentives have no effect either on the absolute number of reported trips nor than on fatigue. Interestingly, the number of trips for people without season tickets (i.e. car drivers) are on a significantly higher level, but response behavior of this group decreases over the reporting period, while for season ticket owners, reported trips are more or less constant over time. For the number of online activities, a negative trend though not significant at common levels has been detected ($p = 0.13$; see also Fig. 5). Incentive levels as well as its interaction with the time trend show no significant effect on fatigue.

To summarize, respondents probably need some time to get used to the travel diary, which, after some days, should impose no difficulties anymore. While incentive levels heavily influence initial participation choice, the absolute number of reported items as well as the quality of long-duration responses seem to be unaffected by the offered incentives. However, saliency effects have been detected for the travel diary, indicating weakly significant fatigue effects for non-season ticket owners, a result that is consistent with all the above findings.

4 Conclusions and Outlook

Long-duration and burdensome studies face different problems when recruiting and motivating respondents, but they substantially add to the empirical basis for transport related planning and policy decisions. Combined with stated preferences, attitudes and personality traits, the analysis of such data might help to get a better understanding of individuals' daily scheduling and travel behavior in a given socio-economic and mobility-related context. The first main survey wave, unique in its content and comprehensiveness, will start in the beginning of May 2015. Based on the findings in the pre-test, several adaptations are proposed to improve the work flow, efficiency and response behavior. Apart from changes in the survey and recruitment process, questionnaires might be shortened, improved or skipped and respondents should be better instructed during the initial recruitment interviews in order to reduce drop-out effects.

An initial idea of the respondents' motivation for participating in the study play an important role for improving the later recruitment and survey process. Results in this paper show evidence for different socio-economic aspects having an effect on participation, completion and response behavior in this long-duration survey. A high incentive level leads to a significantly higher participation rate, but the net-effect on completion is zero. Once recruited, higher incentives

even lead to significantly more drop-out effects. One explanation might be that when realizing the high response burden, the survey was perceived as work effort rather than a contribution to society, and the inhibition threshold to drop-out was lower for high incentives. In contrast, however, no effect of incentive levels on reporting fatigue could be detected.

Findings indicate a general sampling problem observed in many transportation studies. Certain socio-demographic characteristics are consistently overrepresented for participation and drop-out groups: Highly educated households seem interested in the topic and thus agree to participate, but often drop-out after receiving the questionnaires. The share of season tickets in the households strongly affects participation and completion of the survey, while the share of motorized vehicles leads to an augmented drop-out incidence. Findings suggest saliency effects, where response behavior seems to be heavily influenced by the respondents' interest in the topic. While general fatigue effects could not be revealed in this pre-test study (even a positive learning effect was observed for the travel diary), public transport users exhibit a significantly stabler reporting behavior over time than non-public transport users. Hence, saliency effects should be minimized to better address car drivers, e.g. by adapting the invitation letter content and the description of the *Post-Car World* project during the telephonic recruitment.

The choice of an "optimal" incentive level for the main survey is not straight-forward. A combined approach, i.e. reducing the response burden and setting the incentives to a medium level, will be followed to maximize later participation and response behavior and to minimize drop-out probability, given the fundamental research design that - in any case - asks for a longer-duration and more burdensome survey. By reducing the response burden and regarding the results of the participation choice and response behavior models, the incentive will be set to 70 CHF, in the hope of simultaneously achieving both - a higher participation and lower drop-out incidence.

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A Appendix

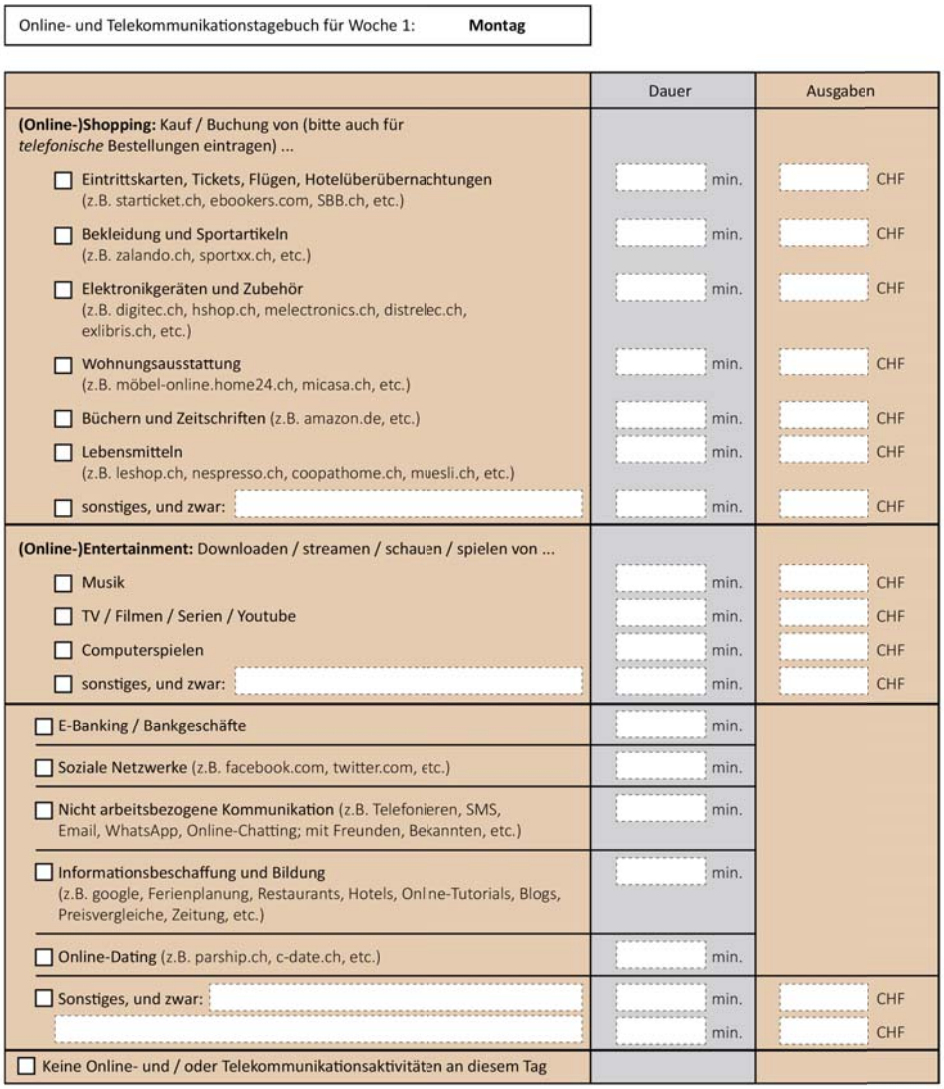
A.1 Stage I Questionnaires

Figure 6: Travel diary.

Wegetagebuch für Woche 2: ☐ MO ☐ DI ☐ MI ☐ DO ☐ FR ☐ SA ☐ SO

Weg Nr.	1	2
Startzeit	Uhr	Uhr
Verkehrsmittel	☐ Zu Fuss min. ☐ Velo min. ☐ Motorrad min. ☐ Auto (Fahrer) min. ☐ Auto (Mitfahrer) min. ☐ Tram / Bus min. ☐ Bahn min. ☐ Sonstige min. Wartezeit: min.	☐ Zu Fuss min. ☐ Velo min. ☐ Motorrad min. ☐ Auto (Fahrer) min. ☐ Auto (Mitfahrer) min. ☐ Tram / Bus min. ☐ Bahn min. ☐ Sonstige min. Wartezeit: min.
Ankunftszeit	Uhr	Uhr
Gesamtdistanz	km (geschätzt)	km (geschätzt)
Ziel des Weges (Adresse oder Lokalität)	Str. Nr. PLZ Ort Lokalität	Str. Nr. PLZ Ort Lokalität
Wegzweck	☐ Rückkehr nach Hause ☐ Jemanden abholen / bringen ☐ Arbeit / Ausbildung ☐ Einkauf (täglicher Bedarf) ☐ Einkauf (langfristiger Bedarf) ☐ Erledigungen / Dienstleistungen ☐ Dienstlich / geschäftlich ☐ Freizeit, und zwar: ☐ Sonstiges, und zwar:	☐ Rückkehr nach Hause ☐ Jemanden abholen / bringen ☐ Arbeit / Ausbildung ☐ Einkauf (täglicher Bedarf) ☐ Einkauf (langfristiger Bedarf) ☐ Erledigungen / Dienstleistungen ☐ Dienstlich / geschäftlich ☐ Freizeit, und zwar: ☐ Sonstiges, und zwar:
Anzahl beteiligte Personen / Hunde	Weg / Aktivität Haushaltsmitglieder Andere bekannte Personen Hunde	Weg / Aktivität Haushaltsmitglieder Andere bekannte Personen Hunde
Planungs-horizont	☐ Routineaktivität / Weg nach Hause ☐ Einen oder mehrere Tage im Voraus ☐ Im Laufe des Tages ☐ Spontan / gerade eben	☐ Routineaktivität / Weg nach Hause ☐ Einen oder mehrere Tage im Voraus ☐ Im Laufe des Tages ☐ Spontan / gerade eben
Ausgaben / Verkehrs-Kosten	☐ ÖV-Fahrkarten CHF ☐ Parkgebühren CHF ☐ Taxi CHF ☐ Mietkosten (z.B. Auto, Velo, ..) CHF ☐ Keine Ausgaben für diesen Weg	☐ ÖV-Fahrkarten CHF ☐ Parkgebühren CHF ☐ Taxi CHF ☐ Mietkosten (z.B. Auto, Velo, ..) CHF ☐ Keine Ausgaben für diesen Weg

Figure 7: Non-physical interaction diary.



Online- und Telekommunikationstagebuch für Woche 1: **Montag**

	Dauer	Ausgaben
(Online-)Shopping: Kauf / Buchung von (bitte auch für *telefonische* Bestellungen eintragen) ...		
☐ Eintrittskarten, Tickets, Flügen, Hotelüberübernachtungen (z.B. starticket.ch, ebookers.com, SBB.ch, etc.)	min.	CHF
☐ Bekleidung und Sportartikeln (z.B. zalando.ch, sportxx.ch, etc.)	min.	CHF
☐ Elektronikgeräten und Zubehör (z.B. digitec.ch, hshop.ch, melectronics.ch, distrelec.ch, exlibris.ch, etc.)	min.	CHF
☐ Wohnungsausstattung (z.B. möbel-online.home24.ch, micasa.ch, etc.)	min.	CHF
☐ Büchern und Zeitschriften (z.B. amazon.de, etc.)	min.	CHF
☐ Lebensmitteln (z.B. leshop.ch, nespresso.ch, coopathome.ch, muesli.ch, etc.)	min.	CHF
☐ sonstiges, und zwar:	min.	CHF
(Online-)Entertainment: Downloaden / streamen / schauen / spielen von ...		
☐ Musik	min.	CHF
☐ TV / Filmen / Serien / Youtube	min.	CHF
☐ Computerspielen	min.	CHF
☐ sonstiges, und zwar:	min.	CHF
☐ E-Banking / Bankgeschäfte	min.	
☐ Soziale Netzwerke (z.B. facebook.com, twitter.com, etc.)	min.	
☐ Nicht arbeitsbezogene Kommunikation (z.B. Telefonieren, SMS, Email, WhatsApp, Online-Chatting; mit Freunden, Bekannten, etc.)	min.	
☐ Informationsbeschaffung und Bildung (z.B. google, Ferienplanung, Restaurants, Hotels, Online-Tutorials, Blogs, Preisvergleiche, Zeitung, etc.)	min.	
☐ Online-Dating (z.B. parship.ch, c-date.ch, etc.)	min.	
☐ Sonstiges, und zwar:	min.	CHF
	min.	CHF
☐ Keine Online- und / oder Telekommunikationsaktivitäten an diesem Tag		

A.2 Stage II Questionnaires

Table 14: Assignment of the different SC questionnaire types.

Driving license	Bike available	Distance	Chosen mode	Choice alternatives	SC type
Yes	Yes / No	< 5 km	Walk	Walk / Taxi / CP / CS / PT	1
	Yes	< 15 km	Bike	Bike / Taxi / CP / CS / PT	2
	No	< 5 km	MIV / PT	Walk / Taxi / CP / CS / PT	1
	Yes	< 5 km	MIV / PT	Bike / Taxi / CP / CS / PT	2
	Yes	5 ≤ ... < 15 km	MIV / PT	Bike / Taxi / CP / CS / PT	2
	No	5 ≤ ... < 15 km	MIV / PT	Taxi / CP / CS / PT	3
	Yes / No	≥ 15 km	MIV / PT	Taxi / CP / CS / PT	3
No	Yes / No	< 5 km	Walk	Walk / Taxi / CP / PT	4
	Yes	< 15 km	Bike	Bike / Taxi / CP / PT	5
	No	< 5 km	MIV / PT	Walk / Taxi / CP / PT	4
	Yes	< 5 km	MIV / PT	Bike / Taxi / CP / PT	5
	Yes	5 ≤ ... < 15 km	MIV / PT	Bike / Taxi / CP / PT	5
	No	5 ≤ ... < 15 km	MIV / PT	Taxi / CP / PT	6
	Yes / No	≥ 15 km	MIV / PT	Taxi / CP / PT	6

CP: Carpooling passenger. CS: Carsharing driver. PT: Public transport.

Figure 8: Example of a mode choice experiment.

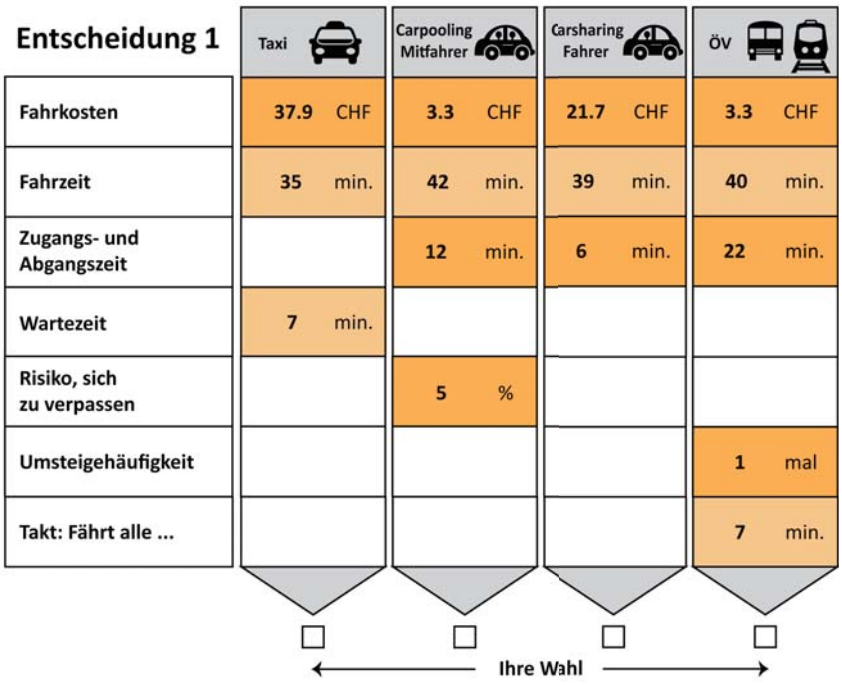


Figure 9: Example of an ICT ordering choice experiment.