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How Late Reporters Effect Data Quality in Longitudinal Surveys – Experiences From the German Mobility Panel

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Abstract

Survey design always has a significant influence on the outcomes. Therefore, this paper investigates how follow-up campaigns affect survey outcomes and response rates in longitudinal surveys. Furthermore, it is assessed how late reports in the fall affect survey outcomes. The analyses are based on the unique data of the German Mobility Panel. Overall, this paper paints a broad picture of the methodological aspects and overlapping effects that should be considered before starting the fieldwork of longitudinal surveys. The results indicate that people who are reminded to participate positively influence the survey outcomes - even when the report is belated.

Keywords: Data Quality, Follow-up campaign, German Mobility Panel, Survey period

1. Introduction

Everyone has preferences about participating in surveys (e.g., PAPI/CAWI) and how he or she wants to be solicited to participate. As a result, studies are often subject to selectivity. For example, postal surveys tend to have lower response rates than face-to-face or telephone surveys (Diekmann, 2021). Therefore, it is essential to investigate how the response rate can be increased by the survey design or by the design of the survey documents. E.g., postal reminders are a proven approach in travel surveys to increase the sample size and reduce bias.

The German Mobility Panel (MOP) is a longitudinal national household travel survey (NHTS) that has collected data on travel behavior in Germany each year. Due to the long history (start in 1994), the survey documents are sent by conventional mail and households that do not report in time are contacted again in a so-called follow-up campaign. The MOP is designed as a panel survey. Participants are asked to report their daily travel over seven days

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(one week) and car utilization (fuel consumption in the second part of the survey) for three consecutive years. Every year, a portion of households drops out and is replaced with new households. Due to the survey design, response rates are lower than in cross-sectional surveys. The response burden for participants to report three years over seven days is considerably high. Dropping out seems easy because many opportunities occur, e. g. during the recruitment or fieldwork phase (Chlond and Kuhnimhof, 2003).

Because participation in the MOP is voluntary, dropping out premature has no adverse consequences. As shown in the literature (Chlond and Kuhnimhof, 2003; Chlond et al., 2013), participants are generally highly motivated (due to the survey content), and follow-up campaigns are used to address those who forgot to participate. This study explores how follow-up campaigns affect the survey outcomes of the MOP. For this study, follow-up campaigns are defined as the period in which participants are interviewed who did not take part in the survey during the main survey period and are therefore reminded to participate. To this aim, this study addresses the following research questions:

- Are households surveyed in the follow-up campaign more likely to drop out the following wave?
- How do the sociodemographics of households surveyed in the follow-up campaign differ from households that report in time?
- Regarding the outcome in travel behavior: how does a delayed report after the clock change (31/10) differ from reports before the clock change in the fall?

2. Literature review

Household travel surveys are essential for transport planning. The high quality of the collected data is required for transport planning and models. Over the last decades, most travel surveys that aim to be representative have been provided as paper and pencil surveys (PAPI). In recent years, more and more surveys have entered the market that collects data using digital tools and devices. However, only a comparatively small number of these studies claim to be representative. It is known from the literature that inadequacies in survey instrument design or technical inadequacies avoid participation (Goodrich, 1979). Several strategies and measures are known for PAPI surveys that can increase response rates. For example, Porst (2001) recommends the following measures:

- The mailing envelope and the official cover letter should make a strong impression.
- The following documents should also be enclosed: reply envelope and data protection sheet.
- Pre-announcements or follow-up campaigns can also increase the response rate.

A major challenge of travel surveys is that people vary in how well they can be motivated to participate. Experience of MOP surveys shows that people between 15 and 44 years are more likely to fail to participate (Zumkeller et al., 2003). Furthermore, large households are less likely to participate than small ones (Hubrich, 2017). To address this problem, reminders and motivating letters are a proven way to reduce and avoid errors due to non-response and incomplete information, thus increasing the quality of data collection and content.

Since the announcement and reminder letters contain the specified cut-off date, the mailings must reach the recipient in good time. For travel surveys, reminders usually affect the assignment of a new record date. In the case of postal surveys, two to three reminders (letters or postcards) at intervals of one to three weeks are standard. The number of reminders depends on cost and field work time (Diekmann, 2021).

The following literature review examines how institutions process their data collection regarding reminders. The urban travel survey “Mobility in cities – SrV 2018” uses reminders. Reminders were only sent to households where no telephone number could be researched. A maximum of two reminder levels is used. If no response is received within 16 days, the households receive the first reminder and, if necessary, a second reminder after another 16 days (Hubrich et al., 2019). All documents are sent by post. The German NHTS “Mobility in Germany 2018” (MiD) also uses reminders to increase response rates. The survey period is staggered and the data collection contains of a household interview and a trip interview. Depending on the contact information, households are reminded to participate by email, phone or SMS the day before the trip interview. Households that missed the trip interview are reminded by email or post (Eggs et al., 2019). The documents were also sent by mail in the

"Österreich unterwegs 2013/2014" survey. Participation reminders were sent by mail and telephone (Bundesministerium für Verkehr, Innovation und Technologie, 2016). In a final step, households who did not participate were sent the survey documents again by mail after three reminders.

The Netherlands Mobility Panel (MPN), a Dutch national household travel survey, also uses reminders. The MPN is an online access panel in which people report their everyday travel over three days. Households receive the survey documents exclusively online. Several reminders are sent during the fieldwork by email. Mobile phone text messages are also sent during the reporting days, reminding them to participate every day. A final reminder is sent 72 hours after the last day if the respondent has not completed the trip diary (Hoogendoorn-Lanser et al., 2015).

3. Data

This section introduces the MOP and gives an overview of the sample and the survey period.

3.1. German Mobility Panel

The MOP is a German national household travel survey (NHTS) conducted yearly since 1994. The MOP survey usually takes place each year in the fall, and the survey weeks are chosen to avoid school and bank holidays since the survey aims to best capture everyday travel. The participants are asked to provide a trip diary containing information about all their trips during one week, i.e., distances traveled, means of transportation, trip purposes, and start and end times. Furthermore, sociodemographic information, the availability of cars and bicycles, and the possession of transit passes are also collected. The survey is carried out on behalf of and funded by the German Federal Ministry of Transport and Digital Infrastructure (BMVI). The market research firm KANTAR is responsible for the fieldwork (i.e., recruitment and data collection). The Institute for Transport Studies of the Karlsruhe Institute of Technology is in charge of the scientific supervision of the survey (Ecke et al., 2021; Zumkeller and Chlond, 2009). The annual sample of the MOP is composed of three cohorts each year: First-time reporters, second-time reporters, and third-time reporters. First-time reporters are all new to the survey (for three years). The following year, first-time reporters are referred to as second-time reporters and drop out of the survey after the third year of the report.

For the data collection, each cohort is divided into two regional splits to account for school holidays in fall in the Federal States of Germany. Consequently, households are not surveyed during holidays. Doing so ensures that events such as vacations do not "distort" the picture of everyday travel. In addition, particular features such as extreme weather events can be intercepted. The two splits are designed to be roughly equal in size. These two splits will cover four weeks, approximately between late September and the end of October. Households are assigned into seven weekday splits to ensure equal distribution across the weekdays (identifying and evaluating fatigue effects, Chlond et al. (2013)) and to smoothen weather effects. In the weekday split, one-seventh of households start to report on each of the seven weekdays (e.g. one-seventh starting on Monday).

Due to institutional and legal requirements, first-year reporters may be interviewed later in the year than second- and third-year reporters. The delayed report of first-time reporters is split into two parts to account for irregularities during fieldwork, such as extreme weather and other anomalies. Four to five weeks after the first dispatch of the survey documents, households who did not participate are reminded. Again, an allocation to weekday splits is considered in the follow-up campaign (Rösch et al., 2017).

3.2. Study Sample

The sample used for this study contains 1,700-1,900 households and 2,700-3,100 persons above ten years. Participants are asked to take part in the MOP for three consecutive years. Each year, a portion of the households is dropped from the subsequent wave and replaced with new households.

Due to late commissioning, there were delays in the fall wave of the 2015 cohort in 2015 and the 2016 cohort in 2016 (first report for both cohorts) (Rösch et al., 2016, 2017). Figure 1 shows the data collection periods for the 2015 and 2016 cohorts for all three report years. Furthermore, the follow-up periods are highlighted. It can be seen that only a relatively small number of households are surveyed in the respective follow-up campaigns. Furthermore, it

can be seen that the two main splits are separated by at least two weeks. This approach can compensate for irregularities in the survey process. The last households are surveyed in a calendar week (CW) 50. It can be assumed that everyday travel is different in the weeks before Christmas due to preparations for Christmas Eve. Consequently, it is essential to finish the data collection in advance.

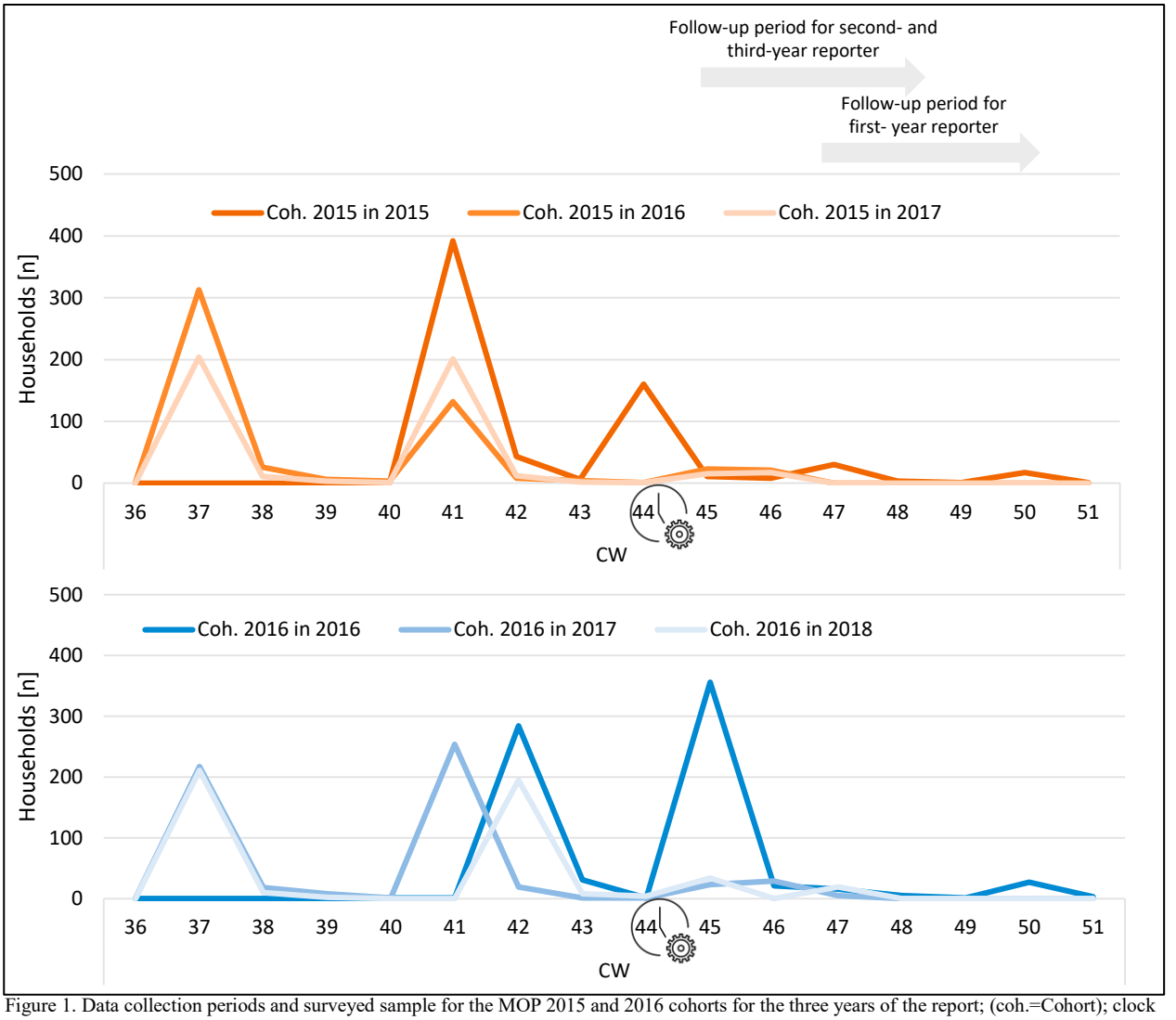

Figure 1. Data collection periods and surveyed sample for the MOP 2015 and 2016 cohorts for the three years of the report; (coh.=Cohort); clock change is highlighted in CW 44

The household sample is controlled by spatial categories, household type, and car ownership. Table 1 displays the sample composition. A sample of 2,344 participants from the MOP 2015 and 2016 cohorts is used for the present study. Compared to the official statistics, the sample used in this study is reasonably representative over the three years of the report. There is a small underrepresentation of small households and an overrepresentation of households with two or more cars.

A study by Chlond et al. (2013) has shown that the motivation to report accurately is higher in the beginning (first wave) and declines each wave (attrition between waves). For example, it can be seen that the share of households surveyed in the follow-up campaign (7.3 %) is lower in the first report than in the second (9.1 %) and third (9.0 %) year of the report.

In particular, households with many people have a higher probability of dropping out of the survey. This is mainly because the organization of the survey documents (and everyday life in general) is more complex than in small households. Furthermore, recruiting carless households is challenging. The mobility of carless households often differs from households with a car because the car is usually used intensively. Low-income households often do not own a car and are generally hard to motivate for such a survey. These households are slightly underrepresented. However, once recruited, the vast majority of households can be retained. The sample of the rotating panel is anticipated to be representative of the population.

Table 1. Sample composition in three years of the report

	Population	cohort 2015 and 2016 (total)		
	2015	1. year	2. year	3. year
		n	n	n
Households	-	1,420	1,115	950
Persons with a trip diary	-	2,344	1,816	1,524
Share	%	%	%	%
# household members				
1	40.8	34.4	35.3	38.2
2	34.4	38.5	40.1	39.1
3+	24.8	27.0	24.6	22.7
# cars				
0	22.6	18.4	18.0	19.9
1	53.9	45.7	46.8	46.7
2+	23.5	35.9	35.2	33.4
Size of town				
0-20 T INH	38.3	36.3	35.9	34.2
20-100 T INH	27.2	27.9	28.8	29.0
100+ T INH	34.6	35.9	35.3	36.8
Share of follow-up households	-	7.3	9.1	9.0

Population statistics are taken from 2013 and 2015 (Statistisches Bundesamt, 2013, 2015); T INH= thousand inhabitants

4. Results

In this section, the main findings of the study are presented. For the assessment, descriptive analyses are utilized. More sophisticated approaches, such as binary regression models, were also tested, but it was impossible to obtain significant results due to the small sample sizes for follow-up households. The following sections focus on survey repetition and compare the travel measures.

4.1. Follow-ups and survey repetition

First, it is essential to note that households that have agreed to participate in the MOP do so voluntarily. To minimize the number of households that reject participation, reminders are sent to those who did not report in time. The fieldwork institute gives no information on the number of households that refused to participate for all three years. A selectivity study during the recruitment phase is documented in Chlond et al. (2013).

The following analysis relies on households that reported at least once within the three years. The sample is nested at the household level to understand the relationship between those who fail to participate, in-time-reporting

households and households that participated in the follow-up campaign (reminded). The groups are nested according to the point of time when the survey documents were sent back (Figure 2). A small subsample (n=147; "Failure") has not participated in the first year of the report but in consecutive years. This illustrates that we have motivated participants who do not report in the first year but are generally willing to cooperate.

104 households were reminded in the first year ("Follow-up"). These households are being categorized as reminded if the household has not returned the survey documents after the main reporting period. This e. g. happen if the household members are on vacation and do not want to report their travel during vacation or fail to start the report on the given starting day. Across all three reporting years, 17% of households are reminded at least once to participate and complete the documents.

The share of households that report in time is always at the highest level. Based on the presented path diagram (Figure 2), we see a slight indication that households being surveyed in the follow-up campaign have a higher tendency to drop out ("Failure") in the following year. E.g., 44% (n=46) of those who reported in the follow-up campaign in year 1 dropped out in year 2, whereas 29% (n=383) of those who reported in time in year 1 dropped out in year 2. Reminded respondents are likely to consist of two groups: One group as bad risks (those who drop out) and those who report belated by any other reasons (but are potentially motivated; good risks).

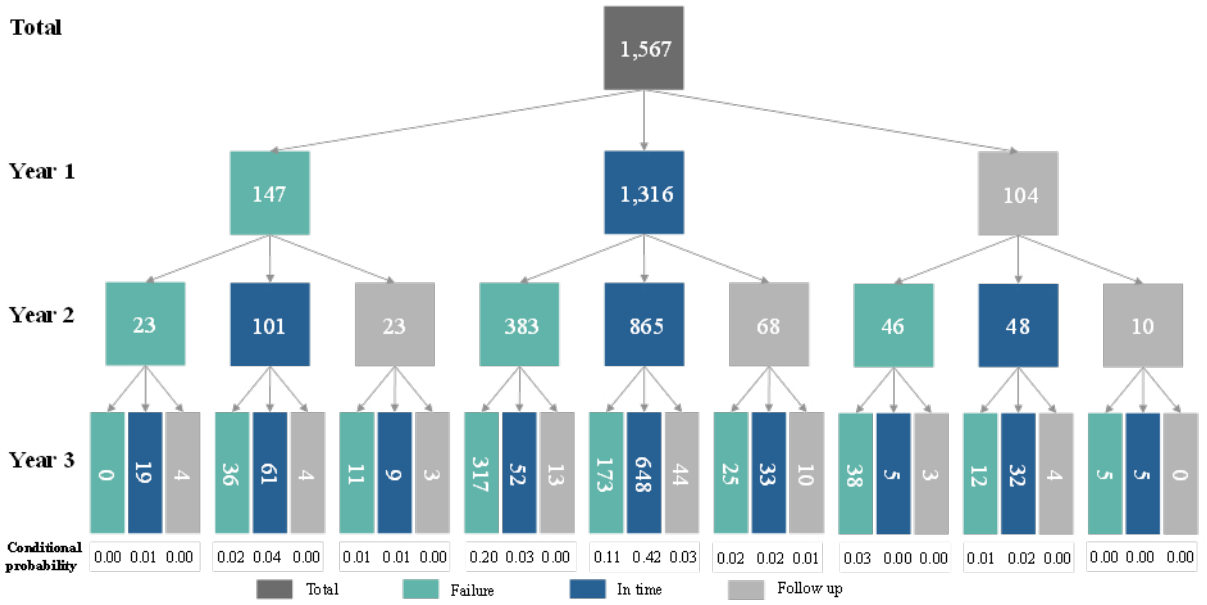

Figure 2. Survey repetition and report status of households that participate in the MOP in three years; analysis based on 2015 and 2016 cohort

4.2. Travel characteristics

This section addresses whether characteristics of everyday travel behavior are associated with group membership, which assigns a person to the group *in time* or reminded (*follow-up*). We differentiate between the three years of the report and if a household was surveyed in a follow-up campaign. If a household fails to report, the household is dropped from the analysis for the respective year. Table 2 displays statistical measures for the number of trips made, distances traveled, time spent while traveling and mobile on the reporting date. Furthermore, t-tests were performed to analyze the significance level between the two groups for each reporting year. Significant values are marked in bolt. Besides the mean values, the table also displays sample statistics at the household level.

The analysis shows no significant differences for trips made between households reporting in time and those reporting in the follow-up campaign. However, the number of trips made in the first year of the report is slightly higher for both groups than in the second or third year. When looking at distances traveled and time spent traveling, we see significant differences between households that reported in time and those who reported in the follow-up campaign in the second year (distances traveled) and third year (time spent while traveling) of the report.

A decrease in time spent traveling and distances traveled results of a time effect. Because vacations and weekend excursions are less likely in November (because it is too far away from the holiday season and holidays in autumn are over), long-distance travel seldom occurs, decreasing these measures.

When interpreting the results, two effects are not separable and need to be considered: A time effect occurs because the follow-up households are surveyed more than weeks after the initial survey document dispatch. For the cohorts of 2015 and 2016, the follow-up campaign is always in November. It can be assumed that everyday travel is different within this period if the year, e.g. people cycle less because of low temperatures and a higher possibility to rainy days (where cycling is uncomfortable). Second, follow-up effects occur, meaning that the reminded people feel responsible for participating and reporting (more) accurately. This again allows the assumption that the reminded households (and their respective household members) consist of two groups.

Table 2 Reported travel of MOP households, grouped by the year of participation and level of reminder (in time/follow up), cohorts 2015/2016

	1. year		2. year		3. year	
	In Time	Follow-up	In Time	Followfup	In Time	Follow-up
Households [n]	1,316	104	1,014	101	865	85
Mean values						
Trips made [#/day]	3.4	3.6	3.2	3.2	3.2	3.2
Distances travelled [km/day]	43.7	44.2	**43.9**	**36.4**	43.3	38.6
Time spent while traveling [min/day]	85.2	96.4	84.5	81.3	**85.4**	**73.8**
mobile on the reporting date [%]	0.92	0.90	0.91	0.89	0.90	0.89
# household members						
1	34.3	36.5	35.9	29.7	39.1	27.6
2	39.1	30.8	41.0	30.7	39.4	35.3
3+	26.6	32.7	23.1	39.6	21.5	37.1
# cars						
0	18.0	23.1	18.2	15.8	20.1	17.6
1	45.5	48.1	47.3	41.6	47.4	40.0
2+	36.5	28.8	34.5	42.6	32.5	42.4
Size of town						
0-20 T INH	36.6	31.7	36.4	30.7	33.5	41.2
20-100 T INH	28.0	26.9	28.5	31.7	29.7	21.2
100+ T INH	35.4	41.4	35.1	37.6	36.8	37.6

Bolt T-test significant at 95% confidence level

T INH (thousand inhabitants)

Furthermore, it is checked whether the subsample compositions of households differ. The analysis is differentiated by spatial categories, household type and car ownership. A chi-square test complements the comparative analyses to indicate the significance of the differences.

No structural differences between the subsamples concerning the number of cars and spatial categories were found. However, differences in the number of household members are identified. In the second and third year, the subsamples differ significantly (2nd year: $\chi 2$ (3, N = 1115) = 14.49, p = .002; 3rd year: $\chi 2$ (3, N = 950) = 12.80, p = .005). Especially households with three or more people are more likely to be part of the follow-up campaign. Compared to a household with one or two people, these households have to arrange the participation for several household members (with different levels of motivation), which is more complex. If more than two people fill out a trip diary, the probability is high that one person will forget. Young people are underrepresented in the MOP sample. The likelihood of finding these persons in a multi-person household is high.

Summing up, no significant change in the number of trips was found, indicating that follow-up households' motivation level is high. On the contrary, significant differences were found between the distances traveled and the time spent. The results can be interpreted to mean that the timing of the survey (September/ October or November) is more likely to affect transport performance and mobility time than whether you were reminded of the report, which will be analyzed in the next section.

It also appears that multi-person households, which have a more challenging time organizing the completion of the documents, are more likely to report in the follow-up campaign. Since these households often include young people who are challenging to keep in the study. The follow-up campaign is an excellent way to motivate these people to participate and to keep the sample composition stable.

4.3. Travel in November

The MOP survey period includes the clock change on 31/10. With the time change in Central Europe (e.g. Germany) in the fall, it becomes light one hour earlier in the morning and dark one hour earlier in the evening. This is why some people change transport modes on their daily trips. For example, some people don't like to ride their bicycles in the dark, which is why they are used less in the late afternoon during winter, e.g. for hobbies. This section deals with the question of how travel characteristics differ depending on the point of time. We first investigate whether the samples differ before and after the clock change to address the paper's focus. Since we further assume that the mode choice differs before and after the clock change, we also analyze that for the samples. Again, we must consider overlapping effects (weather/follow-up/survey period). Since no adequate model was found for the analysis, the evaluation is descriptive.

Descriptive analyses of the people that report in the second and/or third year are shown in Table 3. We intentionally excluded the first year of the report because numerous respondents of the 2016 cohort were surveyed after the clock change in 2016. We assume this would result in inaccurate results, as we see a compensation between a higher motivation in the first reporting period and seasonal effects. For the analysis, we include people without a trip diary. We split the sample into three groups: people without a trip diary, people with only a few days with trips, and others. A chi-square test compares the groups and the point when a person was surveyed.

The chi-square test indicates that the groups differ significantly. In the group of people surveyed after 31/10, the share of people who report no trips is low (0.9%). Further, the share of people who report few trips (98.5%) is significantly higher than those who report on time (83.1%). The reminder in the follow-up campaign makes people feel strongly obligated to participate in the survey. The reminder further emphasizes the importance of participation.

Table 3. Reporting characteristics of people that report before/after 31/10, cohort 2015/2016 in 2. year and 3. year

	Respondents before 31/10	Respondents after 31/10	p-value
Respondents [n]	3,538	331	
No trips reported	15.9 %	0.9 %	<.001
Only 1-2 days or first 3 days reported	1.0 %	0.6 %	
Others	83.1 %	98.5 %	
Total	100.0 %	100.0 %	

Lastly, we analyze mobility key figures of those who completed a trip diary before/after 31/10. Therefore, Table 4 displays statistical measures for different transport modes. In addition, t-tests were performed to check whether the mobility key figures before/after 31/10 differ significantly.

When looking at the sample, no significant differences were found for the number of trips made and trips made on foot and public transport. However, significant differences were found for bike trips and trips by car. Therefore, it can be concluded that the mode choice after the clock change differs from the situation before the clock change. Fewer trips are made by bicycle, maybe because it is colder and darker earlier in November than in October. Trips by car then substitute these bicycle trips.

The results indicate that, unlike our expectations, no clear differences between reports before/after 31/10

can be identified when looking at the age of the respondents.

When interpreting the results, however, it must be taken into account that the travel behavior in the weeks before Christmas differs from the travel behavior in October/November since many people make trips in preparation for Christmas that would otherwise not occur during the year.

Table 4. Mobility key figures of reporting participants before and after the clock change, cohorts 2015-2016

Variable	Group	Respondents before 31/10	Respondents after 31/10	t	p
Total [n]	Total	3,011	329		
	< 35	502	80		
	> 35	2,509	249		
Mobile on the reporting date [%]	Total	90.1	88.5	2.22	0.027*
	< 35	92.1	88.6	2.50	0.013*
	>35	89.6	88.5	1.44	0.151
Trips made [#/day]	Total	3.22	3.22	0.00	0.998
	< 35	3.16	3.24	-0.78	0.434
	>35	3.24	3.22	0.3	0.75
Trips made on foot [#/day]	Total	0.63	0.61	0.51	0.613
	< 35	0.59	0.67	-1.63	0.102
	>35	0.64	0.60	1.42	0.156
Trips made by bike [#/day]	Total	0.32	0.25	1.20	<.001*
	< 35	0.41	0.31	2.26	0.024*
	>35	0.31	0.23	3.56	<.001*
Trips made by car (driver/passenger) [#/day]	Total	1.88	2.00	-2.50	0.012*
	< 35	1.53	1.66	-1.46	0.145
	>35	1.96	2.11	-2.87	0.004*
Trips made by public transport [#/day]	Total	0.32	0.32	-0.30	0.762
	< 35	0.61	0.56	1.08	0.28
	>35	0.26	0.25	0.66	0.51
Distances traveled [km/day]	Total	44.2	37.4	4.86	<.001*
	< 35	48.4	40.7	2.46	0.014
	>35	43.4	36.3	4.49	<.001*

t-test (95% confidence level); *note*: < 35 are people below 35 years; > 35 are people older than 35 years;

5. Conclusion

The presented work analyzes the relationship of households reminded in the MOP survey. The work shows how these households/people affect the survey outcomes. Because of the multifaceted design of the survey (different splits, reminder dispatch, rotating panel, survey period over two months), overlapping effects affect the survey outcomes. The presented study was split into two parts: one explores the differences between households that report in time and those surveyed in the follow-up campaign. The other explores the travel behavior differences for respondents who report before/after the clock change (31/10).

The question is whether it is worthwhile initiating a follow-up campaign. The results show that about 17 % of all households were interviewed at least once in a follow-up campaign. The results also show that the report quality does not significantly differ between the groups. Households reporting in the follow-up campaign contribute

positively to sample exhaustion. The results show that multi-person households are more inclined to report in the follow-up campaign. These households include young adults. They are hard to keep in the MOP because they feel less bound. The follow-up sample contributes positively to the sociodemographic structures of the MOP survey. The fact that persons do not report may have different reasons, but these are not collected in the study. For the future, it is recommended to conduct a non-response study to learn more about the reasons for late reporting.

The results also show that the travel behavior and data quality of people who report after the clock change (and thus in the follow-up campaign) is comparable. Differences are mainly due to seasonal changes (e.g. weather). It was also found that people who report in the follow-up campaign (and therefore after the clock change) travel fewer kilometers and spend less time on the road. It can be assumed that particular long-distance travel events (e.g. vacations) were omitted. A shortcoming of our study is that (optical) survey design adaptions were made but were not considered. In 2016, all survey documents were revised and printed in a new layout. This leads to an increase in response rates and thus biases the results. Since the 2015 cohort knows the latest and the old design, but the 2016 cohort only knows the new design, it is impossible to separate the effects.

Summing up, the presented work shows that the participants of the MOP are highly motivated and willing to participate. The follow-up campaign is thus a proven approach to increasing response rates. However, a permanent assessment of any biases is essential to interpret the results.

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