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Balancing innovation and continuity – Experiences with survey design adaptations of the German Mobility Panel

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Abstract

The German Mobility Panel is one of the longest-lasting studies with a basically unchanged design in mobility behaviour research world-wide. As a result one central asset of this study is the provision of time series data. Nevertheless in repeated surveys, design changes are sometimes inevitable due to new research questions or external developments. Since 1994 the German Mobility Panel has seen only minor design adaptations. After nearly 20 years with a more or less unchanged design, declining participation rates by certain person groups and new survey methods have required fundamental changes in the survey design. This paper describes design changes to the German Mobility Panel in 2013 and analyses the first outcomes generated by the methodological changes.

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Keywords: Panel survey; innovation, design methodology

1. Introduction

One of the central characteristics of repeated or even continuous surveys is the possibility of providing data to describe the dynamics of change. This requires continuity in both the design and the method of a survey (Ampt et al., 2009; Transportation Research Board, 2011, pp. 61ff.). Otherwise any observed changes cannot be distinguished

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from methodological artifacts and thus cannot be assigned to changing frameworks or changed behaviour. Nevertheless, changes are sometimes inevitable in the design of repeated surveys. Reasons might be new research questions or external developments. Therefore there is an issue about handling inevitable methodological changes (Ampt, 2013).

This paper explains design changes to the German Mobility Panel (MOP). Due to the nature of the panel approach these modifications affect the survey results for the following two or three years at least. Our first results show that methodological changes can be dealt with by a careful design without endangering the survey results and the consistency of the time series.

The paper starts with a short introduction to the MOP survey design as it has been used for the last 20 years. Then we discuss the problems that had come up in the last few years which have motivated some design changes. Finally these changes are presented and we report how the transition in design was managed.

Regarding the outcomes of the survey we present results of the first wave after the implementation of the new design. As the design modifications took place smoothly and step by step over a period of three years, we concentrate on the first year's results and, because of the still small sample sizes, do not look at joint effects by different recruitment and reporting approaches. We show typical effects in terms of key mobility indicators and we discuss the outcomes against the objective to keep the survey "continuous". We end with some recommendations from the perspective of the first year's evaluation on how a change can be managed easily.

2. The German Mobility Panel

Since 1994 the German Mobility Panel (Zumkeller et al., 1997; Zumkeller, 2009) annually collects data about the travel behaviour of the German population. Every year approximately 1,000 households with 2,000 persons (age 10 years and older) contribute to the MOP survey by filling in a trip diary for one week. As it is a panel survey, the MOP keeps households and persons in the sample for three consecutive years. The survey always takes place in autumn and the reported weeks are chosen not to contain any holidays ("everyday travel"). Participants provide a completed trip diary containing information about all their trips during a whole week, such as distances, modes, purposes and start and arrival times. They also provide information on socio-demographic characteristics. Participation is voluntary, and not all persons in the household have to participate in the survey to allow the household to be counted as a valid participant. The MOP is a rotating panel, where each year a certain proportion of the households leave the survey after three years of participation and are replaced by a new cohort of first year reporters ("planned replacement"). Beyond this, dropouts from year to year also occur ("unplanned replacement").

Amongst other data sources, the MOP substantially contributes information for developing transportation infrastructure in Germany. It is carried out on behalf of and funded by the German Federal Ministry of Transport and Digital Infrastructure. The Institute for Transport Studies of the Karlsruhe Institute of Technology (KIT) is responsible for the design and scientific supervision of the survey. The market research institute TNS Infratest conducts the fieldwork.

The German Mobility Panel is one of the longest-lasting studies with a basically unchanged design in mobility behaviour research world-wide. One of its central assets is the provision of time series data. The MOP is a multi-purpose instrument. Besides the observation of intrapersonal behaviour changes and options for intrapersonal analysis, the MOP data is used for regular reports of travel demand developments to the German Federal Minister of Transport and Digital Infrastructure. Both aspects require observation of behaviour which must not be distorted by any methodological or random impacts, that is the MOP requires a certain level of continuity. Therefore a main requirement is for the survey design to be robust and stable.

The combined multiday (seven days) and multiperiod (panel) approach leads to substantial respondent burden (Chlond et al., 2009; Zumkeller et al., 1997). Therefore the outcomes of the study are influenced by certain selectivity and attrition effects and the overall success of the panel is endangered by dropout behaviour during days of the reporting week and between the three waves (years) (Chlond et al., 2013; Kuhnimhof et al., 2006). It is known that certain attrition effects depend on socio-demographic characteristics such as age. For the MOP we observe the following panel repetition rates depending on the age (numbers given for the cohort 2011):

- 10 to 17 years: 80% second year, of those 90% third year
- 18 to 25 years: 81% second year, of those 77% third year

- 26 to 35 years: 61% second year, of those 87% third year
- 36 to 50 years: 69% second year, of those 84% third year
- 51 to 60 years: 81% second year, of those 90% third year
- 61 to 70 years: 75% second year, of those 80% third year
- older than 70 years: 92% second year, of those 96% third year.

Young adults aged 26 to 35 years quite often leave the survey after one year (39% loss). However, a very large share of the remaining group in this age participates in the third year (87%).

The MOP has proven its stability in several dimensions:

- It must be assumed that the real travel demand and the real mobility behaviour might not be collected perfectly and that a certain level of selectivity cannot be avoided. But it can also be assumed that these effects are the same across the years because of the unchanged design of the MOP.
- Besides the stability of base effects due to unchanged methodology, the approach of a rotating panel and the participation of the participants over up to three consecutive years also results in additional stability effects – at least in terms of the option to identify particularities of certain cohorts. The effects of attrition and fatigue are smoothed and basically remain the same in each year as far as the cohort sizes and cohort composition remain stable.

3. Design change and research questions

Since 1994 the MOP has seen only minor design adaptations. After nearly 20 years with a more or less unchanged design the declining participation rates in certain person groups (mainly young adults) have eventually required fundamental changes in the survey design. During the last few years these demographic biases could still be compensated for by appropriate weighting procedures. However, the identification of these effects as well as a general climate of decreasing willingness to participate in surveys led to the idea to change the design of the MOP towards a more up-to-date design mainly to attract the young, who represent a new and growing "hard-to-reach group" (Riandey and Quaglia, 2009). Considering the emergence of new survey methods and changing legal conditions such as privacy issues, the following design adaptations have been made:

1. The sampling frame, which had been landline phone owning households only (random digit dialing), has been enlarged. An additional sample is drawn from mobile phone users. Since there are both mobile-only and landline-only households, both sample sources cover different universes and thus can be seen as a dual-frame sampling approach. This mixed approach is expected to better cover the population (Goulia, 2001), but results in new challenges as it is not known how much of the population is covered by the different approaches. We regard the outcome positive as the accessibility and participation of certain household types has been substantially improved, especially of 1- and 2-person households of young adults which had been difficult to recruit in the past.
2. Another fundamental change is the option for new participants to participate in the MOP by means of web-based forms, whereas before the survey was only paper-based with conventional diaries. From previous work (Morris and Adler, 2003; De Leeuw, 2005) it can be assumed that mixed data collection approaches affect the outcome and also the data quality and completeness.
3. The size of the sample has been increased to 1,500 households. This does not look like a problem, but as first-, second- and third-year-reporters have different reporting behaviours (Chlond et al., 2013), a different composition of the sample will also affect key mobility indicators.

All three changes were implemented for the MOP survey in 2013 and are likely to affect the outcomes. The challenge is to identify and quantify these effects, such as changing reporting behaviour and identification of methodological artifacts, to develop appropriate weighting procedures and to provide continuity in the time series and the outcome of the study.

The paper analyses the effects of the two methodological changes. Both samples – households recruited through landline phone ("conventional sample") and households recruited through mobile phone users ("mobile sample") – cover the same population. But respondents in households recruited by different approaches may have different

mobility behaviour as the probability of catching participants at home also depends on their mobility behaviour. The reported mobility behaviour of mobile participants and landline participants is analysed, compared and interpreted.

Filling in the trip diary online as an additional option results in further questions and analyses. The acceptance of the web-based diary compared to the conventional survey design has to be assessed in terms of participation rates, completeness of reports, and socio-demographic characteristics. The main question is whether the outcomes of the conventional diary and the web-based form are comparable or if the continuity is at risk.

4. Fieldwork and data weighting

The design adaption and recruitment started in early summer of 2013. The survey weeks were between September and November 2013. The final data analysis took place in the summer of 2014.

4.1. Fieldwork

A three-stage approach is used to recruit the panel households. First, a representative telephone survey based on a multi-stratified random sample is conducted to screen the German households along the five regional categories and the four household types used in the German Mobility Panel. From this representative sample the relevant households for the subsequent recruitment phases are selected. In the second stage the households are contacted by phone and asked for their willingness to participate in a survey on mobility behaviour. In the third stage the households first have to return a short questionnaire containing information on the household members and a formal agreement to participate and then they receive the survey documents by mail (Kuhnimhof et al., 2006).

In 2013, a dual frame approach, with a combined landline and mobile phone sample, was used for the screening and subsequent recruitment. Thus, the new cohort for the first time includes both households contacted via landline and households contacted via mobile phone. In comparison to former cohorts the coverage of two types of households was improved. Mobile-only users are now included, that is households that only have a mobile phone available, but no landline phone, a target group characterised by a high share of single households and men with a relatively low education level. A second household type whose coverage was improved is the dual use household, that is households that use both a landline phone and mobile phone/s. While these households could be accessed by landline-only in the past, they can now be reached by two channels, both landline and mobile phone. This increases the chances of reaching highly mobile target groups – whose chance to be contacted at home by landline is lower. Regarding socio-demographics, other target respondents in the dual use households are reached when approached by mobile phone such as a higher share of younger people, and more men in general. Moreover, dual use households accessed by mobile phone are slightly larger than those accessed by landline. This is an indication that the probability of reaching a household by mobile phone increases with the number of household members.

During the third stage the participants of the new cohort for the first time had the option to complete both the household questionnaire and the trip diary either by paper-pencil or online via desktop, tablet or smartphone. On average 15% of the target persons completed the trip diary online (see also Section 5.4): 19% of the male and 11% of the female participants chose the online option. As expected, the share of online completions increases with educational level and is lower among older participants.

Both the online household questionnaire and the online trip diary contain data cleaning procedures to prevent participants from giving incomplete or inconsistent answers. Examples are logical checks within the trip diary, such as a warning message if the starting time of a trip is before the ending time of the previous trip or if trip distance and trip duration is not within reasonable bounds for the reported mode. There are some obligatory data fields that have to be filled in before the respondent can enter further questions. We assume that these quality checks help to increase data consistency within the information given. However, whether the higher technical capabilities required to handle the diary online affect the number and structure of reported trips must be studied in detail.

4.2. Data weighting

Each year the final MOP data set passes a set of weighting routines to adjust for socio-demographic bias and to ensure the representativeness of the sample. Key mobility indicators based on the weighted data reflect the everyday

travel behaviour of the German population. The weighting is sub-divided into the weighting of households, of persons and of trip distances, and has been applied in the same way each year.

The cohort of the year 2013 for the first time consists of two different samples, contacted via landline or mobile phone. Therefore the 2013 cohort needs to be weighted according to the different probabilities of inclusion (design weighting for both modes). For this weighting the households have been divided into "landline-only", "mobile-only" and "landline and mobile". Afterwards the traditional MOP weighting (three stages: households, persons and trips) has been applied for all three cohorts.

5. Results

After all data cleaning steps and plausibility checks the final MOP sample of 2013 consists of 1,517 households with 2,369 persons aged 10 years and older having a trip diary of acceptable quality, with 56,603 total trips. The following three cohorts are part of the MOP wave 2013:

- cohort 2011: 326 households with 525 persons (third-year-reporters)
- cohort 2012: 362 households with 572 persons (second-year-reporters)
- cohort 2013: 829 households with 1,272 persons (first-year-reporters).

The enlargement of the overall sample leads to a rather large first-year cohort in 2013. The share of first-year-reporters in the 2013 sample is about 54%.

5.1. Changes in cohort sizes and resulting effects

The MOP is designed as a rotating panel for three consecutive years. Each year the oldest cohort of households and persons leaves the MOP, and the sample is refreshed by a new cohort. Each MOP wave consists of first-year-, second-year- and third-year-reporters. In addition, unplanned dropouts reduce the size of the groups of the second- and third-year-reporters. The dropout rates were more or less stable during the last decade and involved the younger age groups to a large extent. This is relevant for the results as it is known that the reported mobility drops with the number of survey years on the person level, the so-called "attrition between waves". On the other hand, participants reporting for the second or third time are well experienced with the trip diary. All in all, the sample composition concerning the number of times participants have reported on trips affects the mobility key indicators such as trips per week and distances travelled.

Traditionally the share of first-year-reporters was around 43% at the person level (mean value for 2003 to 2012, range between 38% and 46%) due to the stable sample sizes, see Table 1. After the enlargement of the sample in 2013 the share of first-year-reporters increased to 54%. Thus the alteration of cohort shares increases the influence of the new cohort on the MOP data. We observed slightly increased mean mobility key indicators for the overall MOP wave caused by this change. This effect is expected to disappear during the next years, since all following cohorts will be of the larger size, that is after three years we anticipate stationary cohort shares per wave. The design effect will be levelled out. An issue still open is whether participants from the new mobile sample show the same dropout behaviour between waves. Figure 1 shows the number of participants with a trip diary over 2003 to 2013 by first, second and third year.

Table 1. Households and persons with trip diary in the MOP survey (2003 – 2013).

Survey Year		Households			Persons		
		first year	second year	third year	first year	second year	third year
2003	abs.	459	280	322	856	488	587
	%	43%	26%	30%	44%	25%	30%
2004	abs.	419	327	228	748	599	387
	%	43%	34%	23%	43%	35%	22%
2005	abs.	377	331	260	671	575	481
	%	39%	34%	27%	39%	33%	28%
2006	abs.	400	267	240	706	448	401
	%	44%	29%	26%	45%	29%	26%
2007	abs.	392	297	215	714	506	347
	%	43%	33%	24%	46%	32%	22%
2008	abs.	485	327	250	761	589	433
	%	46%	31%	24%	43%	33%	24%
2009	abs.	356	373	253	613	575	442
	%	36%	38%	26%	38%	35%	27%
2010	abs.	443	285	314	797	491	480
	%	43%	27%	30%	45%	28%	27%
2011	abs.	487	351	236	785	611	404
	%	45%	33%	22%	44%	34%	22%
2012	abs.	490	373	310	780	603	530
	%	42%	32%	26%	41%	32%	28%
2013	abs.	829	362	326	1.272	572	525
	%	55%	24%	21%	54%	24%	22%

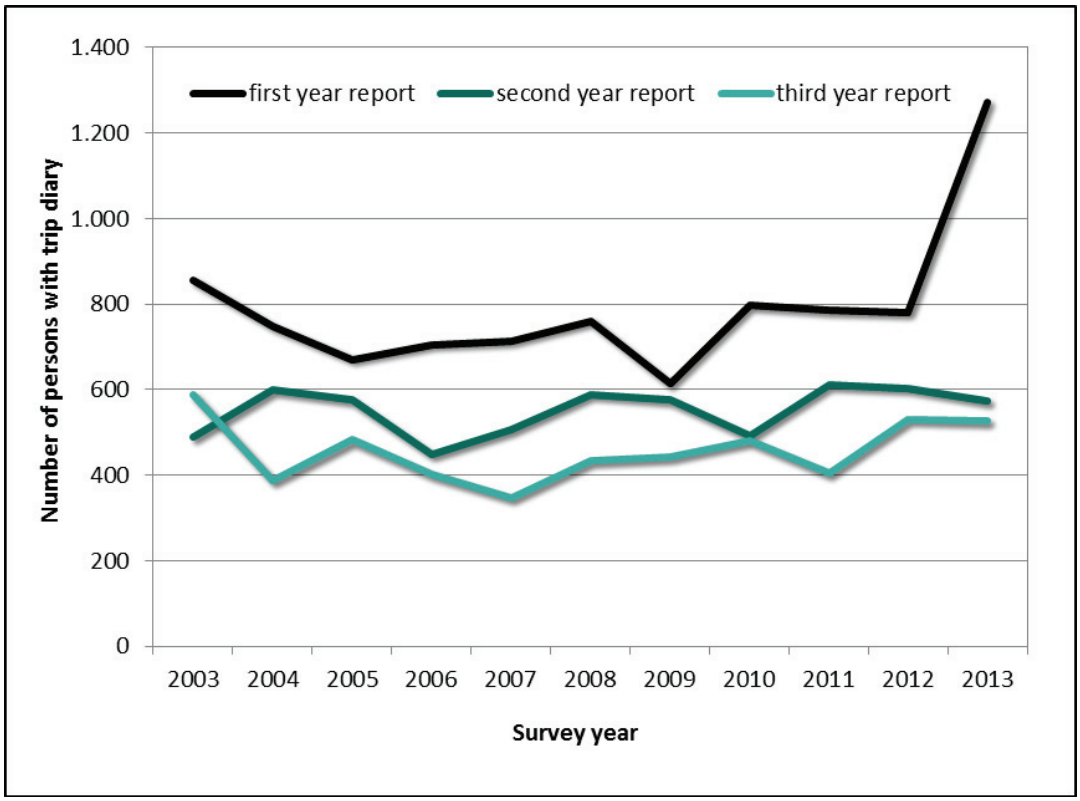

Figure 1. Number of trip diaries in the MOP survey by year of report (2003-2013).

5.2. Selectivity

The MOP is a household-based survey where initially one person in a household is randomly contacted by phone (landline or mobile) and asked to bring the other household members into the survey. Thus, not all possible respondents to the survey have direct contact with the field institute's staff. As the MOP is a voluntary survey, the objective to achieve complete households depends on the initial contact person in the household convincing the other household members to participate. The ability of this contact person to convince others has a fundamental impact on the completeness of households. The recruitment process faces the following challenges:

1. All household members aged 10 years and older should participate in the survey. This increases the representativeness for the German population and household structure and reduces the impact of the weighting.
2. A high share of the new participants should be motivated to participate over all three years and thus achieve the panel approach of the MOP.

The MOP, like other surveys, suffers from the unwillingness of young adults to participate and stay for a longer time. To address this problem, the dual-frame-sample and the online trip diary were introduced in 2013.

Table 2 shows a comparison of the MOP data for individuals for 2012 and 2013. Shown are the age distributions of persons for whom the household questionnaire contains at least basic information on socio-demographic characteristics and of persons with trip diary. In addition, the age distribution of the German population (basic population) is shown. Young adults (18 to 35 years) are underrepresented in the overall data, whereas people aged 51 to 70 years are overrepresented. Households leave the MOP between waves, typically households with young adults deciding about the participation tend to do so. When considering the new cohort only, we observe a positive

effect from the new recruitment process. The share of persons aged 26 to 35 years is 10% in 2013 and thus significantly larger than in 2012 (6%).

Table 2. Age distribution in the MOP person samples (2013 and 2012) against the age distribution of Germany.

Age group	Basic population (GER)	Wave 2013				Wave 2012			
		All persons	Persons with trip diary	All persons (new cohort)	Persons with trip diary (new cohort)	All persons	Persons with trip diary	All persons (new cohort)	Persons with trip diary (new cohort)
10 to 17 years	8%	8%	7%	8%	7%	9%	8%	9%	9%
18 to 25 years	10%	8%	5%	8%	6%	8%	5%	8%	6%
26 to 35 years	12%	8%	8%	10%	11%	7%	6%	6%	6%
36 to 50 years	24%	23%	24%	25%	26%	22%	22%	23%	23%
51 to 60 years	16%	20%	21%	21%	21%	20%	21%	21%	22%
61 to 70 years	12%	18%	19%	16%	17%	18%	20%	18%	20%
71 years and older	17%	15%	16%	12%	13%	17%	18%	14%	15%

Against the background of the skewed age distribution, emerging issues are: How large is the share of persons with a trip diary, how this share differs between the age groups and how it develops from year to year? Analyses of the first year participants in 2011, 2012 and 2013 showed a negative effect for pupils aged 10 to 17 years. The share of persons without a trip diary increases to 36% (mean of 2011 and 2012: 26%). The share in the age group of 18 to 25 years develops positively to 47% (mean of 2011 and 2012: 52%), but at the same time is the highest value in the age groups. Interestingly the share of non-reporters among people aged between 26 and 35 years dropped to 17% (mean of 2011 and 2012: 24%), which is possibly the first positive outcome of the new online trip diary.

5.3. Mobile phone sample

About 40% of the households and 37% of the persons in the new cohort were recruited via mobile phone (329 of 829 households and 474 of 1,272 persons). In the landline sample 7% of all persons are living in “landline-only” households, that is households with no single mobile phone in use. In the mobile sample, 7% of all persons are living in “mobile-only” households and do not have access to a landline phone at home.

Table 3 shows the age distributions of individuals by recruitment method. In the mobile sample a higher share of young adults (18 to 35 years) can be observed in the person data as well as for those with a trip diary. The table also shows the share of persons without a trip diary for each age group. There is a shift in non-reporting: young individuals tend not to fill in a trip diary in the landline sample, whereas older persons have a higher share of non-reporting in the mobile sample. Thus, the way the household has been contacted also determines the structure of the final sample of people who report their travel.

Table 3. Age distribution of the person data by recruitment of the household (cohort 2013).

Age group	Landline sample			Mobile sample		
	All persons	Persons with trip diary	Share of persons without trip diary in this group	All persons	Persons with trip diary	Share of persons without trip diary in this group
10 to 17 years	10%	8%	38%	6%	5%	31%
18 to 25 years	5%	3%	53%	13%	10%	43%
26 to 35 years	8%	8%	14%	14%	15%	19%
36 to 50 years	24%	24%	19%	26%	29%	17%
51 to 60 years	20%	20%	19%	21%	21%	26%
61 to 70 years	18%	20%	10%	12%	12%	24%
71 years and older	14%	16%	10%	8%	8%	20%

On average 40% of the households in the cohort 2013 have been contacted via mobile phone. This proportion varies across type of household as shown in Table 4. Most of the small households without employed persons are retirees spending a lot of time at home and have a high share of landline phones.

Table 4. Share of households recruited by mobile phone, differentiated by household type.

Type of household	Share of mobile phone recruitment
Small household with employed persons (1-2 persons)	46%
Small household without employed persons (1-2 persons)	28%
Household with children aged under 18 years	35%
Household without children, 3 or more adults	35%
All households	40%

5.4. Online users

In 2013 the first-year-reporters for the first time had the option of completing the household and person questionnaires as well as the individual travel diaries online, and 109 out of 829 households (13%) completed the questionnaires online. Except for one person, all further participating persons of those households (166 persons) also used the online form of the trip diary. Only 27 out of 1,105 persons in households with paper-based household questionnaires decided to fill in their individual trip diary using the online access. In total, 193 of 1,272 persons (15%) in the cohort 2013 used the online trip diary. The acceptance of the online trip diary for different age groups is shown in Figure 2. Young adults aged 26 to 35 years have the highest rate of using the online option. People aged 61 years and older have an online participation rate of 10% and less. We assume increasing rates in future years due to cohort effects.

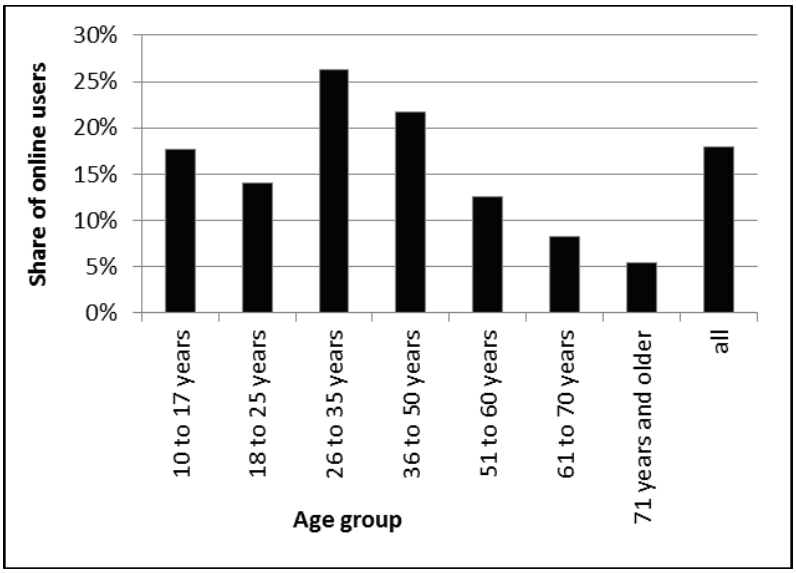

Figure 2. Share of online users by age group.

We further analysed the correlation between the way of recruiting the household and the decision to use the online form to test the tendency of persons in the mobile sample to fill in the trip diary online. Interestingly this is not the case as shown in Table 5. The differences for households and persons are not significant and show that the decision for or against the online form of the survey and the way of recruitment are two different dimensions.

Table 5. Use of online forms depending on the recruitment of households (unweighted analysis).

	Households: form of questionnaire	
Recruitment of household	Paper	Online
Landline phone	88%	12%
Mobile phone	86%	14%
	Persons: form of trip diary	
Recruitment of household	Paper	Online
Landline phone	84%	16%
Mobile phone	85%	15%

5.5. Travel behaviour of persons in the sample of mobile-phone recruitments

The changes in the MOP survey design were aimed at recruiting and retaining persons with certain socio-demographic characteristics as well as persons with travel profiles below or above the average and thus to reflect the travel behaviour of the whole population. Two important pillars are the accessibility of households and persons and the acceptance of the overall survey (content and design).

We analyse differences in the reported mobility of participants in the landline and in the mobile sample. Figure 3, Figure 4 and Figure 5 show number of trips, distances travelled and travel time per person and day for participants in both samples by age. For a better interpretation of the results against the background of the different and partially small sample sizes, significant differences are highlighted. People aged 18 to 25 and 36 to 50 years in the mobile sample have a lower trip frequency whereas the age group 26 to 35 years shows equal trip frequencies in both samples with a higher distance travelled and travel time in the mobile sample. Thus, the differences are for young and middle aged participants.

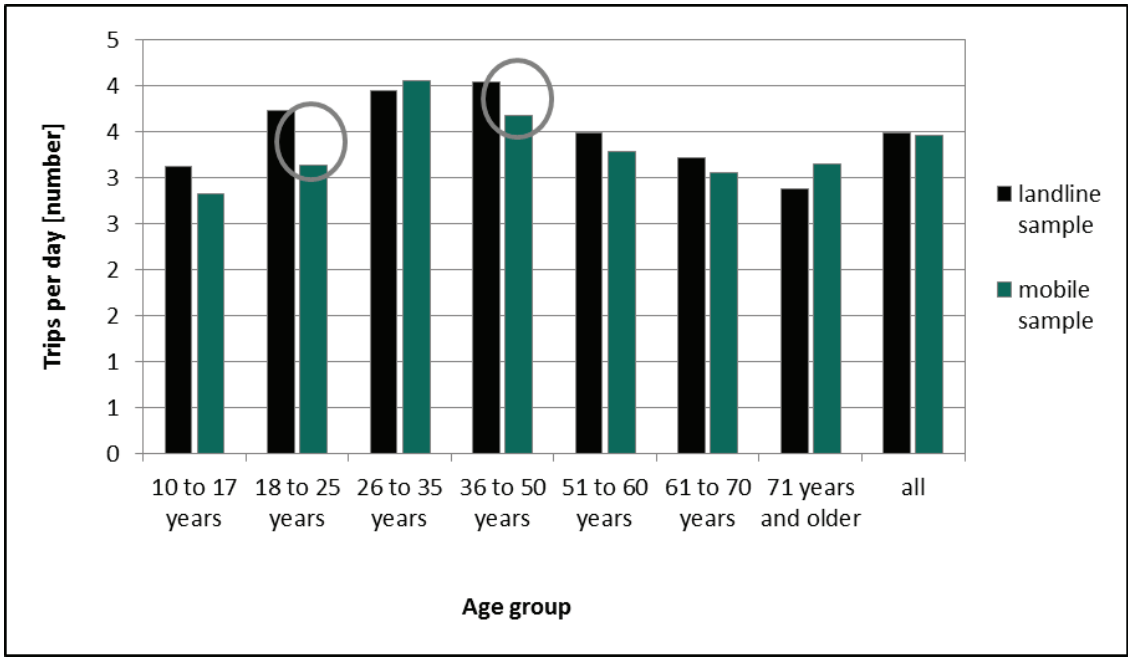

Figure 3. Trip numbers for different age groups and recruitment of the household.

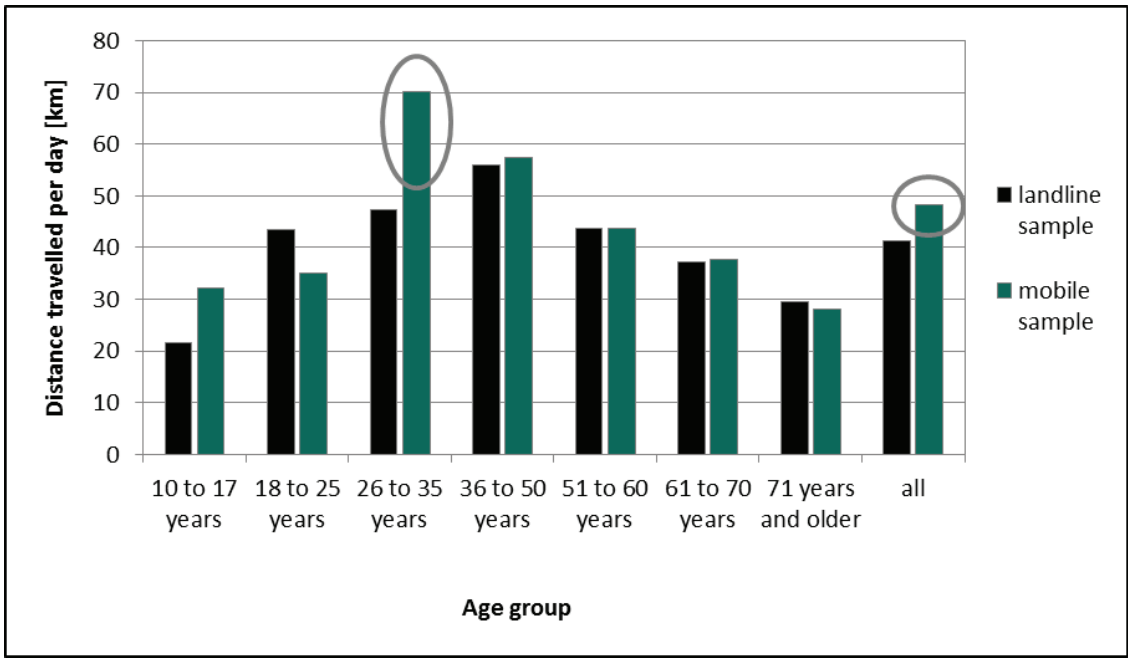

Figure 4. Distances travelled for different age groups and recruitment of the household.

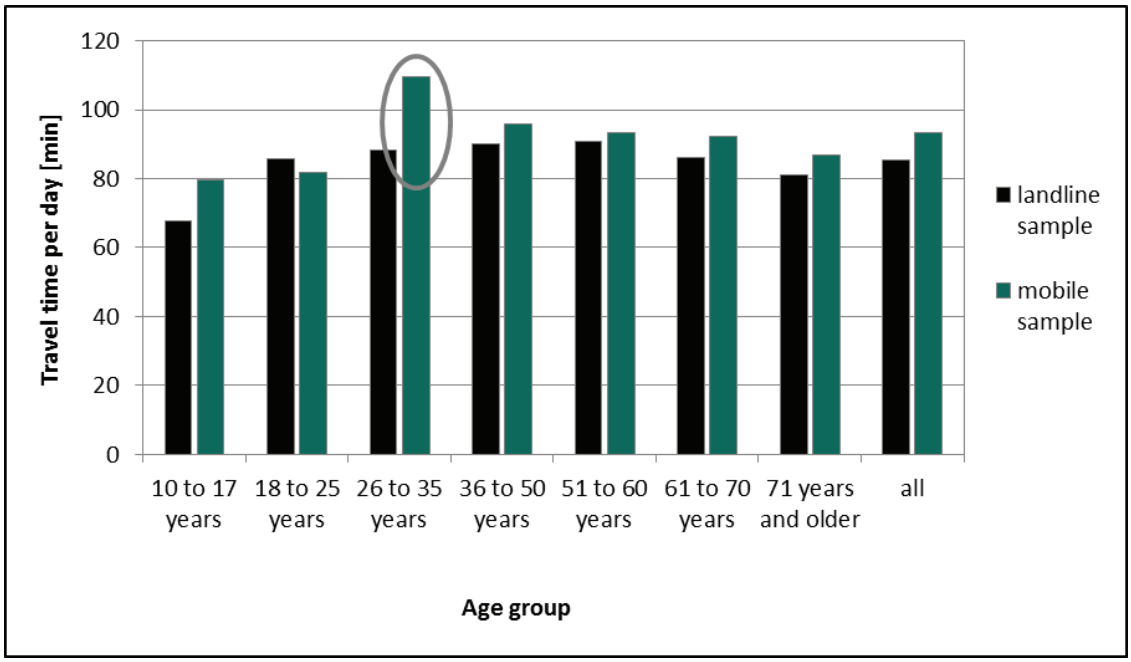

Figure 5. Travel time for different age groups and recruitment of the household.

As the participants recruited by the different approaches in the age group 26 to 35 years had great differences in the distance travelled and the travel time per day, this was analysed in detail.

We observe that this difference is caused by a certain number of persons in the mobile sample having days with a particularly high distance travelled, that is the trip-length-distributions are comparable except for some outliers. Table 6 lists the shares of person days with a certain amount of kilometres travelled ("long distance days") in this age group (unweighted results). The new recruitment process brings persons into the MOP sample who must be regarded as "intensive travellers". The recruitment of those persons is difficult in two ways: they might not have a landline phone at all ("mobile-only") and they are not at home during the day. Both phenomena typically can be observed for young adults without children ("single household"). At the same time the landline sample is very important for the MOP as elderly people do not always own mobile phones and even if they have one, they might not use it and just keep it for holidays.

Table 6. Share of person days with a certain distance travelled, differentiated by recruitment.

Age group 26 to 35 years	Landline sample	Mobile sample
Number of person days	455	504
Share of days with at least 50km	27.3%	36.7%
Share of days with at least 100km	11.9%	19.2%
Share of days with at least 200km	4.6%	8.9%
Share of days with at least 300km	3.3%	4.6%
Share of days with at least 400km	0.2%	4.2%
Share of days with at least 500km	0.2%	2.4%
Share of days with at least 600km	0.0%	1.4%

We further study the travel intensity of persons depending by their recruitment and their access to landline and mobile phones. We observe the following mean distances travelled per person and day (weighted analyses):

- persons in the landline sample without mobile phones ("landline-only"): 33 km
- persons in the landline sample with mobile phones ("dual use 1"): 42 km
- persons in the mobile sample with landline phone ("dual use 2"): 50 km
- persons in the mobile sample without landline phone ("mobile-only"): 43 km.

The subgroup with the highest travel intensity are persons in dual use households contacted via mobile phone. This result corresponds with the experiences of TNS Infratest in other research projects. The group of landline-only persons is characterised by a higher share of low mobile persons.

In the past, before the introduction of the new recruitment approach, a certain share of "highly mobile" persons was obviously missing. The new results are likely to better represent the behaviour of the population. The outcomes affect the key mobility indicators such as distance travelled per person and day.

It must be assumed that only due to the rotating panel approach was it possible to identify and quantify this effect. The repetition of the new sampling approach in 2014 is expected to allow for the verification of these effects.

5.6. Travel behaviour of persons using the online trip diary

We analyse the differences between paper and online travel diaries. Figure 6, Figure 7 and Figure 8 show the number of trips, the distances travelled and the travel time per person and day for persons in both groups differentiated by age. Again, to evaluate the statistical evidence of the results, all significant differences are highlighted. People aged 51 to 60 years with online diary do report more trips, more kilometres travelled and more travel time per day than people with paper diary in this age group. For distances travelled and travel time the same applies for the age group 36 to 50 years. Thus, the two groups of working age are of special interest. It should be noted that we do not describe a change in behaviour. The differences are based on the fact that people who are more likely to use the online form are possibly those with high intensity use of the transport system; at least there is a certain correlation. These people used the paper form in the past, or – and this is the interesting fact – have not been in the sample, as they were not able to be contacted by a landline phone.

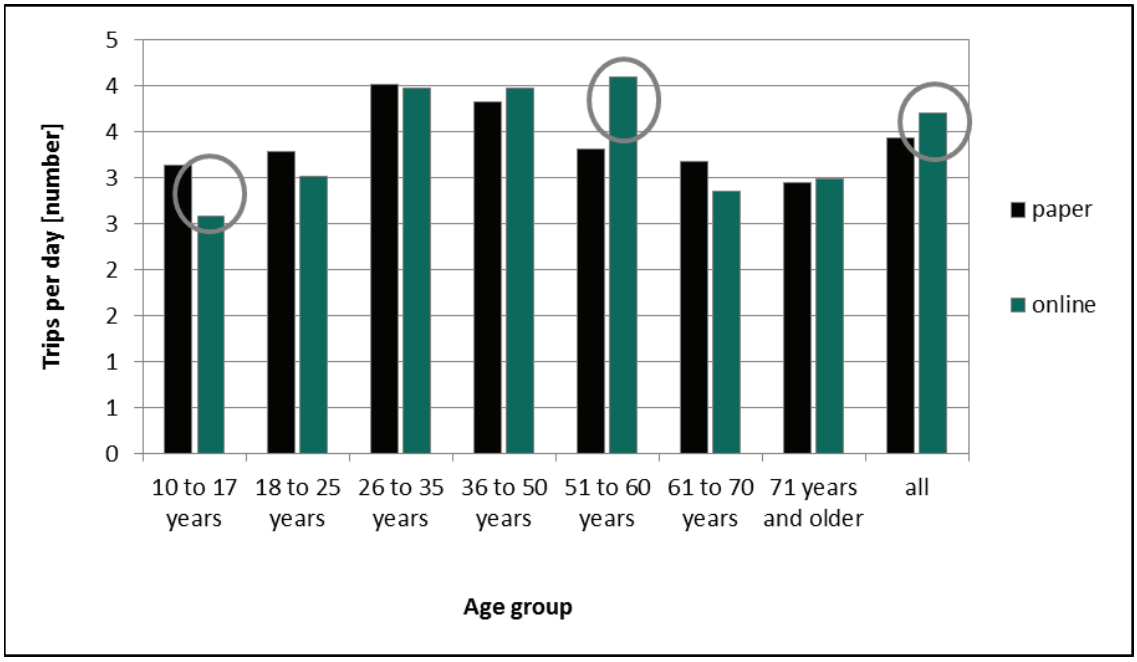

Figure 6. Trip numbers for different age groups and trip diary reports.

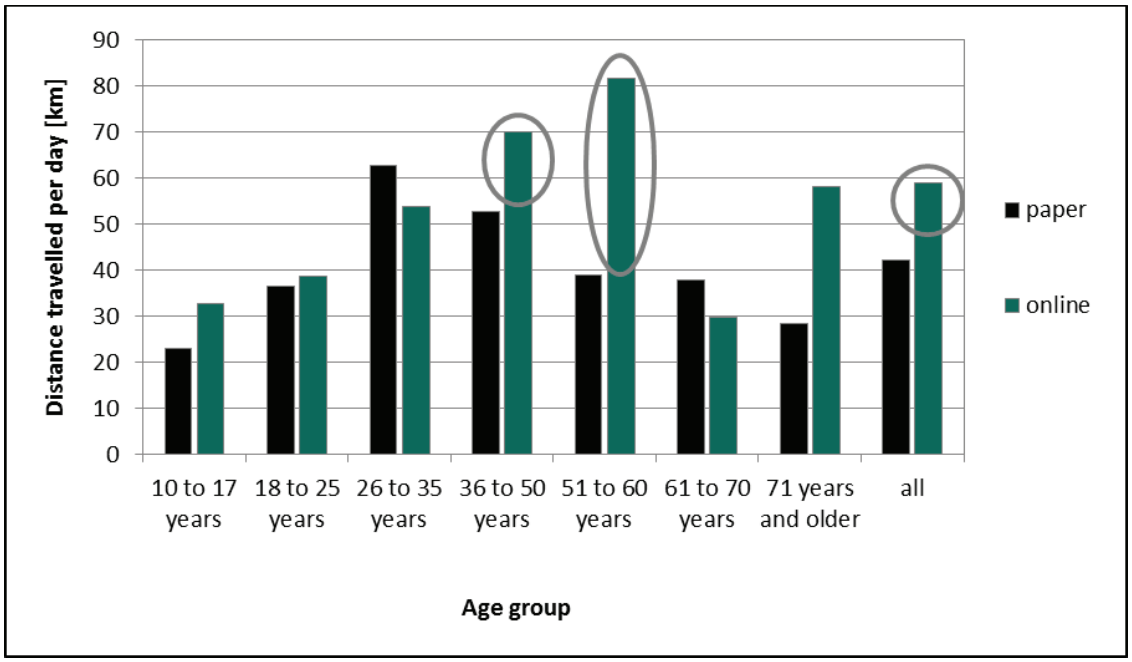

Figure 7. Distances travelled for different age groups and trip diary reports.

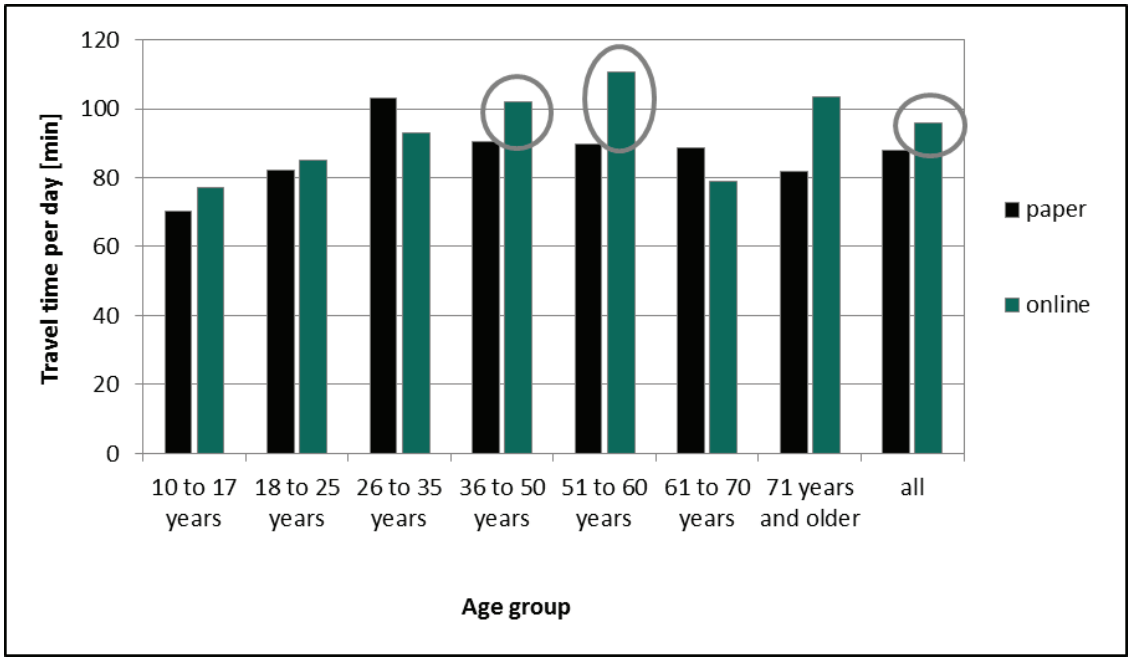

Figure 8. Travel times for different age groups and trip diary reports.

For the age group 51 to 60 years and differentiated by the travel diary, Table 7 shows the share of person days with a certain distance of kilometres travelled (unweighted results). People with online reports show a larger number of "long distance days". We conclude that people with a high intensity of long trips tend to report by the online diary

and thus this form of report is of special relevance for future survey waves in order to keep this group represented. Future MOP waves will show whether it is possible to keep these persons for all three waves in the panel survey.

Table 7. Share of person days with a certain amount of distance travelled, differentiated by form of the travel diary.

Age group 51 to 60 years	Paper diary	Online diary
Number of person days	1,603	231
Share of days with at least 50km	23.6%	32.5%
Share of days with at least 100km	8.7%	13.9%
Share of days with at least 200km	3.4%	5.6%
Share of days with at least 300km	1.9%	3.9%
Share of days with at least 400km	1.0%	3.0%
Share of days with at least 500km	0.6%	1.7%
Share of days with at least 600km	0.2%	1.7%

The MOP as well as other longitudinal surveys suffers from attrition effects in the course of the survey week. From former research (Chlond et al., 2013) it is known that participants in multiday surveys do not record trips immediately and fill in the trip diary several days afterwards. This results in memory losses. Those effects can be observed by an increasing number of days without tripmaking, that is days with no single trips reported, at the person level during the survey week. Travel diaries with an obvious attrition have been excluded from the data set prior to all analyses. Obvious attrition is defined where a person is mobile during the first two or three days of the week, does not report any trips for the remaining days, and at the same time this behaviour cannot be explained by any special incidences such as illness. The remaining diaries in the final data set do not suffer from this effect. However, the question arises whether the new online diary induces some effects of forgetting to report whole days. From the past it is known that people tend to search through the diary and add data for whole days, especially for the weekend. This is not easily possible and intuitive for the online form. Table 8 shows the share of days without tripmaking in all travel diaries differentiated by age group and form of the diary. The group of pupils and young adults below 26 years have a high share of days without tripmaking in the online subgroup. The same applies for the young seniors aged 61 to 70 years. Contrary to this, the reporting behaviour of middle aged adults is comparable for both forms of the trip diary.

Table 8. Share of person days without tripmaking, differentiated by age and trip diary report.

	Share of days without tripmaking	
Age group	Paper diary	Online diary
10 to 17 years	5.7%	10.5%
18 to 25 years	6.8%	14.3%
26 to 35 years	4.5%	3.6%
36 to 50 years	4.9%	5.6%
51 to 60 years	6.4%	4.3%
61 to 70 years	8.3%	22.2%
71 years and older	9.9%	6.4%

6. Conclusion

We observed changes in the mobility key indicators in the new MOP cohort in 2013 which are caused by the new sampling approach. The new sample better represents the population compared with the situation before. As a result of the increased sample the composition of samples in terms of first-, second- and third-year-reporters (that was

stable in the past) will be different in the future. Also, we expect unknown long-term behaviour from those participants who are recruited by mobile phone in terms of attrition between waves.

The rotating panel approach is smoothing all effects and can be regarded as an appropriate tool for the implementation of survey design changes, as certain elements are kept "conventional". As the MOP has two conventional cohorts in the sample of 2013, we are still able to identify and quantify the effects of the new approach. In the last four years Germany has experienced very positive macroeconomic developments compared with other countries. Within the MOP data we can distinguish the methodological effects from this demand effect, as we observed increasing travel demand also for those participants reporting a second or third time. Also for other surveys it might be an option to run additional samples in parallel – one in a conventional form and the other with the design changes implemented.

The following aspects are of particular importance for the implementation of design changes in panels of travel demand:

- Sample sizes need to be controlled carefully to quantify the changes caused by a new composition of cohorts.
- As many design elements as possible should be saved, that is the number of changes should be kept at a low level.
- The interpretation and publication of results should include a discussion of methodological changes and effects on data quality and reliability of the time series.
- Future waves have to be examined carefully for dropout and attrition behaviour.

For the future MOP waves we will analyse which person groups show a different reporting and dropout behaviour compared to the past and whether we will be able to keep persons with intensive travel participating in the survey.

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