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Guidelines for assessing the prevalence of mobile phone use in traffic

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Foreword

This FERSI paper focuses on one of the main key performance indicators (KPIs) in the area of road safety in current times, namely the prevalence of mobile phone use in traffic.

Mobile phone use is a major source of distraction, contributing to the occurrence of accidents. Only few countries systematically measure the prevalence of mobile phone use, and if they do their data collection methods seem to differ substantially. As a consequence, most countries do not have a reliable picture of the size of the problem, the developments over time, or effects of a legal ban and/or a publicity campaign, nor about how their country performs in comparison to others. In line with the European Commission, FERSI considers a KPI-driven road safety policy as a very promising approach[1].

The current document sets out, in detail, the scientifically valid methodological approach for assessing the prevalence of mobile phone use of car drivers, cyclists and pedestrians through on-road observations and self-reports. It presents a total of 55 recommendations related to, for example, variable definition, selection of locations and timing, sample size, non-response, and data weighing. In its meeting in October 2019, FERSI's General Assembly formally adopted the guidelines. They agreed that, even if it might not be possible to fulfil each of the recommendations, taking account of them is an important step towards scientifically reliable information about this highly relevant road safety issue.

As FERSI's current president, I would like to thank first the authors of this paper for their extensive efforts in preparing the document. Furthermore, also on behalf of the authors, I want to acknowledge the input of the members of the FERSI working group and their feedback on several draft versions, notably:

- Stefan SIEGRIST (BFU, Switzerland)
- Lila GAITANIDOU (CERTH-HIT, Greece)
- Marie-Pierre BRUYAS& Dominique MIGNOT (IFSTTAR, France)
- Péter HOLLÓ (KTI, Hungary)
- Sultan ZHANKAZIEV (MADI, Russia)
- Wouter VAN DEN BERGHE (Vias institute, Belgium)
- Astrid LINDER (VTI, Sweden).

Last but not least, our special thanks go to Horst SCHULZE who initiated the development of these guidelines during his FERSI presidency.

Rob Eenink, FERSI president
November 2019

[1] See the FERSI statement *FERSI supports EC policy on Key Performance Indicators (KPIs)*, dated 11 April 2019, retrievable from the FERSI website: https://fersi.org/wp-content/uploads/2019/05/FERSI-supports-EC-policy-on-KPI-final.pdf.

Summary

A major problem of assessing the impact of mobile phone use on traffic safety worldwide is the large diversity of methods and instruments used. To estimate prevalence, online surveys, interviews or observations in traffic are done which in turn are different with respect to the methodological implementation. To name just a few, different questions are used in interviews and surveys, the context of the observations includes different locations, different time-points, various definitions of smartphone-related secondary tasks are used, and different samples of drivers are observed. Thus, guidelines to harmonize this research are sorely needed.

Based on a review of the epidemiological and experimental studies on distraction while driving published between 2000 and 2017, a first draft of a set of guidelines was built which was presented to FERSI experts in an April 2018 meeting. A modified Delphi method was used to further improve these draft guidelines by subsequently sending them to the experts for review and comments to be integrated into revised versions of the document.

These resulting guidelines are intended for researchers planning epidemiological studies to assess prevalence of mobile phone use by car drivers, cyclists and pedestrians. The specific requirements of these different traffic participants are considered. While the term 'mobile phone use' includes all forms of use (phoning handheld and hands-free, texting, using apps etc.), it is encouraged to follow these guidelines also for other mobile or on-board devices.

It is expected that these guidelines will significantly improve the quality of data concerning the mobile phone use in traffic among drivers of passenger cars, cyclists and pedestrians. They will in addition facilitate cross-study comparisons in Europe as well as globally.

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1. Background and scope

The use of smartphones becomes more and more prevalent. By 2018, almost 70% of the population of Western Europe owned such a device (Statista, 2018). As a survey from the U.S. shows, about half of the smartphone owners check their smartphones at least a few times an hour (Newport, 2015). So, it is not surprising that smartphones are also used in traffic. A recent observational study in Germany showed that in cities one out of ten drivers is using a smartphone (Vollrath, Huemer, Teller, & Likhacheva, 2016).

Smartphones can be used for more than just making phone calls or for texting. A recent review and meta-analysis of naturalistic driving studies indicated that different tasks are associated with a different increase in risk. Tasks such as dialling, locating the phone or texting, i.e.,, all tasks that require drivers to take their eyes off the road, are associated with a high increase in risk. The increase is much lower for tasks not requiring drivers to look away from the road like e.g., talking (Simmons, Hicks & Caird, 2016). Overall it is currently estimated that distraction is a contributing factor in 10 to 30% of all road accidents in Europe (TRL, TNO, & RAPPTrans, 2015).

All this indicates that the use of mobile phones in traffic is emerging and should be considered one of the biggest threats to road safety today. Hence, distraction by mobile phones is becoming an increasing concern of policy makers in Europe for all road user groups. The prevalence of mobile phone use in traffic is considered to be a relevant key performance indicator (KPI) for road safety policy making (e.g., current discussions at the EU level - DG MOVE, 2019). However, the exposure to mobile phone related distracting activities and their impact on road safety is not very well known in Europe yet. Because no coordinated data collection is done, the estimation of distraction related accidents currently lacks validity as well as reliability. The main problem is that distraction is a contributory factor that is very difficult to be recorded reliably in the course of post-accident data collection. Moreover, there is no agreed definition of distraction by mobile phones as contributory factor in Europe yet. Correspondingly only in few European countries distraction by mobile phones is recorded as a contributory factor at all.

Because there are no official statistics on the scope of the problem, scientific studies are even more important to gain insight into the prevalence and risk of distracted driving. But still the number of scientific studies done in Europe is very low. Most of the studies on distraction were and are still done outside Europe. Their results cannot be easily transferred to the situation in Europe, partly because of differences in road infrastructure and traffic density. The available studies from Europe have been carried out in selected regions of certain countries only and/or were small in scale. These studies are also different with regard to the methodical procedures used. Due to a lack of standardization, results cannot be merged, and no conclusions can be drawn that are transferrable for Europe. Furthermore, although it is well known that pedestrians and cyclists are also affected (Fisher, 2015; Stavrinos, Pope, Shen, & Schwebel, 2018; SWOV, 2017), there is hardly any research on the prevalence of distraction and the related accident risks among these road users. This applies to both, Europe and the rest of the world.

The Forum of European Road Safety Research Institutes (FERSI) identified this problem in 2017 and has been making efforts since then to initiate more research on this topic in Europe. In addition, in the FERSI General Assembly 2017 in Lisbon experts saw the urgent need for a set of guidelines to

harmonize study designs as this was done for research on drugged driving (Walsh, Verstraete, Huestis, & Mørland, 2008) already. Such guidelines should enable researchers to harmonize the design of their future studies and thereby facilitate cross-study comparisons. It was also the intention to improve the quality of the studies on this important topic for road safety worldwide.

In the FERSI General Assembly in April 2018 in Vienna a draft set of guidelines was presented. Knowledge of an extensive literature survey comprising epidemiological and experimental studies published between 2000 and 2017 on this topic worldwide was included.

It was decided that experts among FERSI members would further develop this draft guidelines by using a modified Delphi technique (Niederberger & Renn, 2018). For this stepwise process aiming at obtaining consensus to a broad range of opinions, a working group was composed consisting of the four authors of this paper as well as Wouter van den Berghe (Vias institute), Marie-Pierre Bruyas (IFSTTAR), Rob Eenink (SWOV), Lila Gaitanidou (CERTH-HIT), Péter Holló (KTI); Astrid Linder (VTI), Dominique Mignot (IFSTTAR), Stefan Siegrist (BFU), and Sultan Zhankaziev (MADI).

In the course of the process, feedback by the members of the working group was summarized and integrated into revised and refined versions of the document at hand. After a final round within the working group in August 2019, all FERSI members were given the opportunity to comment on the guidelines. In its General Assembly in October 2019 FERSI formally adopted the guidelines.

This guideline document concentrates on epidemiological studies of prevalence of distraction by mobile phone use in traffic. It is intended for researchers planning such studies. The aim is to show which aspects should be taken into account in the planning process. For this purpose, practical suggestions are made for the implementation. They have to be transferred to an individual study.

The focus lies on methods aiming at measuring 'point prevalence', or the proportion of the population using a mobile phone in traffic at a specific point in time (roadside observations), and in extension 'trip-based prevalence', or the proportion of the population using a mobile phone in traffic during their last or another specific recent trip, based on which point prevalence estimates can be deduced (roadside interviews, telephone interviews, online surveys). A distinction is made with 'period prevalence' measurements in which self-reported frequencies of distraction in traffic are gathered over a longer time frame (e.g., last month, last year) by using rating scales (e.g., never, sometimes, always).

Throughout this document prevalence refers to point prevalence in traffic unless specified otherwise. Drivers of passenger cars, cyclists as well as pedestrians are considered with their respective characteristics relevant for the assessment.

Since the focus of the proposed guidelines is on studies which enable gathering many data in a comparable manner in different countries (cross-cultural comparisons) and at different time-points (trends and development) with reasonable effort, naturalistic driving studies (NDS) and crash prevalence studies are not considered in this document. NDS require a large effort to record and analyse the data, thus so far, only few NDS have been conducted (e.g., 100-cars NDS[2], SHRP2[3],

[2] https://www.hsdl.org/?view&did=4252
[3] http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/Blank2.aspx

EuroFOT[4], UDRIVE[5]). In their review, Simmons et al. (2016) discuss a number of study biases and quality issues of NDS. They give a good overview on this type of studies. Although NDS are a very relevant method, they are not further considered in this document. The same holds true for the second large aim of epidemiological studies: The estimation of crash risk due to exposure factors, here due to mobile phone use. This estimation requires data about mobile phone use directly before a crash happens. There are major problems which currently make it very difficult to assess this information. These are discussed in the next section.

In summary, the guidelines in this document aim at establishing a methodological standard of how to conduct studies to assess the frequency, circumstances, influencing factors and reasons for mobile phone use in traffic by car drivers, cyclists and pedestrians. This enables a comparison between different countries and time-points.

All in all 55 recommendations are given. After considering basic issues (4 recommendations), the further sections focus on the most common types of epidemiological studies on distraction among road users: roadside observational studies (21 recommendations) and self-report studies, including roadside and telephone interviews and online surveys (30 recommendations).

[4] https://www.ika.rwth-aachen.de/de/forschung/projekte/automatisiertes-fahren/1270-eurofot.html
[5] http://www.udrive.eu/

2. Basic (BA) recommendations for epidemiological studies

Epidemiological research on mobile phone use has two major aims:

(1) Estimating the prevalence of mobile phone use while in traffic and in crashes

(2) Estimating the crash risk due to using mobile phones

For estimating crash risk, the prevalence of mobile phone use in crashes is compared to the point prevalence while driving (without a crash; controls), usually by dividing the odds, i.e.,, calculating an odds ratio. However, this requires either a close matching of crashes and control (like it can be done in a case-control study) or statistically controlling for confounders (e.g., including possible confounding factors as predictors in a logistic regression in a population-based case-control study). Basically, all context factors which might influence the frequency of mobile phone use ought to be controlled in one of the two ways described. These comprise different regions in a country, different road types in an area, the current traffic flow, different times of the day, different seasons and different weather conditions, to mention just the most important ones. To put it differently, crashes and controls should be comparable with regard to all these possible influencing factors. Otherwise, these factors could influence the estimation of crash risk due to mobile phone use. The least that should be done is to record these confounding factors and to control them statistically. However, this also means that different outcomes of each of these factors (e.g., good or bad weather conditions, morning and noon, high and low traffic density) have to be available in the datasets of crashes and of controls.

To control for influencing factors is also important when estimating the prevalence of mobile phone use. To the extent that the factors mentioned above are influencing the prevalence of mobile phone use, this estimation will not be representative for a country as a whole. This is especially important if the results from different prevalence studies are compared between different countries or different time periods (e.g., to examine the impact of new legal measures like banning mobile phone use while driving). The results can only be compared if they have been controlled for these influencing factors. This can either be done by planning the studies in a comparable way or by assessing these confounders and then controlling for them statistically (e.g., by weighing the data or by including confounders into logistic regression models).

Basic Recommendation BA 1: In all epidemiological studies a thorough control and documentation of possible influencing context factors is needed (e.g., region, road type, traffic density, day of week, time of day, weather).

Just as important is the question, what drivers, pedestrians or cyclists are doing when using the phone. In some countries like Germany and Belgium it is allowed to make phone calls when using a hands-free phone, but not a handheld one. Looking at the phone (reading, watching) and typing (text messages, operation of apps) has a substantially larger accident risk than talking on the phone. Thus, giving a clear definition and recording of different tasks when using mobile phones is a necessary requirement of useful epidemiological studies. A suggestion of the most common basic tasks is given in this section.

Basic Recommendation BA 2: In all epidemiological studies a uniform definition of basic tasks when using the mobile phone should be used.

Estimating the crash risk due to different types of mobile phone use could be done by conducting case-control studies for car drivers, cyclists and pedestrians. The basic idea of case-control studies is to compare mobile phone use when driving, cycling or walking without an accident (controls) to mobile phone use directly before crashes occurred. Thus, the two recommendations given above are relevant for case-control studies, too, referring to both the cases and controls. Both have to be matched with regard to possible influencing factors and both have to have a common definition of basic tasks when using the phone.

However, obtaining this second information for the cases requires a different approach than for the controls. In accident-free driving, mobile phone use can be assessed by observations or surveys and interviews. However, to obtain this information for crashes is different and difficult. Observations are not feasible because one would have to go back in time and observe the behaviour directly before the crash. Surveys and interviews could be used if the crashed drivers are living, able and willing to report their behaviour directly before the crash. Crash reconstructions may help for dead drivers. Records from the phone companies about the time and location of phone use can provide some information. However, this may be difficult to obtain due to privacy issues. It is also quite problematic to assess the exact time-point of the crash. As many drivers may phone directly after the crash in order to call for help, even a very small error in time-point estimation may lead to false estimations. Interviews could be done in hospitals with injured drivers, cyclists and pedestrians. However, it is hard to say if they can correctly remember what they were doing directly before the crash and they might not be willing to do so.

Due to these and similar concerns, recommendations for case-control studies are not given in this document. Further exploratory research is needed before formulating guidelines. However, knowledge about the prevalence and circumstances of mobile phone use in traffic is still valuable per se. Thus, these guidelines focus on different methods to estimate the prevalence of mobile phone use by car drivers, cyclists and pedestrian in a manner that allows a comparison between different studies, countries and time-points and provides a better understanding, of why and when people do this.

It is neither feasible nor is it useful to define a uniform study design for prevalence studies. However, this document provides a set of minimum requirements which should be met in any study. This encompasses a basic set of information about the context of mobile phone use (e.g., time of day, locations etc.) which should be included in all studies as well as a core set of variables which should be recorded for every study. Furthermore, some suggestions are given for additional relevant factors which may differ between the methods (observations, surveys and interviews) and the target populations (car drivers, pedestrians, cyclists). Moreover, some basic methodological suggestions are provided to improve comparability. As the aim of this paper is to enable a comparison between different studies, strict definitions are provided for these basic factors. Thus, every study should contain a core sub-set of factors which can then be compared.

Regardless of the type of study, one common problem is the definition of mobile phone use. Earlier studies have started with telephoning. Some have distinguished between hands-free and handheld phoning. With the rise of smartphones, new applications are considered in research. Thus, when looking at different studies, different categories or definitions of secondary task behaviours have been used. Moreover, sometimes descriptions of the behaviours examined are not complete, making it very

difficult to compare the results of different studies. Accordingly, a uniform definition of mobile phone use is a basic prerequisite for future studies.

Basic Recommendation BA 3: The main distraction categories should be assessed in all epidemiological studies (see list below). When reporting the results, the full definition of the categories should be given.

The main distraction categories are listed below. As these recommendations are meant for car drivers, pedestrians and cyclists, these are summarized as 'traffic participants'.

- **No (visible) distraction**: No distraction can be seen when observing a traffic participant. In surveys and interviews, traffic participants state that they were not distracted. Although it will restrict the direct comparison of observations with surveys and interviews, it is not feasible to ask traffic participants to report only visible distractions. Thus, it has to be taken into account when interpreting the data that more distraction types (e.g., mental distraction) is reported in surveys and interviews.
- **Handheld phoning**: The traffic participant is holding the mobile phone in one hand and is pressing it at his/her ear or is holding it in front of the mouth. He/she is either talking or listening.
- **Hands-free phoning**: The traffic participant is talking while there is no other passenger/company. He/she may use earphones or, in the car, the speakerphone. In the car, the mobile phone may be visibly attached to the dashboard but can also lie somewhere else in the car. Pedestrians will usually use earphones and may have the phone in their hand or in some pocket. Cyclists may also have the mobile phone attached to the handlebar. This category should also be used if the phone is not visible, but the traffic participant is talking and alone[6].
- **Texting/keying numbers handheld**: The traffic participant is holding the phone and is visibly operating it. In a car, the car's doors may sometimes, from some perspectives, cover the clear view of the mobile phone for roadside observers. However, if the driver is clearly operating something this should also be counted as texting handheld. For pedestrians and cyclists the phone should be visible.
- **Handheld reading/watching without operating**: The traffic participant is looking at the phone without operating or handling it. Therefore he/she holds the device in the hand.
- **Operating other electronic device in hand**: The traffic participant is operating an electronic device other than a mobile phone (e.g., tablet, navigation system) and is holding this device in the hand.
- **Operating electronic devices fixed in/on the vehicle**: In cars or on bicycles, mounted (vehicle attached) electronic devices like navigation systems may be visibly operated. This will also include instruments in the car (e.g., screen in the middle console). As this is hard to distinguish,

6. There may be some cases where traffic participants are talking to themselves, but these should not be very frequent. Moreover, operating systems by speech may be recorded as hands-free phoning. However, this is also a verbal interaction. In most cases they will be phoning.

this category is used in all cases where the gaze is directed to the device fixed in the vehicle or to a screen in the middle console, away from the road, and fingers are used to operate it.

- **Interacting with others**: In a car, the driver is talking to passengers either on the front seat or at the backseat or he/she is looking at them or interacting with them (e.g., handing a toy to a child) while looking away from the road. For cyclists and pedestrians, this category is used when they are walking or cycling together and are talking with each other while looking away from the direction where they are moving to.
- **Other**: The traffic participant does not look in the direction he/she is moving to but is doing something else which distracts him/her from the traffic situation (e.g., applying lipstick, changing clothes, grooming etc.) and which does not fall into one of the categories mentioned above.
- **Reference distracting activities for benchmarking**: Like using electronic device, eating, drinking and smoking can be a cognitive, visual and physical distraction. These activities are common (see review by Huemer, Schumacher, Mennecke & Vollrath, 2018), not forbidden while driving and are easy to observe or can be reported by respondents. Therefore, they are suitable as comparison values giving some indication whether the frequency of smartphone related tasks is high or low as compared to these everyday secondary task.
    - **Eating/drinking**: The traffic participant is eating or drinking or is holding food or a beverage.
    - **Smoking**: The traffic participant is holding a cigarette (e-cigarette, vaporizer) and/or is smoking (including lighting and extinguishing a cigarette).

Basic Recommendation BA 4: In each epidemiological study, a core set of subject characteristics should be included.

This core set comprises:

- Estimated age-group, e.g., separated into 3 categories: young (18-24 years), medium (25 to 65 years), seniors (older than 65 years) for drivers, plus 2 categories for pedestrians and cyclists: young children (up to 13 years) and youngsters (14-17 years)
- Gender of traffic participant (male, female, other)
- Being alone or with others (in the car with passengers, on the bicycle riding together with other cyclists, as pedestrian walking with somebody else or in a group)

These basic characteristics should always be included, because mobile phone use, but also the behaviour in traffic depends on these characteristics. These are also relevant for external validity in order to examine to which extent the subjects included in the study are comparable to the target population, e.g., German car drivers, young bicycle drivers, pedestrians etc.

These variables can easily be observed and can also be included in surveys and interviews. When doing surveys and interviews, additional core parameters assumed to be related to behaviour in traffic should be included, e.g., annual mileage and professional versus private driving for car drivers or corresponding characteristics for cyclists and pedestrians. This is addressed below (see chapter 4).

3. Recommendations for Roadside Observational Studies (ROS)

3.1 Aims and advantages

The overall aim of Roadside Observational Studies (ROS) in traffic is to estimate the prevalence of different types of distracting activities. This is limited to observable behaviour. Fortunately, the use of mobile phones can be observed quite well. Video recordings would facilitate the assessment but these should only be made in strict compliance with data protection regulations. The main advantages of ROS are:

- Objectivity: The behaviour is observed by independent observers achieving a high reliability after adequate training.
- Efficiency: A large number of observations can be done in a short time period by only a few well-trained observers.
- Representativity: If weighted for traffic volumes, observational studies allow a precise estimate of the numbers of kilometres driven while using a phone.

However, there are also some shortcomings which can be addressed by using additional, alternative methods of assessment:

- Only little information can be collected about the driver, pedestrian or cyclist (mostly only age and gender). Nothing is known about motives, attitudes or subjective evaluations.
- There is only basic information available about what they are doing, e.g., typing on the mobile phone, but not whether they are playing a game, using WhatsApp etc.
- It may be difficult to observe hands-free voice interactions with the phone.

Recommendation ROS 1:To estimate the extent of the problem of mobile phone use in traffic, or to investigate the effect of a campaign or legal measure, observational studies deliver most direct and valid data, and are therefore the preferred methodological option.

Recommendation ROS 2: To better understand the subjective background of mobile phone use in traffic or to describe the traffic participants' behaviours in more detail, self-report studies are more suitable.

Ideally, observational and self-report methods are combined. This enables to better understand who is using the mobile phone and why, even in dangerous situations, when driving, cycling or walking.

*Recommendation ROS 3:*To get a full understanding of the problem of mobile phone use, a combination of ROS and self-report studies is recommended, taking the advantages of each method while compensating for their shortcomings.

3.2 The necessary planning steps

Recommendation ROS 4: When planning an observational study a set of basic methodological aspects should be considered. These should also be documented in the report.

The quality of an ROS study depends on the assessment methodology. When planning an observational study, the following aspects should be considered:

1) Definition of variables to be observed
2) Training of the observers and intermittent checks of assessment quality
3) Selection of locations for the observations
4) Timing of the observations
5) Definition of the prerequisites for the observations
6) Definition of the target group
7) Definition of the way to select targets from traffic
8) Definition of the technical procedure of the observation
9) Estimation of sample size
10) Measures to ensure the safety of the observers
11) Data recording and storage
12) Data weighing

These aspects are briefly explained in the following subsections, if necessary providing specific information to account for the special characteristics of car drivers, cyclists and pedestrians.

3.2.1 Definition of variables to be observed

Recommendation ROS 5: The report should include an exhaustive definition of all variables which are observed or recorded. This definition should allow other researchers to replicate the observation.

While the guidelines include a definition of categories of distracted behaviour (chapter 2) and suggest some key variables to be recorded about the location and circumstances of each observation (see above), it is also necessary to describe to which extent these have been followed or changed in the current study. Thus, it is recommended to include an appendix with a clear definition of each variable recorded.

3.2.2 Training of the observers and intermittent checks of assessment quality

Recommendation ROS 6: Each observational study requires a thorough training of the observers including a performance test to ensure a high inter-rater reliability.

In our experience, a basic training can be done in about two hours (e.g., Vollrath et al., 2016). At the beginning of the training the categories to be observed (see chapter 2) should be explained in detail

and should be discussed with the trainees. Afterwards, they are accompanied by an experienced observer who acts as a trainer to practice observing in real traffic. In traffic, target objects should be selected, and the trainee should describe to the trainer what he or she would rate by using the original forms or assessment device. Feedback is given by the trainer until the trainee gets along well with the assessment. After a short break, trial observations of three 10-minute periods are done in which trainer and trainee are rating the identical traffic participants. Results should be compared directly afterwards. If discrepancies are detected, these should be discussed and solved by further explanation of the categories to be observed as well as by additional training. Ideally, at the end the inter-rater reliability is above 0.90.

If observations are done by only one trained observer, this has the advantage that it is unobtrusive and efficient. However, this observer has to be trained as described. It should be proven by a test that the reliability is high. This should be rechecked at several moments during the assessment period in order to ensure a high data quality.

However, at very busy road sections it may be advisable to have two observers, one doing the observations and providing the results to the second observer, who is recording them. Moreover, two observers should at least occasionally be used in order to prove and control inter-rater reliability. Overall, the recording should comprise a code identifying the observer as part of the quality control (e.g., excluding observations from observers with a low inter-rater reliability).

3.2.3 Selection of locations for the observations

Recommendation ROS 7: The rationale for choosing the locations of the observations should be provided.

This includes a required minimum flow of traffic and a random selection of different regional locations. A minimum number of three different types of locations is recommended in order to get at least some impression about the variability of the estimations. A minimum of 25 different locations can be assumed to be adequate. Ideally, a random sample of all possible locations within a designated area is used.

Recommendation ROS 8: The basic characteristics of the observation sites should be recorded and included in the report.

The sites should first be chosen in a manner to allow a *sufficient number of observations*. This is necessary in order to achieve representativeness. Under the perspective of efficiency, it does not make sense to conduct observations at locations where there is hardly any traffic/pedestrian/cyclist. Therefore, while planning the study, every possible site should be visited around the time points when the observations will be done, in order to count the number of respective traffic participants that can be expected. Alternatively, estimations of traffic density can be used, if available.

If the research question is to obtain a more representative picture about mobile phone use in the region of interest, the *locations should be selected to cover this region*. Three different locations are certainly the minimum to ensure that the effects are not singular for one special location. Within a town, one could select different larger roads where people enter the town from outside and smaller

roads within town. For rural roads and highways, one could also observe at different locations of each road.

The *observation sites should be documented* when describing the study method, including at least the following information for car observations:

- GPS-coordinates of the location
- Type of road (e.g., in town, rural, highway) and speed regime (e.g., 30 km/h or 50 km/h in towns)
- Number of lanes
- Special conditions (e.g., only cars standing at a red traffic light or an intersection)

Observations at larger highways are possible at rest areas, where observers can stand safely behind the barrier, but are thus directly at the highway while observing the cars passing on the highway. From our experience, observations from bridges are not suitable as cars are normally driving too fast. Thus, the choice of location for large highways is limited to these kinds of rest areas. Alternatively, observations can also be made from a moving vehicle in real traffic. In that case, the observation location covers a certain section of the highway (cf. Riguelle & Roynard, 2014).

For *cyclists and pedestrians*, a comparable description should be given:

- Riding on the road or a bicycle path, type of road or bicycle path
- Special conditions (e.g., at a zebra crossing, intersections with traffic lights etc.)

3.2.4 Timing of the observations

Recommendation ROS 9: Observations should cover the whole daytime and different working days. This can be achieved by selecting at least three time-intervals per day and by doing observations at least from Mondays to Saturdays.

Looking at the literature, nearly all observational studies are done during daytime. At night, traffic density is usually low and it is difficult to see inside the car. Therefore, it is recommended to focus on daytime traffic. In order to include different types of trips and target groups, observations should be distributed over the whole day as follows:

- Morning and late afternoon in order to have lots of traffic and commuters
- Other relevant times where a high traffic volume is expected (e.g., when school is finished for the day in order to examine pupils walking or cycling)
- Some periods in between in order to also include traffic not going to/returning from work

3.2.5 Definition of the prerequisites for the observations

Recommendation ROS 10: In order to ensure a high quality of the data, observations should only be done if some basic requirements are met (e.g., weather, light, road condition).

Besides the basic conditions of the observation (selection of location, time schedule) there are also context variables which may prevent an observation from taking place. Both should be defined clearly

and also made clear to the observers. They should be instructed to stop the observation if any of these conditions are not met.

The most relevant prerequisites are:

- Good weather conditions (no heavy rain, no storm, no snow)
- Good visibility (no darkness, no fog)
- Good road conditions (no ice)
- Free flowing traffic (no traffic jam, no crash, no construction site)

Of course, limiting the observations in this manner will influence the estimation of the frequency of mobile phone use. For example, when observing pedestrians, Vollrath, Nicolai and Huemer (2018) found that mobile phone use was much lower in rain and bad weather as compared to good weather. This effect may be smaller in car drivers, but they may refrain from mobile phone use in order to better focus on the road in bad visibility or bad road conditions.

With regard to free-flowing traffic, it may be interesting to see how many people start using their smartphones in traffic jams. However, with regard to traffic safety one should focus on moving traffic.

3.2.6 Definition of the target group

Recommendation ROS 11: External validity of the results requires that the target group is clearly defined.

Recommendation ROS 12: For car drivers, cyclists and pedestrians the observation study should always include private traffic participants (including those on their way to/from work) as they represent the largest part of traffic.

The most important definition of the target group is the type of traffic participant. The three most relevant target groups are:

- Car drivers in private cars (e.g., no trucks or lorries, no taxis, no commercial cars, no police or ambulance cars)
- Cyclists alone on a bike (no couriers, no postmen, no other commercial cyclist, no children at the backseat, no bike trailer, no E-bikes)
- Pedestrians (e.g., only private pedestrians, no postmen)

If other target groups are to be included the type of these different groups should also be recorded. Even in studies about special populations (e.g., e-bikes, taxi drivers) it makes sense to also include these basic target groups for comparison purpose. For cycling studies a distinction should be made between E-bikes or Pedelecs and normal bicycles.

3.2.7 Defining the way to select targets from traffic

Besides the general definition of the target group it has to be defined which of the many possible targets are to be selected in an ongoing observation.

Recommendation ROS 13: Target objects should always be randomly selected from all the possible objects at the location where the observation is done.

Recommendation ROS 14: For the observers, there has to be a clear definition which of the traffic participants belongs to the target group with regard to their characteristics, but also their location.

Only if traffic density is very low it is possible to observe every participant coming along. In order to get a representative sample, targets should be selected at random from the possible subjects. It does not make sense to observe mainly drivers or cyclists who use the phone. The procedure to select the targets has to be defined accordingly. An example would be: "After having finished an observation, look up and take the third car approaching at the right lane".

Moreover, for each location it has to be clearly defined which are possible targets. These should be chosen in a way to create optimum observation conditions. When observing cars, the best targets are cars at the lane nearest to where the observer is standing, and the observer can clearly look into the car. Similarly, bikes which are clearly visible to the observer should be observed. For pedestrians crossing a road, the ones approaching the observer can be best observed.

It is important to clearly define which drivers, cyclists and pedestrians are to be observed at each location. This definition should be included in the description of the study procedure in order to enable a replication of the study. This is especially important when repeating the observations.

3.2.8 Definition of the technical procedure of the observation

Recommendation ROS 15: It is recommended to use tablet computers for the observations.

The method to record the observations has to be defined. One could either use data sheets or tablet computers. For Windows tablets, free and configurable software is provided by TU Braunschweig (Observation; available from www.tu-braunschweig.de/psychologie/verkehrspsychologie/software [05.08.2019]). In order to make the recording easier for the observers, one could use teams of two where one observes and gives the results verbally to the other who then records that on the data sheet or tablet. However, from our experience, when using a limited number of categories even single observers are well able to observe and record at the same time. Prepare for possible technical problems though and foresee also a paper back-up of the coding sheet.

Recommendation ROS 16: At the beginning of each observation session, a key set of variables describing the location should be recorded.

When arriving at a location, the time of the observation and the characteristics of the location (as defined in the chapters above) should be recorded as well as the code of the observer. Probably the most important characteristic is the current traffic flow. It is suggested to count for one minute the number of target objects coming through. The following list gives the most typical variables:

- Date and start/stop time of the observation
- GPS coordinates (if possible, otherwise other specification of the place e.g., address, reference point)
- Code of the observer

- Number of target objects in one minute
- Target lane or path which is to be observed
- Weather conditions (sunny, cloudy)

There should also be an instruction for the observer summing up the most relevant points for the observation, especially the clear definition of the target objects and how to select them.

3.2.9 Estimation of sample size

Recommendation ROS 17: When planning the study, the appropriate sample size should be estimated and used to determine the required number of observational sessions, taking the different types of traffic participants (car drivers, cyclists, pedestrians) into account.

When planning the study, the sample size required for the respective purpose should be considered. For example, to estimate the prevalence of texting on the mobile phone with a precision of 1% (width of 95% confidence interval) and it is assumed that the percentage lies around 5%, one can use the following formula to determine the required number of observations.

$$N_{required} = \frac{1.96^2 * \left(P * (100 - P)\right)}{Precision^2}$$

When using a P = 5% and a Precision of 1%, this gives:

$$N_{required} = \frac{1.96^2 * (5 * (100 - 5))}{1^2} = 1825$$

Thus, a sample size of about 2.000 observations should be sufficient to provide frequency estimations (percentages) in the size of 1% with a 95% confidence interval.

Similarly, to examine the difference in prevalence between different subgroups the sample size required to have enough statistical power to get a significant effect should be estimated. Programs like G*Power (Faul, Erdfelder, Lang & Bucher, 2007; Faul, Erdfelder, Buchner & Lang, 2009) can be used for this. For example, if one wants to examine whether the percentage of texting is different for males and females, the following can be assumed:

- About half of the drivers are male and the others are female (P_{male} = P_{female} = 50%)
- The prevalence of texting is about 5%
- A difference of 1% is considered to be relevant
- A Chi-Square test is used to evaluate the difference with alpha = 5% and a power of 95%

In this case, G*Power estimates a necessary sample size of about 12 000 drivers to find this effect. While this seems a lot, it has to be taken into account that traffic observations are quite efficient with regard to the number of observations that can be made within a given time. When using locations with a traffic flow that enables a nearly continuous observation, the following numbers of observations can be expected:

- Drivers of passenger cars: About 100 cars per hour in town
- Cyclists: About 50 bikes per hour
- Pedestrians: About 50 pedestrians per hour

3.2.10 Measures to ensure the safety of the observers

In general, observers should be instructed to take care that they can observe their targets without any endangerment for themselves or others. Within cities, they should stand at places where pedestrians are allowed to stand (not at the road, not on cycling paths). They should not stand at the middle of pedestrian walkways but at the edge of the road or directly besides the walkways. Obstacles like signposts etc. are well suited to stand behind.

On the other hand, the observers should try to be as inconspicuous as possible. Neon vests are not recommended because they would attract too much attention which could influence the behaviour of the target objects.

The observers should also be provided with information leaflets and some ID cards of the research institution. If necessary, they can give this information to any curious passer-by. Necessary permits must be obtained.

Recommendation ROS 18: When selecting the locations of the observations, it must be ensured that the observations can be conducted safely and inconspicuously.

3.2.11 Data recording and storage

Observations using tablet computers enable to enter and store the data directly in electronic form. Otherwise, paper forms have to be digitized afterwards. Usually, one data file is created for each location. These have to be merged afterwards. Each data file should contain the relevant information about the location, the time of the observation (see Section 3.2.8) as well as the observation data as described in chapter 2. For later analyses of the data it is advantageous to add the information about the location and the time to each case.

Recommendation ROS 19: Each data set (one observation) should include the information about the location and observation time as well as the individual information about the traffic object observed.

3.2.12 Data weighing

Recommendation ROS 20: Data could be weighted according to traffic volumes at the different locations of observation.

This can be done by using traffic count data gathered at the location (e.g., 1-minute counts at the beginning of an observation period; see Section 3.2.8) or by using traffic volume data according to context available from national statistics.

For the weighing, the number of cars, pedestrians or cyclists which could have been observed at each location is estimated. The weight for each location is then computed by dividing this number by the sum of all traffic participants over all locations.

Recommendation ROS 21: Even more importantly, when the results aim to be representative, a weighing with regard to relevant characteristics of the traffic participants and their mobility should be done.

However, this requires the respective information which may not be available. For example, in Germany the MiD study provides this kind of information by an interview study where a representative sample of the German population describes all their trips during one day. This may be used for car drivers, cyclists and pedestrians. However, this study is only done once in several years (the latest being published in 2018, the last one before that in 2008). In Belgium, mobility information from a representative sample can be found in the Monitor study (Leblud et al., 2018), which is also a serial measurement.

4. Recommendations for Self-Report Studies (SRS): roadside interviews, telephone interviews, and online surveys

4.1 Types and aims of SRS

For point prevalence measurement of distraction in traffic, three types of SRS are recommended:

- Roadside interviews: traffic participants are approached directly after a trip or during a trip and asked about mobile phone in a defined phase of their last/current trip.
- Telephone interviews: participants are asked about their last made trip and then about their mobile phone use during that trip.
- Online survey: participants are asked about their last trip or about all their trips made in the last 24 hours and then about their mobile phone use during one (randomly selected) specific trip.

The common aim of SRS is to estimate the prevalence of mobile phone use while driving, cycling or walking. The additional value compared to ROS is twofold:

- Types of distraction that cannot easily be observed can be assessed.
- Characteristics, attitudes, motives and subjective evaluations with regard to distraction in traffic can be assessed.

Recommendation SRS 1: SRS should be used if the focus is on the individual characteristics of the users or on a differentiated analysis of the user behaviour.

4.2 Period of consideration

Recommendation SRS 2: In SRS the frequency of mobile phone use should be assessed based on a certain trip. Thus, the prevalence estimations are more comparable to those derived from observational studies (point prevalence).

Asking about phone use in general (e.g., “Did you ever use your mobile phone and write a text message while driving/walking/cycling?”) may be useful for assessing the proportion of drivers involved in using the phone while driving. But this only gives a broad impression of how many people are using their mobile phone in traffic. In order to get prevalence estimations that are comparable to those derived from observational studies, they must be based on trips. To obtain this point prevalence estimate, the frequency of different behaviours associated with mobile phones must be assessed with respect to an actual driving, cycling or walking episode (e.g., a trip from A to B) instead of a certain longer time interval (i.e.,, period prevalence; e.g., during the last 12 months).

Therefore, the participants should be asked to reflect on a single trip they made within a limited time period (e.g., 24 hours). Such trip-based prevalence estimations can be compared with the results of ROS if the part of the trip driven while phoning is questioned in terms of total time of use or kilometres of use. By combining information on target behaviours (distraction by different sources or activities) with the amount of driving, point-prevalence estimates can be obtained.

4.3 Biases in self-reporting accuracy

The basic problem of SRS is that there is a possible bias in reporting mobile phone use. The two most important reasons are:

- Failure to correctly remember whether the mobile phone was used during a trip at all or in which way it was used. This is a bias caused by memory effects (recall bias). A bigger delay in questioning increases the risk of this bias.
- Failure to report truthfully whether the mobile phone was used during a trip or in which way it was used. This is a bias caused by impression management and social desirability. The more direct personal interactions suffer more from this bias. This applies especially to roadside interviews, but also to telephone interviews.

4.3.1 Compensation of recall bias

The bigger the time lag between the questioning and the actual behaviour, the more risk there is for recall bias. Self-reports in telephone interviews and online surveys are usually more delayed than in roadside interviews. The latter are usually carried out immediately after the trip, thus may suffer less from this bias.

In former times, a phone call was something to remember as it was very special. As mobile phones are nowadays used nearly all the time, it is hard to remember every occasion when it was used. In order to minimize this recall bias, it is suggested to do an interview as soon as possible after the respective trip. In a survey, the respective driving, cycling or walking episode should be not too far in the past.

Recommendation SRS 3: SRS should be done as soon as possible after a trip. Roadside interviews should be done directly after a trip (or during a trip for pedestrians/cyclists) and the time span to be described should not be too long, e.g., the last 30 minutes of the trip. Telephone interviews and online surveys should refer to the last trip made or to another trip made within the last 24 hours.

Roadside interviews for car drivers can be carried out by doing the interviews at parking areas or by conducting roadside interviews where cars are stopped. At parking areas, drivers who have just arrived with their car can be approached by interviewers and asked about the last half hour of their trip (or the whole trip, if duration was below 30 minutes). It has been shown that this is a very effective approach to assess distracting activities while driving (e.g., Fofanova & Vollrath, 2012; Huemer & Vollrath, 2011).

Pedestrians and cyclists can be stopped a long their route, during their trip (if they do not go too fast) or can be approached when stopped or standing at road crossings. In online surveys or telephone interviews, one would ask the participants to remember their last trip as vividly as possible. Another option in online surveys is to first ask the participants to give an overview of all trips made in the last 24 hours, after which the survey system randomly selects one trip to further focus on (e.g., Diependaele, 2015). The detailed recall of the last (or recent) trip is encouraged by letting participants describe when this trip took place, where they were coming from and going to, which way they were choosing and if there was anything special about this trip. Thereby, they will remember this trip as precisely as possible and can then be questioned about mobile phone use in a very detailed way.

In all three types of studies, remembering mobile phone use can also be supported by not only asking in a very general manner about any kind of mobile phone use (e.g., "Did you use your mobile phone during the trip?"), but also asking for specific uses (e.g., "Did you call somebody?, "Did you use WhatsApp?"). It is a basic psychological finding that recognition is better than free recall.

Recommendation SRS 4: SRS should always refer to one tangible trip.

The main objective of online surveys and interviews is to get information about the prevalence of mobile phone use in traffic. Therefore, a random sample of all trips is needed (see Section 4.5.4). Thus, it is important to assess at which date and at which time of the day the respective trip was made.

Recommendation SRS 5: Date, weekday and time of the day when the trip started should be assessed in SRS.

Recommendation SRS 6: The type of road of the major part of the trip (e.g., highway, rural road, urban/city driving) should be assessed.

The information about the trip can be used later to analyse to which extent these trips are comparable to the average traffic in the country of interest. For example, in Germany Mobilität in Deutschland (MOP[7]) provides data about the distribution of trips in Germany. In Belgium, this information can be found in the Monitor study (Leblud et al., 2018).

Recommendation SRS 7: In SRS a combination of free recall and recognition should be used. This means that participants should first be asked to report any kind of mobile phone use (free recall). Then, in addition, they should be asked about each category (see chapter 2) separately and into more detail (e.g., "Did you use an application like WhatsApp on your mobile phone during the trip?"). The duration of use should ideally be asked as well.

4.3.2 Compensation of social desirability bias

The second bias is referring to a possible small willingness to report truthfully and is mainly an issue for roadside (and telephone) interviews. In online surveys the answers can also be affected by social desirability bias, but to a lesser extent (e.g., Goldenbeld & de Craen, 2013). It has to be assured right from the beginning of interviews and surveys that all answers will be kept absolutely confidential and anonymous. No personal data that can link directly to the individual (e.g., name, address etc.) should be collected. Interviewers should avoid any negative comment about the different behaviours but should instead encourage the drivers to remember and to report anything they can remember. In order to minimize interviewer bias, a thorough interviewer selection, training and control is required to maximize accuracy of the interviews (see also Section 3.5.1). Socially desirable answers are generally less found in anonymous online surveys, and as there is no interviewer, there is also no risk of an interviewer effect (participant reports influenced by a specific interviewer). Nonetheless, a social desirability bias in online surveys cannot be completely eliminated. Predefined texts can be included in online questionnaires to encourage respondents to remember as much as possible and to answer honestly.

[7] http://www.mobilitaet-in-deutschland.de [05.08.2019]

Recommendation SRS 8: In order to minimize bias due to social desirability, it has to be made very clear in SRS that all answers will be treated strictly confidential and that there will be no opportunity to trace back data to the individual.

4.4 Exploitation of additional benefits

The big advantage of SRS is the opportunity to find out more about

- what people are really doing when using their mobile phone (elaborate description of secondary tasks),
- what they think about that (attitudes, subjective feeling, social norms etc.), and
- what kind of people they are (age, gender, driving experience, mobile phone use experience personality etc.), as well as
- the characteristics of their trips.

Thus, besides for estimating the prevalence of mobile phone use in traffic, interviews and surveys should always be used to assess additional information.

Recommendation SRS 9: (1) the frequency of mobile phone use should be assessed including the different kinds of secondary activities (see list in chapter 2), and (2) additional information about socio-demographic characteristics, trip and subjective parameters should be gathered.

4.5 The necessary planning steps

Recommendation SRS 10: To ensure a high data quality, some basic methodological concerns should be addressed when planning SRS, and these should always be reported afterwards.

As in ROS, in the course of study planning, a number of methodological aspects should be addressed in interview studies and in surveys. Some of these are relevant for both interviews and online surveys, other aspects are only relevant for one type of study. This is indicated in the text. Overall, these aspects include (Table 1).

These are the main relevant planning steps in each type of considered study. The aim is not to be exhaustive. In the following subsections these aspects are shortly explained, if necessary distinguishing between drivers, cyclists and pedestrians and between different types of interview studies.

Table 1: Methodological aspects to be considered when planning SRS

Roadside interview	Telephone interview	Online survey
4.5.1 Training of the interviewer	4.5.1 Training of the interviewer	4.5.2 Instructions for the respondents
4.5.3 Selection of locations		
4.5.4 Planning and timing	4.5.4 Planning and timing	4.5.4 Planning and timing
4.5.5 Target sample	4.5.6 Selection of the sample	4.5.6 Selection of the online sample
4.5.7 Non-responders	4.5.7 Non-responders	4.5.7 Non-responders
4.5.8 Construction of the interview questionnaire/guideline	4.5.8 Construction of the interview questionnaire/guideline	4.5.8 Construction and programming of the online questionnaire and logics
4.5.9 Estimation of the sample size	4.5.9 Estimation of the sample size	4.5.9 Estimation of the sample size
4.5.10 Data collection and storage	4.5.10 Data collection and storage	4.5.10 Data collection and storage
4.5.11 Definition of relevant variables	4.5.11 Definition of relevant variables	4.5.11 Definition of relevant variables
4.5.12 Data weighing	4.5.12 Data weighing	4.5.12 Data weighing

4.5.1 Training of the interviewer

Recommendation SRS 11: Each interview study requires a thorough training of the interviewer including a performance test to ensure reliability of the results.

Training is required for telephone and roadside interviews in traffic. As described above, the main aim is to encourage subjects to talk as freely and truthfully about mobile phone use as possible. This is supported by providing the interviewers with detailed information about that, and on how to behave and why they should do so.

A training of interviewers can be done in about two hours, depending on the interview length and complexity. After the general information about how to conduct the interviews and on how to encourage subjects to answer completely and honestly, the interview questionnaire is explained to the interviewers. This can also be supported by providing an interview guide where the different questions are explained to the interviewers and background information is given. This is followed by a practical exercise where they are asked to approach an instructor and conduct the interview with him/her. Afterwards, 3-5 real interviews should be done under the supervision of an instructor who will give feedback about their performance. In roadside interviews it may make sense to have teams of two. So, one does the interview and the other one records the answers.

4.5.2 Instructions for the online survey respondents

Recommendation SRS 12: Each online survey requires a well-designed and tested instruction to ensure reliability of the data.

As there is no interviewer in online surveys, the written instructions must take this part. The resulting instruction should be tested by an open interview on naïve participants. The most important information that has to be included is:

- Motivating the participants to complete the questionnaire by explaining the relevance of their answers,
- Encourage them to answer truthfully by pointing out that they are anonymous, and the data cannot be traced to any participant.

4.5.3 Selection of locations for roadside interviews

Recommendation SRS 13: The rationale for choosing the locations of the roadside interviews should be provided. This includes a minimum number of target objects (flow) and a random selection of different possible regional locations.

A minimum number of three different locations is recommended. The locations should first be chosen in a manner to allow a sufficient number of interviews. For cars, large parking lots at supermarkets or rest areas on highways are well suited for that. For pedestrians and cyclists, intersections or other locations should be selected where a sufficient number of target objects are passing. Thus, when planning the study, every possible site should be visited around the time when the assessment is planned, to count the number of target objects.

In order to obtain a more representative picture about mobile phone use in the region of interest, the locations should be selected to be representative for this region. Three different locations for each type of road are certainly a minimum to get a first impression about the variability due to the locations. For a more representative study, at least 25 locations should be chosen, depending on the distribution of the variables which are considered of interest (e.g., different size of cities, different groups of cyclists etc.).

Recommendation SRS 14: The basic characteristics of the locations of roadside interviews should be recorded and included in the report.

The locations should be documented for describing the study. At least the following information for car observations should be included:

- GPS-coordinates of the location,
- Type of area (e.g., large parking lot, rest area, intersection with zebra crossing),
- Special conditions (e.g., only cyclists waiting at a red light, only pedestrians before crossing the road).

4.5.4 Planning and timing

4.5.4.1 Roadside interviews

Besides the location, the time of the interviews has to be selected and documented. Again, the main point is to select times when sufficient target objects are present. Interviews at large parking lots have to take place at shopping hours. Like in the observational studies, interview studies will mainly focus on daytime. In order to include different types of trips and target groups, interviews should be distributed over the whole day.

Recommendation SRS 15: To include different types of trips and target groups, roadside interviews should be distributed over the whole day.

Thus, it is recommended to take the following time periods to conduct the interviews:

- Morning and late afternoon in order to do the assessment at high traffic density and to include commuters, and other relevant times when more traffic is expected (e.g., at noon, when people walk or cycle to go for lunch),
- Some periods in-between in order to also include other traffic.

Recommendation SRS 16: In order to ensure a high quality of the data, roadside interviews should only be done if some basic prerequisites apply. These should be clearly defined for the interviewers.

As in the observations, there are also context variables which may prevent an interview from taking place. These are mainly weather aspects. Thus, interviewers should be instructed to stop the interviews if any of these conditions is not met. The most relevant are:

- Good weather (no rain, no storm, no snow),
- Sufficient number of target object,
- No temporary changes in infrastructure (e.g., construction sites) of which an impact on the behaviour of road users can be expected.

4.5.4.2 Telephone interviews and online surveys

While roadside interview sessions can be organized in a way that all relevant trip characteristics (time of day, day of week, location) are directly considered sufficiently, in telephone interviews and online surveys, the researchers have less control over the trips that will be considered in the study. For these self-report methods, the proposal is to ask about the last trip (as a car driver, pedestrian or cyclist, depending on the type of study) or about different trips within the last 24 hours. However, the time when the interview is done or the participation in the online survey respectively may not be equally distributed over day-time. To some extent this can be supported by planning telephone interviews equally over the different days of the week and times of the day. Online surveys can be sent out in different waves (days of week and times of day) to support a more equal distribution of considered trips. Moreover, online surveys asking first basic information about all trips made in the last 24 hours can be programmed in a way that when generally low-frequency (underrepresented) trips (e.g., night trips) are reported, these are always selected for further information. When no night trips are reported, one trip could be randomly selected in order to get an equal distribution of the final sample of trips.

Recommendation SRS 17: To get a better distribution of trips over different day and time intervals, telephone interviews and online survey invitations should be planned / sent out equally over different week(end) days and time-intervals. Online surveys should be programmed to select one of different reported trips in a pseudo-random way: when underrepresented trips (e.g., night trips) are reported, these are always selected, and otherwise one trip is selected randomly.

4.5.5 Target sample of roadside interviews

Recommendation SRS 18: External validity of the results of roadside interviews requires that the target group is clearly defined.

Recommendation SRS 19: For car drivers, cyclists and pedestrians, roadside interviews should always (but not necessarily exclusively) include private traffic participants as these make up the largest part of traffic.

There must be a clear definition of whom to approach for the interview. The three most relevant target groups (basic target groups) are:

- Car drivers in private cars (e.g., no trucks or lorries, no taxis, no commercial cars, no police or ambulance cars),
- Cyclists being alone on a bike (no couriers, no postmen, no other commercial cyclist, no children at the backseat, no bike trailer, no E-bikes or Pedelecs, and no riders of racing bicycles),
- Pedestrians (e.g., only private persons, no postmen or other persons in commercial service).

If other target groups are to be included the type of these different groups should be recorded in the data. Even in studies about special populations (e.g., e-Bikes, taxi drivers) it makes sense to also include the basic target groups mentioned before for comparison purposes. For cycling studies, a distinction should be made between E-bikes or Pedelecs and normal bicycles.

Recommendation SRS 20: In roadside interviews target objects must always be selected at random among all possible target objects available at the site of the assessment. Therefore, like in observation studies, a precise and binding procedure to select target objects has to be defined.

Recommendation SRS 21: In roadside interviews there has to be a precise definition of the characteristics of the target group and also of where targets should be selected from at the site of the assessment.

Besides this general definition of the target group it has to be defined which of the many possible targets are to be selected in an ongoing interview study. In order to get a representative sample, targets should be selected per random from the possible subjects. It does not make sense to interview mainly drivers or cyclists who use the phone while parking. The procedure to select the targets has to be defined accordingly. An example could be: “After having finished an interview, look up and approach the next car which is parking”.

Moreover, for each site the possible targets have to be defined. These should be chosen in a way to be easily accessible for the interviewers. This could be the area of a parking lot when conducting interviews with car drivers. Cyclists could be approached at the traffic light and pedestrians at a certain section of a walkway. Clearly define which drivers, cyclists and pedestrians are to be interviewed at each location.

This definition should be included in the description of the study procedure in order to enable a replication of the study which is especially important when repeating interviews in another study or in another assessment period.

4.5.6 Selection of the sample for telephone interviews and online survey

Recommendation SRS 22: Telephone interviews and online surveys should be conducted with a representative sample of the target population.

For telephone interviews and online surveys samples from existing (market research) panels can be 'rented', with a request for them to be representative for the target population according to certain characteristics. To guarantee representativity, sample providers can be asked to provide a 'proportionally stratified panel sample', being representative for gender, age (e.g., at least 3 categories), and region (e.g., in Belgium: 3 regions). Separate or crossed quota for these three variables can be given, based on national population statistics (if available). Additional sample requirements in terms of inclusion criteria (e.g., for car drivers: minimum number of driven kilometres per year, only private drivers) can also be provided to panel providers. Due to non-response the final net sample can be disproportionate compared to the required quota though, which requires corrections using weights in the data analysis (see Section 4.5.11).

Overall, the description of the study should include some information about how people were recruited for participation. It is also important to assess some basic characteristics of the target traffic participant sample in order to allow a comparison with the relevant target population (see chapter 2 for the basic characteristics). Of course, the assessment of additional parameters is encouraged in order to be able to better describe the sample and to compare it to the target population in more detail. In the last section of interviews and surveys the following variables could be furthermore included: socio-demographic characteristics, attitudes and beliefs about mobile phone use in traffic or detailed descriptions about what people do with their mobile phone in traffic and under which circumstances they feel safe to do so.

Recommendation SRS 23: Basic characteristics of the subjects should be assessed in telephone interviews and online surveys in order to examine whether the sample is representative for the target population.

4.5.7 Non-responders

Not only in roadside interviews but also in telephone interviews and if possible in online surveys, characteristics of the non-responders should be assessed (e.g., "do not want to be interviewed", "no time", "drop-outs during the survey"). The basic characteristics to be collected are age and gender. Afterwards, this data should be used in a non-responder analysis to find out whether the responders and non-responders differ in any way.

Recommendation SRS 24: Non-responders (refusals) should be recorded and a non-responder analysis should be conducted to examine a possible bias in all interview studies and if technically possible in online surveys.

The quality of interview studies depends on voluntary participation. The most relevant bias would be if a large number of mobile phone users refuses to participate. This would lead to an underestimation of the frequency of mobile phone use. To lower the risk of non-response it is recommended to ask at the beginning of the interview very general about participation (e.g., about traffic behaviour) without

telling that the interview is about mobile phone use while driving. If they refuse that (e.g., because they do not have time), it is most certainly not because of the special topic of the interview. Moreover, characteristics of the non-responders should be assessed. They should be asked for the reason for not participating (e.g., “not wanting to be interviewed”, “no time”). In a nutshell:

- Ask for reasons for refusal
- Record basic observable characteristics of non-responders (gender, age category) in roadside interviews; record this available information in telephone interviews (or ask for it); register basic socio-demographic characteristics of respondents in the beginning of the online survey (before possible dropout).
- Do a non-responder analysis to find out if there are systematic differences between responders and non-responders.

If systematic differences are found, these should be described, and it has to be discussed to which extent it is likely that this may influence the results on mobile phone use. Thus, a better discussion about the representativeness of the sample is possible.

4.5.8 Construction of interview/online questionnaire, online survey programming

Recommendation SRS 25: Interview guides and questionnaires have to be thoroughly tested with naïve subjects. Online surveys require a well-designed and tested instruction to ensure reliability of the results.

In roadside interviews it may make sense to have teams of two where one does the interview and the other one records the answers. Thus, the interviewer can better interact with the participants which improves compliance. Besides the questions on the mobile phone use, there are additional aspects which should always be included in the questionnaire.

Recommendation SRS 26: To increase compliance interviews and online surveys should always start with an introduction ensuring the absolute confidentiality of the data and that all the data will be kept anonymous.

There should be a short introduction with the aims of the study and the relevance of the research at the beginning which can motivate participation. In order to keep non-response rate low, it makes sense to relate to behaviour in traffic in general at the beginning. This first section should also ensure the subjects that all data is treated confidentially and is only used for research purposes. They should also be asked if they are willing to participate (for roadside and telephone interviews). If not, they should be asked about reasons for not doing so and basic characteristics should be recorded (see Section 4.5.7).

As described above (Section 4.5.3) the questionnaire for roadside interviews should always include the information about the interview location.

Recommendation SRS 27: The questionnaire of SRS should include basic information about the trip of consideration (e.g., hour of departure, duration, main road type, main purpose).

Recommendation SRS 28: Of every interview partner and online respondent, some basic characteristics of the person such as age and gender should be included in the questionnaire as well as some basic characteristics of the mobility behaviour.

The basic variables to be always assessed are the following:

- Age
- Gender

For car drivers, the following data is important:

- Overall driving experience (years with a driver's license)
- Current driving experience (km driven during last year)

Similarly, for pedestrians and cyclists one would record:

- Number of walks as a pedestrian per day/week
- Number of rides with the bike per day/week

The last section of the surveys and interviews is open for the additional information which makes interviews so relevant. Here, one could include some of the following aspects:

- Additional socio-demographic characteristics of the respondent
- Attitudes and beliefs about mobile phone use in traffic
- Detailed descriptions about what people do with their mobile phone in traffic and under which circumstances they feel safe to do so

As described above (Section 4.3.1) a combination of free recall and recognition should be used in SRS. While online surveys are less adequate for using a lot of open questions, and are less flexible due to predefined questioning, they can be programmed in a logic, using filter questions followed by more specific questions (e.g., only cyclists get further questions related to bicycle trips), which saves time and provides additional specifications. Moreover, online surveys can be programmed to be sent out in different waves (days of week and times of day) to support a bigger heterogeneity of time intervals of trips in the study, and to allow balanced statistical analyses. This is nevertheless not a guaranty, as persons receiving an invitation e-mail are free to decide when they respond. Online surveys furthermore allow a random selection of one trip from a list of provided trips (in the last 24 hours); and to avoid underrepresentation of certain time interval trips (e.g., night trips), such trips can always be selected when indicated by a respondent (pseudo-random selection) (see also Section 4.5.4). At the start of a telephone interview and online survey participants have to indicate whether they were driving a car (or cycling, or walking) within the last 24 hours. A trip should be clearly defined (e.g., displacements on the public road between two different locations, with the exception of short breaks, e.g., at a tank station). Panel respondents should only once be allowed to the survey.

4.5.9 Estimation of sample size

When planning the study, the sample size required for the respective purpose should be calculated as it is described in Section 3.2.9 for ROS. When looking at the examples provided in this section, it

becomes obvious that the large samples required for estimations of prevalence are harder to achieve by interviews than with traffic observations or online surveys.

Recommendation SRS 29: The appropriate sample size should be estimated and used to determine the required number of interviews or online surveys.

Depending on the duration of the roadside interview and the available number of target objects at a site, about 5-10 interviews can be done per hour. Thus, for 2 000 data sets about 50 days of 6 hours interview time per day would be necessary. In contrast, online surveys allow easily and cost-efficiently 1 000 or more respondents, representative for the population with respect to age, gender, region, and road user type.

Again, this shows that the main focus of interview studies, especially of roadside interview studies, is on the additional information that these studies can provide. If one just wants to examine prevalence, ROS are much more effective. If the aim is to make international comparisons using a uniform study design across countries, online surveys are very cost effective.

4.5.10 Data collection and storage

For online surveys, data is provided in digital form afterwards. Telephone interviews may be done with a direct data entry (CATI; Computer-Assisted Telephone Interviewing). It may also be possible to do roadside interviews with tablet computers (e.g., using CAPI; Computer-Assisted Personal Interviewing). Otherwise, interview data has to be entered into a data processing system afterwards.

4.5.11 Definition of relevant variables

When doing roadside interviews, the information about the location and time of the observation should be included for every case. For online surveys and telephone interviews, the information about the time of the trip and the type of road of the majority of the trip should be included.

4.5.12 Data weighing

As for roadside observations, even if participants have been selected to be representative for the population in telephone interviews or online surveys, a weighing will probably be necessary e.g., due to non-response (see also Section 4.5.6).

Recommendation SRS 30: When the results aim to be representative, a weighing with regard to relevant characteristics of the traffic participants and their mobility should be done.

However, this requires the respective information which may not be available. Basic demographic population statistics are available for most countries (e.g., United Nations Statistics Division, 2019) while up-to-date statistics on owners of car driving licenses for instance are mostly not available. With regard to mobility statistics, for example, the MiD study in Germany[8]and the Monitor study in Belgium (Leblud et al., 2018) provide this kind of information from an interview study where a representative sample of the respective population describes all their trips during one day. This may be used for car

[8] http://www.mobilitaet-in-deutschland.de[12.08.2019]

drivers, cyclists and pedestrians. However, these studies are only done once in several years (e.g., MiD study: the latest being published in 2018, the last one before that in 2008).

In online surveys with pseudo-random selection of trips in the last 24 hours (unbalanced selection of time intervals, e.g., night trips always being selected when reported – leading to an overrepresentation) (see Section 4.5.4), weights should also be applied so that the distribution of time intervals represents the distribution of all time intervals that were indicated by the respondents and not only the specific selected time intervals (trips). The underlying assumption is that the distribution of all reported departure time intervals represents the natural distribution of departure times in the target population (see e.g., Diependaele, 2015).

5. Summary and overview of recommendations

The next three Tables present an overview of the most relevant recommendations related to the estimation of point prevalence of mobile phone use in traffic, distinguishing between BAsic (BA) recommendations for epidemiological studies (Table 2), recommendations for Roadside Observational Studies (ROS; Table 3), and recommendations for Self-Report Studies (SRS) - roadside interview, telephone interview, and online survey(Table 4).The list of recommendations is not aimed to be exhaustive.

Table 2: Summary of BAsic (BA) recommendations for epidemiological studies

BAsic (BA) recommendations for epidemiological studies	
BA1	In all epidemiological studies a thorough control and documentation of possible influencing context factors is needed (e.g., region, road type, traffic density, day of week, time of day, weather).
BA2	In all epidemiological studies a uniform definition of basic tasks should be used.
BA3	The main distraction categories should be assessed in all epidemiological studies. When reporting the results, the full definition of the categories should be given.
BA4	In each epidemiological study, a core set of subject characteristics should be included.

Table 3: Summary of recommendations for Roadside Observational Studies (ROS)

Recommendations for Roadside Observational Studies (ROS)	
ROS 1	To estimate the extent of the problem of mobile phone use in traffic, or to investigate the effect of a campaign or legal measure, observational studies deliver most direct and valid data, and are therefore the preferred methodological option.
ROS 2	To better understand the subjective background of mobile phone use in traffic or to describe the traffic participants' behaviours in more detail, self-report studies are more suitable.
ROS 3	To get a full understanding of the problem of mobile phone use, a combination of ROS and self-report studies is recommended, taking the advantages of each method while compensating for their shortcomings.
ROS 4	When planning an observational study a set of basic methodological aspects should be considered. These should also be documented in the report.
ROS 5	The report should include an exhaustive definition of all variables which are observed or are recorded.
ROS 6	Each observational study requires a thorough training of the observers including a performance test to ensure a high inter-rater reliability.
ROS 7	The rationale for choosing the locations of the observations should be provided.
ROS 8	The basic characteristics of the observation sites should be recorded and included in the report.
ROS 9	Observations should cover the whole daytime and different working days. This can be achieved by selecting at least three time-intervals per day and by doing observations at least from Mondays to Saturdays.
ROS 10	In order to ensure a high quality of the data, observations should only be done if some basic requirements are met (e.g., weather, light, road condition).
ROS 11	External validity of the results requires that the target group is clearly defined.
ROS 12	For car drivers, cyclists and pedestrians the observation study should always include private traffic participants (including those on their way to/from work) as they represent the largest part of traffic.
ROS 13	Target objects should always be randomly selected from all the possible objects at the location where the observation is done.

ROS 14	For the observers, there has to be a clear definition which of the traffic participants belongs to the target group with regard to their characteristics, but also their location.
ROS 15	It is recommended to use tablet computers for the observations.
ROS 16	At the beginning of each observation session, a key set of variables describing the location should be recorded.
ROS 17	When planning the study, the appropriate sample size should be estimated and used to determine the required number of observational sessions, taking the different types of traffic participants (car drivers, cyclists, pedestrians) into account.
ROS 18	When selecting the locations of the observations, it must be ensured that the observations can be conducted safely and inconspicuously.
ROS 19	Each data set (one observation) should include the information about the location and observation time as well as the individual information about the traffic object observed.
ROS 20	Data could be weighted according to traffic volumes at the different locations of observation.
ROS 21	Even more importantly, when the results aim to be representative, a weighing with regard to relevant characteristics of the traffic participants and their mobility should be done.

Table 3: Summary of recommendations for recommendations for Self-Report Studies (SRS))

Recommendations for Self-Report Studies (SRS): roadside interviews, telephone interviews, online surveys	
SRS 1	SRS should be used if the focus is on the individual characteristics of the users or on a differentiated analysis of the user behaviour.
SRS 2	In SRS the frequency of mobile phone use should be assessed based on a certain trip. Thus, the prevalence estimations are more comparable to those derived from observational studies (point prevalence).
SRS 3	SRS should be done as soon as possible after a trip. Roadside interviews should be done directly after a trip (or during a trip for pedestrians/cyclists) and the time span to be described should not be too long, e.g., the last 30 minutes of the trip. Telephone interviews and online surveys should refer to the last trip made or to another trip made within the last 24 hours.
SRS 4	SRS should always refer to one tangible trip.
SRS 5	Date, weekday and time of the day when the trip started should be assessed in SRS.
SRS 6	SRS the type of road of the major part of the trip (e.g., highway, rural road, urban/city driving) should be assessed.
SRS 7	In SRS a combination of free recall and recognition should be used.
SRS 8	In order to minimize bias due to social desirability, it has to be made very clear in SRS that all answers will be treated strictly confidential and that there will be no opportunity to trace back data to the individual.
SRS 9	The frequency of mobile phone use should be assessed including the different kinds of secondary activities, and additional information about socio-demographic characteristics, trip and subjective parameters should be gathered.
SRS 10	To ensure a high data quality, some basic methodological concerns should be addressed when planning SRS, and these should always be reported afterwards.
SRS 11	Each interview study requires a thorough training of the interviewer including a performance test to ensure reliability of the results.
SRS 12	Each online survey requires a well-designed and tested instruction to ensure reliability of the data.
SRS 13	The rationale for choosing the locations of the roadside interviews should be provided.

SRS 14	The basic characteristics of the locations of roadside interviews should be recorded and included in the report.
SRS 15	To include different types of trips and target groups, roadside interviews should be distributed over the whole day.
SRS 16	In order to ensure a high quality of the data, roadside interviews should only be done if some basic prerequisites apply. These should be clearly defined for the interviewers.
SRS 17	To get a better distribution of trips over different day and time intervals, telephone interviews and online survey invitations can be planned / sent out equally over different week(end) days and time-intervals. Online surveys can be programmed to select one of different reported trips in a pseudo-random way: when underrepresented trips (e.g., night trips) are reported, these are always selected, and otherwise one trip is selected randomly.
SRS 18	External validity of the results of roadside interviews requires that the target group is clearly defined.
SRS 19	For car drivers, cyclists and pedestrians, roadside interviews should always (but not necessarily exclusively) include private traffic participants as these make up the largest part of traffic.
SRS 20	In roadside interviews target objects must always be selected at random among all possible target objects available at the site of the assessment. Therefore, like in observation studies, a precise and binding procedure to select target objects has to be defined.
SRS 21	In roadside interviews there has to be a precise definition of the characteristics of the target group and also of where targets should be selected from at the site of the assessment.
SRS 22	Telephone interviews and online surveys should be conducted with a representative sample of the target population.
SRS 23	Basic characteristics of the subjects should be assessed in telephone interviews and online surveys in order to examine whether the sample is representative for the target population.
SRS 24	Non-responders (refusals) should be recorded and a non-responder analysis should be conducted to examine a possible bias in all interview studies and if technically possible in online surveys.
SRS 25	Interview guides and questionnaires have to be thoroughly tested with naïve subjects. Online surveys require a well-designed and tested instruction to ensure reliability of the results.
SRS 26	To increase compliance interviews and online surveys should always start with an introduction ensuring the absolute confidentiality of the data and that all the data will be kept anonymous.
SRS 27	The questionnaire of SRS should include basic information about the trip of consideration (e.g., hour of departure, duration, main road type, main purpose).
SRS 28	Of every interview partner and online respondent, some basic characteristics of the person such as age and gender should be included in the questionnaire as well as some basic characteristics of the mobility behaviour.
SRS 29	The appropriate sample size should be estimated and used to determine the required number of interviews or online surveys.
SRS 30	When the results aim to be representative, a weighing with regard to relevant characteristics of the traffic participants and their mobility should be done.

Researchers should always be aware of the advantages as well as the limitations of the study methods used. Some of the main advantages (+) and disadvantages (-) of the proposed methods for prevalence assessment of distraction in traffic are summarized underneath:

Roadside observation:

+ direct point prevalence measurement in traffic; allows a big sample size in a short time frame; locations and moments of the observation are controlled and can be selected randomly (equal distribution); possibility to weight data using traffic counts.
- risk of observer bias; limited to observable mobile phone tasks; limited collection of socio-demographic characteristics; no subjective parameters; sophisticated study design necessary which might affect comparability across countries.

Roadside interview:

+ method closest to the observation method because of the immediate self-report after (or during) the trip; lowest risk of recall bias; locations and moments of the interviews are controlled (equal distribution); collection of info on all possible secondary tasks, personal and trip characteristics and subjective parameters can be assessed; flexibility in questioning (e.g., open questions can be used – free recall, explanations can be given).
- high time cost per participant, so rather small sample size or big temporal effort; risk of social response bias; risk of interviewer bias.

Telephone interview:

+ collection of info on all possible secondary tasks, personal and trip characteristics, and subjective parameters; flexibility in questioning (e.g., open questions can be used – free recall, explanations can be given).
- risk of recall bias (increased with bigger time span between the interview and the trip); high time cost per participant, so rather small sample size or big temporal effort; risk of social response bias; risk of interviewer bias; less options to control for an equal distribution of trips on different day-times.

Online survey:

+ allows a big sample size in a time- and cost-effective way; a survey panel sample representative for the target population can be used; allows a systematic and uniform data collection across countries (can be programmed as one survey for all the countries); participation independent of the time of day – also night – and geographical location; collection of info on all possible secondary tasks, personal and trip characteristics and subjective parameters can be assessed; no interviewer effect; mitigate social response bias; random distribution of trips can be programmed.
- limited flexibility in questioning and in motivating participants; standard, mostly closed, questions must be used; risk of recall bias; risk of bias related to online panels (subject bias).

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