Computer assisted web-interviewing met een mix van apparaten: een longitudinaal onderzoeksperspectief

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Samenvatting

Online vragenlijsten worden tegenwoordig ingevuld via traditionele apparaten, zoals de desktop en de laptop, en mobiele apparaten, met als voornaamste voorbeelden de smartphone en tablet. Die nieuwe diversiteit vormt een uitdaging voor longitudinaal onderzoek, aangezien de continuïteit in datakwaliteit en kwantiteit van groot belang is. In deze bijdrage voor het CVS congres gaan we in op een drietal vragen: [1] Wat is het relatieve belang van smartphone- en tabletgebruikers binnen een panelstudie? [2] Hoe kunnen deze mobiele respondenten gefaciliteerd worden? [3] Wat zijn de effecten van het actief ondersteunen van de smartphone- en tabletgebruikers binnen online vragenlijsten? Voor ons onderzoek maken we gebruik van een reeks meta-analyses, waarbij we de inzichten uit eerdere studies combineren en aggregeren. De meta-analyses worden aangevuld met de belangrijkste inzichten uit de internationale literatuur.

De resultaten laten zien dat het aandeel mobiele respondenten – gebruikmakend van smartphone of tablet – al boven de 33% ligt in online panels in Noordwest Europa. In 2009 was dit nog nihil. Daarbij valt ook op dat een hoog tabletgebruik vooral voorkomt in Nederland en omliggende landen. Het gebruik van mobiele apparaten is niet aselect. De mobiele respondent heeft een profiel dat deels aansluit bij de moeilijk te bereiken doelgroepen voor online vragenlijsten. Gelet op het relatieve en absolute belang van deze mobiele respondenten is uitsluiten geen optie, ook omdat men veelal niet alsnog een traditioneel apparaat zal gebruiken. Het beste kunnen deze respondenten actief gefaciliteerd worden in het online-onderzoek. We identificeren vier benaderingswijze voor actief faciliteren: mobiel eerst, responsief survey ontwerp, adaptief survey ontwerp en eenvoud. Daarbij lijkt de *mobiel eerst* benadering voorbij te gaan aan de wensen en mogelijkheden van traditionele respondenten, die nog altijd in de meerderheid zijn. Eenvoud in de opzet van een vragenlijst kan daarentegen nooit kwaad en kan goed gecombineerd worden met adaptief of responsief ontwerp. Het actief ondersteunen van mobiele apparaten heeft ook duidelijke positieve effecten op het verminderen van uitval gedurende het invullen van de vragenlijsten. Ook de totale doorlooptijd wordt zo verkort. Beide zijn een goede proxy voor een verminderde belasting op de respondent. Smartphone respondenten waarderen de extra inspanning, wanneer de vragenlijsten geschikt worden gemaakt voor het kleine aanraakscherm dat zij hanteren.

Kortom, vrijwel alle inzichten pleiten voor het actief ondersteunen van respondenten die gebruik wensen te maken van smartphone en tablet binnen het panel.

1. Smartphone and tablet respondents in longitudinal surveys

The unparalleled rise of new mobile devices has drawn the attention of survey research scientists the world over (Callegaro, 2010; Peytchev and Hill, 2010; De Bruijne, 2015; Struminskaya, 2014). Computer-assisted web interviews are nowadays by definition mixed-device surveys, with desktops, laptops, smartphones and tablets included (Toepoel and Lugtig, 2015). One of the initial concerns among survey research scientists was *unintended* mobile response: respondents use smartphones to complete a survey, yet the survey itself is not designed for small touchscreens (Peterson, 2012). Buskirk and Andrus (2012) call this 'the passive approach' to mixed-device surveys.

For a number of reasons, unintended mobile response has raised concerns about data quantity and quality (De Bruijne, 2015; Peterson, 2012; Lugtig and Toepoel, 2013; Peytchev and Hill, 2010). A traditional survey might not fit on the smaller screens of mobile devices, which implies the need for scrolling, with options potentially being overlooked by respondents in the process (Peytchev and Hill, 2010). A touchscreen keyboard as input modus has raised concerns about typing errors, as well as the respondents' willingness to provide lengthy answers to open questions or select conditional open answers. The use of 2G and 3G networks raised concerns about completion times and costs for mobile device users.

Unintended mobile response is a concern that demands further attention, especially in panel surveys (Arn et al., 2015). These longitudinal studies already have existing infrastructures, software, communication procedures and fixed questions, fixed question formats or even fixed full-length surveys. Changes to the design, layout, wording of questions and other elements could impact the data and the survey's longitudinal character. Such issues also apply to our longitudinal survey of travel behavior: The Netherlands Mobility Panel (MPN) (Hoogendoorn-Lanser et al., 2015).

In this paper we discuss three topics related to the challenges of mobile response in longitudinal surveys. First, we endeavor to assess the relevance of mobile respondents. Second, we aim to identify the options for dealing with mobile response in longitudinal surveys. And finally, we strive to improve our understanding of the effects of longitudinal multi-device web surveys, with the primary focus on the surveys designed for multiple modes. Hence, this paper's research questions, as discussed per section, are:

1. What is the relative importance of mobile respondents in longitudinal surveys?
2. How to cope with mobile response within an already existing survey?
3. What are the mode-effects in surveys designed for both traditional and mobile respondents?

In order to find answers for our research questions, we relied on a series of meta-analyses. If necessary, the quantitative results from other studies were strategically combined and modelled. We present models for mobile device use in surveys, variability in mobile device use, completion times, break-off rates, and many other aspects. Our findings are combined with state-of-the-art literature.

Our research questions serve to structure this paper. In section 2 we address the question of the relative importance of mobile respondents in online surveys, which we did by looking at the share of mobile respondents in surveys, the number of participants that used a mobile device at least once, and the profiles of mobile respondents. In section 3 we examine the various options for the treatment of mobile respondents in surveys, which includes an overview of design strategies for facilitating mobile response. In section 4 we assess the impact of mobile response on data quantity and response burden; this assessment focuses on surveys that actively integrate and support mobile response, in contrast to a more passive approach to mixed-device surveys. We discuss response rates, break-offs, attrition, completion times, missing items, and the respondents' survey evaluations. Finally, in section 5, we present our main conclusions and recommendations for longitudinal surveys.

Before proceeding, it is necessary to first explain some key terms used in this paper. *Mobile devices* are smartphones and tablets. Other mobile devices, such as smartwatches and e-readers, are disregarded in this paper. *Mobile respondents* are respondents who use their smartphones or tablets to complete online questionnaires. In multiple instances we refer to *traditional devices*: this denotes desktop computers and laptops that do not have touchscreens or the option of converting them into tablets. Unfortunately, not all papers studied in our literature review were clear with regard to their definitions of mobile and traditional devices. The meaning of *optimized for mobile completion* or *mobile-friendly survey design* refers to those surveys that feature active support and integration of mobile devices (§3.2).

2. Assessing the relevance of mobile respondents

To assess the added value of allowing mobile response in surveys, we examined three aspects. We estimated the share of mobile response in surveys without the hard or soft refusal of mobile respondents; we examined mode change and wave-to-wave variability; and we studied the profiles of mobile respondents. The first two aspects revealed the quantified relative importance. The third aspect offered insights into the question of whether mobile respondents belong to a hard-to-reach subgroup.

2.1 Share of mobile respondents

Based on the actual shares in 168 observational studies, a prediction was made for the average share of mobile respondents (n=158 for smartphone; n=106 for tablet)[1]. The period covered in this meta-analysis ranged from 2009 to mid-2016. In order to establish the share of mobile respondents, we used two beta regression models - one per device. In our model we accounted for the rapid rise of mobile device use (month-by-month), the type of survey (cross-sectional / longitudinal), the research motive (academic / commercial), and regional differences.

Table 1: Estimated shares of mobile respondents in observational studies

	Smartphone		**Tablet**	
	est.	*s.e.*	*est.*	*s.e.*
Months	0.0416	0.0012	0.0434	0.0006
Cross-Sectional	0.6430	0.0289	0.2159	0.0166
Commercial	0.5496	0.0346	0.3478	0.0186
Mobile-Friendly	0.3173	0.0602	0.0859	0.0220
Rest of Europe	0.5350	0.0430	-0.7121	0.0359
North America	0.4372	0.0356	-0.1755	0.0182
Other regions	*0.0040*	*0.0583*	-11.031	0.0459
Target group: young	0.2984	0.0617	-12.549	0.0423
Intercept	-36.661	0.0193	-30.890	0.0094
N	158		106	
Pseudo-Rho2	0.66		0.68	

Estimates in *italics and grey* are insignificant. Ref. level: Jan-2013, Panel, non-commercial, not mobile-friendly in panel, North-West Europe, general population.

[1] Volledige data is beschikbaar via de auteurs

The model's results are presented in Table 1. The month-by-month increase of mobile respondents was substantial and highly significant. The share of mobile respondents in 2009 was estimated at 2% in total. By 2016, this figure had reached 34%. Indeed, one out of every three survey participants was a mobile device respondent. Mobile-friendly panels were more often accessed by mobile device users. Tablet use was most common in North-West Europe (ref. level). Commercial and cross-sectional studies demonstrated significantly higher shares of mobile respondents (cf. Schmidt and Wenzel, 2012).

2.2 Device switching

Two relevant types of switching occur in longitudinal surveys: switching during completion of a single wave, and switching between waves. The number of respondents that switched during the completion of a single survey, and hence used multiple devices in one questionnaire, is rarely known, and there are numerous reasons for this knowledge gap. First, a general lack of knowledge about the devices used: the device used to complete a survey is often unknown (Macer and Wilson, 2016). Second, a lack of interest: metadata in online studies remains of secondary importance and is rarely actively used. Researchers are primarily interested in the survey results; that is, the answers to their survey questions. Third, in order to record switching behavior during a single survey, the device information must be captured multiple times.

Four studies that include data about device switching during completion affirmed low rates of switchers. Callegaro (2010) reported that 7% of the survey participants had switched from a mobile to a traditional device once they concluded that the survey was unsuited for mobile completion. In a research project involving ten experimental conditions, mobile respondents demonstrated an overall low likelihood of switching while completing the survey: the share of switchers ranged from 0.4% to 2.3% (n=2181; McGeeney and Marlar, 2013). Hupp et al. (2014) found that 93 of 570 respondents switched from a smartphone to either a PC or tablet while completing a non-optimized survey. Horwitz (2014) reported that 8.5% of smartphone respondents switched to a computer while completing the lengthy (>30 minutes) survey. This figure was only 3.7% for tablet users.

Table 2 combines the main findings from four analyses of switching between waves of probabilistic panels. In line with our previous findings, there was an observable increase in mobile device use in recent years. The share of respondents using mobile devices at least once was much higher than in single wave observations, which not only implies switching between waves but also stresses the need of support for multi-modal access, as a single negative survey experience can result in panel attrition.

Table 2: Mobile device use in probabilistic longitudinal surveys

Source	Waves	Period	Mobile friendly	Avg share per wave* *Smartphone*	*Tablet*	Usage at least once* *Smartphone*	*Tablet*
Poggio et al (2015)	8	2011-12	N	2.0%	1.4%	8.3%	
Lugtig and Toepoel (2016)	6	2013	N	2.4%	7.9%	5.5%	13.4%
Struminskaya et al. (2015)	6	2014	Y	8,8%	9,3%	19.3%	17.0%
Lugtig, Toepoel & Amin (2016)	7	2014	Y	12.1%	8.8%	19.1%	13.6%

*Based on our calculations

We were also able to obtain some insights into device usage consistency from the studies reported in Table 2. We found that on the most aggregated level traditional device users are highly consistent; they are highly likely to also use traditional devices in the subsequent wave. This consistency is much lower for tablet users, and even lower for smartphone users (idem), which indicates a more erratic nature in mobile device usage. The same type of pattern emerges in all studies.

2.3 Profile of mobile respondents

As we demonstrate in this subsection, the profiles of mobile respondents differ from the profiles of other respondents, meaning that in the long run their absence will result in a bias. Additionally, for many surveys, mobile respondents could be of particular interest, as they are part of a hard-to-reach subgroup.

We examined the differences in characteristics in the findings of 13 studies conducted in North America and Europe (De Bruijne and Wijnand, 2014; Toepoel and Lugtig, 2015; Bosnjak et al. 2013; Dewes, 2014; Schmidt and Wenzel, 2013; Poduska and Johnson, 2010; Peterson, 2012; Merle et al., 2015; Lugtig, Toepoel and Amin, 2016; Richards et al. 2016; Lambert and Miller, 2015; Cook, 2014; Zijlstra et al., 2017). Most of these studies used a logistic regression model for identifying key differences, with either smartphone or tablet usage serving as the dependent variable. The independent variables varied greatly from study to study and could not be combined.

The primary observation in this analysis was that younger participants were more likely to self-select a mobile device for survey administration. All models included age or age classes, and in all models smartphone respondents were significantly younger. Regarding gender, the results slightly favored women. Three studies reported a significantly higher share of men among mobile respondents, and six studies reported a higher share of women, while the differences in the remaining studies were insignificant. Marriage is associated with increased mobile response. Bosnjak et al. (2013) observed that widows and divorced persons were less likely to use mobile devices, while Lugtig, Toepoel and Amin (2016) reported a positive effect from being married. The degree of urbanization appeared to have no clear impact, as all studies that included this variable reported insignificant results, except for Zijlstra et al. (2017), which found lower mobile response rates in rural areas. The results were mixed regarding income levels and employment status, although tablet use in Europe does appear to be more prevalent among higher income groups and those in full-time employment. The effect of education levels was largely insignificant. The attitude towards new technologies or internet use generally was a seemingly far more important determinant for mobile response than most available socio-demographic or economic characteristics (De Bruijne, 2015; Barlas and Thomas, 2015; Zijlstra et al., 2017). The overrepresentation of the technology-minded — already observable in opt-in web-panels — is likely to be even more pronounced among mobile respondents.

3. Towards mixed-device surveys

3.1 Three strategies for coping with mobile response

Callegaro (2010) provides three basic options for dealing with (unintended) mobile response: [1] flag mobile device respondents in order to control for them in statistical models or delete them all together; [2], block mobile devices (*access control*); and [3] design a survey that is fully compatible with any device. We discuss these options individually.

The option to flag mobile device respondents and subsequently delete them will result in a significant loss in respondent numbers, as we demonstrated in the previous section. The option to flag them and account for mode-effects seems the better option, although this remains a suboptimal solution, as not all differences are known or easily controlled for. Moreover, it is not a sustainable path, as poor survey experiences result in higher drop-out rates during completion, and this could also result in a reluctance to join a next survey when invited. In longitudinal surveys, this denotes panel attrition. One should not expect that respondents will change their device-at-hand according to the survey design, as we demonstrated in the previous section.

The second option, *access control*, is a seeming attractive, simple and effective option; however, blocking mobile respondents will result in lower overall response rates. Blocked respondents do not routinely make extra efforts to complete a survey with another device (McClain et al. 2012; Millar and Dillman 2012; Peterson, 2012), yet we have already established that one out of three respondents is a mobile respondent. When participants are requested to switch devices, there is an observably strong reluctance to follow such instructions (Toepoel, 2016; Wells et al., 2014; Keusch and Yan, 2016); in Toepoel (2016), for example, 39% of all respondents failed to follow the experiment's instructions, even though they did have access to the specified device.

The option to support and integrate mobile respondents is generally regarded as the way forward (Wells, 2015; Lugtig and Toepoel, 2015; Kelly et al. 2012; Callegaro, 2010; Weber et al., 2008). As Wells (2015, p. 529) states in his thorough review of this topic: "Mobile respondents should not be blocked, screened out or disqualified from surveys, or redirected to a PC. They should be accommodated and surveys should be optimized for mobile devices." This recommendation is supported by references to the rapid rise in mobile device use, its anticipated further growth, a reluctance to switch devices for survey administration, and the fact that many tasks previously done on traditional devices are now done on mobile devices. Lugtig and Toepoel (2015: p. 158) conclude: "It seems only a matter of time before mobile phone or mobile devices in general are preferred for survey completion over regular desktop PC's. Therefore, the best option is to improve the surveys experience for mobile devices."

3.2 The active approach to mixed-device surveys

In this section we present an overview of design strategies for improving the survey experience for mobile and non-mobile device users. We discuss design principles, concerns and practical issues. Today, experts stress the need for mobile-optimal, device agnostic or mobile friendly surveys (Wells, 2015; Peterson, 2012; Lugtig and Toepoel, 2015). Meanwhile, these classifications are used interchangeably, with only some authors managing to provide additional details, figures and illustrations as elaboration of their terms (e.g. Arn et al, 2015; Wells et al. 2014; Mitchell, 2015).

The search for a better survey experience remains an ongoing quest, as also illustrated by the semantic confusions and proliferation of studies that aim to reveal the best way of presenting surveys on multiple devices. In the literature we identified a total of four design strategies for mixed-device surveys. Our overview is inspired by the work of Cehovin and Vehovar (2013), Mitchell (2015), Buskirk and Andrus (2012) and Arn et al., (2015).

- **Mobile-first.** The philosophy of this design approach is: 'if a survey works on mobile devices, it will work on all devices'. Surveys designed according to the mobile-first approach present the same survey layout on all devices, just as the traditional designs did previously. The key difference is that the survey is now designed to be displayed on the smallest types of screens, with a touchscreen as input mode. A number of studies tested this approach (De Bruijne and Wijnand, 2013; Tharp, 2015; Barlas et al., 2015), and the results indicated that by paying too much attention to mobile respondents, the majority of participants were overlooked. Traditional devices are confronted with a sub-optimal survey experience, which implies that mobile-first does not mean device agnostic.
- **Responsive layout.** Due to the rise of mobile devices, many websites were recently redesigned in order to improve reading and navigation on smartphones,

with a popular approach for achieving this being the use of responsive frames (Marcotte, 2010; Arn et al., 2015), which are frames programmed to automatically rescale to screen size and screen orientation. The content of each window is scaled and reorganized accordingly. FluidSurveys and GoogleForms are examples of survey software using responsive layouts. In order to support automatic scaling, the responsive approach favors the use of vector files over pixel-based images.

- **Adaptive design.** In the adaptive design approach, a specific design is created for each type of device. The information received from the respondent is used to determine the best option to send to their device (Gustafson, 2012; Arn et al., 2015). Grids and other complex question formats are presented differently, depending on which type of device is being used. For grids, this could be row-by-row for smartphone users, while desktop users are shown the full (original) grid. A potential disadvantage of adaptive designs is that they require more programming, as two or more separate layouts must be designed. Qualitrics software already offers adaptive designs by default.
- **Survey simplicity.** Many survey research experts recommend keeping the survey short and simple (Link et al., 2014; Callegaro, 2012; Saunders, 2015; Barlas et al., 2015; Weber et al., 2008). A traditional survey design — featuring shorter and simpler question and answer options — can therefore be deemed a conscious step toward a mixed-device survey. One benefit of this is that making changes to the traditional survey software can be avoided. Barlas et al. (2015) successfully tested this approach. If a survey is too long or complicated, the option of cutting the full survey into smaller pieces should be investigated (Kelly et al., 2012). This simplicity strategy can be combined with the other three design strategies.

The following arguments support the recommendation of keeping surveys short and simple (see e.g. Link et al., 2014; Revilla et al., 2016): first, navigation and reading is more burdensome with smartphones; second, respondents are accustomed to making regular but brief use of their mobile devices, hence shorter surveys fit more naturally with regular mobile device use; third, in web-based surveys, connectivity can become an issue for respondents who are on the move, as they may encounter dead spots; and fourth and finally, many mobile respondents are charged per downloaded megabyte or have monthly data limits. Consequently, in terms of bits and bytes, a minimal sized survey will prevent unpleasant surprises.

We demonstrated in this section that taking an active approach to mixed-device surveys is a multidimensional challenge. It is not simply a question of using the best software. Optimization for multiple devices must also contend with survey length, the readability of question and answer options, visualization, the amount of data to be downloaded and uploaded, and navigational and reading issues. Consequently, to state that a survey is mobile-optimal is a rather bold statement, as there are varying degrees of mobile-friendliness.

4. The effects of improved survey designs

In this section we offer an overview of the effects of improved mixed-device surveys. We discuss response rates, break-off rates, completion times, item nonresponse, and survey scores.

4.1 Response rates

As a result of instant internet access, its mobile character and high levels of private ownership, the assumption was that mobile phones with internet connectivity would boost response rates in mobile surveys (Weber et al., 2008). Many of those conditions have now been fulfilled: smartphones are constantly in stand-by mode, and many people not only own mobile phones but carry them wherever they go. Hence, in panels, the rise in mobile device usage should be positively correlated to general response rates, provided that we do not reject this 'mobile impulse' hypothesis. Based on the data derived from longitudinal surveys (Lugtig and Toepoel, 2016; Lugtig, Toepoel and Amin, 2016; Struminskaya et al., 2015), we tested this hypothesis. A simple scatterplot (not shown) reveals that there is no correlation between the share of smartphone users and the difference in response rates ($\rho^2 = 0.004$). Moreover, the correlation between more tablets and higher response rates is also very poor ($\rho^2 = 0.101$). Consequently, no evidence is found to support the hypothesis that longitudinal surveys have more respondents because of mobile devices.

Studies in which respondents are assigned a particular device offer more compelling information about response rates. One can find further details about response rates per device in multiple experiments involving random assignment. Given the results of 11 samples in 8 studies (Buskirk and Andrus, 2012; De Bruijne 2015; Wells et al., 2014; Antoun, 2015; Cook, 2014; Mavletova, 2013; Mavletova and Couper, 2013; Toepoel, 2016), we observe that respondents assigned to a mobile device are less inclined to start a survey, with an OR of 0.404 (weights based on sample size). Smartphone users were more inclined to respond (OR: 1.487) in only one experiment, by Wells et al. (2014), although candidates were not selected based on device accessibility, but rather were pre-screened for their willingness to install a survey app.

Given these findings, we may conclude that mixed-device surveys do not boost response rates, yet a lack of support for mobile respondents will result in lower response rates. Hence, an active approach to mixed-device surveys is needed to ensure stabilization and prevent loss.

4.2 Break-off

Compared to traditional device users, mobile device users demonstrated a significantly higher likelihood of leaving surveys before completion: a differential factor of three to four was not uncommon (Mavletova and Couper, 2015; Poggio et al., 2015; Lambert and Miller, 2015; Stapleton, 2013; Schmidt and Wenzel, 2013). This observation holds for smartphone users only. Tablet users hardly differed from traditional device users in this respect. Moreover, some studies even reported higher completion rates among tablet users (Poggio et al., 2015). The differences in observational studies could be explained by self-selection effects, as there were clear dissimilarities in socio-economic characteristics (§3.3). However, higher dropout rates were also reported in experimental studies and surveys (Wells et al., 2014). Multiple studies reported a lack of a mobile-friendly design as a key determinant (Stapleton, 2013; Barlas et al., 2015; Sarraf et al. 2015), although higher break-off rates were still reported in surveys that took an active approach to mixed-devices (Barlas et al., 2015; McGeeney and Marlar, 2013).

A meta-analysis conducted by Mavletova and Couper (2015) confirmed that an active approach to mixed-device surveys will lower drop-out rates among smartphone respondents. The researchers compared the completion rates of mobile respondents in 14 projects and 39 independent samples. By narrowing the scope to mobile device users only, Mavletova and Couper avoided the problem of self-selection. When compared to a survey with a traditional design, the more mobile-friendly design lowered the odds of drop-outs among mobile respondents by 40% (OR 0.71; c.i.: 0.54 – 0.89). The opportunity to choose the preferred survey mode (PC or mobile) was also associated with lower break-off rates among mobile respondents (OR = 0.62 with c.i. 0.35-0.97). More complicated survey designs ― featuring grids, drop-down questions, images, sliders or progress indicators ― were associated with higher break-off rates. The odds ratio is 1.30 (c.i.=1.20–1.39) when a survey featuring one of these complex elements is compared to a survey devoid of such elements. The OR increased to 1.91 (c.i.=1.76-1.97) when 5 of these complex elements were included, as compared to a survey devoid of complex elements. These findings support the need to keep mobile surveys simple.

We can conclude that incomplete cases are a serious issue in mixed-device surveys, as several studies have indicated that mobile respondents have a significantly higher tendency to abort surveys. Mobile respondents need to be supported.

4.3 Attrition

In the research discussed in §2.2, we found some indications regarding attrition. Lugtig and Toepoel (2016) observed a higher likelihood of non-participation in subsequent waves among mobile respondents. Traditional device users exhibited relatively loyal behavior, with an 83% probability that they would participate in the next wave, as compared to 75% for mobile device users (OR: 0.61). No significant differences were observed between tablet and smartphone users. Similar patterns were observed in the GESIS panel, although the German panelists were more obliging (Struminskaya et al. 2015). Traditional device users demonstrated a 95.3% probability of participating in the subsequent wave, and this probability was largely the same for tablet users (95.1%; OR: 0.96), although significantly lower for smartphone users (91.3%; OR: 0.52). It is worth noting here that this was not necessarily solely due to the survey experience as pertaining to the devices used; rather, self-selection effects could also play a role, as previously explained in Section 3.3.

We can conclude that there is some evidence that mobile respondents are less likely to participate in a panel’s subsequent wave, but this risk can be mitigated by offering device agnostic designs and giving respondents the freedom to select a certain device.

4.4 Completion time

Completion time is generally regarded as a proxy for response burden. Moreover, surveys that take longer to complete are considered to be a risk. Longer interview durations for mobile respondents, as compared to desktop respondents, were observed in many surveys (Schmidt and Wenzel, 2012; Gummer and Roβman, 2015; Couper and Peterson, 2017). With their meta-analysis, Gummer and Roβman (2015) demonstrated that this was a structural phenomenon, although they did not account for survey design.

Using a multilinear regression model featuring data from 80 samples from 37 studies[2], we observed that the smartphone users’ median completion time was 47% longer than the traditional device users’ completion time, in cases in which the surveys were not mobile-friendly (Table 3). For the mobile-friendly versions of these surveys, the median completion time was 19% to 24% longer. There is small and insignificant difference in completion time ratios for experimental (random assignment) versus observational (self-selection) studies. In 10 out of 80 cases, the majority of mobile respondents were faster than the majority of traditional device users.

[2] Volledige data is beschikbaar via de auteurs

Couper and Peterson (2017) examined and substantiated three explanations for longer completion times by mobile respondents: [1] slower transmission of data over cellular or WiFi networks; [2] reading and navigation difficulties; and [3] the increased mobility of mobile respondents and higher risk of distraction during survey administration. Differences in completion times are likely to diminish in the near future, owing to faster networks and improved survey designs for mobile devices.

Table 3: Weighted and unweighted results for the meta-analysis of completion times

	Unweighted		**Weighted**	
	est.	*s.e.*	*est.*	*s.e.*
Random Assignment	0.06	0.10	0.13	0.10
Mobile-Friendly	-.27**	0.09	-.23**	0.07
Mean times	-.13	0.08	-.19**	0.06
Truncated mean times	0.66***	0.18	0.31	0.18
Intercept	1.46***	0.06	1.47***	0.06
N	80		80	
Adj-Rho2	0.27		0.24	

Notes: reference is self-selection, not mobile-friendly and median completion time ratios. Weights in the second model are based on the squared root of the sample size.

4.5 Missing items

In this subsection we examine differences in item non-response between traditional and mobile devices, which involved studying observational and experimental data. Due to smaller screens, some options might be overlooked on mobile devices. Further, respondents could be inclined to avoid open answers.

Multiple studies reported higher levels of missing items among the mobile respondents taking traditional surveys in which they were free to select their completion device (eg. Struminskaya et al., 2015; Sarraf et al., 2015; Lugtig and Toepoel, 2016), although this finding was not consistent throughout the literature (Guidry, 2012; McClain et al., 2012; McGeeney and Marlar, 2013). A potential explanation for the conflicting evidence could be found in the composition of the sample. Struminskaya et al. (2015) and Lugtig and Toepoel (2016) analyzed a probability-based online panel, while Guidry's (2012) sample consisted of students only. Hence, a higher level of item nonresponse could also be attributed to self-selection effects, as was also noted by Lugtig and Toepoel (2016, p. 87): "It could be that people who generally report with high measurement error have different device preferences from people who report with low measurement error." A further explanation for the conflicting evidence pertains to the survey length. McGeeney and Marlar (2013), and McClain et al. (2012), used relatively short surveys.

In terms of missing items among mobile respondents, we find smartphone users to be of primary concern. A differential factor of two or three between smartphone and desktop respondents is not unlikely (Struminskaya et al. 2015, Lugtig and Toepoel, 2016; Lambert and Miller, 2015; Sarraf et al., 2015). Missing items are less common among tablet users, and, moreover, they sometimes perform even better than traditional device users. These observations are in line with the expected negative effects of smaller screen sizes and the more complicated navigation on smartphones.

Experimental studies allow researchers to establish mode effects, while also controlling for self-selection effects or other biases. In their experiment, in which respondents were presented with a mobile-friendly survey, Keusch and Yan (2016) found higher levels (factor 2) of item non-response among iPhone users than among desktop respondents.

Buskirk and Andrus (2014) — whose survey was optimized to look app-like — did not observe significant differences in missing items in their survey.

In observational studies, the use of mobile-friendly surveys lowered the risk of item non-response among mobile respondents (Sarraf et al., 2015), which also implies that not all observed differences can be attributed to self-selection – mode effects are also present.

4.6 Survey design evaluation by respondents

Offering a good survey experience is perhaps one of the best ways to prevent panel attrition, with attractive designs and optimal functionality assisting in this endeavor. However, comparing satisfaction levels between various surveys is complex, as satisfaction is determined by multiple factors that cannot all be accounted for. Hence, in this context, comparisons within studies are more useful. Potentially useful sources include experimental studies that offer varying conditions to multiple groups, and longitudinal panels that change over time. It is often the case that both categories converge, as panelists are eagerly used in experimental studies.

We found information about survey satisfaction among participants in three experimental studies that did not use panelists. Tharp (2015) used students to test the quality of a mobile-friendly survey's two design approaches, namely, mobile-first and responsive designs (§3.2). These approaches were compared to a traditional design. The results of the mobile-first approach (n=2,400) were mixed, with the students using a smartphone (accounting for 14% of the sample) rating the survey as more easy to complete, while desktop users rated the survey significantly lower in terms of its 'professional looks' and complained about the need for scrolling. The results for the responsive web design (n=20,900) were far more positive: for both smartphones (24%) and desktop users, the survey was rated higher on all evaluation items. Sarraf et al. (2015) found that the optimized version of an annual student survey in the US and Canada had significantly better scores in terms of ease of use and visual design. Respondents using the mobile-friendly version were more optimistic about the ease of use, as compared to desktop users. In their survey, Baker-Prewitt and Miller (2013) randomly assigned participants to multiple devices: PC, tablet and smartphone (optimized and traditional). The survey participants were then questioned about their preferred mode for survey completion. The overall scores strongly favored the traditional devices. The results also revealed a tendency towards self-selection or uncertainty avoidance, as the device in-use was more often selected. One out of three smartphone users stated that they would "definitely take another survey on the same device", regardless of whether they were presented with the optimized or non-optimized web survey, while this figure was two out of three for traditional device users.

A number of experimental studies using panelists reported on the respondents' survey evaluations. Under three experimental conditions, Saunders et al. (2012) observed no significant differences between mobile and traditional respondents. Mitchell (2015) reported significantly higher levels of survey satisfaction among mobile device users when presented with a mobile-friendly or mobile optimized version of the survey. However, no details were provided for the majority of the participants in the sample: the traditional respondents.

We found two studies that contained evaluations of new designs in longitudinal, probability-based panels. Arn et al. (2015) tested a new look responsive web design, observing a general improvement in all criteria used (e.g. color, orientation, design and usability). The improvement was greater for smartphone users than for desktop users, and consequently the researchers found that "the old design is liked less by smartphone users than desktop users, but the new design is rated better by smartphone users" (p. 204). For the statements 'it is easy to complete the questions in this layout' and 'people will quickly learn to work with this layout', De Bruijne and Wijnand (2013) observed significantly higher scores among mobile web users using a mobile-first design. The ratings of two other statements, pertaining to the layout's attractiveness and professional look, did not significantly differ for mobile device users. Meanwhile, when presented with the mobile-first design, traditional device users were less optimistic: the scores were significantly lower for all four statements cited above. In terms of survey evaluation and experience, the modest improvements for a small group of mobile respondents (15%) came at the expense of the majority of respondents (85%) using a traditional device. Consequently, the aggregate is negative.

There is little doubt that mobile respondents appreciate active support for mobile devices. In all studies, the updated look and functionalities outperformed the 'traditional' appearance. Responsive design performs relatively well. However, some traditional device users seem to be rather attached to the traditional design of surveys. The aggregate, as a result of an updated design, will depend on the ratio of traditional to mobile respondents.

5. Discussion and conclusions

The unprecedented rise of smartphones and tablets over the past decade presents challenges for longitudinal surveys, as such surveys come with pre-existing procedures, questions, question types, and software. Any redesign done to accommodate the needs of these new mobile respondents is a potential threat to the continuity of a panel's data. In this paper we examined the various approaches to dealing with mixed-device surveys, we assessed the added value for mobile respondents in longitudinal surveys, and we studied the quantitative effects of mobile respondents in mixed-device surveys. Multiple meta-analyses were used in combination with state–of- the-art literature.

We observed a rapid rise of mobile device use in surveys. According to our estimates, one out of every three respondents was a mobile respondent in 2016. Mobile respondents tend to be younger (and may share other characteristics), rendering them part of an interesting, hard-to-reach group in the general population. Nowadays, switching devices in and between waves is common practice. Moreover, the number of panelists that used a mobile device at least once significantly transcends the one out of three ratio cited above.

There are three basic coping strategies for mobile responds in surveys: [1] blocking; [2] identifying and treating; and [3] supporting and integrating. The findings for the first research objective strongly favor the latter option, supporting and integrating, which can be achieved by updating the survey, making it shorter and simpler. Responsive or adaptive design approaches can offer both mobile and traditional device users a positive survey experience. A mobile-first strategy should be avoided.

Various mode effects come into play. In this paper we studied response ratios, break-off rates, item nonresponse, and completion times. For tablet users, the results were generally positive or neutral, with hardly any effects recorded. However, when smartphones were used for survey administration, some negative effects occurred. Smartphone respondents are less inclined to respond, are more inclined to drop-out, have more missing items, and need more time to complete the survey. Most of these effects are significantly mitigated - but not eliminated - when using a mobile- friendly design.

Many of the remaining identified issues pertaining to mobile completion in a more mobile-friendly survey will likely be solved in the near future. The improvement of cellular networks - up to 4G and even 5G - is a crucial step in the right direction. Preloading web-based surveys can also be a solution for faster completion times. Reading and navigation issues could become less relevant, owing to the emergence of larger smartphone screens and improved navigation skills. Moreover, further improvements in resolution, speed, touch screen navigation and software imply a less burdensome experience for survey respondents.

Opmerking

Deze bijdrage aan het CVS is een licht bewerkte versie van het originele artikel dat werd gepresenteerd op het ISCTSC, 24-29 september 2017, Québec, Canada

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