The effect of assigning sample members to their preferred device on nonresponse and measurement in Web surveys

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Abstract

Web surveys are completed on a range of different devices and even if Web surveys encourage sample members to respond with one specific device, some sample members do not follow the instructions and complete the Web survey with a different device. The prevalence of non-conforming respondents indicates that people have a device preference for Web survey participation. Thus, most Web surveys use a responsive questionnaire design that accommodates all devices. Web surveys using a responsive questionnaire design, also called mixed-device Web surveys, give sample members the opportunity to choose the device for participation at their own convenience. The assumption so far is that the opportunity to choose their preferred device for Web survey participation increases response rates compared to Web surveys that encourage one specific device for participation. Mixed-device Web surveys are a unique type of concurrent mixed-mode surveys and findings of previous research revealed that response rates of concurrent mixed-mode surveys were lower than response rates of surveys using a unimode design. These results can be explained by the paradox of choice. The opportunity to choose from a range of modes/devices may increase the complexity and burden of responding. Thus, the choice between modes/devices may dissuades sample members from responding. Accordingly, the allocation to one device may decrease burden of responding further even if Web surveys use a responsive questionnaire design. However, the assumption is that device instructions only help, if sample members are assigned to their preferred device. In particular, this thesis examines if the allocation to the preferred device can decrease nonresponse compared to being assigned to the non-preferred device.

Furthermore, people are expected to prefer devices for Web survey participation that are less burdensome and more motivating. Thus, the task difficulty of answering questions is lower and the respondents' degree of motivation is higher, if sample members respond with their preferred device instead of their non-preferred device. According to the satisficing framework, task difficulty increases the likelihood of satisficing and the degree of motivation decreases the likelihood of satisficing. Thus, respondents who complete the Web survey with their preferred device are less likely to shortcut the question-answer process resulting in higher data quality compared to respondents who answer the Web survey with their non-preferred device. The second aim of this thesis is to determine the effect of responding with the preferred device on measurement.

The findings of this thesis revealed that respondents who were assigned to their preferred device were more likely to respond with the requested device than respondents who were assigned to their non-preferred device. However, being assigned to the preferred device did not affect unit nonresponse rates of sample members. Thus, higher conformance rates of sample members assigned to their preferred device were primary due to the decrease of non-conforming respondents. Findings of the effect of responding with the preferred device on data quality were inconclusive. Seven indicators of data quality (survey breakoff, item nonresponse, response time, survey focus, degree of differentiation, length of answers and primacy effects) were analyzed. Two indicators (survey breakoff and degree of differentiation) revealed that data quality of respondents who completed the Web survey with their preferred device was lower than data quality of respondents who answered the Web survey with their non-preferred device. However, findings on the respondents' survey focus and their response time at question level indicated that data quality of respondents who completed the Web survey with their preferred device was higher than data quality of respondents who answered the Web survey with their non-preferred device. No effects were found for the remaining indicators.

In conclusion, if sample members are assigned to one specific device for Web survey participation the sample members' device preference should be considered, because non-conformance of device instructions can be reduced to a great extent resulting in higher conformance rates. Responding with the preferred device did not affect most indicators of data quality and effects on the remaining indicators of data quality were contradictory. Thus, overall responding with the preferred device should not affect data quality. The effect on conformance rates was stronger than the effect on data quality. Thus, in mixed-device Web surveys, it seems worth considering assigning sample members to their preferred device.

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1 Introduction

Web surveys, in common with surveys in general, are conducted to collect data on attitudes, behaviors and facts of a sample of households or individuals. According to the working group of the German Market Institutes and Social Research Institutes (ADM), Web surveys have rapidly been established as a legitimate methodology amongst the more traditional methods of survey data collection such as face-to-face interviews, telephone interviews, and mail interviews since the beginning of the 21st century (see Figure 1, left) (ADM, 2010, 2017). In 2017, Web surveys were the most often used quantitative research method, accounting for 39 percent of all quantitative survey projects conducted by these German institutes (see Figure 1, right). Telephone surveys made up 29 percent, followed by face-to-face surveys with 27 percent and mail surveys with 5 percent (ADM, 2017).

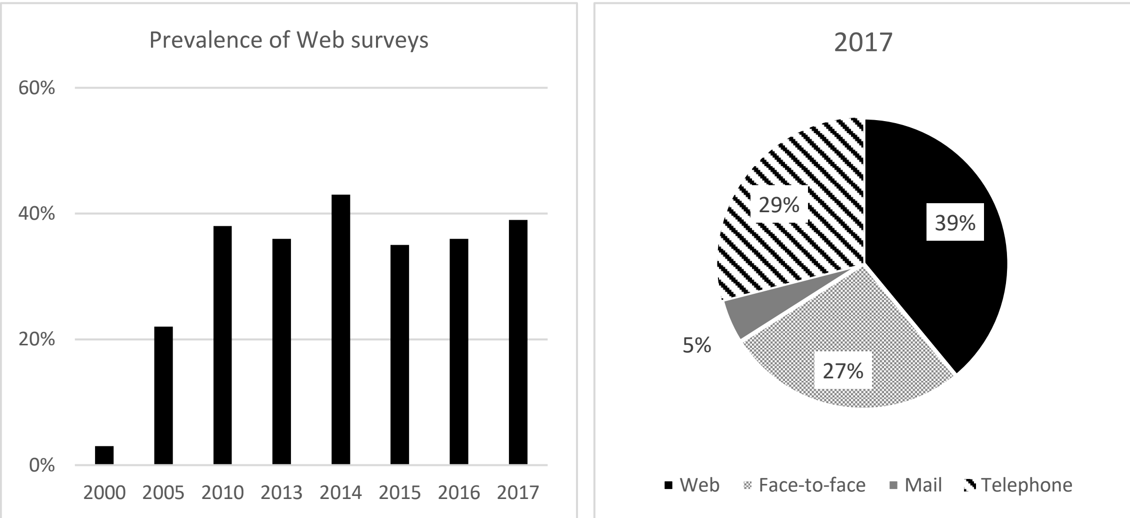

Figure 1: Left: Development of Web surveys since 2000. Right: Quantitative interviews of the ADM institutes by survey mode in 2017

From 2010 to 2017, the percentage of Web surveys among all quantitative surveys conducted by the German Market Institutes and Social Research Institutes stayed stable between 35 percent and 39 percent with a peak in 2014 (43 percent) (ADM, 2017). This stagnation indicates that even though Web surveys have a lot of advantages compared to the more traditional survey methods, they are not appropriate for all research projects. The main advantages of Web surveys are their cost-efficiency and time-efficiency compared to the more traditional survey modes such as mail, telephone and face-to-face surveys (Callegaro, Lozar Manfreda, & Vehovar, 2015; Couper & Bosnjak, 2010;

Toepoel, 2016). In contrast to interviewer-administered surveys, the costs of Web surveys in common with other self-administered surveys are lower because costs for interviewers do not accrue. Moreover, the absence of an interviewer reduces social desirability biases (Chang & Krosnick, 2009; Kreuter, Presser, & Tourangeau, 2008). On the other hand, the lack of interviewer assistance can also increase measurement error because there is no interviewer who can provide additional support if respondents have difficulties understanding and answering the question and who motivates respondents to provide data of high accuracy. Measurement issues of Web surveys will be discussed in greater detail in Chapter 2.4. Compared to mail interviews, the costs of Web surveys are lower because questionnaires do not have to be printed and enveloped. Moreover, fee required mailing is not necessary and costs for data entry are omitted. The use of the Internet allows for the contact of a large number of respondents all over the world within a very short time. In addition, the use of the computer simplifies filtering and branching in the questionnaire. The electronic storage of survey data provides the opportunity to access and analyze survey responses immediately after respondents have completed the survey. Advantages of Web surveys as well as their disadvantages are described in more detail in Chapter 2.

In recent years, the prevalence of the mobile Internet increased rapidly, and mobile broadband subscriptions became affordable for the majority of people. Globally, mobile broadband subscriptions increased from 2013 to 2016 by 25 percentage points, from 27 percent in 2013 to 52 percent in 2016. In 2017, 56 percent of the world’s population are expected to have a mobile broadband subscription (ICT, 2017). In the developed world, the coverage of mobile broadband subscriptions is even higher and increased from 2013 to 2016 by 20 percentage points from 74 percent to 94 percent. In 2017, 97 percent of the population in developed countries are expected to own a mobile broadband subscription (ICT, 2017). In line with this development, more and more people use mobile devices such as tablet computers and smartphones to access the Internet.

This trend also affects Web surveys. The prevalence of respondents using their tablet computer or smartphone for Web survey participation is still on a low level but increasing (tablet computer: 2-10 percent; smartphones: 3-11 percent) (de Bruijne & Wijnant, 2014b; Jue, 2014; Lugtig & Toepoel, 2015; Revilla, Toninelli, Ochoa, & Loewe, 2016; Struminskaya, Weyandt, & Bosnjak, 2015). Smartphones and tablet computers differ from desktop and laptop computers (PCs) according to their data entry input method. Smartphones and tablet computers use touch screen technology, whereas PCs use a computer mouse/touchpad and a keyboard for navigation and data entry. Moreover, smartphones differ from PCs and tablet computers according to their screen size. Thus, tablet computers share some characteristics with PCs (screen size) and other characteristics with smartphones (touch screen technology). Some studies compare small screen devices to large screen devices, whereas other studies compare devices with touch screen technology to devices using a computer mouse and keyboard. Early research on tablet computer and smartphone respondents revealed that data quality of PC respondents is similar to data quality of tablet respondents indicating that the screen size of devices is a major factor influencing data quality of respondents (Guidry, 2012; Lugtig & Toepoel, 2015; Struminskaya et al., 2015)[1]. Thus, especially the use of smartphones in Web surveys with a standard questionnaire design has raised several challenges. The standard questionnaire design of Web surveys is designed for devices with a large screen. This is why smartphone respondents have to zoom in and scroll to read the questions and response options and to select an answer. Therefore, Web surveys using a standard questionnaire design are more burdensome for smartphone respondents than for PC/tablet computer respondents resulting in higher breakoff rates and longer completion times among smartphone respondents than among PC/tablet computer respondents (Couper & Peterson, 2015; Guidry, 2012; Mavletova, 2013; Poggio, Bosnjak, & Weyandt, 2014). Nevertheless, the increasing use of smartphones in Web surveys makes it necessary to optimize Web surveys for smartphone respondents.

The burden for smartphone respondents can be decreased by using a mobile first questionnaire design (Tharp, 2015). Contrary to the standard questionnaire design the mobile first design is optimized for small screen devices. The font size as well as radio buttons and check boxes are bigger. Thus, smartphone respondents can read the questions and response options and select an answer without zooming in. Compared to the standard questionnaire design the mobile first design was rated higher on “easy to complete” by smartphone respondents. On the contrary, PC respondents were not convinced by the mobile first design because it required a lot of scrolling (Tharp, 2015).

To guide respondents to use the appropriate questionnaire design, a push-to-PC-Web method and a push-to-smartphone-Web method has been used. In Web surveys with a standard questionnaire design, respondents are encouraged to use a PC/tablet computer

[1] In this thesis, PC respondents are also combined with tablet computer respondents and are compared to smartphone respondents.

and in Web surveys with a mobile first design, respondents are encouraged to respond with a smartphone. Peterson (2012) used the push-to-PC-Web method. He informed sample members that PCs and tablet computers are the most suitable devices to complete the Web survey. However, even though sample members were encouraged to use their PC or tablet computer, there were still some sample members responding with their smartphone. On the other hand, Millar and Dillman (2012) used the push-to-smartphone-Web method and encouraged sample members to use their smartphones to complete the Web survey. Smartphone participation significantly increased among sample members receiving this message but only to a small extent. Most sample members still used their PC for Web survey participation. Respondents who participate in Web surveys with a device that is not suitable for the questionnaire design are called non-conforming respondents. The phenomenon of non-conforming respondents (especially of non-conforming smartphone respondents) has been observed in several studies (de Bruijne & Wijnant, 2014a, 2014b; Revilla, Toninelli, Ochoa, et al., 2016; Wells, Bailey, & Link, 2013). Non-conforming respondents indicate that people have a strong device preference and are not willing to use a different device for Web survey participation even if they experience difficulties due to the questionnaire design not optimized for their preferred device.

To avoid that the burden of responding differs between devices most Web surveys use a responsive questionnaire design that accommodates size and input mode of the respective device and enables respondents to respond with their preferred device. A disadvantage of responsive questionnaire designs is differences in the questionnaire design between devices, for instance, grid questions on PC or tablet computers are presented in an item-by-item question format on smartphones. These differences in questionnaire design have the potential to induce differential measurement error. However, previous research has shown that differences of the questionnaire design between devices do not induce differential measurement error (Antoun, Couper, & Conrad, 2017; Revilla, Toninelli, & Ochoa, 2016; Sarraf, Brooks, Cole, & Wang, 2015). Thus, a responsive questionnaire design seems to be a good tradeoff for Web surveys.

Web surveys allowing sample members to respond with any device are also called mixed-device Web surveys (de Leeuw & Toepoel, 2018; Toepoel & Lugtig, 2015). Mixed-device surveys offer sample members to choose their preferred device for Web survey participation. However, leaving the choice which device to use to sample members may dissuade them from responding because the choice between multiple devices increases the complexity and burden of responding (Dhar, 1997; Iyengar & Lepper, 2000; Medway & Fulton, 2012; Millar & Dillman, 2011; Schwartz, 2004). Moreover, a decision requires tradeoffs which may make choices to be less attractive than if one option is offered alone (Schwartz, 2004). Mixed-device Web surveys can be compared to concurrent mixed-mode surveys, which offer sample members multiple modes at the same time to participate. Thus, sample members can choose their preferred mode for survey participation. The assumption was that response rates of concurrent mixed-mode surveys are higher than response rates of unimode surveys because more sample members can choose their preferred mode if multiple modes are offered for survey participation than if only one mode is offered. However, findings of previous studies revealed that response rates of concurrent Web/mail mixed-mode surveys were lower than response rates of mail surveys (Medway & Fulton, 2012; Millar & Dillman, 2011). These findings support the assumption that sample members prefer to be assigned to one survey mode rather than having the opportunity to choose from multiple survey modes. All these findings transferred to mixed-device Web surveys suggest that even if a responsive questionnaire design is used, respondents should be assigned to one device rather than offering a choice. Additionally, the prevalence of non-conforming respondents indicating that respondents are not willing to participate in Web surveys with a different device than their preferred device suggests that in mixed-device Web surveys, respondents should be assigned to their preferred device. In the push-to-smartphone-Web method and the push-to-PC-Web method, the device preference of sample members was not considered. Sample members who did not conform instructions may have been sample members who were assigned to respond with a different device than their preferred device. Thus, assigning sample members to their preferred device may increase response rates due to two reasons: (1) the burden of Web survey participation is decreased because sample members do not have to decide which device to use for responding and (2) benefits of responding are increased because sample members are assigned to respond with their preferred device. The first aim of this thesis is to examine the effect of assigning sample members to their preferred device on response rates.

Furthermore, people are expected to prefer devices for Web survey participation that minimize their response burden and at the same time maximize their motivation (Smyth, Olson, & Kasabian, 2014). Thus, Web survey participation is less difficult and more motivating for respondents who complete the Web survey with their preferred device than for respondents who answer the Web survey with their non-preferred device. According to the satisficing framework (see Chapter 5.2.2), task difficulty increases the likelihood to satisfice, whereas motivation decreases the likelihood to satisfice. Satisficing respondents shortcut the question-answer process (see Chapter 5.1) and provide lower data quality. Therefore, respondents who complete the Web survey with their non-preferred device are expected to provide lower data quality than respondents who answer the Web survey with their preferred device. Thus, the second aim of this thesis is to assess the effect of responding with the preferred device on data quality. In particular, this thesis will empirically examine the following research questions:

1. Are response rates of sample members assigned to their preferred device higher than response rates of sample members assigned to their non-preferred device?
2. Is data quality of respondents who complete the Web survey with their preferred device higher than data quality of respondents who answer the Web survey with their non-preferred device?

In Chapter 2, opportunities and challenges of Web surveys are discussed following the structure of the total survey error framework. The accuracy of survey data is affected by various error sources which can be grouped into error sources affecting the accuracy of the target population's representation and error sources affecting measurement of theoretical constructs (Groves et al., 2009). The four primary sources of the total survey error framework are described with a special focus on Web surveys. An overview of the four primary sources of the total error framework that affect the accuracy of survey data is essential to understand the relation between the various error sources. The research questions of this thesis are based on research on mixed-mode surveys, thus, Chapter 3 summarizes the state of research on mixed-mode surveys with a special focus on mode preference of respondents and the effect of allocating sample members to their preferred mode on nonresponse and measurement. Furthermore, Web surveys *per se* are discussed as a special form of mixed-mode surveys and previous research on device preferences of respondents in Web surveys is summarized. So far, no experimental studies have been conducted to determine the effect of being assigned to the preferred device on nonresponse and responding with the preferred device on measurement. However, the prevalence of non-conforming respondents in Web surveys and differences of response rates between mixed-device Web surveys offering a choice of devices for responding and

Web surveys encouraging sample members to participate with one specific device provide some insights into the effect of being assigned to the preferred device on nonresponse. Moreover, findings on data quality of respondents in mixed-device Web surveys allowing sample members to respond with their preferred device are also discussed to gain some further insights on the effect of responding with the preferred device on data quality. In Chapter 4, the different stages of the sample member's decision process in Web surveys are discussed to gain a better understanding *what* decisions sample members have to make when receiving a survey request. Furthermore, a lot of theories have been used to explain and predict participation behavior in surveys in general. Two of these theories underlying the first research question of this thesis, the social exchange theory and the leverage-salience theory, are described in more detail to gain a better understanding *how* respondents decide whether they participate in Web surveys. According to the leverage-salience theory, sample members differentiate with respect to the magnitude and direction of their rating of attributes of the survey request and the sample members' motive of Web survey participation may affect the magnitude of their rating of survey aspects. Therefore, media gratification theories are explained to identify the sample members' motives of Web survey participation. Once respondents have decided to participate in a Web survey, they need to make further decisions on the processing of survey questions. The different stages of the cognitive processing of survey questions and response strategies implemented by respondents to answer survey questions are discussed in Chapter 5. It is important to understand the respondent's processing of survey questions because measurement error is an important component to this study, in addition to nonresponse error. Against the backdrop of the previous chapters, hypotheses of this thesis are outlined in Chapter 6. Two studies were conducted to assess the hypotheses. The study designs and the operationalization of the theoretical constructs were described in Chapter 7. In Chapter 8 findings are presented. Finally, in Chapter 9, the main findings of the present study are summarized and evaluated, followed by limitations and directions for further research.

2 Opportunities and challenges of Web surveys

This chapter provides some further insights into opportunities and challenges of Web surveys and positions the content of this thesis into a broader context of survey methodology. The aim of Web surveys, in common with surveys in general, is to make inferences about the general population or a specific population. However, inferences about populations of interest are susceptible to a variety of errors. The quality of survey estimates is influenced by various errors at the different stages of the survey process and the framework of total survey error outlines all these errors sources. Often researchers use the framework of total survey error to decide which survey mode is the most appropriate one for their research question. In general, researchers usually aim for the survey design with the smallest total survey error that can be conducted given their fixed budget.

Several survey researchers proposed total survey error frameworks (Groves & Lyberg, 2010). Figure 2 is a slight adaptation of the framework of total survey error outlined by Groves et al. (2009). This concept suggests a dichotomous classification of error sources that differentiates between (a) errors which affect the measurement of a theoretical construct of one respondent such as validity, measurement error, and processing error and (b) errors that determine the accuracy of the target population's representation by the weighted net sample such as coverage error, sampling error, and nonresponse error. The error sources are not usually observed separately, because interaction effects between the error sources affecting measurement and representation are likely. Thus, decreasing one error often results in increasing another error (Groves, 1987). For example, Groves and Couper (1998) suggested that decreasing nonresponse rates by persuading reluctant respondents to participate in a survey may increase measurement error, because reluctant respondents are less motivated due to being more prone to satisficing response strategies (see Chapter 5.2). Several previous studies revealed this interaction effect between nonresponse and measurement (Kaminska, Goeminne, & Swyngedouw, 2006; J. M. Miller & Wedeking, 2006; Olsen, Feng, & Witt, 2008; Yan, Tourangeau, & Arens, 2004), whereas other studies did not find such an interaction effect (Hox, de Leeuw, & Chang, 2012; Kaminska, McCutcheon, & Billiet, 2010). This study also assesses the relationship between nonresponse and measurement. However, the focus of this study is not on reluctant respondents. As outlined above, this study examines whether being assigned to the preferred device in mixed-device Web surveys decreases nonresponse error and how measurement is affected by responding with the preferred device. The assumption behind the present nonresponse and measurement analyses is that the same factor affects nonresponse and measurement (common cause model) (Hox et al., 2012; Olsen & Kennedy, 2006).

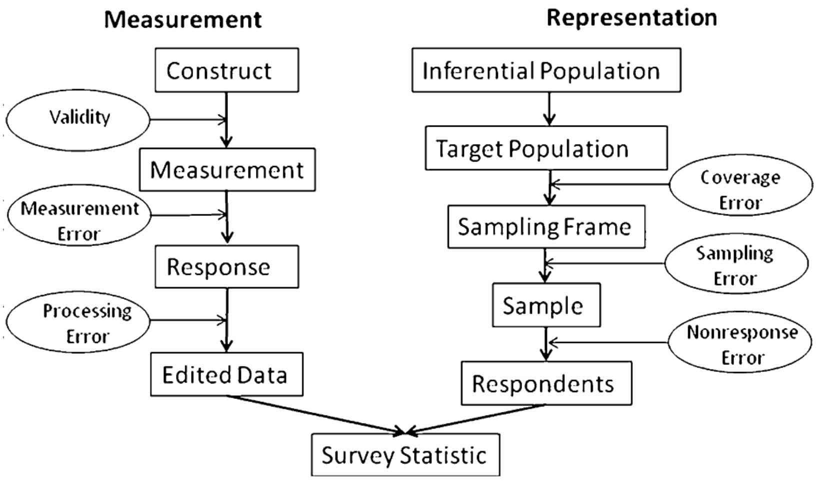

Figure 2: Total survey error components separated into steps of the measurement and representational process (Groves et al., 2009)

The error sources have the potential to induce random and systematic errors. Both types of survey error refer to the deviation between the respondent's true value and the respondent's observed value (Biemer & Lyberg, 2003). Random error increases the variance of survey estimates, whereas means of survey estimates remain unaffected, because negative deviations between observed values and true values are balanced by positive deviations. In contrast, systematic error produces deviations that primarily lead in one direction. Thus, means of survey estimates are biased compared to true means of the population's respective parameter. Accordingly, the level of data accuracy is affected by the variance and bias of survey estimates (Biemer & Lyberg, 2003). Furthermore, systematic overestimation or underestimation of the underlying true value of a theoretical concept can either strengthen or weaken correlations between variables (Alwin, 2010; Groves, 1989).

Both types of survey error are considered by the mean squared error that adds up the sum of all random errors that occur within the different stages of the survey process and the squared sum of all systematic errors. The mean squared error is used to measure the total survey error. High values of the mean squared error indicate that one or more error sources cause systematic and/or random error and minimize the accuracy of survey estimates. However, the mean squared error is rarely calculated, because most often the sample members' true values are not known (Biemer & Lyberg, 2003).

In the remainder of this chapter, the framework of total survey error is used to describe the tradeoffs which survey researchers have to make when conducting Web surveys. The framework of total survey error proposed by Groves et al. (2009) outlines six errors, however, the four primary error sources are coverage, sampling, nonresponse, and measurement (Couper, 2000). These four errors of interest here are discussed in greater detail in the following chapters.

2.1 Coverage error

Coverage error arises due to deviations between the target population and the sampling frame. The sampling frame is defined as a list of the target population including the members' contact details such as telephone numbers or email addresses. It is used to draw a random sample of the target population and it ideally includes all members of the target population once (Biemer, 2010). Thus, all members of the target population have an equal non-zero probability to be selected for the sample. However, the quality of sampling frames often suffers from undercoverage error and overcoverage error. Undercoverage error means that eligible units are missing in sampling frames. By contrast, overcoverage error refers to ineligible units who are included in sampling frames or duplicate eligible units in terms of members of the target population who are listed twice or multiple times in sampling frames.

Among others, one of the main challenges of Web surveys is the undercoverage error (Callegaro et al., 2015). In Web surveys, undercoverage error is mainly caused by members of the target population missing from sampling frames of Web surveys because they do not have access to the Internet. Even though the world's penetration rate of individuals using the Internet increased by 39 percentage points from 8 percent in 2001 to 46 percent in 2016, more than half the world's population (54 percent) is still not using the Internet in 2016 (International Telecommunication Union, 2017a). The percentage of the non-covered population is smaller in America with 36 percent and even much smaller in Germany with 10 percent in 2016 (International Telecommunication Union, 2017a, 2017b).

Today, people use various devices to access the Internet and to participate in Web surveys. Therefore, the percentage of the non-covered population also depends on the Web survey's administration. In Web surveys that do not limit devices for participation, the non-covered population is defined by people who do not have access to the Internet (see above). However, in Web surveys which disallow smartphone participation, the non-covered population is larger, because people with no Internet access and people who only or mostly access the Internet with a smartphone are excluded from Web survey participation. Previous studies have shown that the percentage of people who only use their smartphone to access the Internet is still on a very low level but steadily growing (Metzler & Fuchs, 2017; A. Smith & Page, 2015). In 2015, 5 percent of the European Internet population were smartphone Web only users (Metzler & Fuchs, 2017) and 7 percent of the American population were smartphone-dependent users, people who have limited options to access the Internet and no broadband service at home other than their smartphone's data plan (A. Smith & Page, 2015). Peterson (2012) reported that even 25 percent of the US population were smartphone only or mostly users in 2010. If smartphone Web only and smartphone Web mostly users belong to the target population, Web surveys should allow smartphone participation to minimize the percentage of the otherwise non-covered population.

However, even if the percentage of the non-covered population is on a low level, Web surveys still cannot "replace other data collection modes for probability surveys of the general population" (Callegaro et al., 2015), because coverage error is a function of both the proportion of the non-covered population and the relative difference on socio-demographic variables and other substantive variables between the non-covered population and the covered population (Groves, 1989, p. 85). Thus, even if the percentage of the non-covered population is on a very low level, coverage bias can become substantial due to large differences related to key variables of interest between the Internet population and the remaining population without Internet access. Previous studies in Europe have shown that people with Internet access are more likely male, younger and highly educated (Bethlehem, 2010; Mohorko, de Leeuw, & Hox, 2013). In the United States, studies on socio-demographic characteristics of the Internet population found similar results. People with Internet access are younger, better-educated and more likely non-Hispanic Whites (Antoun, 2015b; Couper, Kapteyn, Schonlau, & Winter, 2007; Tourangeau, Conrad, & Couper, 2013). Furthermore, in Web surveys disallowing smartphone participation, smartphone Web only and smartphone Web mostly users also have the potential to induce coverage error because smartphone Web only/mostly users differ from the remaining Internet population. Findings of previous studies revealed that smartphone Web only users in the European countries were more likely females, younger, less educated, and less likely working as a manager (Metzler & Fuchs, 2017). In America, smartphone mostly/smartphone-dependent users were more likely younger, non-Whites, and less affluent (Antoun, 2015b; A. Smith & Page, 2015). However, findings on the educational level of smartphone mostly/smartphone-dependent users differ. According to Antoun (2015b) people with some college/associates degree are more likely smartphone mostly users than people with less than a high school degree and people with a college graduation. On the other hand, A. Smith and Page (2015) revealed that smartphone-dependent users are more likely less educated. Finally, survey researchers have to consider that these demographic differences between the covered and the non-covered population may imply biased estimates of substantive variables of interest such as health ratings, financial-related measures and voting behaviors (Bethlehem, 2010; Couper, Kapteyn, et al., 2007).

Focusing on coverage error, Web surveys are still an inappropriate mode for target populations with moderate to low Internet penetration rates and inferences based on Web surveys are restricted to people of the target population with Internet access. However, for populations with high Internet penetration rates such as students, members of professional societies and business people Web surveys might be the optimal mode, in case the population with no Internet access does not differ from the Internet population (Callegaro et al., 2015; Couper, 2000; Crawford, Couper, & Lamias, 2001; Dillman & Bowker, 2001; Lozar Manfreda, Vehovar, & Batagelj, 2001).

2.2 Sampling error

The second potential error source which affects the representation of the target population is the sampling method. Most often a sample is drawn from a sampling frame instead of surveying all units of the target population (census) due to costs and logistical infeasibility. Survey researchers can choose between nonrandom sampling methods and random sampling methods. However, while random sampling methods provide the theoretical basis for statistical inferences, nonrandom sampling methods do not even have the aspiration to represent a target population (Biemer & Lyberg, 2003). Therefore, the remainder of this chapter refers to random sampling methods. The fact that only a random sample is surveyed instead of the whole target population induces sampling variance. Thus, sampling variance occurs due to nonobservation. Various samples of the same target population include different members, resulting in estimates that slightly differ from each other and deviate from the population statistic of interest. Sampling variance can be controlled by the sample size (Krotki, 2008). Large samples reduce the number of nonobservations, thus, estimates of various samples of the same target population differentiate less from each other and approach the population statistic of interest. This means that sampling variance decreases and data accuracy increases with the sample size.

The second component of the sampling error is the sampling bias. Sampling bias is caused by imperfect sampling frames due to undercoverage or overcoverage error (see Chapter 2.1) and failures made during the sample selection process. A probability sample can be selected by list sampling or by methods which randomly generate the required contact information. Lists of the target population are often not available or incomplete, thus various methods of random sampling were conducted that have the potential to minimize the total survey error compared to list sampling based on incomplete lists. For example, random route sampling in combination with the last birthday method are often used in face-to-face surveys (Kish, 1965) whereas the random digit dialing method[2] in combination with the last birthday method are often used in telephone surveys, when no appropriate list of the target population is available (Glasser & Metzger, 1972; Lavrakas, 1993; Waksberg, 1978). So far, no random sampling method is available for Web surveys, because email addresses are not standardized. However, if the use of smartphones for Web survey participation increases a random sampling method can be also realized for Web surveys. Smartphone Web surveys may become a common survey mode in the future, if smartphone Web penetration rates will further increase. Survey researchers will have the opportunity to define a random sample for smartphone Web surveys using SMS invitations even if no sampling frame providing smartphone numbers of the target population is available. When conducting a smartphone Web survey, researchers have the opportunity to randomly generate smartphone numbers by using a random digit dialing method (Fuchs & Busse, 2009; Toepoel & Lugtig, 2015). However, most Web surveys are still mixed-device Web surveys rather than smartphone Web surveys, because most

[2] In Germany telephone numbers are not standardized, thus, for telephone surveys an adapted version of the random digit dialing method, the Gabler-Häder design, in combination with the last birthday method are used to draw a random sample, when no appropriate list of the target population is available (Gabler & Häder, 1999).

respondents still use a PC or tablet computer rather than a smartphone to participate in Web surveys and nonresponse rates of smartphone Web surveys might still outweigh sampling advantages of smartphone Web surveys.

Therefore, in Web surveys a list with email addresses has to be available to draw a random sample. Complete lists of email addresses might be available for specific populations with high Internet penetration rates such as students or business people but for most target populations such a list is not available. Alternatively, survey researchers often use a mixed-mode design. They use a probability-based sampling method such as random digit dialing or random route to contact sample members and invite them to a Web survey. This strategy is often used by probability online panels which use telephone or face-to-face interviews to recruit people for an online panel. Some probability-based online panels restrict their members to people with Internet access (GESIS online panel in Germany, Gallup panel in the US) while other probability-based online panels provide Internet enable devices and Internet access to people with no Internet access, thus, panel members represent the general population (LISS panel in the Netherlands, American Life Panel in the US).

However, most online panels use nonprobability-based sampling methods to recruit their members (access, opt-in and volunteer panels). These online panels are made up of volunteers who self-selected to register as panel member. Most of these online panels use Online recruitment methods. The easiest way is to have volunteers sign up directly at the website of the online panel. Furthermore, banner ads that redirect potential volunteers to the website of the online panel are also often used. These banner ads are targeted at frequently visited websites to get the attention of a large group of potential volunteers or on specific websites to recruit specific panel members based on their interest (Callegaro et al., 2015). The online panel of Respondi used for one of the two studies which were conducted to assess the effect of being assigned to the preferred device on nonresponse and the effect of responding with the preferred device on measurement is also a nonprobability online panel. Although, at the first stage the recruitment of online panel members is based on a nonprobability sampling method, at the second stage probability-based sampling methods or quota sampling methods can be used to select panel members for a specific Web survey (Couper, 2000). However, a random sample of online panel members only allows inferences to online panel members whereas quota sampling provides the possibility to create a sample that matches the target population's distribution of at least some variables. Thus, quota sampling allows inferences to the respective target population under the assumption that the sample represents the target population. Quota sampling methods can be realized in non-probability online panels, because basic socio-demographic information are collected within the registration process and are available for all online panel members.

2.3 Nonresponse error

The quality of survey estimates is further influenced by missing data. Thus, even if the sample was drawn by means of probability-based sampling methods from a complete sampling frame, the quality of survey estimates will suffer from nonresponse. Survey researchers differentiate between three types of nonresponse: unit nonresponse, partial nonresponse and item nonresponse (de Leeuw & Hox, 2008). Unit nonresponse occurs early in the response decision process (see Chapter 4.1) and refers to sample members who do not receive the survey invitation or to sample members who receive the survey request but refuse to participate in the survey (Keusch, 2015). By contrast, partial and item nonresponse are response behaviors that occur at a later stage of the response decision process (Bosnjak & Tuten, 2001b; Vehovar, Batagelj, Lozar Manfreda, & Zaletel, 2002). Although sample members have decided to participate in the survey, they only answer parts of the questionnaire and fail to respond to all questions of the questionnaire. Respondents who abandon the survey and thereby refuse to answer all questions after a certain point in the survey are called survey breakoffs (or partial nonrespondents), whereas respondents who complete the questionnaire to the end but skip single questions throughout the questionnaire are defined as item nonrespondents. However, these two types of nonresponse arise mainly from aspects of the questionnaire design and questionnaire administration which correspond to causes of measurement error (see Chapter 2.4).

Increasing unit nonresponse rates are a major threat to all surveys across modes and countries (Curtin, Presser, & Singer, 2005; de Leeuw & de Heer, 2002; Harris-Kojetin & Tucker, 1998; T. W. Smith, 1995; Steeh, 1981). Nevertheless, increasing unit nonresponse rates are particularly challenging for self-administered surveys, such as mail surveys and Web surveys, because sample members are more likely to reject a survey request received by mail or email than a personal survey request by an interviewer (Callegaro et al., 2015). Lozar Manfreda, Bosnjak, Berzelak, Haas, and Vehovar (2008) conducted a meta-analysis on response rates incorporating 45 studies comparing response rates of Web surveys and other survey modes (mostly mail). Results showed that response rates of Web surveys were 11 percentage points lower than response rates of the alternative survey mode. Shih and Fan (2008) also conducted a meta-analysis of response rates and compared Web and mail survey modes. Their findings also revealed that mail surveys have higher response rates than Web surveys. Therefore, among self-administered surveys increasing unit nonresponse rates seem to be especially threatening for Web surveys. C. Cook, Heath, and Thompson (2000) found in their meta-analysis of response rates in Web surveys that the average response rate of Web surveys was 35 percent. However, meta-analyses were based on Web surveys completed on desktop and laptop computers (PCs), whereas Web surveys completed on tablets and smartphones were not considered. According to Tourangeau et al. (2017), unit nonresponse rates of tablet users are similar to unit nonresponse rates of desktop and laptop users, indicating that the use of tablets does not impact unit nonresponse rates of Web surveys any further. However, previous research on unit nonresponse rates of smartphone Web surveys has shown that unit nonresponse rates of smartphone Web surveys are even higher than unit nonresponse rates of PC/tablet computer Web surveys (Antoun et al., 2017; Buskirk & Andrus, 2014; de Bruijne & Wijnant, 2013; Mavletova, 2013; Mavletova & Couper, 2013; Wells et al., 2013). Thus, unit nonresponse rates of Web surveys might even further increase due to an increasing proportion of people who access the Internet with their smartphone.

Even if response rates of Web surveys are on a very low level, they do not necessarily induce bias, or conversely, response rates close to 100 percent do not imply high accuracy of the target population’s representation by the probability sample (Krosnick, 1999). Unit nonresponse bias is defined by the deviation between the means of respondents and unit nonrespondents as well as by the percentage of unit nonrespondents (Biemer & Lyberg, 2003). Thus, the representativeness of survey estimates does not necessarily increase with response rates. The representativeness of survey estimates depends on the degree to which unit nonrespondents systematically differ from respondents with respect to key variables of interest (Bethlehem, Cobben, & Schouten, 2011; de Leeuw, Hox, & Huisman, 2003; Little & Rubin, 2002). If unit nonrespondents are a random group of sample members, higher unit nonresponse rates increase the variance of survey estimates and thereby decrease the reliability of survey estimates but they do not induce bias. However, if the group of unit nonrespondents systematically differs from the group of respondents regarding the variables of interest, survey estimates are biased and the validity of survey estimates decreases. In this case unit nonresponse rates increase the variance of survey estimates and the biasing effect.

Previous studies examined various factors which affect unit nonresponse in Web surveys (Fan & Yan, 2010; Keusch, 2015; Vehovar et al., 2002). The main factors affecting unit nonresponse in Web surveys will be described in the remainder of this chapter. In Web surveys, in common with surveys in general, unit nonresponse rates are influenced by several socio-demographic characteristics of sample members. Previous research has shown that gender is a strong predictor of Web survey participation. Female sample members are more likely to participate in Web surveys than male sample members (Busby & Yoshida, 2015; Dykema, Stevenson, Klein, Kim, & Day, 2013; Stephen R. Porter & Michael E. Whitcomb, 2005). Furthermore, Web survey respondents differ from unit nonrespondents with respect to age, education, and race/ethnicity (Couper, Kapteyn, et al., 2007; Vehovar et al., 2002). In smartphone Web surveys, respondents are younger than unit nonrespondents (Elevelt, Lugtig, & Toepoel, 2018; Mavletova & Couper, 2015a). However, contradictory to traditional Web surveys, previous research on unit nonresponse in smartphone Web surveys has shown that female sample members more likely refuse to participate than male sample members (Antoun, 2015a; Mavletova & Couper, 2015a). Moreover, previous research revealed that in traditional Web surveys as well as in smartphone Web surveys, a positive attitude towards survey participation in general and the respondent’s interest in the survey topic increase the probability of cooperation (Antoun, 2015a; Bosnjak, Metzger, & Gräf, 2010; Bosnjak, Tuten, & Wittmann, 2005; Keusch, 2013; Stephen R Porter & Michael E Whitcomb, 2005).

Besides these typical factors which also predict survey participation in traditional surveys, computer and Internet literacy of sample members are major predictors of Web survey participation. Sample members with a high level of computer and Internet literacy are more likely to participate in Web surveys than sample members with a low level of computer and Internet literacy (Couper, 2000; Dillman & Bowker, 2001; Lozar Manfreda et al., 2008). Accordingly, smartphone use, social media use, and smartphone email use are important factors determining participation in smartphone Web surveys (Antoun, 2015a; de Bruijne & Wijnant, 2014b; Mavletova & Couper, 2014, 2015a). Furthermore, the device type affects unit nonresponse rates. In smartphone Web surveys, previous research revealed that unit nonrespondents owned less advanced phones than respondents (de Bruijne & Wijnant, 2014b). Moreover, in mixed-device Web surveys device type and conditions of the sample member's Internet connection may affect participation (Couper, Antoun, & Mavletova, 2017). Unit nonresponse rates of sample members assigned to respond with a smartphone are higher than unit nonresponse rates of sample members assigned to respond with a PC/tablet computer and the difference remains even if only sample members are invited who are willing to participate with a smartphone and meet the requirements for smartphone participation (Antoun et al., 2017; Buskirk & Andrus, 2014; de Bruijne & Wijnant, 2013; Mavletova, 2013; Mavletova & Couper, 2013; Wells et al., 2013). One assumption is that the effect of device type on unit nonresponse rates may be due to differences of the Internet connection between devices. People who use a smartphone to access the Internet are more likely to use a mobile broadband Internet than people who access the Internet with a PC. Mobile broadband Internet is still slower and less reliable than fixed-broadband Internet which could affect survey participation of sample members. On the other hand, the effect of device type on unit nonresponse may be due to the sample member's device preference. Most people still prefer a PC/tablet computer for Web survey participation over a smartphone (see Chapter 3.2). Assuming, that the likelihood of survey participation is higher if sample members are invited to their preferred device, higher unit nonresponse rates of sample members assigned to respond with a smartphone could be due to the lower percentage of people preferring a smartphone over a PC/tablet computer for Web survey participation. One focus of this thesis is on this latter assumption.

The factors mentioned so far are out of the researcher's control, or can only be influenced indirectly by factors related to the Web survey design. However, among others these factors can be used to compensate for nonresponse. On the one hand, the factors can be included as control variables in multivariate regression analyses accounting for unit nonresponse. On the other hand, the factors can be used for statistical adjustments (weighting or calibration). Present multivariate regression analyses of the effect of responding with the preferred device on data quality account for unit nonresponse by including variables predicting unit nonresponse as control variables.

Aspects of the Web survey design affecting unit nonresponse are the only factors that are within a survey researcher's control. Three design aspects associated with unit nonresponse that are of special interest for traditional Web surveys as well as smartphone Web surveys are discussed in the following. In traditional Web surveys invitations are send by email. Emails are a very cost and time saving way to invite potential respondents to Web surveys and sample members can easily access the Web surveys using the URL included in the email invitation. For smartphone Web surveys, text messages may be a more appropriate invitation mode, because text messages would decrease the likelihood that sample members receive the invitation on a different device than their smartphone preventing that sample members have to switch their device for participation. Findings of previous research confirmed this assumption. Email invitations significantly decreased response rates among smartphone Web respondents compared to text message invitations (de Bruijne & Wijnant, 2014a; Mavletova & Couper, 2014). However, findings of a meta-analysis conducted by Mavletova and Couper (2015b) revealed that email invitations significantly increased response rates of smartphone Web surveys compared to text message invitations. These findings are supported by the assumption that text message invitations are less efficient than email invitations due to the limited length of text messages. A second survey design aspect associated with unit nonresponse that is within a researcher's control is the length of the questionnaire. Galesic and Bosnjak (2009) showed that in traditional Web surveys the stated length of the questionnaire increased unit nonresponse rates. Considering the rise of smartphone respondents, the length of the questionnaire becomes even more crucial because Internet browsers on smartphones are accessed for shorter durations than on PCs (Tossell, Kortum, Rahmati, Shepard, & Zhong, 2012). Previous research has shown that the modularization of a Web survey increased response rates of smartphones respondents but had no effect on response rates of PC/tablet computer respondents (Toepoel & Lugtig, 2018). These findings indicate that the level of acceptability of PC/tablet computer respondents is higher than the level of acceptability of smartphone respondents regarding the questionnaire length of Web surveys. Finally, offering a mixed-mode or a mixed-device survey design can decrease unit nonresponse in Web surveys because respondents who refuse to participate in a Web survey may still participate, if they are offered another survey mode (Groves & Kahn, 1979). Similar in mixed-device Web surveys, respondents who refuse to participate with one device may still participate if they are able to respond with another device(de Bruijne & Wijnant, 2014b; Revilla, Toninelli, Ochoa, et al., 2016). The effect of mixed-mode and mixed-device survey designs on Web survey participation are discussed in greater detail in Chapter 3.

2.4 Measurement error

While coverage, sampling and nonresponse affect the representation of the target population, measurement error is one of three survey errors that affect the measurement of a theoretical construct. Measurement error occurs while respondents answer survey questions. It describes the deviation between the respondent's true value and the observed value relating to a theoretical construct (Biemer & Lyberg, 2003; Groves et al., 2009). Respondents either unintentionally or intentionally report incorrect answers which results in random or systematic measurement error. As outlined above, random measurement error increases the variance of survey estimates but does not affect the mean of survey estimates, whereas systematic measurement error induces biased answers which either overestimate or underestimate the underlying true value of a theoretical construct. In order to assess deviations between the respondents' true values and observed values a rich sampling frame providing the respondents' true values of survey questions is necessary (Kreuter et al., 2008). However, most sampling frames do not provide enough information to determine deviations between the respondents' true values and observed values. Thus, most studies use indirect indicators to examine measurement error such as the degree of differentiation in grid questions, the length of answers in open-ended questions and response order effects (Galesic & Bosnjak, 2009; Kunz, 2013; Lugtig & Toepoel, 2015; Mavletova, 2013; Smyth, Olson, & Kasabian, 2014; Struminskaya et al., 2015; Zhang & Conrad, 2013). Moreover, survey breakoff and item nonresponse are two further errors that occur from the measurement process. All these indicators will be discussed in detail in Chapter 5.2.3.

In Web surveys, in common with self-administered surveys in general, measurement error can arise from respondent-related factors and method-related factors (Viswanathan, 2005). The respondent's ability and motivation are the primary respondent-related sources of measurement error, which are discussed in greater detail in Chapter 5.2.2. Respondent-related sources are not within the survey researcher's control, or can only be influenced indirectly by method-related factors. Thus, in order to minimize measurement error, survey researchers examine method-related factors. In interviewer-administered surveys, interviewers can assist and motivate respondents to understand and interpret the question meaning and to generate an answer (see Chapter 5.1). However, in self-administered surveys interviewer assistance is not available for respondents and all the information presented to respondents is processed visually rather than verbally. Thus, the questionnaire design and administration play a particularly important role in order to minimize measurement error. “[T]he survey instrument must be easy to understand and to complete, must be designed to keep respondents motivated to provide optimal answers, and must serve to reassure respondents regarding the confidentiality of their responses” (Couper, 2000). The length of the questionnaire, the order of questions and response categories, the number of questions on a screen, the question format as well as the verbal and visual design of questions are relevant sources of measurement error (Couper, Traugott, & Lamias, 2001; Krosnick & Presser, 2010; Tourangeau & Rasinski, 1988). Moreover, distraction is another factor that affects measurement error. The devices used for Web survey participation easily allow multitasking and respondents can simply leave the Web survey page and switch to another window or browser tab (de Leeuw, 2005; Sendelbah, Vehovar, Slavec, & Petrovcic, 2016).

Finally, mixed-device Web surveys are completed on various Internet-enabled devices that differ regarding their screen size and data input method. The appearance of the Web survey design differs between devices and has the potential to induce differential measurement error. A lot of research on measurement error has been conducted comparing smartphone, tablet computer and PC respondents as well as different Web survey designs such as standard questionnaire designs, mobile first designs and responsive questionnaire designs.

Especially, the use of smartphones for Web survey participation causes new challenges for survey researchers regarding measurement error. A long time, the standard questionnaire design of Web surveys was exclusively intended for respondents using a desktop or laptop computer. Thus, when respondents first started to use smartphones for Web survey participation, the questionnaire design of Web surveys was not optimized for smartphones because survey researchers had not taken into account the special requirements of smartphone respondents. Findings of Web surveys using a standard questionnaire design indicate that data quality of PC respondents is similar to data quality of tablet respondents, whereas data quality of smartphone respondents seems to be slightly lower than data quality of PC/tablet computer respondents (Guidry, 2012; Lugtig & Toepoel, 2015; Struminskaya et al., 2015). Especially, survey breakoff rates among smartphone respondents were higher than survey breakoff rates among PC/tablet computer respondents. Smartphone respondents differ from PC/tablet computer respondents (see Chapter 3.2). Thus, higher survey breakoff rates of smartphone respondents have the potential to induce differential measurement error, if the characteristics of smartphone respondents that differ from PC/tablet computer respondents affect the variable of interest (Bethlehem et al., 2011; de Leeuw et al., 2003; Little & Rubin, 2002).

Findings on item nonresponse rates of smartphone and PC/tablet computer respondents are inconclusive. Some studies find higher item nonresponse rates for smartphone respondents than for PC/tablet computer respondents (Keusch & Yan, 2016; Lugtig & Toepoel, 2015; Struminskaya et al., 2015), whereas other studies found no differences (Andreadis, 2015; Buskirk & Andrus, 2014; Toepoel & Lugtig, 2014). Item nonresponse is associated with multitasking, sensitive and difficulty questions (Millar & Dillmann, 2012; Sendelbah et al., 2016; Tourangeau & Yan, 2007).

Contrary to expectations, some studies revealed that the likelihood of straightlining was higher for PC respondents than for smartphone respondents (Keusch & Yan, 2016; Lugtig & Toepoel, 2015). Responsive Web survey designs often use an item-by-item format for rating scale items among smartphone respondents and a grid format for PC/tablet computer respondents. The study conducted by Keusch and Yan (2016) used a responsive Web survey design, thus, findings can be explained due to the different question format. However, the study conducted by Lugtig and Toepoel (2015) used a standard questionnaire design, thus, the higher likelihood of straightlining cannot be explained by differences in the question format. However, another Web survey using a standard questionnaire design showed opposite results (Struminskaya et al., 2015). Findings revealed that the likelihood of straightlining was higher among smartphone respondents than among PC/Tablet computer respondents. A lot more research was conducted on grid questions in mixed-device Web surveys (de Bruijne & Wijnant, 2013; Lattery, Park Bartolone, & Saunders, 2013; McClain & Crawford, 2013; Revilla, Toninelli, & Ochoa, 2016) and more research needs to be conducted to optimize the design of grid questions in mixed-device Web surveys in order to keep measurement error for smartphone respondents and for PC/tablet computer respondents on a low level (Couper et al., 2017).

To minimize measurement error of smartphone respondents in Web surveys, survey researchers started to conduct Web surveys with a responsive questionnaire design that accommodates all devices (Peterson, Griffin, LaFrance, & Li, 2017). Previous research has shown that responsive questionnaire designs have the potential to decrease measurement error among smartphone respondents (Baker-Prewitt, 2013; Mavletova & Couper, 2015b; Peterson, Mechling, LaFrance, Swinehart, & Ham, 2013; Toninelli & Revilla, 2016). On the other hand, contrary to the standard questionnaire design, the responsive questionnaire design might induce differential measurement error in Web surveys because the visual design of questions differs slightly for smartphone and PC/tablet computer respondents. However, previous research revealed that even though the questions' visual design differs between smartphone respondents and PC/tablet computer respondents, it did not induce differential measurement error (Antoun et al., 2017; Revilla, Toninelli, & Ochoa, 2016; Sarraf et al., 2015). Thus, a responsive questionnaire design seems to be the best solution for Web surveys in order to keep measurement error at a low level.

One focus of this thesis is on measurement error. Respondent-related factors (see Chapter 5.2.2) are assumed to differentiate between respondents who participate in mixed-device Web surveys with their preferred device and respondents who participate in mixed-device Web surveys with their non-preferred device resulting in measurement error.

3 Mixed-mode and mixed-device surveys

As outlined in Chapter 2, the threat of undercoverage and increasing unit nonresponse rates are major challenges of Web surveys. In order to overcome these challenges, many Web surveys use mixed-mode designs for data collection. Mixed-mode approaches have the potential "to reduce data collection costs, improve coverage of the target population, increase response rates, or reduce measurement error" (Tourangeau, 2017, p. 115). Various classifications of mixed-mode designs are available. Dillman, Smyth, and Christian (2009) use the data collection's objectives to differentiate between four types of mixed-mode surveys, whereas de Leeuw (2005) focuses on the stages of survey projects such as contact phase, response phase and follow-up phase to define seven types of mixed-mode surveys. These classifications include types of mixed-mode surveys that use different modes for data collection as well as types of mixed-mode surveys that use one mode to contact (prenotification or reminder) or recruit respondents and a different mode for data collection. In the remainder of this section, the focus is on mixed-mode surveys that use multiple modes for data collection, especially cross-sectional surveys that use one survey mode for some sample members and another mode of data collection for the remaining sample members to collect the same data.

Survey researchers who conduct such mixed-mode surveys can adapt two different strategies. Multiple modes can be offered to respondents at the same time, thus, respondents can choose which mode they prefer for survey participation. This strategy is called concurrent mixed-mode design. In a second strategy called sequential mixed-mode design, one survey mode is offered first and a different mode of data collection is used for the nonresponse follow-up (de Leeuw, 2005; Dillman et al., 2009; Tourangeau, 2017). A concurrent mixed-mode design is used for the household survey within the German census. Sample members receive an invitation for a paper-based survey which also provides a link for a Web option of the survey. Thus, sample members are able to select the survey mode of their choice to participate in the household survey (Groves & Kahn, 1979). The sequential mixed-mode design is implemented in the European Value Study in Germany and some other countries. Sample members are invited to a Web survey and a paper-based survey is offered to nonrespondents in a follow-up (de Leeuw, 2005). The aims of both strategies are to improve coverage and increase response rates, while at the same time survey costs can be reduced. However, concurrent and sequential mixed-mode surveys also have the potential to induce differential measurement error because respondents may provide different answers to the same question depending on the survey mode in which they participate. Method-related sources such as the presence of an interviewer, the type of communication of information (aural vs. visual) and differences in the question design affect measurement error in concurrent and sequential mixed-mode surveys. Thus, differential measurement error can be minimized if mixed-mode surveys use either only interviewer-administered modes or self-administered modes and design questions in a unimode format (Dillman et al., 2009).

Mixed-device Web surveys *per se* can also be seen as a special form of concurrent mixed-mode design, because they can be completed on several devices that respondents choose at their own convenience (de Leeuw & Toepoel, 2018). PCs, tablet computers and smartphones differ regarding several characteristics such as screen size and input mode. As a result, most mixed-device Web surveys use a responsive questionnaire design that accommodates screen size and input mode of the respective device. However, this also implies that the questionnaire design of Web surveys differentiates slightly between devices. Thus, mixed-device Web surveys have the potential to induce differential measurement error due to divergent question designs. On the other hand, mixed-device Web surveys are expected to increase response rates compared to Web surveys encouraging a specific device for participation, because sample members can choose their preferred device for Web survey participation. Before findings of previous research on the respondent's device preference in mixed-device Web surveys are discussed, findings of previous research on the respondent's mode preference in mixed-mode surveys are evaluated. This is because survey research on answering mixed-device Web surveys with their preferred device is based on survey research on participating in surveys in their preferred mode.

3.1 Mode preference

When survey researchers use a mixed-mode approach for data collection, they are assuming that sample members have a pre-existing mode preference (Groves & Kahn, 1979). In most studies on mode preference, a preferred mode is defined as the mode which respondents select when they are offered multiple modes for survey participation (Dillman et al., 2009; Shih & Fan, 2007). A related definition was used by Olson, Smyth, and Wood (2012) who assumed that respondents have a pre-existing attitude towards survey modes. A pre-existing attitude towards survey modes influences the respondent's choice when they are offered multiple modes for survey participation. However, most mixed-mode surveys offer a limited number of survey modes. Thus, the respondents' choice for one survey mode in a mixed-mode survey does not necessarily identify their overall mode preference. It solely indicates which of the offered modes respondents prefer. However, self-reports of mode preference seem to be affected by the survey mode in which attitudes on mode preference are measured. Several studies used the respondent's mode choice to operationalize mode preference (Dillman, West, & Clark, 1994; Diment & Garrett-Jones, 2007; Shih & Fan, 2007) while other studies used the respondent's attitude towards survey modes (Groves & Kahn, 1979; Millar, O'Neill, & Dillman, 2009; Olson et al., 2012; Tarnai & Paxson, 2004). However, independent of the study's definition of mode preference, no consistent mode preference has been identified.

At first, previous findings on the respondents' mode selection in concurrent mixed-mode surveys are summarized. Results of a meta-analysis on response rates of concurrent Web-mail mixed-mode surveys revealed that response rates of the mail survey mode are 14 percentage points higher than response rates of the Web survey mode (Medway & Fulton, 2012). However, findings of another meta-analysis on response rates of concurrent Web-mail mixed-mode surveys revealed no difference between response rates for the mail survey mode and the Web survey mode (Shih & Fan, 2007). Thus, according to these findings it remains inconclusive whether respondents prefer mail surveys or Web surveys. Furthermore, most of concurrent Web-mail mixed-mode studies sent the survey invitation by postal mail. The invitation letter included the URL and further access information for Web survey participation. Respondents who decided to participate in the Web survey mode had to type in the URL and in some cases required an access code to participate in the Web survey. Thus, Web survey participation might have been more burdensome for respondents than completing the mail survey which could also explain higher response rates of the mail survey mode compared to the Web survey mode in the first meta-analysis on response rates of concurrent Web-mail mixed-design surveys. Findings of a concurrent mixed-mode survey offering respondents a Web, face-to-face and telephone survey revealed that respondents preferred the Web survey over the face-to-face and telephone survey. Response rates of the Web survey mode (44 percent) were higher than of the face-to-face survey mode (31 percent) and the telephone survey mode (25 percent) (Revilla, 2010). Finally, findings of a concurrent face-to-face-Web mixed-design survey and a concurrent telephone-Web mixed-design survey showed that response rates of the Web survey mode were higher (19 percent and 12 percent, respectively) than response rates of the face-to-face survey mode (13 percent) and the telephone survey mode (10 percent). However, both surveys were conducted among a hard-to-survey population (Haan, Ongena, & Aarts, 2014). These studies provide some evidence that based on the respondents' device selection in concurrent mixed-mode surveys respondents seem to prefer self-administered survey modes to interviewer-administered survey modes.

Findings of previous studies that used the respondents' attitude towards survey modes to measure device preference were even more ambiguous (see Table 1). In a face-to-face survey and a telephone survey conducted by Groves and Kahn (1979) respondents were asked whether they prefer the face-to-face survey mode, the telephone survey mode or the mail survey mode to complete survey questions. 78 percent of respondents of the face-to-face survey reported to prefer face-to-face surveys to mail surveys and telephone surveys, whereas in the telephone survey only 23 percent of respondents reported to prefer face-to-face surveys to mail surveys and telephone surveys. In the telephone survey, most respondents preferred telephone surveys (39 percent) whereas in the face-to-face survey, only two percent of respondents reported their preference for the telephone survey mode. Olson et al. (2012) also asked respondents in a telephone survey to report their preferred survey mode and results revealed that most respondents prefer telephone surveys (50 percent) followed by mail surveys (25 percent) and Web surveys (20 percent). Only few respondents reported a preference for face-to-face surveys (2 percent) and 5 percent reported a non-substantive answer. In a Web-mail mixed-mode survey, 87 percent of respondents who completed the mail survey stated a preference for mail surveys whereas only 10 percent of respondents who completed the Web survey reported to prefer mail surveys (Millar et al., 2009). Finally, Tarnai and Paxson (2004) conducted a Web-mail mixed-mode survey with a telephone survey offered to nonrespondents in a follow-up. At the end of the survey, respondents were asked about their preferred survey mode and respondents had a choice between mail surveys, telephone surveys, Web surveys, face-to-face surveys and no preference. 75 percent of respondents who completed the mail survey reported to prefer mail surveys, whereas only 17 percent of respondents who completed the Web survey and 43 percent of respondents who participated in the telephone survey mode reported to prefer mail surveys. Similar were results for the respondent's telephone and Web survey preference. Four percent of respondents who answered the telephone follow-up preferred telephone surveys whereas only two percent of respondents who participated in the mail survey mode preferred telephone surveys. None of the respondents who selected the Web survey mode reported their preference for telephone surveys. However, 77 percent of respondents who selected the Web survey mode reported their preference for Web surveys, whereas less respondents who selected the mail survey mode or the telephone survey mode stated to prefer Web surveys (9 percent and 16 percent, respectively). All these findings further strengthen the assumption that the respondent's attitude towards survey modes is strongly affected by the survey mode used to collect survey data.

Table 1: The reported mode preference by mode of collection of respondents in several studies

		Reported mode preference				
		Face-to-Face	**Telephone**	**Mail**	**Web**	**Others/DK**
Survey mode of participation and reference	**Face-to-Face** (Groves & Kahn, 1979)	**78%**	2%	17%		3%
	Telephone (Groves & Kahn, 1979)	23%	**39%**	28%		10%
	Telephone (Olson et al., 2012)	2%	**50%**	25%	20%	4%
	Mail (Millar et al., 2009)			**87%**	13%	
	Web (Millar et al., 2009)			10%	**90%**	
	Mail (Tarnai & Paxson, 2004)	1%	2%	**75%**	9%	13%
	Web (Tarnai & Paxson, 2004)	0%	0%	17%	**77%**	6%
	Telephone (Tarnai & Paxson, 2004)	**4%**	4%	43%	16%	34%

Furthermore, studies on mode preference examined which characteristics of respondents are associated with mode preference. Findings revealed that gender, age, employment status, educational level, income and marital status have a significant effect on mode preference (Diment & Garrett-Jones, 2007; Millar et al., 2009; Revilla, 2010; Smyth, Olson, & Millar, 2014). Respondents who are male, younger than 65 years, students, highly educated, affluent and separated or living with a partner more likely prefer the Web survey mode over mail survey mode (Diment & Garrett-Jones, 2007; Millar et al., 2009; Smyth, Olson, & Millar, 2014). Respondents who prefer mail surveys to Web surveys are more likely women, elderly respondents (>65 years) as well as respondents who are unemployed/retired, less educated, less affluent and widowed (Diment & Garrett-Jones, 2007; Millar et al., 2009; Smyth, Olson, & Millar, 2014). The respondent's familiarity and comfort with the Internet is also essential to identify respondents who prefer Web surveys over mail surveys (Smyth, Olson, & Millar, 2014). Millar et al. (2009)

determined that Internet use, the need for assistance for Internet use, fear of computer viruses and scam, an available Internet connection at home and the type of Internet connection affect the likelihood that respondents prefer Web surveys to other survey modes. When choosing between a Web survey mode, a telephone survey mode and a face-to-face survey mode, respondents who prefer Web surveys are more likely male and between 20 and 64 years old (Revilla, 2010). Findings of the concurrent mixed-mode survey conducted by Revilla (2010) also revealed that female respondents and respondents who are between 65 and 79 years old are more likely to select the telephone survey mode over the face-to-face mode and the Web mode. The face-to-face survey mode is also more likely selected by female respondents and elderly (>80 years) or very young (16-19 years) respondents as compared to the telephone mode and the Web mode (Revilla, 2010).

3.1.1 Effects on response rates

One of the main objectives of mixed-mode surveys is to increase response rates. Survey researchers assume that offering sample members multiple survey modes may improve response rates because sample members have a preference for one survey mode and if they are not willing to complete a survey in one mode they may be willing to complete the survey in another mode (de Leeuw, 1992; Dillman et al., 2009; Groves & Kahn, 1979; Shih & Fan, 2007).

However, previous findings on response rates of concurrent mixed-mode surveys showed mixed results. Schneider et al. (2005) examined whether response rates of the U.S. Census 2000 could be increased by offering sample members a second mode in addition to the mail survey. In addition to the mail survey, they either offered a telephone option or a Web questionnaire in two distinct experimental groups. The control group was invited to a unimode mail survey. Schneider et al. (2005) found that response rates of the experimental groups were significantly higher than response rates in the control group. However, the increase was relatively small. Offering sample members multiple modes improved response rates only by two percentage points compared to offering respondents just the mail survey. Whether respondents were offered a telephone interview or a Web questionnaire in addition to the mail survey did not show any significant effect. Response rates of the two experimental groups did not differ significantly. Contrary, findings of a sample survey among households of small towns and rural communities conducted by

Smyth, Dillman, Christian, and O'Neill (2010) indicated significantly lower response rates among sample members who were able to choose between a mail survey and a Web questionnaire than among sample members who were initially offered only a mail survey. Millar and Dillman (2011) also showed that response rates of unimode mail surveys outperformed response rates of concurrent Web-mail mixed-mode surveys. These results are further strengthened by a meta-content study which compares response rates of concurrent Web-mail mixed-mode surveys to response rates of mail surveys (Medway & Fulton, 2012). Findings of the meta-analysis also revealed that response rates of sample members who were offered a concurrent Web option in a mail survey were lower than of sample members who were just offered a mail survey. These counterintuitive findings can be explained by Schwarz’s (2004) “paradox of choice”. Every alternative provides advantages and disadvantages to sample members. If sample members have to choose between multiple modes of responding they have to accept tradeoffs which make the choice between multiple modes of responding less appealing than surveys offering sample members just one mode for participation. Moreover, the opportunity to select a mode for survey participation increases complexity and burden of survey participation compared to a unimode design dissuading sample members from responding (Medway & Fulton, 2012; Millar & Dillman, 2011). Sequential mixed-mode surveys seem to be more promising, as Dillman et al. (2009, p. 305) remarked that “assigning respondents to one mode ahead of time based on their preference, if it is known, can be useful.”

Only few experimental studies have been conducted to examine the effect of mode preference on response rates (Gilbert, 2009; Levenstein, 2009; Olson et al., 2012; Smyth, Olson, & Kasabian, 2014). Olson et al. (2012) used a multi-step approach to collect data on the respondent’s mode preference in a first study and to analyze response behavior in a subsequent study. Results indicated that sample members who received their preferred mode more likely participated in the survey than those who received their non-preferred mode. For example, in the Web survey mode of the subsequent study response rates of sample members who reported their preference for Web surveys in the first study were higher (40 percent) than response rates of sample members who stated in the first study that they prefer mail surveys or interviewer-administered surveys (22 percent). Moreover, the respondent’s mode preference continued to predict response rates after accounting for sample compositions, indicating that the effect of the respondent’s mode preference on response rates is not simply due to differences of sample compositions (Olson et al., 2012).

3.1.2 Effects on data quality

Most research on mode preference has determined the effect of mode preference on unit nonresponse and only one study to my knowledge has examined experimentally the effect of device preference on data quality. Smyth, Olson, and Kasabian (2014) examined the effect of device preference on data quality using the same data as Olson et al. (2012) (see above). They assumed that sample members responding in their preferred mode need less energy and cognitive effort to interact with the survey technology (i.e. paper and pencil in mail surveys or computer in Web surveys). Thus, they are able to spend more energy and cognitive effort on the question-answer process resulting in higher data quality (see Chapter 5). In comparison, respondent burden is higher for sample members responding in their non-preferred mode because they need more energy and cognitive effort to interact with the survey technology. To compensate their overall cognitive effort for survey participation, they may spend less energy on answering the questions resulting in lower data quality. Results indicated that data quality of respondents who answered the survey in their non-preferred mode was affected by verbal and visual design features as well as by the question format. In cases where the verbal and visual design features or the question format increased the response burden, sample members responding in their non-preferred mode provided data of lower quality. For example, the size of the answer box of narrative open-ended questions affected item nonresponse rates of respondents who participated in their non-preferred survey mode. Furthermore, results also revealed that the data quality of sample members responding in their preferred mode was not affected by verbal and visual design features or the question format. Obviously, data quality of respondents participating in their preferred mode did not suffer from increased response burden due to aspects of the questionnaire design. These findings indicated that, as expected by Smyth, Olson, and Kasabian (2014), respondents who participated in their preferred mode focused stronger on the question’s content than on its design.

3.2 Device preference

As mentioned above, mixed-device Web surveys allow sample members to respond with the device of their choice. Today, respondents use various devices to complete Web surveys. Most Web surveys do not restrict respondents to use one specific device in order to increase response rates. Furthermore, most Web surveys implement a responsive questionnaire design that accommodates all devices to minimize respondent burden. Therefore, Web surveys *per se* can be seen as a special type of mixed-mode surveys. Based on considerations of the operationalization of mode preference, device preference can either be measured by the respondent's choice for one device when participating in mixed-device Web surveys or by the respondent's attitude towards the respective Internet-enabled device for Web survey participation (Groves & Kahn, 1979; Haan et al., 2014; T. I. Miller, Kobayashi, Caldwell, Thurston, & Collett, 2002; Revilla, 2010).

At first, previous findings on the respondents' device selection in mixed-device Web surveys are summarized. Most respondents of Web surveys still use desktop or laptop computers for survey participation, followed by smartphones and tablets (de Bruijne & Wijnant, 2014b; Lugtig & Toepoel, 2015; Mavletova, 2013; Struminskaya et al., 2015). In December 2014/January 2015, 79 percent of respondents of the GESIS Panel in Germany used a desktop or laptop computer for survey participation, 11 percent of respondents used a smartphone and 10 percent of respondents used a tablet (Struminskaya et al., 2015). Compared to February 2014 the percentage of PC respondents decreased by 5 percentage points, while the percentage of tablet and smartphone respondents increased by 2 and 3 percentage points, respectively (Struminskaya et al., 2015). The trend in the LISS Panel in the Netherlands is similar. In April 2013, 90 percent of respondents of the LISS Panel used a PC, while 8 percent of respondents used a tablet and 2 percent of respondents used a smartphone (Lugtig & Toepoel, 2015). Slightly variations are examined throughout the year but results of September 2013 are the same as results of April 2013 (Lugtig & Toepoel, 2015). However, both the GESIS Panel and LISS Panel are not optimized for smartphones and panel members are used to respond with a PC which explains the relative low percentages of smartphone respondents compared to other Web surveys. Peterson (2012) analyzed the percentage of smartphone respondents in 17 distinct consumer surveys fielded between December 2011 and April 2012 and the percentage of smartphone respondents ranged from 1 percent (high net worth investors) to 30 percent (mobile telecom customers). The Campus Climate Survey Validation Study conducted in 2015 among college students in the U.S. also reported a relatively high percentage of smartphone respondents. "Across all of the schools, 70% of respondents used a desktop or laptop computer, 27% used a smartphone, and 3.2% used a tablet" (Krebs et al., 2016). However, in 2011/2012, a few years earlier, surveys conducted among college students have reported substantial less smartphone respondents (4 to 7 percent) (Guidry, 2012; McClain, Crawford, & Dugan, 2012; Millar & Dillman, 2012).

Finally, previous research has shown that in a mixed-mode Web survey a push-to-smartphone-Web design can increase smartphone participation to 57 percent (Toepoel & Lugtig, 2014). Mobile optimization of the mixed-device Web survey by means of a responsive questionnaire layout was made salient in the invitation and respondents who started the survey with a PC received a second recommendation to use the smartphone. Thus, in the Web survey conducted by Toepoel and Lugtig (2014), the respondent's choice was strongly influenced. In this mixed-device Web survey, the percentage of respondents using a smartphone might not be a valid measure of the respondent's device preference because the smartphone was used by respondents who prefer a smartphone and respondents who prefer a PC but are willing to complete the Web survey on their smartphone. Willingness to choose a stated mode does not measure the respondent's device preference for Web survey participation. Studies on the respondent's willingness to use a smartphone for Web survey participation are not reported here (Antoun, 2015a; Revilla, Couper, & Ochoa, 2018; Revilla, Toninelli, Ochoa, et al., 2016).

However, the share of non-conforming respondents provides further insights into device preference of respondents. Non-conforming respondents are respondents who use a smartphone to complete Web surveys even though Web surveys encouraged them to use a PC (non-conforming smartphone respondents) or respondents who use a PC/tablet computer for Web survey participation even though Web surveys instructed them to use a smartphone (non-conforming PC/tablet computer respondents). Non-conforming smartphone respondents are respondents with a strong preference for smartphones for Web survey participation and non-conforming PC/tablet computer respondents are respondents with a strong preference for PC/tablet computer to complete Web surveys. Previous research has shown, that the share of non-conforming PC/tablet computer respondents is higher than the share of non-conforming smartphone respondents (Antoun, 2015a; de Bruijne & Wijnant, 2013; Mavletova & Couper, 2013), supporting the impression conveyed above that more people prefer a PC/tablet computer for Web survey participation than a smartphone.

Findings of studies that used the respondents' attitude towards Internet-enabled devices to measure their device preference are summarized in Table 2. Revilla, Toninelli, Ochoa, et al. (2016) used the respondent's attitude to measure device preference of members of the Netquest Panel in Spain in July 2013. Respondents were asked to report the device they usually use to participate in Web surveys and which device they would use, if the Netquest Panel would only propose surveys using a responsive questionnaire design. 81 percent of panel members who own a smartphone, tablet, and PC stated that they usually use a PC to complete Web surveys, followed by smartphones (7 percent) and tablets (5 percent). However, if the Netquest Panel would only propose surveys with a responsive questionnaire design in the future, the majority of respondents would use a smartphone (37 percent) followed by PCs (23 percent) and tablets (20 percent). These findings also revealed that a push-to-smartphone-Web design may have the potential to increase smartphone participation. In 2013, in a Web survey conducted among CentERpanel members in the Netherlands, respondents were asked explicitly to report their preferred device for Web survey participation (de Bruijne & Wijnant, 2014b). The majority of respondents stated that they prefer a desktop or laptop computer to complete Web surveys (83 percent) followed by tablets 11 percent and smartphones with only 2 percent. In a Web survey conducted among undergraduate students, the percentage of respondents who stated that they prefer smartphones to complete Web surveys was higher (7 percent) but still on a low level compared to other devices (Millar & Dillman, 2012). However, in line with results on mode preference the attitude of respondents towards Internet enabled devices for Web survey participation seems to be affected by the device which respondents use to answer the question on device preference (Baker-Prewitt, 2013). 72 percent of PC respondents reported that they prefer a PC to complete Web surveys, whereas the percentage of tablet and smartphone respondents who stated a PC preference for Web survey participation was lower (51 percent and 51/52 percent, respectively). Tablets were preferred by 44 percent of tablet respondents whereas only 19 percent of PC respondents and 31/38 percent of smartphone respondents preferred a tablet to complete Web surveys. Finally, 18 percent of smartphone respondents in the mobile optimized Web survey and 10 percent of smartphone respondents in the non-optimized mobile Web survey stated to prefer a smartphone for Web survey participation compared to 8 percent of PC respondents and 4 percent of tablet respondents (Baker-Prewitt, 2013). To conclude, most respondents still use a desktop or laptop computer to complete Web surveys but low proportions of respondents using a smartphone to complete Web surveys will likely continue to rise.

Table 2: The reported device preference by device of collection of respondents in several studies

		Reported device preference		
		PC	**Tablet**	**Smartphone**
Device of participation and reference	**Not defined** (usually) (Revilla et al., 2016)	81%	5%	7%
	Not defined (future) (Revilla et al., 2016)	23%	20%	37%
	Not defined (de Bruijne & Wijnant, 2014b)	83%	11%	2%
	Not defined (Millar & Dillman, 2012)			7%
	PC (Baker-Prewitt, 2013)	**72%**	19%	8%
	Tablet (Baker-Prewitt, 2013)	51%	**44%**	4%
	Smartphone (optimitzed/non-optimized) (Baker-Prewitt, 2013)	51/52%	31/38%	**18/10%**

Respondents who prefer a smartphone for Web survey participation to a desktop or laptop computer identify themselves as pioneers when it comes to adopting new technology (de Bruijne & Wijnant, 2014b). Thus, socio-demographic characteristics of smartphone respondents are probably similar to socio-demographic characteristics of early technology adopters: young, well-educated and within high incomes (Yu, 2006). Previous research on socio-demographic characteristics of respondents who prefer a smartphone for Web survey participation revealed that these respondents were significantly more likely to be young, female, less educated, less affluent, to reside in larger households, Hispanic or African-American (W. A. Cook, 2014; de Bruijne & Wijnant, 2014b; Lugtig, Toepoel, & Amin, 2016; Peterson, 2012; Wells et al., 2013). Thus, respondents who prefer smartphones to complete Web surveys are only similar to early technology adopters regarding their age not regarding their education and income. These findings indicate that respondents who prefer a smartphone for Web survey participation over a PC/tablet computer are not necessarily early technology adopters. Smartphone penetration might already be too prevalent to define smartphone respondents as early technology adopters. Respondents who prefer a tablet to complete Web surveys were also more likely to be young, female and Hispanic or African-American, however, additionally working status and housing composition were also significant predictors (W. A. Cook, 2014; de Bruijne & Wijnant, 2014b; Lugtig et al., 2016). Sample members responding with a tablet were more likely doing paid work (for the reversed effect see Lugtig et al. (2016)) and living in a multi-person household. Contrary, PC respondents were more likely to be older than 55 years, male, less educated, without paid work and living in a single- or two-person household (de Bruijne & Wijnant, 2014b; Revilla, Toninelli, Ochoa, et al., 2016). Besides socio-demographic characteristics previous findings also revealed that sample members who access the Internet primarily with their smartphone are also more likely responding to Web surveys with their smartphone (Wells et al., 2013). Furthermore, Haan, Lugtig, and Toepoel (2017) showed that respondents who find it easy to use modern technology more likely prefer smartphones for Web survey participation.

3.2.1 Effects on response rates

So far, to the best of my knowledge, no experimental studies have been conducted to determine the effect of the respondent's device preference on response rates. However, some studies examined the effect of several questionnaire designs of Web surveys on response rates (Borger & Funke, 2015; Tharp, 2015). In the Web survey conducted by Tharp (2015), respondents were able to select their preferred device for participation. In the first experiment, respondents were randomly assigned to either a standard questionnaire design (optimized for PC/tablet computers) or a mobile first design (optimized for smartphone respondents) independent of their selected device. Findings revealed that response rates of smartphone respondents increased when a mobile first Web survey design was implemented compared to a standard questionnaire design (by 9 percentage points). On the other hand, response rates of PC respondents were lower in Web surveys using a mobile first Web survey design than in Web surveys using a standard questionnaire design (5 percentage points) (Tharp, 2015). Although, results were not significant, findings indicated that Web surveys deterring sample members from responding with their preferred device may suffer from lower response rates than Web surveys encouraging sample members to respond with their preferred device. In the second experiment, respondents were randomly assigned to either a standard questionnaire design or a responsive questionnaire design independent of their device choice (Tharp, 2015). Findings revealed slight differences between the two designs for smartphone respondents regarding survey breakoff, response time and the respondents' evaluation. The responsive questionnaire design improved survey participation for smartphone respondents to a small extent. However, differences were not significant. Findings for PC respondents are inconclusive. On the one hand, the responsive questionnaire design significantly increased survey breakoff and response time. On the other hand, the evaluation of PC respondents of the responsive questionnaire design was higher than the evaluation of PC respondents of the standard questionnaire design (Tharp, 2015). Contrary to findings of the first experiment, findings of the second experiment did not really support the assumption that encouraging sample members to respond with their preferred device (responsive questionnaire design) increased response rates compared to Web surveys encouraging respondents to participate with a PC/tablet computer (standard questionnaire design). Further studies comparing response rates between Web surveys using a responsive questionnaire design and Web surveys with a standard questionnaire design confirmed these findings (Borger & Funke, 2015; McGeeney & Marlar, 2013).

Contrary, results of a study conducted by Stapleton (2013) revealed that breakoff rates of smartphone respondents were significantly higher in Web surveys using a standard questionnaire design than in Web surveys using a responsive or a mobile optimized design. Again, respondents were able to choose their preferred device for participation and findings indicate that Web surveys encouraging participation with the preferred device have the potential to increase response rates compared to Web surveys limiting participation to one specific device. Finally, findings of studies which assigned sample members to respond with either a smartphone or a PC/tablet computer also revealed that due to lower breakoff rates response rates of smartphone respondents were higher in Web surveys optimized for smartphones than in non-optimized Web surveys (Baker-Prewitt, 2013; Mavletova & Couper, 2015b; Peterson et al., 2013). However, these findings refer to sample members who are willing to respond with a smartphone rather than sample members with a smartphone preference.

Finally, the prevalence of non-conforming respondents seems to be a good indicator that offering sample members to respond in Web surveys with their preferred device increases response rates (Antoun, 2015a; de Bruijne & Wijnant, 2014b; Mavletova & Couper, 2013; Millar & Dillman, 2012; Peterson, 2012; Revilla, Toninelli, & Ochoa, 2016). Non-conforming respondents have a very strong device preference. If they are assigned to respond in a Web survey with a different device than their preferred device, they may either ignore the survey researcher's device allocation and participate with their preferred device or refuse to participate at all (Peterson et al., 2017). Thus, percentages of non-conforming respondents in Web surveys provide some evidence for the difference of response rates between sample members who are invited to respond with their preferred device and sample members who are invited to respond with their non-preferred device. As outlined above, the percentage of non-conforming respondents in PC web surveys is lower (4 percent and 1 percent, respectively) than the percentage of non-conforming respondents in smartphone Web surveys (12 percent and 10 percent, respectively), because the percentage of people with a PC/tablet preference for Web survey participation is still higher than the percentage of people with a smartphone preference (Antoun, 2015a; de Bruijne & Wijnant, 2013). However, the difference of response rates between sample members who are invited to respond with their preferred device and sample members who are invited to respond with their non-preferred device might be even larger because it results from non-conformance and unit nonresponse.

3.2.2 Effects on data quality

A lot of studies examined the data quality of smartphone respondents and PC/tablet computer respondents in Web surveys (Tourangeau et al., 2017). Some research has shown that data quality differs between PC/tablet computer and smartphone respondents (Keusch & Yan, 2016; Mavletova, 2013; Revilla & Ochoa, 2016), whereas other research found no difference of data quality between smartphone and PC/tablet computer respondents (Antoun et al., 2017; Buskirk & Andrus, 2014; Wells, Bailey, & Link, 2014). However, most studies that assessed the effect of the device on data quality in Web surveys randomly assigned sample members to respond either with a smartphone or a PC/tablet computer. Thus, findings of these studies do not reveal any insights for the effect of responding with their preferred device on data quality, because respondents were not able to choose their preferred device for participation. Furthermore, studies do not provide any information on the device preference of respondents assigned to respond with a smartphone and respondents assigned to respond with a PC/tablet computer.

Observational studies on differences of data quality between smartphone respondents and PC/tablet computer respondents offer the opportunity to examine differences of data quality between respondents with a smartphone preference and respondents with a PC/tablet computer preference, because in these studies respondents self-selected the device for participation. Findings revealed that data quality was lower among smartphone respondents than among PC respondents, however comparisons of data quality between smartphone respondents and tablet respondents revealed inconclusive (Lugtig & Toepoel, 2015; Struminskaya et al., 2015). While in the GESIS Panel smartphone respondents scored lowest on almost all data quality indicators (item missing rate, length of answers and straightlining) compared to PC/tablet computer respondents (Struminskaya et al., 2015), findings were different for respondents of the LISS Panel. In the LISS Panel, the item missing rate of smartphone respondents was higher than the item missing rate of PC/tablet computer respondents. Moreover, smartphone respondents were more prone to primacy effects than PC/tablet computer respondents. However, the mean length of answers to open-ended questions of smartphone respondents was lower than of PC respondents but slightly higher than of tablet respondents. Regarding straightlining, the data quality of smartphone respondents was higher than of PC respondents but lower than of tablet respondents (Lugtig & Toepoel, 2015). However, most observational studies, similar to both studies mentioned above, use a standard questionnaire design and differences of data quality may result from the higher response burden for smartphone respondents due to the inappropriate Web survey design rather than from their device preference.

In the following chapters various frameworks and existing theories are explained to better understand the respondent's decision process of survey participation (see Chapter 4) and the cognitive processes respondents go through when answering questions (see Chapter 5). Moreover, these frameworks explain why being assigned to the preferred device in Web survey may affect the decision of survey participation and why responding to Web surveys with their preferred device may influence data quality of respondents in Web surveys.

4 Survey participation in Web surveys

As outlined in Chapter 2.3 several factors influence whether sample members participate in Web surveys. The decision whether to participate in Web surveys is based on several decision stages and factors predicting nonresponse can affect each decision stage. Respondents who refuse to participate in Web surveys have various reasons for their decision. However, most theoretical explanations assume that the sample member's decision is based on a cost-benefit equation of aspects of the survey request. This applies also to the social exchange theory and the leverage-salience theory. Moreover, in Web surveys, the decision on acceptance or refusal of a survey request will be further influenced by the sample member's motive of Internet usage. The uses and gratifications paradigm provides insights into the people's motive of Internet usage and at the end of this chapter the paradigm will be applied to the sample member's decision on Web survey participation.

4.1 Stages of the response decision process

Decision stage models describe the decision process from initial contact through submission of a survey. Furse and Stewart (1984) proposed a decision stage model for mail surveys, whereas Green, Tull, and Albaum (2004) developed a decision stage model for telephone surveys. Some stages of the decision process of prospective respondents are similar across modes, thus Albaum and Smith (2012) conducted a more simple model which can be used for all types of surveys. Finally, Keusch (2015) proposed a decision stage model for Web surveys using email invitations which is adapted from the models of Furse and Stewart (1984) and Albaum and Smith (2012). Since the focus of this study is on Web surveys, the decision stage model for Web surveys by Keusch (2015) is described in more detail in the remaining part of this section.

As shown in Figure 3, the model begins with sample members receiving an email invitation of a Web survey. The first decision sample members have to make is whether to delete the email invitation without reading or to open it. Whether prospective respondents delete the email invitation before opening it depends on factors of survey administration such as prenotification messages (Bandilla, Couper, & Kaczmirek, 2012; Keusch, 2012; van Veen, Göritz, & Sattler, 2016) and design elements of the email invitation such as the sender and subject line (Edwards, Dillman, & Smyth, 2014; Mavletova, Deviatko, & Maloshonok, 2014; Sutherland, Amar, & Laughon, 2013). Next, sample members who open the email invitation can decide to delete the email invitation without reading it or to read and evaluate the request. In mail surveys, unconditional prepaid incentives are a substantial factor increasing response rates (Baumgartner & Rathbun, 1997; Church, 1993). Respondents who decide to open the mail invitation are able to recognize a cash prepaid incentive without reading and evaluating the invitation message. Thus, prepaid incentives in mail surveys probably affect the second stage of the decision process and increase the probability that respondents read and evaluate the invitation. In Web surveys, prepaid incentives send by mail also have a positive effect on response rate (van Veen et al., 2016). However, the sample members' addresses are often not available in sampling frames of Web surveys. Previous findings on prepaid incentives send by email such as PayPal credits and Amazon gift codes did not indicate any advantages on the respondents' willingness to participate in Web surveys and the response rate of Web surveys (Bosnjak & Tuten, 2003; Campbell, Marlar, Rodkin, Marken, & Maturo, 2018). Furthermore, prepaid incentives in Web surveys send by mail or email influenced or would have influenced all stages of the decision process rather than just the second decision, because in all experiments the prepaid incentives are sent as prenotifications. Sample members who decide to read and evaluate the email invitation have various alternatives to choose from at the third stage of the decision model. They can still delete the email invitation, postpone the decision whether to participate in the survey or start the Web survey. At this decision stage design elements of the invitation message such as sponsor, topic, duration, position and design of the URL link, incentives, confidentiality messages and the signature play an important role. Furthermore, the questionnaire design of some Web surveys requires that respondents use a specific device to complete the Web survey and in other Web surveys researchers assign respondents to use a smartphone, a tablet or a desktop computer. In both cases, respondents who opened and evaluated the email invitation on another device than the one they are asked to use for survey participation have to decide to switch the device and conform the survey researcher's requirements on device usage or to start the Web survey with the device already in use. Sample members who postponed their decision might be motivated to start the Web survey by means of a reminder message. Finally, sample members who started the survey may either complete the survey or abandon the survey before completion. Whether respondents complete the Web survey depends on various design aspects of the

Web survey (see Chapter 2.4) and factors fostering satisficing (see Chapter 5.2.2). Furthermore, respondents who completed the Web survey using a device which is not appropriate for Web survey participation in the survey researcher's view are defined as non-conforming respondents.

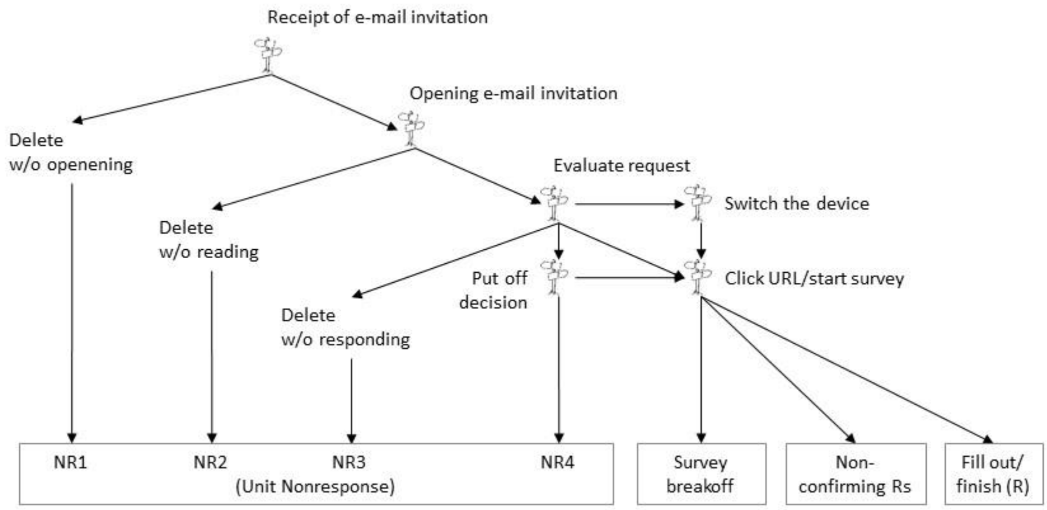

Figure 3: Response decision process in Web surveys using email invitations (adapted from Keusch (2015))

4.2 Theories examining participation decision

While decision stage models illustrate the process of the sample member's response decision, they do not evaluate the decision process by itself. However, various theoretical frameworks are proposed to explain the survey response decision. The four most appropriate frameworks explaining survey participation are the self-perception theory, the theory of cognitive dissonance, the concept of commitment/involvement and the social exchange theory (Albaum & Smith, 2012). According to the theory of self-perception people who perceive themselves as helpful and responsible, individuals participate in surveys to keep their behavior consistent with their favorable self-perception (Albaum & Smith, 2012; Keusch, 2015). Contrary, the cognitive dissonance theory asserts that people who refuse to participate in surveys experience unpleasant feelings which can only be minimized by participating in surveys (Albaum & Smith, 2012; Keusch, 2015). The concept of commitment/involvement implies that respondents are more likely to complete surveys when they perceive the topic, sponsor or researcher/research organization as relevant. The degree of involvement determines the person's level of commitment to survey participation (Albaum & Smith, 2012; Keusch, 2015). At last, the social exchange theory argues that a person's probability to participate in surveys increases when he/she is confident that the perceived rewards of completing the survey outweigh the perceived costs (see Chapter 4.2.1). Furthermore, the leverage-salience theory (see Chapter 4.2.2) as well as compliance principles such as reciprocation, consistency, social validation, authority, scarcity, liking (Groves, Cialdini, & Couper, 1992) are also often used to explain survey participation.

However, in the following only the social exchange theory and the leverage-salience theory are described and discussed in more detail because these two frameworks have the potential to explain why offering a person's preferred device in Web surveys will increase response rates.

4.2.1 Social exchange theory

Among others, the social exchange theory is based on the work of Thibaut and Kelley (1959) who assume that the outcome of every social interaction is based on cost-benefit analysis. "By rewards, [they] refer to the pleasures, satisfactions, and gratifications the person enjoys. …By costs, [they] refer to any factors that operate to inhibit or deter the performance of a sequence of behavior" (Thibaut & Kelley, 1959, p. 12). People assess the value of participating in a social exchange by comparing received rewards and accrued costs. If rewards of a social exchange outweigh its costs, people will decide to participate in this social exchange.

The social exchange theory was first applied to survey methodology by Dillman (1978). His Total Design Method is based on the social exchange theory extended by the construct of trust. Applying the social exchange theory to survey research, sample members are more likely to complete surveys when they expect that the perceived rewards of responding are greater than the expected costs and when they trust in the adherence of rewards and are confident that no further costs will occur once they have started the survey. Thus, when designing a survey, researchers should aim at increasing perceived rewards, minimizing expected costs and building up trust that the promised rewards will be fulfilled and no further costs will occur (Dillman et al., 2009). Rewards respondents enjoy when participating in surveys are tangible rewards such as incentives and intangible rewards such as supporting research, social acknowledgement and engagement with an interesting topic. Rewards of responding consider features of, among others, the self-perception theory, the theory of cognitive dissonance and the involvement/commitment concept, thus, the social exchange theory subsumes other theories to some extent (Helgeson, Voss, & Terpening, 2002). Costs determine the degree of burden perceived by respondents when participating in surveys. Web surveys can be burdensome for respondents due to people's shortage of time, the attractiveness of alternate activities, comprehension problems, and due to intangible costs such as their uncertainty about unfamiliar situations and their fear of loss of anonymity (Keusch, 2015). To reduce costs questionnaires should be kept short and accessing, the Web survey should be made easy for respondents. At last, a recognized sponsor, prepaid incentives and confidentiality messages may help to build up trust (Dillman et al., 2009).

Analyses on the effectiveness of incentives on response rates are often based on the social exchange theory. Interestingly, previous research indicated that small unconditional prepaid incentives have the potential to increase response rates of mail surveys whereas conditional incentives showed only small effects or even no effect on response rates in mail surveys (Church, 1993). As mentioned above, similar results of unconditional and conditional incentives send by mail were found for Web surveys (van Veen et al., 2016) whereas prepaid and postpaid incentives send by email (PayPal credits, Amazon gift codes) had the same or even no effect on response rates (Bosnjak & Tuten, 2003; Campbell et al., 2018). According to Dillman et al. (2009) findings of the effect of incentives on response rates in mail surveys support the social exchange theory because small unconditional prepaid incentives convey the impression that receiving the prepaid incentive is the first action of a social exchange whereas larger conditional postpaid incentives are not considered as rewards of a social exchange. They convey the impression of an economic exchange in terms of: "If you complete this questionnaire, I will pay you for it." (Dillman et al., 2009, p. 241). In the former situation sample members perceive the incentive as favor and due to the social norm of reciprocity sample members may decide to participate in the survey. Contrary, in the latter situation sample members may check whether the amount of the incentive is adequate for the effort and time they would need to spend to complete the survey and conclude that survey participation is not worth the incentive. Several problems occur, if survey participation is considered as economic exchange. Resources of researchers are often limited; thus, they cannot afford to offer respondents incentives in the amount that would correspond to the respondent's effort and time exposure and using money as primary motivation will cause problems such as low-quality data. Therefore, survey researchers agreed on deliberate policies to approach survey participation as social exchange and not to use payments that compensate survey participation. However, the approach of online panels to determine monetary incentives based on the survey duration often contradicts these policies.

4.2.2 Leverage-salience theory

The leverage-salience theory is an extension of the social exchange theory and was proposed by Groves, Singer, and Corning (2000). Whether respondents participate in Web surveys depends on factors of the social environment, the person characteristics and survey design attributes (see Chapter 2.3). Similar to the social exchange theory the leverage-salience theory differs between aspects of the survey request that motivate sample members to participate in Web surveys (rewards) and aspects that deter sample members from participating in Web surveys (costs). However, the leverage-salience theory extends the social-exchange theory by focusing on the assumption that people differentiate regarding the direction of their rating of aspects. For example, sample members with a high interest in sustainable development invited to a survey on renewable energies will probably rate topic interest as a positive aspect whereas sample members with a low interest in sustainable development invited to the same survey will probably rate topic interest as a negative aspect. Furthermore, according to the leverage-salience theory people also differentiate in their importance rating of aspects of the survey request. Aspects of a survey request that are very important for one sample member might be of lower importance or even irrelevant for another sample member. Thus, leverage refers to the magnitude and direction of the influence of aspects of the survey request. The last assumption of the leverage-salience theory is that the sample member's decision on survey participation is stronger influenced by aspects that are made salience in the survey request. To summarize, "[t]he achieved influence of a particular feature is a function of how important it is to the potential respondent, whether its influence is positive or negative, and how salient it becomes to the sample person during the presentation of the survey request" (Groves et al., 2000, p. 301).

To visualize the leverage-salience theory Groves et al. (2000) used a scale (see Figure 4). Both sides of the scale provide hooks and each hook represents an attribute which is consider by sample members in their decision process for survey participation.

Attributes which motivate sample members to participate in the survey are positioned on the right-hand side of the fulcrum whereas attributes that deter sample members from participating in surveys are placed on the left hand side. The distance varies depending on the sample member's importance rating of the attributes. Attributes which are placed close to the fulcrum are rated less important by the sample member than attributes which are placed closer to one of the two ends. The size of the weight (diameter of circles) visualizes how salient the attribute was made within the survey request.

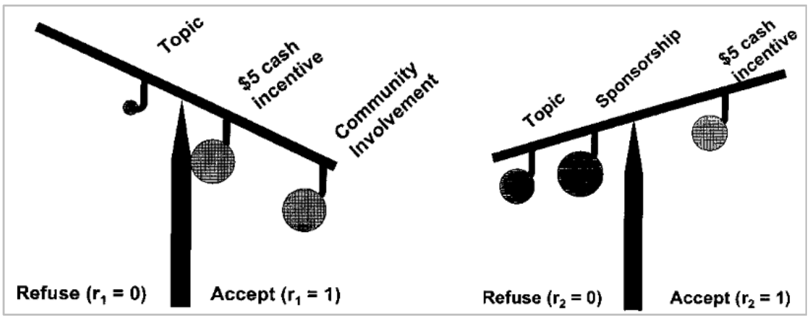

Figure 4: Visualization of the leverage-salience theory: Two persons with different leverages and saliences associated with survey attributes (Groves et al., 2000).

Both sample members visualized in Figure 4 consider the survey topic as negative aspect. However, the topic of the survey is of greater importance for the person on the right-hand side (Person 1) than for the person on the left hand side (Person 2). Furthermore, Person 1 received a survey request that did not draw attention on the survey topic whereas Person 2 received a survey request that made the survey topic salient to a higher extent. Person 1 considers the incentive and community involvement as positive attributes and both attributes were made salient in the survey request to the same extent. Salience of these two attributes is higher than of survey topic. However, the importance rating of community involvement is higher than the importance rating of the incentive, thus, the decision on survey participation of Person 1 is stronger affected by community involvement than by the incentive. Person 1 decides to participate in the survey. Besides survey topic Person 2 also rates sponsorship as negative attribute. Sponsorship is of lower importance for Person 2 than survey topic, however, in the survey request received by Person 2 sponsorship was made salient to a higher extent than survey topic. Thus, in sum both negative rated attributes probably affect the response decision to the same extent. Person 2 rated only the incentive as positive. The importance is moderate and in the survey request received by Person 2, the attention drawn to the incentive was as high as to the topic of the survey. In sum, Person 2 refuses to participate in the survey.

Groves et al. (2000) also provided empirical findings for their theory. In a two-wave survey, they assessed the influence of incentives on response rates among sample members with a high level of community involvement and sample members with a low level of community involvement. Their assumption was that the effect of incentives on response rates is minimized among respondents with a high level of community involvement because respondents motivated primarily by civic duty should assign lower positive leverage to incentives compared to respondents with a low level of community involvement. Findings revealed that incentives increased response rates of sample members with a low level of community involvement but had no effect on response rates of sample members with a high community involvement. Another study providing evidence for the leverage-salience theory was conducted by Baumgartner and Rathbun (1997). Results of their study showed that incentives increased response rates of sample members with a low level of topic interest but did not influence response rates of sample members with a high level of topic interest. These findings indicate that sample members with high topic interest assign lower leverage to incentives than sample members with a low level of topic interest. However, findings of the study conducted by Groves, Presser, and Dipko (2004) revealed no significant evidence for the leverage salience theory.

Implications of the leverage-salience theory are (Groves et al., 2009, p. 199):

- People consider various attributes of survey requests which either motivate people to participate in surveys or deter them from participating. These attributes are not of the survey researcher’s knowledge.
- Survey requests cannot draw attention to all attributes of diverse sample members.
- Survey researchers need to identify important aspects of survey requests acting as motivators to participate in Web surveys and make these attributes salient.

According to the social exchange theory and the leverage salience theory, respondents consider various aspects of surveys requests when deciding whether to participate in the survey. Sample members prefer devices for Web survey participation towards which they have a positive attitude. Thus, sample members assigned to their preferred device in mixed-device Web surveys may rate the device allocation as a positive aspect of the survey request, whereas sample members assigned to their non-preferred device in mixed-device Web surveys may rate the device allocation as a negative aspect of the survey request. Therefore, the likelihood of survey participation seems to be higher among sample members assigned to respond with their preferred device than among sample members assigned to their non-preferred device. However, according to the leverage-salience theory also the magnitude of the importance rating of survey design aspects needs to be considered. Thus, according to the leverage-salience theory the strength of the positive influence of being assigned to the preferred device and the negative influence of being assigned to the non-preferred device on the sample members' survey response decision differentiates between sample members. The strength of the effect of the device allocation on survey participation can be explained by sample members' motives of Internet usage.

4.3 Motives for Internet usage and their association with survey participation

Communication research primary assesses the effects of mass media as well as uses and gratifications of mass communication. Research on the effects of mass media assumes that mass media have the ability to change opinions and attitudes of individuals, whereas research on the uses and gratifications of mass media determines whether social and psychological characteristics of individuals affect their use of mass media (Katz & Foulkes, 1962). The remainder of this chapter will focus on the second approach of communication research that asks the question "What do people do with the media?" (Katz & Foulkes, 1962, p. 378).

Various motives for survey participation in general which are also appropriate for Web survey participation have already been mentioned in Chapter 4.2. However, implementing uses and gratifications for the Internet to Web survey research might provide some further insights for the sample member's decision process on Web survey participation.

4.3.1 The uses and gratifications paradigm

The uses and gratifications approach emerged in the early 1940's when Herzog (1940) determined the recipient's appeals to listen to radio quiz shows. She identified four reasons why people choose to listen to radio quiz shows: competitive, educational, selfrating and sporting. Herzog's approach was adopted by several researchers who examined the recipient's motivation to read newspapers and watch television and investigated the motivation for mass media usage of specific populations such as children and women (Berelson, 1949; Maccoby, 1954; Warner & Henry, 1948; Wolfe & Fiske, 1949). However, the focus of communication research was still on the effects of mass media analyzing the influence of mass media usage on the recipient's opinions and attitudes.

In the early 1960's, the limited effects tradition declined due to "the tradition's narrow conceptual scope and the persistent, glaring contradiction between powerful media effects found in the laboratory and only minimal effects observed outside the lab" (Swanson, 1992, p. 308). The approach of the early studies on motivators of mass media usage profited from the reexamination of the effects tradition and became a reasonable alternative of communication research, especially, due to Katz and Foulkes (1962) who defined the early studies as uses and gratifications approach and contrasted these studies to studies examining effects of mass media usage.

Contrary to the functional theory that assigns a passive role to recipients and assesses stimulus-response effects, the uses and gratifications approach conceives recipients as active and assumes that the recipient's mass media use is goal directed. People use mass media to satisfy various needs. Furthermore, according to the uses and gratifications approach the recipients take the initiative in choosing the optimal media to meet their needs and besides mass media recipients also consider alternative means to satisfy their needs (Katz, Blumler, & Gurevitch, 1973-74). People have various needs and some cannot be compensated by mass media usage. Thus, the uses and gratifications theory focuses on needs which mass media usage can potentially satisfy such as need for information, need for company and need for orientation. Gratifications studies ascertained many different motives of mass media usage, however, according to Swanson (1992) a simple dichotomous classification of motives is sufficient to classify all motives for mass media usage. He differentiates between content and process related motives. People with content related motives have the aim to learn something from media content and to apply what they have learned in practical affairs. They use media messages to gain knowledge or understanding. Whereas people with process related motives enjoy being involved in the process of communication rather than media content.

According to Katz et al. (1973-74), the recipient's motives of mass media usage may be determined by social and environmental circumstances. For example, social and environmental circumstances may evoke awareness of specific problems, thus, recipients use mass media to search for relevant information regarding this problem. However, the origin of the recipient's needs is of no further interest for this study. More important to note is that media gratification can be derived from three sources: media content, exposure to the media and the social context of the media usage (Katz et al., 1973-74). Although research primary refers to media content to explain media gratification, it is obvious that the need for relaxation can be derived from the act of watching television and that the need for doing something worthwhile can be satisfied by the act of reading whereas the need for company can be meet by watching television at home together with other family members or by going to the movies with friends. Thus, whether a medium is appropriate to satisfy a need depends on its characteristic contents, typical attributes and typical use of context. Therefore, media with similar attributes will probably also satisfy similar needs (Katz et al., 1973-74).

The uses and gratifications approach has been applied to a wide range of conventional mass media such as television, radio and newspaper (Palmgreen, Wenner, & Rosengren, 1985) as well as to interpersonal communication (Rubin, Perse, & Barbato, 1988) and, since the beginning of the century, to the Internet (Korgaonkar & Wolin, 1999; Song, Larose, Eastin, & Lin, 2004; T. F. Stafford, Stafford, & Schkade, 2004). The implementation of the uses and gratifications approach to Internet usage will be further discussed in the next chapter.

4.3.2 Uses and gratifications of the Internet

The uses and gratifications approach can also be applied to Internet usage. People use the Internet for many different reasons and gratifications studies on Internet usage have identified various motives. The most complex classifications differentiate between seven motives (Korgaonkar & Wolin, 1999; Song et al., 2004). However, following Swanson's (1992) approach of a dichotomous classification, Song et al. (2004) suggest that the simple dichotomous distinction between content-orientated and process-orientated motives can also be applied to Internet usage. People who access the Internet to simply enjoy random browsing and site navigation seem to be motivated by process gratifications, whereas people who are motivated by content gratifications, access the Internet to find specific information and to gain knowledge from informational content of Web sites, which they can pass on in offline conversations (Song et al., 2004).

Rodgers and Thorson (2000) differ between two types of Internet users, “researchers” and “surfers” and they assume that the researcher’s Internet use is highly goal-directed while the surfer’s Internet use is not goal-directed at all or only to a very low extent. Surfers more likely explore the Internet without any specific goal in mind. They are motivated by the act of browsing the Internet *per se*. Furthermore, Rodgers and Thorson (2000) assume that people who access the Internet for a serious reason (researchers) spend more cognitive effort on informational content than people who access the Internet for a playful reason (surfers). Contrary to researchers, surfers will devote more cognitive effort to other tasks that spontaneously catch the surfer’s attention (e.g. ads). This assumption also indicates that the Internet use of surfers might be more dynamic and unpredictable whereas the Internet use of researchers seems to be relatively stable and homogeneous due to goal directedness.

4.3.3 Insights for Web survey participation

Applying the above described dichotomy of content and process gratifications to Web survey participation provides some further insights into the decision process of sample members whether to participate in Web surveys.

As mentioned in Chapter 4.2.2 the leverage-salience theory proposes that respondents consider various attributes of survey requests when deciding whether to participate in surveys. Furthermore, the theory argues that sample members differentiate with respect to the direction (positive/negative) of their rating of attributes of survey requests and regarding their importance rating (magnitude) of these attributes. Thus, according to the leverage-salience theory mixed-device Web surveys assigning sample members to their preferred device have the potential to increase response rates due to the positive rating of the device allocation. However, the theory would also assume that the allocation to the preferred device only affects response rates of sample members with a low topic interest, because sample members with a high topic interest assign lower leverage on device usage. However, whether the sample member’s importance rating of topic interest is higher than the importance rating of the allocation to the preferred device does not necessarily depend on the level of topic interest. Applying the uses and gratifications approach it rather depends on the sample member’s motive of Web survey participation. Sample members with a content-orientated motivation probably assign higher weights to the topic of the survey than to the allocation to the preferred device, whereas the importance rating of the allocation to the preferred device of sample members with a process-orientated motivation is probably higher than their importance rating of the survey topic, because they are just looking for a task to further enjoy the act of browsing the Internet. Thus, the sample member’s interest in the survey topic affects whether they rate survey topic as positive or negative attribute and the sample member’s device preference affects whether the device allocation is rated as a positive or negative aspect. However, the strength of the effect of being assigned to the preferred device on the sample member’s decision on survey participation depends on the sample member’s motive of Web survey participation. This extension of the survey participation frameworks is necessary to understand the ex post hypothesis of this thesis assuming that the sample composition of respondents who use their preferred device for Web survey participation and respondents using their non-preferred device differs regarding their content and process orientation (see Chapter 6.4).

5 Survey responding in Web surveys

The response decision process does not stop when sample members have decided to start the survey. However, response decisions of respondents which are made after respondents have started the survey rather affect the measurement error than the nonresponse error of surveys. Respondents are expected to provide data of high quality which requires a lot of cognitive effort from respondents. Thus, each question increases the burden of responding. Respondents reevaluate their decision to participate in the survey after each question and if the burden of responding exceeds the cognitive effort respondents are willing to involve for survey participation, they either decide to abandon the survey (Peytchev, 2009) or they find systematic response strategies to again decrease the burden of responding (Krosnick, 1991). These systematic response strategies affect the data quality of respondents and reflect errors of the measurement process. Respondent-related and method-related sources affect the burden of responding. Method-related-sources of measurement error were discussed in Chapter 2.4 and respondent-related sources are discussed in the remaining chapter. Respondent-related sources also explain why respondents using their preferred device for Web survey participation are expected to provide higher data quality than respondents who complete the Web survey with their non-preferred device. However, at first the question-answer process is described to understand the determinants of complete and accurate survey responses and shortcuts of this process are discussed.

5.1 Question-answer process

The question-answer process describes the cognitive stages respondents have to go through when answering questions. There are many different models describing the question-answer process (Cannell, Miller, & Oksenberg, 1981; Groves, 1989; Sudman, Bradburn, & Schwarz, 1996; Tourangeau, Rips, & Rasinski, 2000). Although these models differ in many details they generally agree on the main processes. This section describes the question-answer process proposed by Sudman et al. (1996) (see Figure 5). First, respondents have to comprehend the question meaning before they can recall relevant information from memory. In most cases, retrieved information does not include a previously formulated judgment and respondents have to formulate a judgment *ad hoc* based on the retrieved information. Once respondents have formulated a judgment they need to format their judgment. In open-ended questions respondents can format their response in their own words, however, in close-ended questions they need to format their answer according to the predefined response categories. Lastly, before reporting the answer, respondents may edit it due to reasons of social desirability, threat of disclosure or their tendency towards acquiescent responding. Similar to other models of the question-answer process, this model also suggests that respondents do not go through the different stages sequentially, instead, it is more likely that respondents take loops and go back and forth between the different cognitive stages of the question-answer process (Sudman et al., 1996, p. 77; Tourangeau et al., 2000, p. 15).

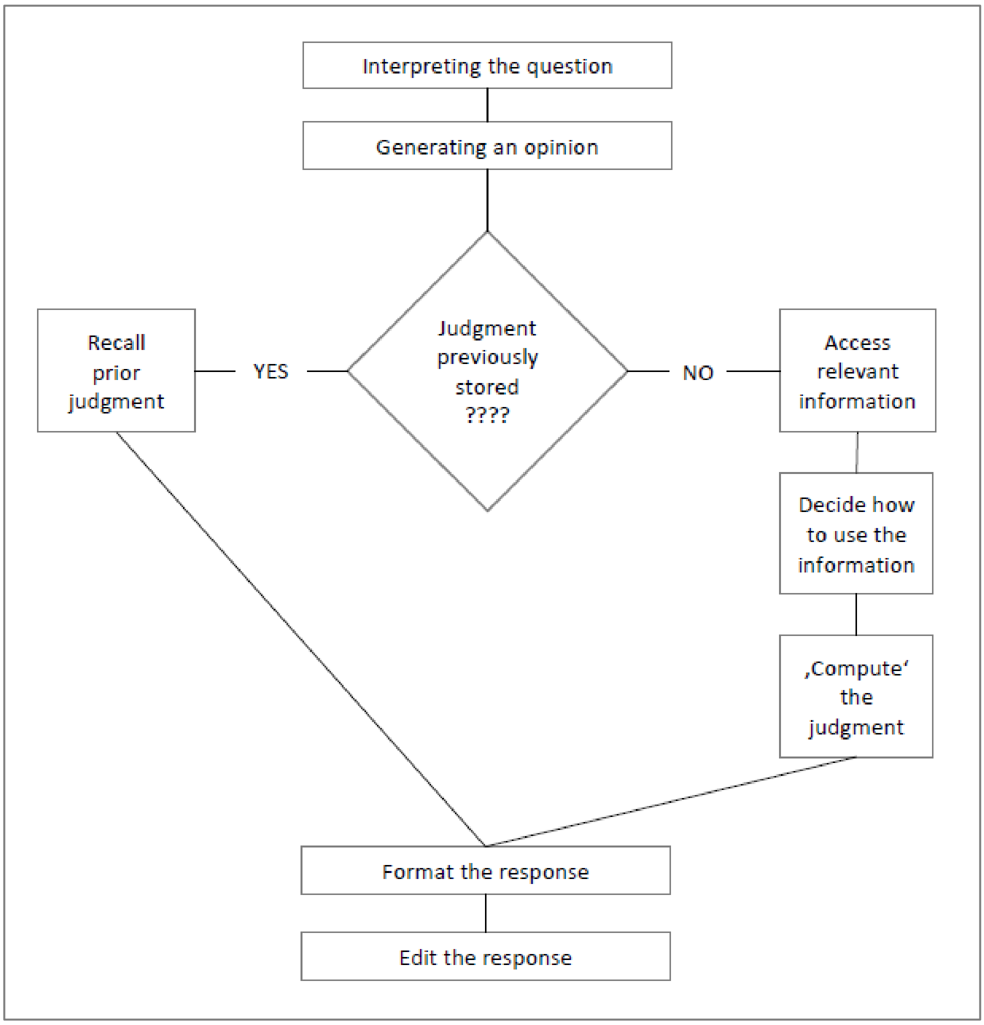

Figure 5: Model of information processing in a survey situation (Sudman et al., 1996)

5.1.1 Question comprehension

At the first stage of the question-answer process, respondents need to understand the survey question and, to increase the quality of responses, it is essential that respondents understand the question's meaning in line with the researcher's intention. Respondents need to understand two components of the question's meaning: the literal and pragmatic meaning (Sudman et al., 1996). While the understanding of the literal meaning can be controlled by careful question wording, the intended pragmatic meaning of a survey question is difficult to communicate. A lot of research has been conducted to study the pragmatic meaning of survey questions and results indicate that respondents assign various meanings to the same survey question (Conrad & Schober, 2000; Fowler, 1992; Suessbrick, Schober, & Conrad, 2000; Tourangeau et al., 2006). Belson (1981) also examined the pragmatic meaning of key terms in survey questions and his findings showed that the respondents' interpretation differs even for very commonly used terms like 'you' and 'weekend'. Thus, avoiding ambiguous, vague and unfamiliar words in survey questions is required to ensure that respondents understand the literal question meaning; however, it does not necessarily improve the understanding of the pragmatic question meaning.

To understand the pragmatic question meaning, respondents often draw on contextual information (Bradburn, 2004; N. Schwarz, 2005; Sudman et al., 1996). This behavior conforms to the framework of conversations, which can be applied to survey interviews. According to Grice (1975) the logic of everyday conversation is based on the cooperativeness principle comprising four maxims. People involved in a conversation are supposed to tell the truth (maxim of quality), provide relevant information (maxim of relation), be adequately informative (maxim of quantity) and make clear contributions (maxim of manner). Thus, respondents assume that survey researchers try to be truthful, relevant, informative and clear and do not ask meaningless questions (Sudman et al., 1996). Respondents also try to comply with the rules of conversations and consider contextual information to understand the pragmatic meaning of a survey question as intended, thus, they are able to provide relevant answers (maxim of relation).

At questionnaire level, respondents consider preceding survey questions to interpret the question meaning of the target survey question (Schuman & Presser, 1981; N. Schwarz & Strack, 1999; Strack, Martin, & Schwarz, 1988; Wänke & Schwarz, 1997). At question level, respondents use verbal information such as definitions and response options to better understand the pragmatic question meaning. For example, studies on the frequency range of response categories in closed-ended questions indicate that respondents use response categories to interpret the pragmatic meaning of survey questions in self-administered surveys (Dillman et al., 2009; Fuchs, 2005; N. Schwarz, Strack, Müller, & Chassein, 1988). For example, N. Schwarz et al. (1988) demonstrated that the range of response categories affects the interpretation of the pragmatic meaning of the key term “irritated”. Respondents assigned to a low frequency scale more likely reported severe instances of irritations, whereas respondents assigned to a high frequency scale more likely referred to minor irritation. These findings indicated that respondents used the response categories to determine the intended meaning of the frequency question on irritating instances.

Furthermore, in Web surveys, similar to self-administered surveys, information are generally presented visually and, in addition to verbal information, respondents can also draw on visual information such as pictures (Couper, Tourangeau, & Conrad, 2007; Couper, Tourangeau, & Kenyon, 2004), numeric and symbolic language (Christian, Dillman, & Smyth, 2007; Fuchs, 2005; N. Schwarz, Knäuper, Hippler, Noelle-Neumann, & Clark, 1991), and graphic paralanguage such as brightness, color, shape and location (Christian & Dillman, 2004).

5.1.2 Generating an opinion

Once respondents have understood the literal meaning and determined the researcher’s intention of the question, respondents need to recall all relevant information from memory. Ideally, respondents will retrieve a previously formed relevant judgment that they can report as an answer. However, most often retrieved information do not include a previously formed relevant judgment and respondents need to compute a judgment *ad hoc* (Sudman et al., 1996). Whether a judgment is stored in memory and accessible depends on different factors. The probability that a previously formed judgment of an attitude object is stored in memory and accessible depends on the respondent’s personal importance of the issue and personal experience with the attitude object (Sudman et al., 1996; Tourangeau et al., 2000). Previously formed judgments of attitude objects with a high degree of experience or importance are more likely stored in memory and accessible than previously formed judgments of attitude objects with a low degree of experience or importance. Judgments of behaviors are more likely stored in memory if behaviors are highly important and seldom, such as getting married. Previous judgments of highly frequent behaviors are only stored in memory if the behavior is highly regular, such as brushing teeth. In this case, respondents can retrieve a rate of that behavior stored in memory. Finally, formed judgments of preceding questions that are related to the target question are also easily accessible (Sudman et al., 1996).

As mentioned above, most often respondents cannot retrieve a previously formed judgment. Thus, they need to compute a judgment *ad hoc*. The quality of the judgment depends on the accuracy of the retrieval process. Ideally, respondents retrieve all relevant information on the question's topic to compute a judgment. However, respondents most often truncate the process of retrieving relevant information, when they have – in their opinion – retrieved enough information to generate a judgment (Tourangeau et al., 2000). Thus, respondents compute judgments on information that are most easily accessible from memory, such as information that respondents have recently retrieved to answer previous questions. Besides the accessibility of information, the accuracy of the retrieval process is further influenced by failures of the retrieval (Bradburn, 2004). Especially in behavior frequency questions, asking respondents to report the number of instances of a behavior within a specific time period, respondents often forget to recall relevant information, or they recall incorrect information due to telescoping effects. Respondents either recall instances that did not take place during the reference period or do not recall instances that actually did take place during the reference period both due to forward or backward telescoping. The former failure of recall results in overreporting of instances and the latter failure results in underreporting of instances (Neter & Waksberg, 1964).

Once respondents have retrieved relevant information on the question's topic, they need to formulate a judgment. The strategy used to formulate a judgment depends on the information retrieved. According to the top-down approach, respondents retrieve more general values to answer an attitude question and, based on these values, they have to formulate a judgment on the attitude issue in question. This top-down strategy can be compared with the estimation strategy in behavior frequency questions. Respondents retrieve a rate or vague quantifier of the behavior of the question and, based on this information, they may estimate a frequency (Tourangeau et al., 2000). The other strategy used by respondents to formulate a judgment is a bottom-up approach. In an attitude question asking for an evaluation of a political party, the respondent's judgment may be based on retrieved information on specific members of the political party or on other facts that deal with this political party. In behavior frequency questions, the button-up approach is known as recall-and-count strategy. Using this strategy respondents recall and count all relevant instances to formulate a judgment on behavior frequency questions (Tourangeau et al., 2000).

According to the principles of everyday conversation, respondents try to provide relevant (maxim of relation) and non-redundant (maxim of quantity) answers (see Chapter 5.1.1). Respondents consider the content of questions but also take account of contextual information of questions within the various stages of the question-answer process to meet these requirements. Respondents use context information to understand and interpret the question meaning (see Chapter 5.1.1), but they also consider contextual information when generating an opinion. At questionnaire level, this means that judgments of previous questions influence judgments of later questions resulting in assimilation effects (N. Schwarz & Bless, 1992) or contrast effects (N. Schwarz, Hippler, Noelle-Neumann, & Münkel, 1989; N. Schwarz, Strack, & Mai, 1991). At question level, verbal and visual information influence the retrieval and judgment process. For example, clarification features in terms of retrieval cues (Metzler, Kunz, & Fuchs, 2015; Tourangeau, Conrad, Couper, & Ye, 2014) and pictures (Couper et al., 2004) have the potential to activate the memory search process and to improve the likelihood of exhaustive retrieval.

5.1.3 Formatting stage

"When formatting the response, information is evaluated and a response is formulated according to the format requested in the question" (Biemer & Lyberg, 2003, p. 141). Two formats of questions are basically used in surveys: open-ended questions and close-ended questions. Although, open-ended questions allow respondents to report their recalled or previously formed judgment in their own words, they have to involve a lot of cognitive effort to answer an open-ended question. Furthermore, it is also very time consuming and cost-intensive for survey researchers to code answers of open-ended questions. Therefore, closed-ended questions are used most often in surveys. Close-ended questions request respondents to format their answer according to the predefined response categories (Sudman et al., 1996). This involves less cognitive effort for respondents than formatting an answer in their own words. However, problems occur if none of the response categories reflects the respondents' judgment. In this case respondents may ideally go back to previous stages of the question-answer process to adapt their question comprehension and/or generate a more adequate judgment that is reflected by one of the response options. Nevertheless, it is more likely that respondents skip that question or choose to report any available answer even if it is not the optimal response option (Sudman et al., 1996). A solution for this problem is hybrid questions providing a response option “other” that allows respondents to report their answer in their own words if response options provided by the survey researcher are not sufficient. However, previous research has shown that respondents did not make use of the response option “other” (Schuman & Presser, 1981). Thus, close-ended question should be used only, if survey researchers are aware of the exhaustive set of response categories.

Response options in close-ended questions can have different formats. They can form a rating scale, some other ordered set or an unordered list. Depending on the format of response options, respondents use different strategies to format their judgments. If an ordered set of response categories is provided, respondents format their judgment based on two principles (Sudman et al., 1996). First, respondents use the endpoints of a rating scale to rate the most extreme items and to anchor the endpoints of a rating scale (range principle). All other items are rated relatively to the two most extreme items. Thus, an item will be rated less extreme, if presented in the context of a more extreme item than if presented in the context of a less extreme item (range effect). The second principle describes the respondent’s strategy to equally use response categories in order to be as informative as possible, if the respondent has to rate a large number of items based on an ordered set of response options (frequency principle). Thus, the rating of an item also depends on the number of items and response categories. If respondents have to use an unordered list of response options to format their judgment, they use a different strategy. Respondents evaluate unordered response options sequentially. However, the respondent’s attention to response options depends on their position and the mode of presentation. If response options are presented visually, respondents draw more attention to the first response options of a list (primacy effect), and, if response options are presented orally, respondents draw more attention to response options at the end of a list, which they have heard last (recency effect) (Fuchs, 2005; Galesic, Tourangeau, Couper, & Conrad, 2008; Knäuper, 1999). In close-ended questions, response categories have a strong effect on the formatting process. However, the effect of response categories is not limited to the formatting stage of the question-answer process. Often response categories affect multiple cognitive processes of the question-answer process rather than one cognitive process exclusively (Fuchs, 2005; N. Schwarz, 1995; N. Schwarz et al., 1988).

In open-ended questions, previous research has shown that the size of the answer box has a strong effect on the formatting stage. Larger answer boxes increase the length of answers and the number of topics mentioned by respondents (Christian & Dillman, 2004; Emde & Fuchs, 2012; Israel, 2010).

5.1.4 Editing stage

The last stage of the question-answer process is the editing stage. Especially when answering sensitive questions, respondents are not always willing to report their true answer and they might edit their response before reporting it (Bradburn, 2004; N. Schwarz, 2005). Respondents edit their answer before reporting it due to different reasons. The first reason is threat of disclosure (Biemer & Lyberg, 2003; Tourangeau & Yan, 2007). Respondents are concerned about consequences of reporting their true answer. They fear that either a third party will overhear or observe their given answers or that their reported answers are not kept anonymous and confidential. Another reason why respondents may edit their answer is social desirability (Sudman et al., 1996; Tourangeau & Bradburn, 2010). Respondents try to avoid reporting socially undesirable behaviors and attitudes. As a result, socially undesirable behaviors and attitudes are underreported and socially desirable behaviors and attitudes are overreported. Using record data Kreuter et al. (2008) were able to show that, in a telephone survey, university graduates underreported socially undesirable behaviors such as receiving unsatisfactory grades and dropping a class and overreported socially desirable behaviors such as receiving academic honors and donating money to University of Maryland. Social desirability has a stronger effect on the question-answer process in interviewer-administered surveys than in self-administered surveys. Thus, self-administered surveys are preferred to interviewer-administered surveys for data collection on sensitive questions (Biemer & Lyberg, 2003). However, if interviewer-administered surveys are used, it is important to increase the social distance between interviewer and respondents to collect accurate data on sensitive questions (Bradburn, 2004). This can be done by implementing a mixed-mode design. In interviewer-administered surveys, at least some of the questions are conducted in a self-administered mode (mail survey, CASI, Audio-CASI) to provide social distance when asking sensitive questions (Groves et al., 2009; Tourangeau & Yan, 2007). Finally, acquiescent behavior affects whether respondents edit their answer (Biemer & Lyberg, 2003). Acquiescent behavior also occurs more often in interviewer-administered surveys than in self-administered surveys (Liu, Conrad, & Lee, 2017). Respondents prone to acquiescent behavior will rather report answers that – in their opinion – correspond with the view of the survey researcher or interviewer than reporting their true answer. To respondents editing their response due to acquiescent behavior, it is essential to use a neutral and balanced question wording (Biemer & Lyberg, 2003).

5.2 Response strategies

Each step of the question-answer process requires a lot of cognitive effort from respondents and survey researchers expect respondents to spend the substantial cognitive effort to ensure high quality data and thereby the accuracy of survey estimates. As mentioned above, the different stages of the question-answer process require respondents to understand and carefully think about the question meaning, recall all relevant information, consider this information when computing a judgment and to format their answer before reporting it (Bradburn, 2004; Sudman et al., 1996; Tourangeau et al., 2000). However, respondents differentiate regarding the degree of cognitive effort they are willing to spend on the various stages of the question-answer process resulting in two response strategies, the optimizing and satisficing response behavior (Krosnick, 1991).

5.2.1 The satisficing framework

Respondents who are willing to spend the substantial cognitive effort required by the various stages of the question-answer process and thoroughly go through each stage when answering questions apply an optimizing response behavior. Only few respondents use the optimizing response strategy when participating in surveys and they often do not maintain this response strategy throughout the questionnaire. It is likely that already after a few questions, the substantial cognitive effort required by the optimizing response behavior becomes increasingly burdensome for respondents. Respondents are likely to become fatigue, disinterested and distracted. As a result, respondents may change from an optimizing to a satisficing response strategy to comply with their decision to participate in the survey, while at the same time reduce their response burden (Petty & Cacioppo, 1986; Simon, 1959).

In general, most respondents try to minimize the cognitive effort required by the question-answer process. Instead of going thoroughly through every step of the question-answer process, some respondents perform the different cognitive processes superficially to minimize their cognitive effort (Cannell et al., 1981; Krosnick & Alwin, 1987; Sudman et al., 1996). These respondents might be less thoughtful about the question meaning, recall just enough information to generate a judgment, they might not consider carefully all recalled information when computing a judgment, or they might select a response option randomly. Although these respondents go through all cognitive processes of the question-answer process, they do so less thoroughly. Accordingly, they are using a weak form of satisficing (Krosnick, Narayan, & Smith, 1996). However, respondents also simplify the question-answer process by omitting the retrieval and judgment process. These respondents may interpret the meaning of the question superficially, but they will not recall any information to compute a judgment. Thus, they select any answer that seems reasonable. Accordingly, this response strategy is defined as strong satisficing (Krosnick et al., 1996).

On a scale of completeness and thoroughness, the optimizing response strategy and the strong satisficing response strategy would anchor the two endpoints (Krosnick, 1990). While optimizing respondents complete all cognitive stages of the question-answer process to provide optimal answers, respondents using a strong satisficing response strategy skip cognitive stages of the question-answer process and are likely to provide only suboptimal answers. Respondents applying a weak satisficing response strategy complete all cognitive stages but less thoroughly. They also provide rather satisfactory responses and are positioned in the middle of the scale. The deviation between the optimal and the suboptimal answer of respondents results in measurement error and decreases data accuracy. Additionally, the deviation has the potential to induce measurement bias if satisficing respondents differ from optimizing respondents.

5.2.2 Factors fostering satisficing response behavior

Whether respondents use the optimizing response strategy and provide high-quality data depends on three factors: the difficulty of the task, the respondent’s ability and the respondent’s motivation (Krosnick, 1991). According to Krosnick (1991), respondents are more likely to use the optimizing response strategy for less difficult tasks. Respondents with a high cognitive sophistication, a lot of practice on thinking about a given topic and an existing attitude as well as highly motivated respondents are more likely to use the optimizing response strategy.

Task difficulty

The degree of task difficulty depends on attributes of the question design and on features of the questionnaire's administration (Krosnick & Presser, 2010). Attributes of the question design can increase the cognitive effort of every stage of the question-answer process which respondents have to involve providing an optimal answer. For example, using ambiguous words in the question stem increases the task difficulty of questions because respondents must involve more cognitive effort to understand and interpret the meaning of the question (Alwin, 1991; Bradburn, 2004; Podsakoff, MacKenzie, Jeong-Yeon, & Podsakoff, 2003). Furthermore, questions asking respondents to report behavior frequencies within a distant reference period or questions asking respondents to rank multiple items require respondents to recall information which are difficult to access or to recall an enormous amount of information (Beatty & Herrmann, 2002; Krosnick, 1991; Peytchev, 2009; Tourangeau, Rasinski, & D'Andrade, 1991). As a result, the difficulty of the retrieval process increases and thereby also the task difficulty of answering the question. However, ranking questions do not only increase the cognitive effort respondents have to involve at the retrieval stage of the question-answer process. They also increase the cognitive effort respondents must involve for the judgment task. Ranking questions require multiple judgments of respondents because they must consider multiple pairwise comparisons before they are able to compute a judgment of the order of items (Alwin & Krosnick, 1985; Thomas, Miller, & Johnson, 2005). Thus, the difficulty of the judgment task increases if the number of constituent decisions increases. Finally, the task difficulty of a question increases if respondents must involve more cognitive effort for the formatting process to provide an optimal answer. Like the comprehension stage, the difficulty of the formatting stage increases if predefined answer categories include ambiguous words (Krosnick, 1991). Furthermore, respondents must also involve more cognitive effort for the formatting stage, if response scales have only the end-points labelled. In this case, the meanings of the mid-scale points are ambiguous and respondents must involve more cognitive effort to conclude their meanings from the labels of the end-points (Krosnick, 1991). To sum up, questions provoke satisficing if they use design attributes that increase at least one of the cognitive processes respondents must go through when answering a question.

Considering the administration of Web surveys, situational context effects that distract respondents from answering survey questions determine the task difficulty of answering survey questions. If respondents are distracted by third parties or engaged in other activities, their attention is drawn from survey questions to other objects. Thus, providing optimal answers to survey questions becomes more difficult and the likelihood of satisficing increases (Sendelbah et al., 2016; Zwarun & Hall, 2014).

As mentioned above, the absolute task difficulty is determined by various aspects of the question design and the survey's administration, however, the respondent's perceived task difficulty depends on two further factors, the respondent's ability and motivation.

Respondent's ability

Three aspects of the respondent's ability influence whether he or she uses a satisficing response strategy. First, respondents with high cognitive sophistication are more capable to retrieve all relevant information and to make judgments. Cognitive sophistication is not equivalent to general intelligence; it rather describes the ability of people to retrieve information from memory and to compute judgments based on this information (Krosnick, 1991). Furthermore, respondents who answer questions on a topic they are highly interested in need to involve less cognitive effort to retrieve relevant information because they have a lot of practice at thinking about this topic and relevant knowledge about this topic stored in memory will be easily accessible (Tourangeau & Bradburn, 2010). At last, the retrieval and judgment process involves only little cognitive effort for respondents who have a previously formed judgment on the issue in question stored in memory. These respondents need less cognitive effort to provide an optimal answer, because they do not have to compute a judgment ad hoc (Sudman et al., 1996). Thus, these respondents are more likely to optimize than respondents who do not have a previously formed judgment on the issue in question stored in memory.

There is no direct measure for the respondent's ability, thus, previous studies have used indirect measures such as age and education to measure the respondent's cognitive ability (Fuchs, 2005; Knäuper, 1999; Krosnick et al., 1996). The assumption is that the cognitive ability of elder people and people with lower educational achievements is limited. Previous studies have shown that response tendencies which indicate a satisficing response behavior such as response order effects and acquiescence occur less often among young respondents and respondents with a high educational achievement (Fuchs, 2005;

Knäuper, 1999; Krosnick et al., 1996). Measuring the respondent's cognitive ability in Web survey, it is important to consider at least a third indicator, the respondent's level of computer and Internet usage. In Web surveys, respondents have to involve cognitive effort to interact with the computer and Internet as well as to answer the survey questions. Thus, respondents with a low level of computer and Internet literacy have to involve a lot of cognitive effort operating the technology resulting in a low level of cognitive ability remaining to answer survey questions. Contrary, respondents with a high level of computer and Internet literacy have to involve less cognitive effort operating the technology, resulting in a higher level of cognitive ability remaining to answer survey questions. Therefore, respondents with a low level of computer and Internet literacy are expected to provide data of lower quality than respondents with a high level of computer and Internet literacy. Findings of previous research confirmed this assumption (Dillman & Bowker, 2001; Dillman, Tortora, & Bowker, 1998).

Respondent's motivation

The last factor determining the likelihood of satisficing is the respondent's motivation. The degree of the respondent's motivation depends on various sources. Topic interest is one of the primary sources (Groves et al., 2004; Holland & Christian, 2009; Keusch, 2013). Respondents with a high level of topic interest are motivated to participate in surveys by contributing their opinion. Thus, they are more likely to provide complete and accurate responses than respondents with a low level of topic interest. Findings of previous studies confirmed that respondents with high interest in the survey topic were less prone to response tendencies indicating satisficing response behavior. In Web surveys, breakoff rates and item nonresponse rates were higher among respondents with a low level of interest in the survey topic than among respondents who were highly interested in the survey topic (Galesic, 2006; Holland & Christian, 2009; Keusch, 2013; Lozar Manfreda, Batagelj, & Vehovar, 2002). Furthermore, respondents who are highly interested in the survey topic report longer answers and a higher number of topics to narrative open-ended questions (Holland & Christian, 2009). Keusch (2013) showed that respondents highly interested in a Web survey's topic were more likely to speed than respondents with a low level of interest in the survey topic. However, contrary to these results (Tourangeau, Groves, Kennedy, & Yan, 2009) found a reversed effect of topic interest on the item missing rate. The item nonresponse rate of respondents with a high level of topic interest was significantly higher than of respondents with a low level of topic interest.

The respondent's motivation further depends on the position of the survey question within the questionnaire. Independent of the respondent's degree of motivation at the beginning of the questionnaire, respondent motivation decreases within the survey progress. Even if respondents are highly motivated at the beginning of a questionnaire, each additional question increases the cognitive effort respondents have to involve in completing the questionnaire. Correspondingly, the respondent's motivation to provide complete and accurate answers decreases while respondent burden increases. As long as the perceived burden does not exceed the respondent's threshold of cognitive effort, they are willing to involve for Web survey participation, respondents rather continue the survey instead of abandoning it. However, to minimize their cognitive effort, they are likely to change from an optimizing to a satisficing response strategy. As a result, response tendencies indicating satisficing such as length of answers to open-ended questions, degree of differentiation in grid questions, and response order effects are more likely in later questions than in questions positioned at the beginning of a questionnaire (Galesic & Bosnjak, 2009).

At third, the respondent's motivation may arise from his or her preference to perform cognitively complex tasks (need for cognition). Need for cognition is not correlated with cognitive sophistication. Thus, independent of the respondent's cognitive sophistication, respondents who enjoy demanding cognitive tasks instead of easy ones are more likely to apply an optimizing response strategy (Krosnick, 1991).

Respondents are expected to prefer devices which are less burdensome and more motivating. Thus, in mixed-device Web surveys respondents who respond with their preferred device are expected to have more cognitive ability available for answering survey questions, because they have to involve less cognitive effort operating the device. Furthermore, they are motivated to a higher degree, thus, the task difficulty of answering survey questions decreases for respondents completing the Web survey with their preferred device resulting in less satisficing and higher data quality among these respondents. Contrary, answering survey questions is more burdensome for respondents who answer the Web survey with their non-preferred device. They have to involve more cognitive effort operating the device, thus, they have less cognitive ability available for answering survey questions. Using their non-preferred device does not increase their motivation, thus, the task difficulty of answering survey questions increases for these respondents resulting in more satisficing response and lower data quality.

5.2.3 Measures of satisficing response behavior

Early research on satisficing identifies three response tendencies that measure satisficing: response order effects, nondifferentiation and "don't know" responses (Krosnick, 1991). According to Krosnick (1991), response order effects are indicators for weak satisficing whereas nondifferentiation and "don't know" responses are indicators for strong satisficing. Meanwhile, studies on satisficing have identified further response tendencies such as item nonresponse, length of answers to narrative open-ended questions, rounding, acquiescent and extreme responding to measure satisficing and data quality (Lugtig & Toepoel, 2015; Mavletova, 2013; Struminskaya et al., 2015). Furthermore, various response behaviors such as survey breakoff, response latency, and multitasking are indirect indicators of satisficing, because these response behaviors are often related to response tendencies that indicate satisficing (Metzler & Fuchs, 2018; Sendelbah et al., 2016; Zhang & Conrad, 2013). The indicators of data quality which are of interest for the present analyses are discussed in the remainder of this chapter[3].

Survey breakoff

Once sample members have decided to participate in Web surveys, a common but undesirable response behavior is survey breakoff. The point of dropout defines the respondent's threshold of cognitive effort he or she is willing to involve in completing the Web survey and according to Galesic (2006) the respondent's increasing preference to abandon the Web survey is associated with an increase in lower data quality. Findings of previous studies revealed that prior to survey breakoff, item nonresponse rates were significantly higher and answers to open-ended questions were significantly shorter (Galesic, 2006; Metzler & Fuchs, 2018; Mittereder, 2018). However, not only questions prior to the point of dropout can suffer from lower data quality. The data quality of questions following the point of dropout may also be affected by survey breakoff. Respondents who decide to abandon Web surveys refuse to answer questions after a certain point of the questionnaire. Missing data can affect data accuracy of these questions, resulting in higher variances of survey estimates. Furthermore, if respondents

[3] For a more exhaustive discussion on various satisficing indicators see Roßmann (2017).

who abandoned the Web survey differ from respondents who completed the Web survey, survey breakoff can also induce differential measurement error (see Chapter 2.4). Thus, survey breakoff has the potential to affect data quality of questions preceding the point of dropout and may even affect data quality of questions following the point dropout. Therefore, survey breakoff is seen as an appropriate respondent behavior which affects data quality.

Item nonresponse

Item nonresponse is an important indicator of data quality (de Leeuw & Hox, 2008). However, survey researchers are discordant whether item nonresponse results from satisficing. On the one hand, various studies listed item nonresponse as indicator of satisficing (Baker et al., 2010; Díaz de Rada & Domínguez-Álvarez, 2014; Jäckle, Roberts, & Lynn, 2006; Lenzner, Kaczmirek, & Lenzner, 2010). On the other hand, Holbrook, Green, and Krosnick (2003) stated that the satisficing theory cannot explain item nonresponse because choosing a response strategy to minimize the cognitive effort of answering questions does imply that respondents provide a response. However, Heerwegh (2005) argues that “in a self-administered questionnaire, as opposed to an interviewer-administered questionnaire, the transition from satisficing to leaving questions blank and eventually terminating the survey cooperation is less gradual” (p. 70f.). Thus, at least in self-administered surveys item nonresponse may be an acceptable indicator of satisficing. Especially, in self-administered surveys not providing “don’t know” options, respondents who would have selected the “don’t know” option for one question might decide to skip that question. Thus, item nonresponse is equivalent to “don’t know” answers and already the primary literature on satisficing has suggested that “don’t know” answers are an indicator of strong satisficing (Krosnick, 1991).

The study conducted by Kaminska et al. (2010) examined whether reluctant respondents provide lower data quality than eager respondents. Reluctant respondents are expected to be less motivated than eager respondents. Thus, the likelihood of satisficing is expected to be higher among reluctant respondents than among eager respondents (Hox et al., 2012; Yan et al., 2004). Findings of the study conducted by Kaminska et al. (2010) revealed that among other indicators of data quality the number of “don’t know” answers was higher among reluctant respondents than among eager respondents.

Response times

Within the context of Web surveys, paradata (in terms of the amount of time respondents spent on answering a survey question) are commonly used to gain deeper insights into the cognitive processing of survey questions. Response times can be considered an indicator of the respondents' cognitive effort expended on processing a survey question and their susceptibility to cognitive shortcutting within the question-answer process (Bassili & Fletcher, 1991; Couper & Kreuter, 2013; Yan & Tourangeau, 2008). Thus, response times are often used as an indirect indicator of satisficing (Callegaro, Yang, Bhola, Dillman, & Chin, 2009; Lynn & Kaminska, 2012; Stieger & Reips, 2010; Zhang & Conrad, 2013). However, the interpretation of response time is difficult. On the one hand, survey researchers assume that short response times indicate that respondents process the cognitive stages of the question-answer process superficially and that response times of optimizing respondents are longer, because it takes more time to thoroughly go through each cognitive stage of the question-answer process (Callegaro, Yang, et al., 2009; Smyth, Dillman, Christian, & Stern, 2006; Toepoel, Das, & van Soest, 2008; Tourangeau et al., 2009). On the other hand, short response time can also indicate that respondents have easily accessible and stable judgments whereas long response times indicate that respondents perceived difficulties in answering the question (Bassili & Fletcher, 1991; Draisma & Dijkstra, 2004; Heerwegh, 2003). Therefore, speeding has increasingly been used as an indicator of satisficing. Speeding refers to answers which are given unreasonable fast, thus, speeding can identify respondents who have arbitrarily selected a response alternative without reading the question (Greszki, Meyer, & Schoen, 2014; Zhang & Conrad, 2013). Previous research has shown that speeding was associated with primacy effects, straightlining, less elaborated answers to narrative open-ended questions, the amount of "don't know" answers and non-substantive answers (Greszki et al., 2014; Malhotra, 2008; Rao, Wells, & Luo, 2014; Revilla & Ochoa, 2015; Zhang & Conrad, 2013).

Survey focus

Respondent multitasking occurs when respondents engage in other activities while responding Web surveys (Sendelbah et al., 2016). Many survey researchers have expressed their concern that respondents who are engaged in other activities while answering survey questions provide data of lower quality than respondents who concentrate solely on answering the survey questions (Sendelbah et al., 2016; Zwarun &

Hall, 2014). This concern is based on the satisficing theory indicating that respondents more likely apply a satisficing response strategy for difficult tasks than for more easy tasks (Krosnick, 1991). Being engaged in multiple activities increases the degree of difficulty of answering survey questions and satisficing is more likely. However, the few studies which examined the effect of respondent multitasking on data quality revealed that multitasking has no or even a positive effect on data quality (Kennedy, 2010; Roßmann, 2017; Sendelbah et al., 2016).

Degree of differentiation in grid questions

The second indicator of data quality used in present analyses is the degree of differentiation in grid questions. Grid questions provide a lot of information to respondents. In tabular form, they present several statements listed in rows and rating scale options listed in columns. This presentation of rating scale items is a space-saving arrangement standardizing the context of rating scale items. However, at the same time, it provides a lot of information at once increasing the task difficulty (Dillman et al., 2009). Thus, respondents need to be highly motivated and need to provide a high level of cognitive sophistication to provide optimal responses to each item of a grid question. However, the motivation and cognitive sophistication of most respondents is not sufficient for the task difficulty of grid questions and to reduce the cognitive effort which respondents have to involve answering grid questions, they often apply a satisficing response strategy that is less taxing (Christian, Parsons, & Dillman, 2009; He, Bartram, Inceoglu, & van de Vijver, 2014; Krosnick, 1991; Paulhus, 1991). Among others, the degree of differentiation can give some indication whether respondents use a satisficing or optimizing response strategy (Anand et al., 2005; Yan, 2008; Zhang & Conrad, 2013). The assumption is that respondents with a high level of differentiation reconsider all rating scale options for each item when answering grid questions whereas respondents with a low level of differentiation consider only a minimum of rating scale options when evaluating items of a grid question. Thus, the level of differentiation is higher for optimizing respondents than for satisficing respondents. While respondents who consider only a limited amount of rating scale options at the formatting stage of the question-answer process apply a weak form of satisficing, respondents who select one rating scale option for the first item of a grid question and use the same rating scale option for all the following items of a grid questions apply a strong form of satisficing (Krosnick, 1991). The response tendency of respondents who select the same answer category for all items is called straightlining (Baker et al., 2010; Kaminska et al., 2010). However, a low degree of differentiation or even straightlining can also reflect the true attitudes of respondents (Chang & Krosnick, 2009; Krosnick, 1999) or can result from badly designed questions (Baker et al., 2010). Previous research on the question format of rating scale items provides some evidence that the likelihood of straightlining decreased when an item-by-item design was used rather than a grid format (Blumenstiel & Roßmann, 2013; Klausch, de Leeuw, Hox, Roberts, & de Jongh, 2012; Tourangeau, Couper, & Conrad, 2004). However, other studies revealed that the question format of rating scale items was not associated with straightlining (Callegaro, Shand-Lubbers, & Dennis, 2009; Kunz, 2015; Revilla & Couper, 2017). Furthermore, in line with the satisficing theory (see Chapter 5.2.2) a low level of differentiation and straightlining was more likely among respondents with a low level of education (cognitive ability of respondents) and occurred more often in grid questions positioned at the end of questionnaires (respondents motivation) (Galesic & Bosnjak, 2009; Kaminska et al., 2010; McCarty & Shrum, 2000; Taylor, 2006). Consequently, a lot of studies use the degree of differentiation as satisficing indicator (Couper, Tourangeau, Conrad, & Zhang, 2013; Heerwegh, 2009; Lynn & Kaminska, 2012; Revilla & Ochoa, 2015; Roßmann, 2017; Zhang & Conrad, 2013).

Length of answers to narrative open-ended questions

Another question format that requires a lot of cognitive effort from respondents are narrative open-ended questions. On the one hand, narrative open-ended questions enable respondents to formulate their judgment in their own words and they are not restricted by matching their judgment to one of the predefined answer categories. However, formulating an answer in their own words requires a lot of cognitive effort which respondents are often not willing to involve, thus, answers to narrative open-ended questions suffer from low data quality in terms of higher item nonresponse rates (Millar & Dillmann, 2012). Previous studies used the length of answers, the number of topics and the degree of elaboration to measure data quality of answers to narrative open-ended questions (Christian & Dillman, 2004; Emde & Fuchs, 2012; Smyth, Dillman, Christian, & McBride, 2009). Again, in line with the satisficing theory (see Chapter 5.2.2), respondents low in literacy and with a low educational level (cognitive ability of respondents) reported shorter answers to narrative open-ended questions than respondents high in literacy and with a high educational level (Galesic et al., 2008; Oudejans & Christian, 2010; Smyth, Powell, Olson, & Libman, 2012; Stern, Dillman, & Smyth, 2007). Furthermore, answers of narrative open-ended questions positioned at the end of the questionnaire were on average shorter than answers of narrative open-ended questions positioned at the beginning of the questionnaire (respondents motivation) (Galesic & Bosnjak, 2009). Consequently, the quality of answers of narrative open-ended questions, in terms of length, the number of topics and the degree of elaboration, seems to be a reasonable indicator of satisficing.

Response order effects

Finally, response order effects are used as indicator of weak satisficing (Krosnick, 1991). Response order effects occur if respondents do not consider all response categories within the formatting stage of the question-answer process. For example, if response categories are presented orally, respondents more easily remember response categories mentioned last and more likely select one of these last response categories resulting in recency effects. By contrast, if response categories are presented visually, respondents are more likely to select one of the first response categories resulting in primacy effects, because they involve deeper cognitive processing for items early in a list than for items at the end of a list (Krosnick & Alwin, 1987). Thus, in Web surveys satisficing respondents select the first acceptable answer rather than processing all response categories to identify their optimal answer (Galesic et al., 2008). Response order effects indicate a weak form of satisficing, because respondents superficially go through all cognitive stages of the question-answer process rather than omitting one stage. Galesic et al. (2008) conducted an eye-tracking study to examine the explanation of primacy effects. The eye-tracking data indicated that respondents drew more attention to response options at the beginning of the list than to response options at the end of the list. Furthermore, findings revealed that some respondents even completely ignored response options at the end of the list (Galesic et al., 2008). Accordingly, these findings provided empirically evidence of the satisficing theory. Moreover, in line with the satisficing theory (see Chapter 5.2.2) response order effects were associated with lower cognitive abilities. Previous research has shown that respondents with a low educational level were more prone to primacy effects than respondents who are highly educated (Fuchs, 2005; Krosnick & Alwin, 1987; Krosnick et al., 1996; Malhotra, 2008). Findings also revealed that primacy effects were stronger among very young respondents (10-13 years) and respondents older than 65 years (Fuchs, 2005; Knäuper, 1999). The assumption is that the cognitive ability increases with age but after a certain age decreases again. Thus, findings also correspond with the satisficing theory that response order effects are stronger among respondents with a lower cognitive ability than among respondents with a high level of cognitive ability. Consequently, in Web surveys primacy effects seem to be an appropriate indicator of satisficing and data quality.

6 Hypotheses

Considering the relevant literature on mixed-mode surveys in general and mixed-device Web surveys in particular as well as frameworks and theories on survey participation and response strategies multiple hypotheses can be derived. These hypotheses assume that the allocation to the respondents' preferred device affects the participation behavior of sample members and that responding with the preferred device influences the data quality of respondents.

6.1 Survey participation

When sample members are explicitly asked to use a specific device for Web survey participation, three different participation behaviors are possible: (1) sample members can refuse to participate in the Web survey, (2) sample members can ignore the allocation to the device and participate in the Web survey with another device or (3) sample members can conform the device allocation and participate in the Web survey with the required device.

6.1.1 Unit nonresponse rates

As outlined in Chapter 2.3 unit nonresponse rates are a primary challenge of Web surveys and sample members refuse to participate in Web surveys due to various reasons. If sample members are randomly assigned to a device which they are asked to use for Web survey participation, this device allocation can also play an essential role for the response decision process (see Chapter 4.1). According to the social exchange theory (see Chapter 4.2.1) the likelihood of Web survey participation increases, if benefits outweigh costs of participation. Excluding sample members who do not access the Internet through all required devices of the randomization, two aspects of the device allocation can affect the response decision process of sample members. *First*, if sample members are assigned to their non-preferred device, the device allocation increases costs of Web survey participation; on the contrary, if sample members are asked to use their preferred device, the device allocation increases benefits of Web survey participation. Thus, unit nonresponse is more likely among sample members assigned to their non-preferred device than among sample members assigned to their preferred device. *Second*, if sample members are assigned to the same device which they used to evaluate the email request, the device allocation increases the likelihood of Web survey participation, because sample members do not have to switch the device to respond to the Web survey. Contrary, if sample members are assigned to a different device than the one they have used to evaluate the email request, the device allocation increases costs of Web survey participation, because sample members have to change the device to respond to the Web survey (see also Chapter 4.1).

The assumption is that most sample members who are assigned to the preferred device will evaluate the Web survey request on the device they are asked to use for Web survey participation. Thus, survey participation does not involve any additional burden and even if they evaluate the survey request on their non-preferred device due to reasons of the situational context, they are more likely to switch their device, because the benefit of using their preferred device for Web survey participation will equalize or even outweigh the burden of switching the device. Contrary, most sample members assigned to their non-preferred device will evaluate the Web survey request on their preferred device and need to change their device to conform the device allocation, thus, Web survey participation involves additional burden. Moreover, the received burden will not be rewarded by participating with their preferred device. Costs will even further increase by participating with their non-preferred device. Additionally, few sample members who are assigned to their non-preferred device will evaluate the Web survey request on the respective device. Although, these sample members do not have to switch their device for Web survey participation, they might refuse to participate anyway, because of their negative rating of participating with their non-preferred device. Thus, nonresponse rates of sample members assigned to their preferred device are expected to be lower than nonresponse rates of sample members assigned to their non-preferred device.

H_1: Unit nonresponse rates of sample members who are assigned to their preferred device are lower than unit nonresponse rates of sample members who are assigned to their non-preferred device.

In both studies, sample members of the respective second wave were randomly assigned to respond with a PC/tablet computer (PC/tablet computer Web survey) or with a smartphone (smartphone Web survey). PCs and tablet computers were combined because previous research has shown that screen size is the main factor associated with differences in response rates and data quality between devices (Couper et al., 2017; Wenz, 2017). Half of the sample members who were assigned to respond with a PC/tablet computer also preferred a PC/tablet computer for Web survey participation and hence were assigned to their preferred device, whereas the other half of sample members assigned to respond with a PC/tablet computer preferred a smartphone for Web survey participation and hence were invited to respond with their non-preferred device. Accordingly, half of the sample members assigned to respond with a smartphone also preferred a smartphone and hence were assigned to their preferred device, whereas the other half of sample members assigned to respond with their smartphone preferred a PC/tablet computer and hence were invited to their non-preferred device. Therefore, the overall effect of being assigned to the preferred device on unit nonresponse was also assessed separately for sample members assigned to respond with a PC/tablet computer and sample members assigned to respond with a smartphone.

H_{1a}: In a PC/tablet computer Web survey, unit nonresponse rates of sample members with a PC/tablet preference are lower than unit nonresponse rates of sample members with a smartphone preference.

H_{1b}: In a smartphone Web survey, unit nonresponse rates of sample members with a smartphone preference are lower than unit nonresponse rates of sample members with a PC/tablet computer preference.

6.1.2 Rates of non-conforming respondents

Sample members who are not willing to respond with their non-preferred device and sample members who are not willing to change their device for Web survey participation can either refuse to participate at all, as outlined above, or they decide to ignore the device allocation and respond with the device of their choice. Non-conforming respondents seem to differentiate from unit nonrespondents regarding two aspects. *First*, Web survey participation in general may be more important for non-conforming respondents than for unit nonrespondents. *Second*, conformance with the device allocation may be less important for non-conforming respondents than for unit nonrespondents. Thus, Web survey participation is more important for non-conforming respondents than conforming the survey researchers' device allocation. Non-conforming respondents decide to participate in the Web survey, but they are not willing to involve a lot of effort for Web survey participation. Thus, to minimize response burden, they decide to respond with the device they have used to evaluate the email invitation or with their preferred device, even though they are not assigned to the respective device. All sample members of the respective second wave reported in the respective first wave that they access the Internet through both devices a PC/tablet computer and a smartphone. Thus, non-conformed responding due to sample members who are not willing to access the Internet with the assigned device is prevented. Rates of non-conforming respondents are expected to be higher among sample members who are assigned to their non-preferred device than among sample members who are assigned to their preferred device, because most sample members who are assigned to their non-preferred device are expected to evaluate the Web survey request with their preferred device. Responding with the assigned device becomes very burdensome for these sample members because they have to switch their device and, in the end, respond with their non-preferred device. Thus, if these sample members decide to participate in the Web survey, they probably participate with their preferred device. Contrary, most sample members assigned to their preferred device are expected to evaluate the email invitation with their preferred device. These sample members can respond to the Web survey with their preferred device and do not have to switch their device to conform the device allocation, thus, the response burden for these sample members is on a very low level and rates of non-conforming respondents are expected to be very low.

H_2: Rates of non-conforming respondents are lower among sample members who are assigned to their preferred device than among sample members who are assigned to their non-preferred device.

H_{2a}: In a PC/tablet computer Web survey, rates of non-conforming respondents are lower among sample members with a PC/tablet preference than among sample members with a smartphone preference.

H_{2b}: In a smartphone Web survey, rates of non-conforming respondents are lower among sample members with a smartphone preference than among sample members with a PC/tablet computer preference.

6.1.3 Conformance rates

The last survey participation behavior is conforming. Conformance rates refer to sample members who decide to participate in the Web survey and respond with the assigned device. Survey participation is less burdensome for sample members who are assigned to their preferred device than for sample members who are assigned to their non-preferred device. The likelihood that sample members participate in Web surveys decreases with the level of difficulty. Thus, conformance rates of sample members assigned to their preferred device are expected to be higher than conformance rates of sample members assigned to their non-preferred device. Moreover, conformance rates are the inverse to unit nonresponse rates and rates of non-conforming respondents. Thus, the third hypothesis can also be concluded from the first and the second hypothesis.

H_3: Conformance rates of sample members who are assigned to their preferred device are higher than conformance rates of sample members who are assigned to their non-preferred device.

H_{3a}: In a PC/tablet computer Web survey, conformance rates of sample members with a PC/tablet preference are higher than conformance rates of sample members with a smartphone preference

H_{3b}: In a smartphone Web survey, conformance rates of sample members with a smartphone preference are higher than conformance rates of sample members with a PC/tablet computer preference.

6.2 Data quality

As outlined by Chapter 5.1 respondents have to involve a lot of cognitive effort to provide complete and accurate responses to survey questions. People are expected to prefer devices for Web survey participation that are less burdensome and more motivating. Thus, respondents who complete the Web survey with their preferred device have to involve less cognitive effort to operate the device than respondents who answer the Web survey with their non-preferred device. Accordingly, respondents who complete the Web survey with their preferred device can involve more cognitive effort in answering the survey questions than respondents who use their non-preferred device for Web survey participation. As a consequence, respondents who complete the Web survey with their preferred device are expected to provide data of higher quality than respondents who answer the Web survey with their non-preferred device.

6.2.1 Survey breakoff

Respondents re-evaluate their initial decision to participate in the survey after each question. Once the cognitive effort of responding exceeds the respondent's threshold of cognitive effort, they are willing to spend on Web survey participation, respondents abandon the Web survey. The threshold of cognitive effort respondents are willing to spend on Web survey participation is higher for respondents who use their preferred device for Web survey participation than for respondents who use their non-preferred device. Thus, respondents who complete the Web survey with their non-preferred device are expected to abandon the Web survey more often than respondents who answer the Web survey with their preferred device. Higher breakoff rates among respondents who use their non-preferred device for Web survey participation could affect the data quality of questions right prior to the point of survey breakoff and following the point of survey breakoff.

H_4: Survey breakoff rates of respondents who are assigned to their preferred device are lower than survey breakoff rates of respondents who are assigned to their non-preferred device.

H_{4a}: In a PC/tablet computer Web survey, breakoff rates of respondents with a PC/tablet computer preference are lower than breakoff rates of respondents with a smartphone preference.

H_{4b}: In a smartphone Web survey, breakoff rates of respondents with a smartphone preference are lower than breakoff rates of respondents with a PC/tablet computer preference.

6.2.2 Item nonresponse

A less consequential form of nonresponse on question level is item nonresponse. Respondents complete the Web survey but refuse to answer single questions. Item nonresponse is a satisficing response strategy because respondents skip the retrieval and judgment process. As mentioned above, respondents who complete the Web survey with their preferred device can involve more cognitive effort in answering survey questions because they have to involve less cognitive effort in operating the device. Thus, respondents who complete the Web survey with their preferred device are expected to skip fewer questions than respondents who answer the Web survey with their non-preferred device due to their higher cognitive ability.

H_5: Item nonresponse rates of respondents who are assigned to their preferred device are lower than item nonresponse rates of respondents who are assigned to their non-preferred device.

H_{5a}: In a PC/tablet computer Web survey, item nonresponse rates of respondents with a PC/tablet computer preference are lower than item nonresponse rates of respondents with a smartphone preference.

H_{5b}: In a smartphone Web survey, item nonresponse rates of respondents with a smartphone preference are lower than item nonresponse rates of respondents with a PC/tablet computer preference.

6.2.3 Response time

Longer response times can indicate either difficulties within the question-answer process or a very thorough performance of the various cognitive stages of the question-answer process (Bassili & Fletcher, 1991; Callegaro, Yang, et al., 2009; Draisma & Dijkstra, 2004; Heerwegh, 2003; Smyth et al., 2006; Toepoel et al., 2008; Tourangeau et al., 2009). In the present studies, low response times are seen as indicator of satisficing. According to the satisficing framework of Krosnick (1991) satisficing respondents perform the cognitive stages of the question-answer process superficially or even skip the retrieval and judgment process. Thus, compared to respondents using an optimizing response strategy, satisficing respondents are expected to need less time to answer survey questions and complete the Web survey. Thus, response times of respondents who use their preferred device for Web survey participation are expected to be longer than response times of respondents who use their non-preferred device because their cognitive processing of survey questions is more through.

H_6: Respondents who are assigned to their preferred device take more time to answer survey questions and to complete the Web survey than respondents who are assigned to their non-preferred device.

H_{6a}: In a PC/tablet computer Web survey, respondents with a PC/tablet computer preference take more time to answer survey questions and to complete the Web survey than respondents with a smartphone preference.

H_{6b}: In a smartphone Web survey, respondents with a smartphone preference take more time to answer survey questions and to complete the Web survey than respondents with a PC/tablet computer preference.

6.2.4 Survey focus

The devices used to participate in mixed-device Web surveys easily allow multitasking. The likelihood that respondents participate in secondary activities while answering Web surveys increases, if respondents are bored or frustrated with the task of responding (Sendelbah et al., 2016). The cognitive effort respondents can involve in answering survey questions is limited, if they complete the Web survey with their non-preferred device. Therefore, the task of responding may be more difficult for respondents who complete the Web survey with their non-preferred device than for respondents who answer the Web survey with their preferred device. Consequently, the likelihood of frustration is higher among respondents who use their non-preferred device which increases the prevalence of multitasking. Thus, the survey focus of respondents who complete the Web survey with their preferred device is expected to be higher than the survey focus of respondents who use their non-preferred device for Web survey participation.

H_7: Respondents who are assigned to their preferred device are less likely to leave the Web survey page than respondents who are assigned to their non-preferred device.

H_{7a}: In a PC/tablet computer Web survey, respondents with a PC/tablet computer preference are less likely to leave the Web survey page than respondents with a smartphone preference.

H_{7b}: In a smartphone Web survey, respondents with a smartphone preference are less likely to leave the Web survey page than respondents with a PC/tablet computer preference.

6.2.5 Degree of differentiation

Grid questions provide a considerable amount of information to respondents which increase the task difficulty of responding. Accordingly, grid questions are more prone to systematic responding than other question formats. Among others, nondifferentiation or, in its extreme form, straightlining is a common systematic response strategy that respondents use to minimize the cognitive effort they have to involve answering grid questions. The task difficulty of grid questions is even higher for respondents with a low level of cognitive ability. Thus, respondents who use their non-preferred device for Web survey participation are expected to more likely apply systematic response strategies in grid questions such as nondifferentiation and straightlining than respondents who complete the Web survey with their preferred device.

H_8: The degree of differentiation in grid questions is higher among respondents who are assigned to their preferred device than among respondents who are assigned to their non-preferred device.

H_{8a}: In a PC/tablet computer Web survey, the degree of differentiation in grid questions is higher among respondents with a PC/tablet computer preference than among respondents with a smartphone preference.

H_{8b}: In a smartphone Web survey, the degree of differentiation in grid questions is higher among respondents with a smartphone preference than among respondents with a PC/tablet computer preference.

6.2.6 Length of answers

Narrative open-ended questions are another question format that requires a lot of cognitive effort from respondents. Respondents have to format their answer in their own words which is easier for respondents with a high level of cognitive ability than for respondents with a low level of cognitive ability. Accordingly, respondents with a high level of cognitive ability provide more elaborated answers, whereas respondents with a low level of cognitive ability are more likely to provide short and simple answers to minimize the cognitive effort required by answering a narrative open-ended question. Therefore, answers of respondents who complete the Web survey with their preferred device are expected to be longer than answers of respondents who use their non-preferred device for Web survey participation.

H_9: Answers to narrative open-ended questions of respondents who are assigned to their preferred device are longer than reported answers of respondents who are assigned to their non-preferred device.

H_{9a}: In a PC/tablet computer Web survey, answers to narrative open-ended questions of respondents with a PC/tablet computer preference are longer than reported answers of respondents who are assigned to their non-preferred device.

H_{9b}: In a smartphone Web survey, answers to narrative open-ended questions of respondents who are assigned to their preferred device are longer than reported answers of respondents who are assigned to their non-preferred device

6.2.7 Primacy effects

The last indicator of data quality used in the present studies are primacy effects. In multiple-response questions respondents are asked to select their answers from a list of several response options. Processing all response options of a list requires a lot of cognitive effort from respondents and a common systematic response strategy of respondents to minimize the cognitive effort of answering multiple-response questions is to vary the extent of cognitive processing between response options. In Web surveys, in common with self-administered surveys in general, the cognitive processing of the first response options in a list is deeper than the cognitive processing of response options at the end of a list. Thus, in Web surveys, response options at the beginning of a list are more often selected than response options at the end of a list. Respondents rather select an appropriate answer than the optimal answer. Furthermore, respondents with a low level of cognitive ability more likely use systematic response strategies than respondents with a high level of cognitive ability. Thus, primacy effects are expected to be stronger among respondents who use their non-preferred device for Web survey participation than respondents who use their preferred device.

H_{10}: Respondents who are assigned to their preferred device are less prone to primacy effects than respondents who are assigned to their non-preferred device.

H_{10a}: In a PC/tablet computer Web survey, respondents with a PC/tablet computer preference are less prone to primacy effects than respondents with a smartphone preference.

H_{10b}: In a smartphone Web survey, respondents with a smartphone preference are less prone to primacy effects than with a PC/tablet computer preference.

All hypotheses on survey participation behaviors and data quality are summarized in Figure 6.

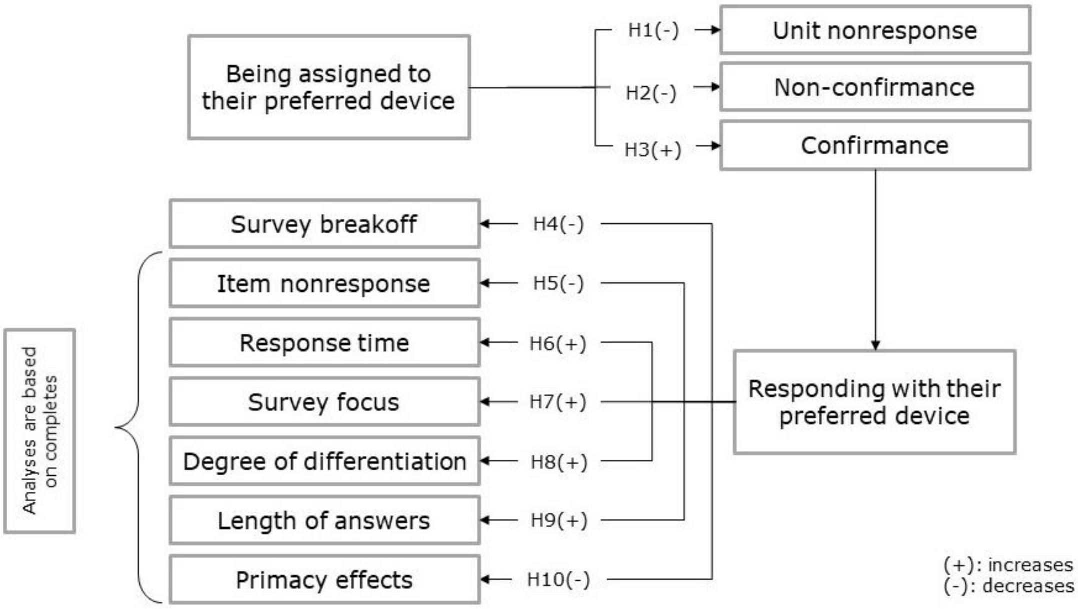

Figure 6: Visual summary of hypotheses

6.3 Interaction effect

PCs have already been available for individuals for almost four decades whereas the first smartphone was released about ten years ago. Thus, sample members with a smartphone preference probably also have a high PC literacy. Furthermore, sample members with a smartphone preference will probably not have any problems to access the Internet with a tablet computer because the navigation of both devices is similar. The primary difference between tablet computers and smartphones is the screen size and the larger screen size of tablet computers seems to make navigation easier (Couper et al., 2017; Wenz, 2017). Contrary, sample members with a PC/tablet computer preference may have problems to access the Internet through a smartphone either because of the different navigation and data input method compared to PCs or due to the smaller screen size compared to PCs and tablet computers.

Accordingly, the burden of responding and conforming the device allocation seems to be lower for sample members with a smartphone preference who are assigned to respond with a PC/tablet computer than for sample members with a PC/tablet computer preference who are assigned to respond with a smartphone. Therefore, the differences between unit nonresponse rates, rates of non-conforming respondents and conformance rates are expected to be lower between sample members with a PC/tablet computer preference who are assigned to respond with a PC/tablet computer and sample members with a smartphone preference who are assigned to respond with a PC/tablet computer than between sample members with a smartphone preference who are assigned to respond with a smartphone and sample members with a PC/tablet computer preference who are assigned to respond with a smartphone.

Moreover, sample members with a smartphone preference who respond with a PC/tablet computer may have to involve less cognitive effort in operating the device than sample members with a PC/tablet computer preference who respond with a smartphone. Consequently, sample members with a smartphone preference who respond with a PC/tablet computer can involve more cognitive effort in answering survey questions than sample members with a PC/tablet computer preference. Accordingly, the difference of data quality is expected to be lower between of respondents with a PC/tablet computer preference who respond with a PC/tablet computer and respondents with a smartphone preference who respond with a PC/tablet computer than between respondents with a smartphone preference who respond with a smartphone and respondents with a PC/tablet computer preference who respond with a smartphone.

Thus, effects of being assigned to the preferred device on survey participation behaviors and effects of responding with the preferred device on data quality are expected to be lower among sample members assigned to respond with a smartphone than among sample members assigned to respond with a PC/tablet computer.

H_{11}: Effects of being assigned to/responding with the preferred device on survey participation behaviors/data quality are stronger in smartphone Web surveys than in PC/tablet computer Web surveys.

6.4 Motives of Web survey participation

Two studies were conducted to assess the hypotheses on survey participation behaviors and data quality. Contrary to expectations, analyses of the first study revealed that responding with the preferred device was associated with lower data quality regarding three indicators of data quality (see Chapter 8.1). Thus, an additional hypothesis was formulated which will only be assessed in the second study.

The assumption was that differences in data quality between respondents who completed the Web survey with their preferred device and respondents who answered the Web survey with their non-preferred device were due to differences in sample compositions which multivariate regression analyses in the first study did not account for. According to the uses and gratifications paradigm (see Chapter 4.3) people access the Internet due to content-orientated and process-orientated gratifications. Content-orientated people are motivated by the informational content of Web sites, whereas process-orientated people simply enjoy browsing. Whether sample members participate in Web surveys depends on several factors. According to the social exchange theory (see Chapter 4.2.1) and the leverage-salience theory (see Chapter 4.2.2) sample members perform cost-benefit equations to decide whether they participate in Web surveys. Sample members are expected to rate the allocation to their preferred device as benefit and the allocation to their non-preferred device as cost. However, the magnitude of the importance rating of the allocation to their preferred device may differentiate between sample members (leverage-salience theory). The assumption is that being assigned to the preferred device is more important for sample members who are motivated by process-orientated gratifications than for sample members who are motivated by content-orientated gratifications. Therefore, among sample members assigned to their preferred device content-orientated sample members are expected to refuse more often to participate in the Web survey, resulting in an overrepresentation of process-orientated conforming respondents. Whereas, among sample members assigned to their non-preferred device process-orientated sample members are expected to refuse more often to participate in the Web survey, resulting in an overrepresentation of content-orientated conforming respondents.

According to Rodgers and Thorson (2000) people who access the Internet due to process-orientated gratifications spend less cognitive effort on the informational content of Web sites than people who are motivated to access the Internet by content-orientated gratifications. Thus, in Web surveys, process-orientated respondents may be more likely satisficing respondents than content-orientated respondents which could explain the higher data quality of respondents who complete the Web survey with their non-preferred device.

H_{12}: Negative effects of responding with the preferred device on data quality are due to differences of sample compositions regarding the respondents' level of content-orientated and process-orientated motivation.

7 Methods

7.1 Experimental designs

The aim of this study is to determine the effect of device preference on survey participation and data quality. To analyze the effect of device preference on survey participation, information about survey nonrespondents are required. “A common approach to study nonresponse has been the use of frame data available for both respondents and nonrespondents” (Groves & Couper, 1998, p. 49). However, frame data are often limited to few socio-demographic variables, not providing any information on the preferred device to complete Web surveys.

Further approaches of nonresponse analyses that are applicable to study differences between respondents and nonrespondents in Web surveys are to examine reluctant respondents or respondents who rarely participate in Web surveys, follow-up surveys among nonrespondents and determining panel nonresponse (Groves & Couper, 1998). Studying reluctant respondents can provide insights about nonrespondents due to the assumption that reluctant respondents are similar to nonrespondents (Jang, Lin, & Kang). However, there is evidence that sample members who do not participate in surveys even though survey researchers have spent a lot of effort to persuade them differ from those who are eventually convinced to participate in surveys (Studer et al., 2013). A similar problem occurs if nonresponse analyses are based on respondents who rarely participate in surveys. The assumption is that analyses on respondents who report high refusal rates of survey requests can provide insights about nonrespondents. However, respondents with high refusal rates of survey requests will be underrepresented in surveys measuring the respondents’ refusal rates of survey requests, because they probably also refused to participate in this specific survey.

Compared to the last two approaches mentioned above, studying reluctant respondents or respondents with a high refusal rate of survey requests, conducting follow-up surveys among nonrespondents has the potential to collect data on actual nonrespondents (Bethlehem & Kersten, 1985; Groves & Peytcheva, 2008; McGuckin, Liss, & Keyes, 2005). However, low response rates of follow-up surveys among nonrespondents are one major drawback of this approach. Furthermore, nonrespondents who participate in the follow-up survey may still differ from nonrespondents who participate neither in the main survey nor in the follow-up survey.

Finally, panel attrition can be studied to investigate differences between respondents and nonrespondents in Web surveys. Survey data collected in the first wave can be used to determine nonresponse of the second wave (Lynn, 2003; Minder, Müller, Gillmann, Beck, & Stuck, 2002). However, there is some evidence that nonrespondents in the recruitment phase/first wave differ from panel members who attrite from the panel at the second wave or later (Lugtig, Das, & Scherpenzeel, 2014). These findings indicate that nonrespondents of the second wave of surveys also differ from nonrespondents of cross-sectional surveys.

The last two approaches were considered to compare survey participation and data quality of sample members invited to complete the Web survey on their preferred device and sample members invited to complete the Web survey on their non-preferred device. Even though these two approaches provide better data quality for nonresponse analyses than the other approaches (Busse, Laub, & Fuchs, 2015; Groves & Peytcheva, 2008), data collection preceding or following the actual survey request is biased by nonresponse (Vercruyssen, Roose, Carton, & van de Putte, 2014). In this study, the approach to examine panel nonresponse was preferred to the follow-up survey of nonrespondents, because the latter might convey the impression among nonrespondents that their decision to refuse the survey request is not considered by the survey researcher. In multiple-wave studies only respondents of the first wave, who agreed to be contacted for a follow-up survey, are invited to the second wave of the study. Thus, the approach to study panel nonresponse or nonresponse in a multiple-wave study seems to correspond more closely with the guidelines for Web surveys of the German Society for Online Research (DGOF) than follow-up surveys of nonrespondents. The guidelines stress that respondents need to consent to be contacted for a follow-up survey (DGOF, 2007). Furthermore, in follow-up surveys of nonrespondents only a few questions should be asked to minimize response burden – limiting the amount of information about nonrespondents that can be collected – and without offering any incentives response rates in follow-up surveys among nonrespondents are probably on a very low level. Incentives could increase response rates of follow-up surveys among nonrespondents, but at the same time increase survey costs.

Two studies were conducted to determine the effect of being assigned to the preferred device on survey participation and the effect of responding with the preferred device on data quality. Both studies used a two-wave Web survey design. The first Web survey wave of both studies was used to measure the respondents' device preference and other control variables such as motives of Internet usage, topic interest and socio-demographic characteristics. Whereas in the second Web survey wave of both studies a randomized experiment was conducted to determine whether being assigned to the preferred device predicts survey participation of sample members and whether responding with the preferred device is associated with data quality of respondents. In the first study, sample members of the second wave were randomly assigned to use either a PC/tablet computer or a smartphone to complete the Web survey. Thus, in the first study, device treatment of the second Web survey wave is an experimentally assigned factor but the allocation to their preferred device is not experimentally assigned. In the second study, the randomization of sample members differed slightly to ensure that the allocation to their preferred device is an experimentally assigned factor. Sample members with a smartphone preference and sample members with a PC/tablet computer preference were randomly assigned respectively to use either a PC/tablet computer or a smartphone for Web survey participation. Considering the device preference of sample members measured in the first wave and the device treatment of the second Web survey wave the control group and the experimental group can be identified: (CG) sample members who are assigned to respond with their non-preferred device and (EG) sample members who are assigned to respond with their preferred device and (see Table 3).

Table 3: Experimental conditions

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Device choice in the 1st wave
(Device preference)</td></tr>
<tr><td>Smartphone</td><td>PC/tablet</td></tr>
<tr><td rowspan="2">Assigned device in the 2nd wave
(Device treatment)</td><td>Smartphone</td><td>Allocation to their
preferred device
Experimental group</td><td>Allocation to their
non-preferred device
Control group</td></tr>
<tr><td>PC/tablet</td><td>Allocation to their
non-preferred device
Control group</td><td>Allocation to their
preferred device
Experimental group</td></tr>
</table>

Previous research has shown that the optimal invitation mode differs across devices. There is some evidence that email invitations outperform text message invitations in PC Web surveys (Bosnjak, Neubarth, Couper, Bandilla, & Kaczmirek, 2008) and that text message invitations are an effective mean of increasing response rates in smartphone Web surveys (de Bruijne & Wijnant, 2014a; Mavletova & Couper, 2014). These findings indicate that sample members assigned to smartphone Web surveys are best invited by a text message, whereas sample members assigned to PC/tablet computer Web surveys are best invited by an email. Unfortunately, the optimal invitation mode could not be used in the second Web survey wave of both studies, because phone numbers of sample members of the respective second Web survey wave were not provided. Thus, sample members of the PC/tablet computer Web survey received an email invitation instructing them to complete the Web survey on a desktop, laptop or tablet computer and sample members of the smartphone Web survey also received an email invitation instructing them to use a smartphone to answer the Web survey (see Appendix A).

The sample of the second wave was limited to respondents of the first wave who agreed to be contacted for the second wave and reported to be dual device users (people, who access the Internet through both PC/tablet computer and smartphone). Single device users (smartphone only users and PC/tablet computer only users) were excluded from the randomized experiment of the second wave to prevent nonresponse due to inability to access the Internet through the assigned device. Furthermore, smartphone only users and PC/tablet computer only users are expected to differ from each other and from dual device users (Lugtig et al., 2016). Thus, smartphone only users could not simply be invited for the smartphone Web survey and PC/tablet computer only users could not simply be invited for the PC/tablet Web survey. Nor was it within the means of this study to provide smartphone only users assigned to the PC/tablet computer Web survey with a PC/tablet computer and PC/tablet computer only users assigned to the smartphone Web survey with a smartphone.

7.2 Data collection

7.2.1 Study 1

The first study was conducted among former university applicants who applied for studies at the Darmstadt University of Technology in fall 2012, 2013, 2014 or 2015. The first wave of data collection was conducted in March 2016. 6,111 university applicants (10 percent) started the Web survey of which 3,120 respondents were willing to participate in the second Web survey of this study, fulfilled the requirement accessing the Internet through both PC/tablet computer and smartphone and reported a valid email address. Of these respondents, 58 percent (n=1,806) used a PC/tablet computer to complete the first Web survey wave and 42 percent (n=1,314) used a smartphone to answer the questionnaire of the first Web survey wave. The second wave of this study was conducted by the end of January 2018 and sample members of the second Web survey wave were randomly assigned with equal allocation either to the PC/tablet computer Web survey (n=1,560) or the smartphone Web survey (n=1,560; see Table 4). Thus, some students were invited to complete the second Web survey wave with their preferred device and others were invited to answer the questionnaire of the second Web survey wave with their non-preferred device (see Table 3). Thus, sample members who were assigned to their preferred device to complete the second Web survey wave of Study 1 may differ from sample members who were allocated to their non-preferred device for Web survey participation, because the allocation to their preferred device was not an experimentally assigned factor. To address this issue, the respondents' socio-demographic characteristics and variables on their Internet and device use were included in the analyses (see Chapter 7.6).

A total of 3,089 students received an email invitation for the second Web survey wave (PC/tablet computer Web survey: n=1,547; smartphone Web survey: n=1,542). The unit nonresponse rate in the PC/tablet computer Web survey was 65 percent (n=1,005) and in the smartphone Web survey 62 percent (n=959). Percentages of respondents, who self-selected to complete the Web survey with a different device than they were assigned to (non-conforming respondents), were lower and comparable with other studies (PC/tablet Web survey: 10 percent; smartphone Web survey: 19 percent) (Antoun, 2015a; Toninelli & Revilla, 2016). In the PC/tablet computer Web survey, 388 students (25 percent) started the Web survey and used the required device (conformance rate), 346 (22 percent) of which completed the Web survey (AAPOR, RR6). In the smartphone Web survey, 305 students (19 percent) conformed, 269 (16 percent) of which completed the Web survey (AAPOR, RR6).

Table 4: Participation behavior of sample members of the second Web survey wave of the first study

	PC Web Survey		**Smartphone Web Survey**	
	n	**%**	**n**	**%**
Number of invitations	1560		1560	
Number of eligible cases	1547	100%	1542	100%
Starts: all devices	542	35%	583	38%
Starts: assigned device	388	25%	305	19%
Completes: assigned device	346	22%	269	16%

7.2.2 Study 2

For the second study, data was collected in Germany through the opt-in online panel (mingle) of Respondi (https://www.respondi.com/) with cross quotas for age (18-29, 30-39, 40-49, 50-59, 60+) and gender and independent quotas for education (low, medium, high)[4]. See Appendix B for quota assignments. The first wave of this study was carried out from May 17 - May 29, 2018. From 2,113 panel members who started the Web survey, 1,671 answered the first survey question of the main part of the Web survey, following the quota and filter questions. The remaining respondents were excluded based on filter questions (n=233) or quotas (n=188), or they abandoned the Web survey within the screening questions (n=21). Respondents younger than 18 years and respondents who do not use both devices, a smartphone and a PC or tablet computer, were excluded from the Web survey. Only 18 respondents abandoned the Web survey within the main part of the questionnaire. Thus, a total of 1,653 respondents completed the survey and quotas were met. Finally, 1,365 respondents of the first Web survey wave of the second study, reported

[4] Quotas came from the German Federal Statistical Office and represented the distribution of the general population in Germany, because the distribution of the three variables for the Internet population are not available for free. Three-dimensional cross quotas were not implemented due to the given study budget.

owning a PC/tablet computer and a smartphone and stated accessing the Internet through both devices. Thus, these respondents met the requirements and were invited to the second wave of the second study (PC/tablet computer Web survey: n = 682; smartphone Web survey: n = 683) (see Table 5).

The second wave was carried out from June 11 - June 25, 2018. It was designed to appear independent and unrelated to the first wave, thus, response decisions of the second Web survey wave of this study are more comparable to response decisions of a cross-sectional survey. The topic, layout and sponsor of the second wave differed from the first wave. Overall, 10 cases were excluded from analysis due to non-exclusive IDs (PC/tablet computer Web survey: n = 6; smartphone Web survey: n = 4). The unit nonresponse rate in the PC/tablet computer Web survey was 14 percent (n=98) and in the smartphone Web survey 16 percent (n=109). According to Respondi, members of their online panel are used to answer Web surveys on their PC. Thus, as expected, the percentage of non-conforming respondents was higher in the smartphone Web survey (35 percent) than in the PC/tablet computer Web survey (7 percent). As a result, the percentage of panel members who started the Web survey using the required device was higher in the PC/tablet computer Web survey (79 percent) than in the smartphone Web survey (49 percent). 524 respondents (78 percent) completed the PC/tablet computer Web survey (AAPOR, RR6) and 329 respondents (48 percent) completed the smartphone Web survey.

Table 5: Participation behavior of sample members of the second Web survey wave of the second study

	PC Web Survey		**Smartphone Web Survey**	
	n	**%**	**n**	**%**
Number of invitations	682		683	
Number of eligible cases	676	100%	679	100%
Starts: all devices	578	86%	570	84%
Starts: assigned device	531	79%	331	49%
Completes: assigned device	524	78%	329	48%

7.3 Characteristics of sample members

7.3.1 Study 1

The majority of the gross sample of the second Web survey wave of the first study (n=3,089) was male (59 percent) and the age of sample members ranged from 17 to 65 years ($\bar{x}$=23.03; SD=4.41) (see Table 6). The first study was conducted among university applicants, thus, sample members do not differ regarding their highest school diploma, because the German Abitur or an equivalent school diploma is required in Germany to study at a university. However, the educational background of sample members (highest educational level of parents) may differ. The majority of sample members reported that at least one of their parents finished The German Abitur or some higher educational degree (74 percent). 20 percent of sample members stated that the highest educational degree of their parents was the German Realschulabschluss and only 6 percent of sample members reported that the highest educational degree of their parents was the German Hauptschulabschluss or that their parents finished school without any degree. No information was available on the PC, tablet and smartphone literacy of sample members in general. However, the Internet literacy of sample members, measured by the time sample members spend on the Internet using the respective device, revealed that the Internet literacy of sample members was on a very high level for PCs ($\bar{x}$=4 hours; SE=0.02) and smartphones ($\bar{x}$=3.1 hours; SD=3.5) but on a very low level for tablet computers ($\bar{x}$=0.5 hours; SD=1.7). Additionally, sample members perform on average 3.7 Online activities (SD=1.8) out of eight Online activities primary on a PC. They perform on average 2.8 Online activities (SD=2.8) primarily on a smartphone and on average for only 0.3 Online activities (SD=0.8) sample members mostly use a tablet. Thus, the Internet literacy of sample members should not prevent them from conforming the device allocation of the second Web survey wave.

Furthermore, Table 6 provides data on characteristics of sample members of the control group and the experimental group to ensure their comparability although being assigned to the preferred device was not an experimentally assigned factor. According to findings of Pearson's chi-squared tests and one-way ANOVAs comparability between the control group and the experimental group is given with the two exceptions that sample members assigned to their non-preferred device perform on average slightly more Online activities primary on a PC than sample members assigned to their preferred device.

Whereas, sample members assigned to their preferred device perform on average slightly more Online activities primary on a smartphone than sample members assigned to their non-preferred device. To compensate for these differences, variables are included as control variable in multivariate regression analyses.

Table 6: Sample composition of the gross sample of the second Web survey wave of the first study – overall, for the control group and the experimental group.

	Gross sample (n=3,089)	**Allocation to preferred device (EG) (n=1,512)**	**Allocation to non-preferred device (CG) (n=1,577)**
Characteristics	Mean or Percent	Mean or Percent	Mean or Percent
Age	23.03	22.98	23.07
Gender (=female)	41%	42%	40%
Highest education of parents			
Hauptschulabschluss or less (9 years or less)	6%	7%	5%
Realschulabschluss (10 years)	20%	20%	21%
Abitur (high school) or higher (12/13 years)	74%	73%	74%
Internet usage (in hours)			
PC	3.84	3.85	3.83
Tablet	0.53	0.58	0.48
Smartphone	3.06	3.12	2.99
Online activities			
PC	3.66	3.59	3.73*
Tablet	0.28	0.29	0.27
Smartphone	2.80	2.86	2.75*

Note. Pearson's chi-squared tests and one-way ANOVAs were computed to compare characteristics of sample members of the control group to characteristics of sample members of the experimental group. The table shows means or percentages with $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$, $^{+}p < .10$.

7.3.2 Study 2

In the gross sample of the second Web survey wave of the second study (n=1,355), 51 percent of sample members were women and the median age was between 40 and 49 years (see Table 7). The educational level of sample members was well-balanced. 35 percent of sample members had a low educational level (German Hauptschulabschluss), 32 percent a moderate educational level (German Realschulabschluss) and 33 percent of sample members had finished the highest school diploma in Germany (German Abitur). According to self-reports of sample members the PC and smartphone literacy is on a very high level whereas the tablet literacy is on a lower level. 72 percent of all sample members reported to use a PC daily and 93 percent stated to use a smartphone daily. By contrast, only 26 percent of sample members reported to use a tablet on a daily basis. Accordingly, 81 percent of sample members assessed themselves at least as advanced PC users and the percentage was the same for sample members who assessed themselves at least as advanced smartphone users (81 percent). The percentage of sample members who assessed themselves at least as advanced tablet users was lower (53 percent) but higher than the percentage who reported to use a tablet daily. Results on the Internet literacy of the respective devices indicated the same pattern as findings on the general device literacy. On average, sample members use the Internet on a PC for about three hours on a typical day. Smartphones were also used for about three hours to access the Internet on a typical day, however, on average tablets were only used for about two hours. Overall, the device and Internet literacy of sample members of the second Web survey wave of the second study was on a very high level, thus, according to their device and Internet literacy sample members should be able to conform the respective device allocation of the second Web survey wave.

Furthermore, Table 7 also shows sample compositions of sample members assigned to their preferred device and sample members assigned to their non-preferred device to ensure that the randomization of sample members generated two comparable groups. According to findings of Pearson’s chi-squared tests and one-way ANOVAs comparability between the control group and the experimental group is given.

Table 7: Sample composition of the gross sample of the second Web survey wave of the second study – overall, for the control group and the experimental group.

	Gross sample (n=1,355)	Allocation to preferred device (n=678)	Allocation to non-preferred device (n=677)
Characteristics	Mean or Percent	Mean or Percent	Mean or Percent
Age			
18-29	17.8%	18.4%	17.1%
30-39	16.7%	17.1%	16.2%
40-49	17.7%	15.8%	19.6%
50-59	18.5%	19.2%	17.7%
60+	29.4%	29.5%	29.2%
Gender (=female)	50.7%	48.7%	52.7%
Education			
Hauptschulabschluss or less (9 years or less)	34.6%	32.7%	36.5%
Realschulabschluss (10 years)	32.4%	32.9%	31.9%
Abitur (high school) (12/13 years)	33.0%	34.4%	31.6%
PC usage (frequency)			
Everyday	71.7%	73.5%	70.0%
Once/multiple times a week/month	23.9%	22.0%	25.5%
Seldom/never	4.4%	4.4%	4.4%
Tablet usage (frequency)			
Everyday	26.1%	26.7%	25.6%
Once/multiple times a week/month	27.6%	29.7%	25.5%
Seldom/never	46.3%	43.5%	49.1%
Smartphone usage (frequency)			
Everyday	92.8%	91.7%	93.8%
Once/multiple times a week/month	6.9%	7.7%	6.0%
Seldom/never	0.4%	0.6%	0.1%
PC knowledge			
Beginners	19.0%	17.2%	20.9%
Advanced/Professional	80.9%	82.9%	79.0%
Tablet knowledge			
Beginners	44.7%	42.0%	47.4%
Advanced/Professional	55.3%	58.0%	52.5%
Smartphone knowledge			
Beginners	18.6%	18.4%	18.8%
Advanced/Professional	81.5%	81.6%	81.3%
Internet usage (in hours)			
PC	3.34	3.38	3.30
Tablet	1.88	1.73	2.04
Smartphone	3.15	3.13	3.16

Note. Pearson's chi-squared tests and one-way ANOVAs were computed to compare characteristics of sample members of the control group to characteristics of sample members of the experimental group. The table shows means or percentages with ****p* < .001, ***p* < .01, **p* < .05, ^{+}p < .10.

7.4 Questionnaire

7.4.1 Study 1

The first study was on globalization and the refugee crisis. A responsive questionnaire design that accommodates all devices was implemented in both survey waves to ensure that respondents perceived no additional burden irrespective of the device they used to answer the Web survey. The responsive questionnaire design contained no images or logos, a larger font size was used for verbal information, an item-by-item format was used for grid questions and radio buttons/check boxes were enlarged. The questionnaire of the second Web survey wave which was used to measure response behavior and data quality contained 31 pages and 34 questions. A paging design was used but at the end some questionnaire pages showed multiple socio-demographic questions. The questionnaire contained questions on the respondent's attitude towards globalization, the European and German refugee policy as well as questions on the respondent's attitude towards and behavior with refugees.

7.4.2 Study 2

The two Web survey waves of the second study were on different topics. The first wave was on Internet and media use and the second wave was on the respondents' interest in policies and their attitude towards refugees. Again, a responsive questionnaire design was implemented in both Web survey waves to minimize the respondent burden due to questionnaire design. The responsive questionnaire design used a larger font size for verbal information, an item-by-item format for grid questions and radio buttons/check boxes were enlarged. In the first Web survey wave no images or logos were used but in the second Web survey wave the logo of the Darmstadt University of Technology was implemented to maximize the probability that it appears independent from the first Web survey wave. Logos and images are not recommended for responsive questionnaire designs because they take too much space from the available screen space on smartphones (Wells et al., 2014). However, the logo was small and additional burden for smartphone respondents due to the logo was expected to be on a very low level. The questionnaire of the second wave which again was used to measure response behavior and data quality contained 21 pages and 22 questions. A paging design was used but one questionnaire page showed two questions. Questionnaires of the second study differed slightly from questionnaires of the first study because socio-demographic questions were asked first rather than at the end. In the first Web survey wave of the second study, cross quotas for gender and age and independent quotas for education were used. Thus, questions on socio-demographic characteristics were asked at the beginning of the questionnaire. In the second Web survey wave of the second study, no quotas were used. However, questions on socio-demographic characteristics were again asked at the beginning of the questionnaire, because panel members of the online panel of Respondi are used to this question order.

7.5 Defining device preference

Previous studies on mode preference identified two different indicators which can be used to measure mode preference. Some mixed-mode surveys used the respondent’s mode choice whereas other surveys used the respondent’s attitude towards survey modes to measure mode preference (Groves & Kahn, 1979; Haan et al., 2014; Millar et al., 2009; Revilla, 2010). However, both indicators have limitations. The respondent’s mode choice does only indicate which of the survey modes offered in a mixed-mode survey respondents prefer while their overall mode preference might deviate from their mode choice in a mixed-mode survey (Smyth, Olson, & Kasabian, 2014). Regarding the attitude of respondents towards survey modes previous research has shown that the attitude is strongly influenced by the survey mode which is used to collect data on the attitudes of respondents towards survey modes (Olson et al., 2012; Tarnai & Paxson, 2004; Vandenplas, Loosveldt, & Vannieuwenhuyze, 2017). Both indicators have been adjusted and were used in previous research to measure device preference of respondents in Web surveys (de Bruijne & Wijnant, 2014b; Lugtig & Toepoel, 2015; Revilla, Toninelli, Ochoa, et al., 2016; Struminskaya et al., 2015). Using the attitude of respondents towards devices of Web survey participation previous research has shown that the drawback which occurred in the measurement of mode preference remains. The attitude of respondents towards devices of Web survey participation is affected by the device respondents use to answer the question on their attitude towards devices of Web survey participation (Baker-Prewitt, 2013). Therefore, the respondent’s choice is used to measure device preference of respondents in Web surveys. Furthermore, contrary to mixed-mode surveys, mixed-device Web surveys allowing respondents to use any Internet enabled device do not restrict the respondent’s device choice, thus, the respondent’s device choice in Web surveys might be a better indicator of the overall device preference of respondents for Web survey participation than using the respondent’s mode choice in mixed-mode surveys as indicator of the overall mode preference of respondents.

Device preference is measured separately from the Web survey which is used to evaluate response behavior and data quality to minimize shared method variance and to ensure an experimental investigation of the effect of responding with the preferred device on nonresponse and measurement. In the first study, the between-wave interval was very long with approximately two years, whereas in the second study approximately two weeks passed between both waves. According to F. P. Stafford (2010, p. 768) “the desirable periodicity depends on how quickly the phenomena under study are expected to change.” Previous research on the stability of mode preference has shown that mode preference was not a stable attitude for some respondents (51 percent) while other respondents stated the same mode preference over time (49 percent) (Al Baghal & Kelley, 2016). Al Baghal and Kelley (2016) used the attitude of respondents towards survey modes to measure mode preference in three survey waves over a two-year period. However, for some respondents the survey design changed from a unimode design (CAPI) to a sequential Web-CAPI mixed-mode design within this period. As mentioned above, the attitude of respondents towards survey modes depends on the survey mode, which is used to collect data on the respondent’s attitude towards survey modes, thus, changing the survey design might have affected the stability of mode preference. Comparing only the last two waves which used the same survey design only 27 percent of respondents changed their mode preference and 73 percent of respondents reported the same mode preference.

Considering the respondent’s device preference for Web survey participation the rapid evolvement and popularity of smartphones leads to the assumption that the respondent’s device preference for Web survey participation may change faster than the respondent’s mode preference. Moreover, Revilla, Toninelli, Ochoa, et al. (2016) showed that some respondents prefer to vary devices for Web survey participation. Their device preference depends on the respective survey request (length, topic, questionnaire design) and their situational context when receiving a survey request. However, previous research on device consistency in online panels revealed that a substantial amount of respondents used the same device for Web survey participation which they have used in the previous

Web survey wave (Lugtig & Toepoel, 2015; Struminskaya et al., 2015). In the GESIS panel in 2014, the average consistency for PC usage was 89 percentage points, for tablet use 68 percentage points and for smartphone participation 61 percentage points (Struminskaya et al., 2015). Results for the LISS panel for Web survey waves of the second and third quarter of 2013 were similar. The consistency for PC participation ranged from 72 to 90 percentage points, for tablet usage from 24 to 64 percentage points and for smartphone use from 29 to 45 percentage points (Lugtig & Toepoel, 2015). In both online panels the consistency of PC participation was on a very high level. The consistency of tablet and smartphone use was on a lower level but increased in both online panels within the considered time period. Thus, in 2016 when the first Web survey wave of the first present study was conducted the consistency of tablet and smartphone participation was considered even higher than the average consistency of tablet and smartphone use reported by Struminskaya et al. (2015). The periodicity of Web survey waves was one month in both online panels, thus, the between-wave interval of the second present study (two weeks) seems to be appropriate. However, the between-wave interval of the first present study (two years) should be treated with caution. The assumption is that respondents who preferred a smartphone for Web survey participation in 2016 still preferred a smartphone in 2018 but respondents who preferred a PC/tablet computer in 2016 might have changed their device preference for Web survey participation by 2018 which would result in lower effects of responding in their preferred device on nonresponse and measurement in the PC/tablet computer Web survey. The decision for the periodicity of the second study was based on another research interest, the long-term change of the attitude of young people at the beginning of their professional career towards globalization and the refugee crisis.

7.6 Data analyses

In the analyses, the control group is compared to the experimental group in terms of survey participation behaviors and their data quality. Descriptive analyses are used to determine the main effect of being assigned to the preferred device on survey participation behaviors and the main effect of responding with the preferred device on data quality. Descriptive analyses were conducted for the overall effect and separately for the smartphone and PC/tablet computer Web survey. Furthermore, multivariate regression analyses including various control variables were conducted to examine whether the main effect is due to differences of sample compositions. As outlined above, in the first study all sample members of the second Web survey wave were randomly assigned to complete the Web survey either with a smartphone or a PC/tablet computer rather than randomly assigning sample members with a smartphone preference and a PC/tablet computer preference respectively to device treatments. As a result, responding with the preferred device was not an experimental factor, thus, especially in the first study descriptive analyses on survey participation behaviors need to be extended by multivariate regression analyses controlling for differences of sample compositions between the control group and the experimental group (see Chapter 7.3.1). Moreover, device preference is not randomly assigned and analyses revealed that people with a smartphone preference differ from people with a PC/tablet computer preference (see Chapter 8.1.1 and Chapter 8.2.1). These differences can effect separate analyses of the smartphone Web survey and the PC/tablet computer Web survey. Thus, all descriptive analyses are extended by multivariate regression analyses accounting for these differences. Age and variables on the respondents' device literacy and Internet literacy were good predictors of device preference (Chapter 8.1.1 and Chapter 8.2.1). Furthermore, it is likely that analyses on data quality are affected by unit nonrespondents and non-conforming respondents. Thus, in multivariate regression analyses on data quality further socio-demographic variables predicting unit nonresponse and non-conformed responding were included. To provide consistency over all multivariate regression analyses control variables for analyses on survey response behaviors and data quality were standardized. Finally, multivariate regression models also provided the possibility to include the interaction term of device treatment and experimental design to examine whether the respective main effect differed between the smartphone Web survey and the PC/tablet computer Web survey (see H_{11}).

In the first study, missing values of control variables included in multivariate regression analyses decreased the sample size by 25 percentage points. To reduce item nonresponse of the control variables item missing data of control variables with item missing rates higher than three percent were multiple imputed 20 times using predictive mean matching (PMM), because variables were not normally distributed. Item missing data of three variables were multiple imputed: the highest school diploma of the respondents' father, the number of hours respondents spend on PCs and the monthly available financial resources of respondents. Using the multiple imputed data the sample size multivariate regression analyses are based on was increased by nine percentage points from 85 percent (n=2,616) to 94 percent (n=2,914). In the second study, missing data of control variables were not multiple imputed, because missing data of control variables included in multivariate regression models only decreased the sample size by 9 percentage points.

7.6.1 Indicators of participation behavior

In present analyses, nonresponse refers to sample members who did not participate in the Web survey (unit nonrespondents) and to sample members who ignored the device allocation and self-selected to participate with a different device (non-conforming respondents). Thus, conformance rates only refer to respondents who participated in the Web survey using the device they were assigned to.

Unit nonresponse rate

Compared to mail surveys, Web surveys using a paging design have the advantage that they can separate unit nonrespondents from survey breakoffs. In mail surveys no data is available for sample members who do not return the questionnaire and it remains unknown to survey researchers whether sample members refused to participate in the survey or started the survey but abandoned it later on. In Web surveys paradata or metadata allow survey researchers to trace the participation process in more detail, thus, survey breakoffs can be distinguished from unit nonrespondents (Bosnjak & Tuten, 2001a).

As outlined in Chapter 4.1, the decision process of sample members whether to participate in Web surveys involves various stages. However, for both present studies no data is available on the decision process prior starting the Web survey, thus, for example, unit nonrespondents who deleted the survey request without reading it cannot be separated from unit nonrespondents who refused to participate in the Web survey after evaluating the survey request. Data is only available for sample members who decided to click the survey link. Thus, the unit nonresponse rate (AAPOR, adapted REF3) is defined by the division of unit nonrespondents and all eligible sample members (AAPOR, 2016).

$$REF3 = \frac{R[-BO]}{(I + P) + (R + NC + O)}$$

REF=Refusal rate
R=Refusal and break-off
BO=Break-off
I=Complete interview
P=Partial interview
NC=Non-contact
O=Other

Rate of non-conforming respondents

In the first study, sample members of the second Web survey wave were able to participate with any device. Sample members who were assigned to respond with their smartphone but started the Web survey with a PC/tablet computer or sample members who were assigned to complete the Web survey with their PC/tablet computer but used a smartphone were identified as non-conforming respondents irrespective of their response behavior, whether they completed the Web survey or abandoned it. In the second study, sample members of the second Web survey wave were disallowed to participate in the Web survey with any other device than the one they were assigned to. The device sample members used to click on the survey link was recognized, thus, even though the second Web survey wave disallowed sample members to participate with an unassigned device, non-conforming respondents could be identified. Moreover, the device check was implemented by Respondi within the forwarding to the Web survey. Thus, it was possible for respondents who abandoned the Web survey to continue the Web survey with an unassigned device, because after abandoning the Web survey respondents were forwarded to the last questionnaire page they have seen. Hence, they were able to circumvent the device allocation. These respondents (smartphone Web survey: n=14; PC Web survey n=8) were also defined as non-conforming respondents. For analyses of the effect of being assigned to the preferred device on rates of non-conforming respondents, the amount of sample members who started or, after abandoning the Web survey, continued the Web survey with an unassigned device was divided by the number of respondents who participated in the Web survey with the assigned device.

According to Newell (1992) three different strategies of analysis can be applied to randomized controlled trials. The data structure of the present studies is similar to randomized controlled trials analyzing the effect of clinical interventions. Thus, the strategies of analysis can also be applied to the present studies. The intention-to-treat analysis compares respondents in the groups to which they were originally randomly assigned (compares 1+2 with 3+4 in Figure 7) (Hollis & Campbell, 1999). The second strategy is the efficacy analysis which compares group 1 to 3 and ignores group 2 and 4 (see Figure 7) and the last strategy of analysis, the treatment received analysis, compares respondents who used a smartphone with respondents who used a PC/tablet computer (compares 1+4 with 2+3 see Figure 7). In the present analyses the efficacy analysis was used, because the effect of the received device is of interest and not the effect of the device as assigned. Furthermore, the random assignment of respondents to complete the Web survey either with a smartphone or with a PC/tablet computer intended to reduce self-selection bias. Thus, the efficacy analysis was also preferred to the treatment received analysis. According to the efficacy analysis, non-conforming respondents counted as nonrespondents. Therefore, unit nonrespondents and non-conforming respondents are excluded for analyses on data quality.

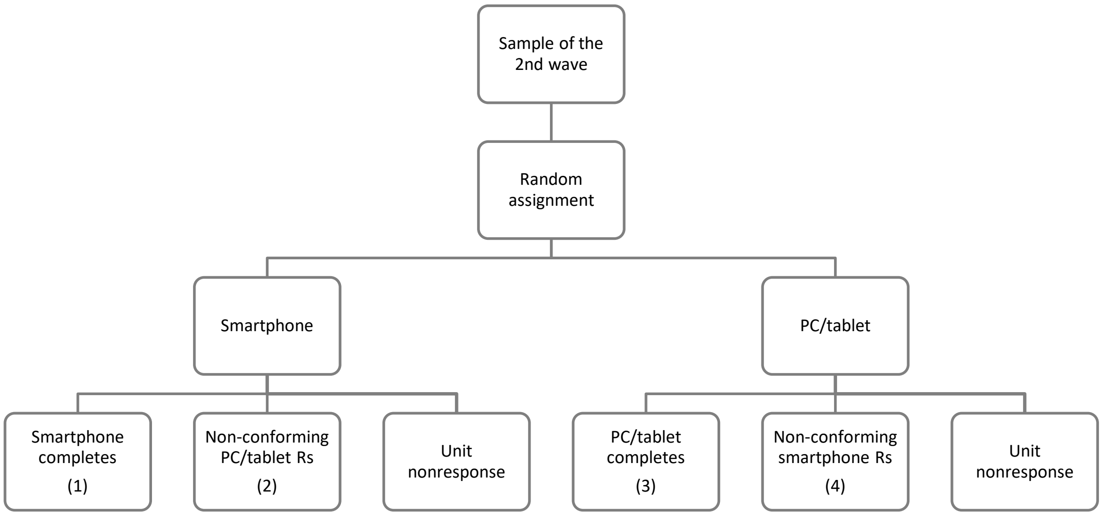

Figure 7: A simplified schema for the experimental design of the second wave of the present studies

Conformance rate

Finally, the conformance rate was calculated dividing the amount of respondents who participated in the Web survey and conformed the device allocation by the amount of all eligible cases (unit nonrespondents, non-conforming respondents and respondents conforming the assignment). Thus, the conformance rate is the inverse of the unit nonresponse rate and rates of non-conforming respondents. However, both studies do not provide information on the effort respondents expended to conform the assignment. Respondents who opened the email invitation on an unassigned device and switched to the assigned device to participate in the Web survey cannot be separated by respondents who received the email invitation on the assigned device and were able to conform the device allocation without switching the device. The latter group of respondents had to involve less effort to conform the device allocation than the former group of respondents, which may be an indicator of the respondent’s motivation associating their data quality. Respondents who conformed the device allocation can be identified but the effort they have expended to conform was not measured.

7.6.2 Indicators of data quality

In addition to the extent of survey breakoff, item nonresponse, the respondents' response latency and survey focus, response tendencies such as degree of differentiation in grid questions, length of responses to narrative open-ended questions and response order effects are commonly assumed to reflect a respondent's susceptibility to cognitive shortcuts and indicate the degree of data quality (Barge & Gehlbach, 2012; Kaminska et al., 2010; Krosnick, 1991; Smyth et al., 2009).

Survey Breakoff

In both studies, survey breakoff was measured by dividing the number of respondents who abandoned the Web survey at any questionnaire page by the number of all respondents who started the survey. However, the survey breakoff rate of the second study was on a very low level (1 percent). Thus, analyses were conducted on a comparable indicator. The number of respondents who temporarily abandoned the Web survey but completed it at a later time was divided by the number of all completes. Accordingly, analyses of the second study were based on interruption rates.

Item missing

In both studies, respondents were able to proceed to the next survey question without providing an answer. They were not prompted to report a response. Thus, skipping single survey questions had no consequences for respondents. Item nonresponse can be calculated at questionnaire level or at question level (e.g. grid questions). In both studies, item nonresponse rates were calculated on questionnaire level dividing the sum of all missing values by the number of questions. However, in both studies, item nonresponse rates were on a very low level. Thus, for analyses on item nonresponse a dummy variable was computed indicating whether respondents failed to answer at least one survey question or provided an answer to all survey questions.

Response time

In Web surveys, response times are commonly used measures but there are different ways to measure them (Couper & Peterson, 2016; Yan & Tourangeau, 2008). In both studies, response times were gathered by means of standard client-side time stamps implemented in the Web survey environment by default. For every questionnaire page a time stamp was gathered when respondents pressed the next button. The time stamp of the final questionnaire page provides the response time of survey completion. The response time at questionnaire level was used as first indicator of response time analyses. Furthermore, the response time at question level was calculated by subtracting the time stamp of the previous questionnaire page from the time stamp of the questionnaire page of interest. Response times of grid questions were used as second indicator of response time analyses. Grid questions were chosen for analyses, because the task difficulty of grid questions is higher compared to other question formats. Hence, satisficing is more likely in grid questions. Results are only presented for selected grid questions.

In the present analyses short response times are seen as an indicator of satisficing, because respondents who superficially go through the different stages of the question-answer process need less time to answer survey questions than respondents who thoroughly go through the question-answer process. However, the interpretation of response times is difficult (see Chapter 5.2.3) and speeding is a more unambiguous indicator of satisficing. According to Zhang and Conrad (2013, p. 128) "[s]peeding thresholds should be set low enough to capture answers that are unreasonably fast." In the present studies, speeding was defined by the tenth percentile of the response time of all respondents. Speeding was also defined at questionnaire level and at question level. Thus, four indicators were used for response time analyses.

Survey focus

In both studies, the JavaScript tool SurveyFocus (Schlosser & Höhne, 2018) was implemented providing client-side paradata on page-defocusing. The tool was implemented on each questionnaire page. Thus, survey focus can be analyzed on questionnaire level and on question level. In the present studies, survey focus on questionnaire level was assessed and a numeric variable was computed counting how often respondents left the Web survey page to engage in a secondary activity while completing the questionnaire. Thus, a high number indicates a weak survey focus whereas a low number indicates a strong survey focus.

Degree of differentiation

In general, the degree of differentiation describes to which extent respondents differentiate in their ratings of values in grid questions. Thus, respondents with a low degree of differentiation tend to report the same (straightlining) or nearly the same response option (nondifferentiation) for items of a grid question. Nondifferentiation is considered as an indicator of weak satisficing whereas straightlining is considered as an indicator of strong satisficing (Krosnick, 1991). Both indicators were used for analyses. For the calculation of the degree of differentiation, the formula suggested by McCarty and Shrum (2000) was used. Values can range from 0 to 1, with higher values indicating higher degrees of differentiation. However, the highest value depends on the number of items and response options of a grid question.

For analyses of the second indicator a dummy variable was computed indicating whether respondents used the same response option for all rating scale items of a grid question. However, in both studies, the definition of straightlining was weakened slightly and also respondents who used the same response option for all rating scale items except for one were defined as straightlining respondents.

Length of responses

The quality of responses to narrative open-ended questions is most often measured by the length of responses. Answering narrative open-ended questions is more burdensome for respondents than answering close-ended questions because formulating a response in your own words requires more cognitive effort than choosing an option from a close-ended question. To minimize the cognitive effort of responding, respondents may not answer narrative open-ended questions at all (item missing) or report shorter, less elaborated answers. Thus, long and more detailed answers to narrative open-ended questions seem to be an indicator of optimizing, whereas short and less detailed answers are an indicator of weak satisficing.

For analyses on the quality of answers to narrative open-ended questions the number of characters of answers were counted. Furthermore, the number of topics mentioned in answers to narrative open-ended questions were counted. However, analyses are only presented for the length of answers, because analyses on the number of topics mentioned in answers did not provide any further insights.

Primacy effects

In general, there are two types of response order effects. If response options are presented to respondents orally, the recency effect is more likely to occur. Whereas the primacy effect more likely occurs, if response options are presented to respondents visually. In the present studies, data quality is measured in Web surveys presenting response options to respondents visually. Thus, primacy effects are used as an indicator of weak satisficing (Krosnick, 1991). Primacy effects describe a respondent’s tendency to select response options presented early in a list rather than response options at the end of a list. Respondents either pay less attention to the later response options of a list due to respondent fatigue or they terminate their response process once they come upon a reasonable response option.

In the present studies, response options of multiple response questions were presented in two orders. For half of the respondents, response options were displayed in the original order and for the other half of respondents, response options were presented in the reversed order. To assess primacy effects, the difference between the percentage of respondents who selected at least one item of the items presented at the first half of the list and the percentage of respondents who selected at least one of these items when they were presented at the end of the list was calculated. Thus, the strength of primacy effects was assessed by the percentage point difference between the proportion of respondents who selected at least one item of a group of items in the original order and the proportion of respondents who selected at least one item of the same group of items in the reversed order.

7.6.3 Motives of survey participation

In the second study, multivariate regression analyses on data quality also accounted for the respondent’s content-orientated and process-orientated motivation. Both indicators were measured in the first Web survey wave in the second study. To measure the respondents process-orientated motivation and content-orientated motivation tested rating scale items on two motives of accessing the Internet were used. Two rating scale items on the motive escapism were used to measure the respondents’ process orientation and three rating scale items on the motive information were used to measure the respondents’ content orientation (Meeder, 2007, p. 209). All rating scale items used a five-point scale ranging from “totally agree” to “do not agree at all”. Response options were recoded, thus, low values indicated a low degree of content-orientation or process-orientation and high values indicated a high degree of content-orientation or process-orientation. The wording of the items is presented in Appendix C.

8 Results

8.1 Study 1

8.1.1 Device preference

The respondent's device choice of the first wave of the university applicants Web survey (Study 1) was used to measure their device preference (see Chapter 7.5). 42 percent of sample members of the second Web survey wave preferred a smartphone to complete the Web survey and 58 percent preferred a PC/tablet computer. In line with previous findings on device preference in Web surveys conducted among young respondents (students), the percentage of respondents who prefer a smartphone to a PC/tablet computer was on a very high level. However, most of the young respondents still prefer a PC/tablet computer to a smartphone.

A multivariate logistic regression analysis was conducted to determine how characteristics of sample members with a smartphone preference differ from sample members with a PC/tablet computer preference. Various socio-demographic characteristics which predicted device preference in previous studies were included in the multivariate logistic regression analysis such as age, gender, educational background, financial resources available per month and household size. However, only age showed a significant effect on device preference (see Table 8). Younger sample members of the second Web survey wave were significantly more likely to prefer a smartphone to a PC/tablet computer than older sample members. In addition to socio-demographic characteristics, indicators of the sample members' Internet behavior on the various devices are good predictors of the sample members' device preference for Web survey participation. The amount of hours sample members spend on the Internet on various devices on a typical day and the device sample members use most often to send and read emails were implemented in the multivariate logistic regression analysis. Results revealed that the likelihood that sample members prefer a smartphone to a PC/tablet computer significantly decreased the more time sample members spend on the Internet on a PC/tablet computer. As expected, the likelihood that sample members prefer a smartphone to a PC/tablet computer increased the more time sample members spend on the Internet on a smartphone. Finally, sample members who write and read emails most often on a PC/tablet computer were less likely to prefer a smartphone to a PC/tablet computer than sample members who write and read emails most often on a smartphone.

Table 8: Odds ratios of characteristics of sample members with a smartphone preference relative to sample members with a PC/tablet computer preference (Study 1)

	Odds ratio	**Standard error**
Intercept	6.14***	2.09
Age (continuous)	0.96**	0.01
Gender		
female	--	--
male	0.96	0.08
Highest education of parents (continuous)	0.95	0.04
Financial resources on a monthly basis (continuous)	1.00	0.00
HH size		
single-person HH	1.07	0.12
multi-person HH	--	--
Internet hours (continuous)		
PC	0.89***	0.01
Tablet	0.92*	0.03
Smartphone	1.11***	0.02
Email use		
PC	0.22***	0.02
Tablet	0.27***	0.06
Smartphone	--	--

Note. Multivariate logistic regression models with the dummy variable “smartphone preference” (0=PC/tablet computer preference; 1=smartphone preference) as dependent variable were computed. The table shows coefficients with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. “--“ identifies the reference categories.

8.1.2 Survey participation

Unit nonresponse rates

Overall, 64 percent (n=1,964) of sample members refused to participate in the second Web survey of Study 1. In the PC/tablet computer Web survey, 65 percent of sample members refused to participate and in the smartphone Web survey, the unit nonresponse rate amounted to 62 percent. The difference of 3 percentage points was not significant.

The assumption of Hypothesis 1 is that unit nonresponse rates are higher among sample members assigned to their non-preferred device than among sample members assigned to their preferred device. Figure 8 shows that the unit nonresponse rate amounted to 63 percent among sample members assigned to their preferred device whereas 65 percent of sample members assigned to their non-preferred device did not participate in the second Web survey of Study 1. The difference between unit nonresponse rates was very low and not significant. Findings of the PC/tablet computer Web survey revealed a

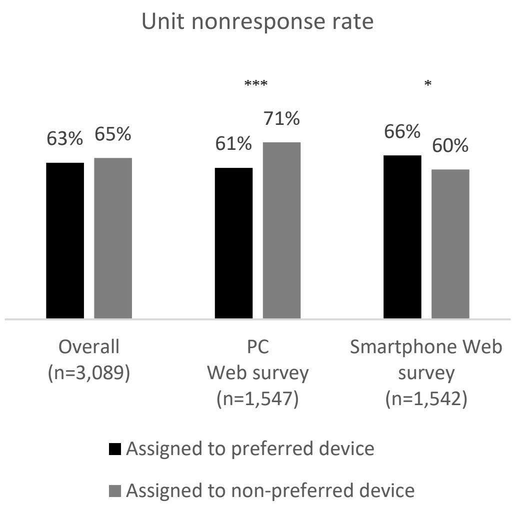

Figure 8: The effect of being assigned to the preferred device on unit nonresponse rates of the second Web survey wave of Study 1 overall and for the two device treatments
***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$

significant difference of unit nonresponse rates between sample members with a PC/tablet computer preference (assigned to their preferred device) and sample members with a smartphone preference (assigned to their non-preferred device) (χ^2 (1, 1,547) = 17.05, p < .001). As expected, the unit nonresponse rate in the PC/tablet computer Web survey was significantly higher among sample members assigned to their non-preferred device than among sample members assigned to their preferred device. The unit nonresponse rate of sample members with a PC/tablet computer preference amounted to 61 percent, whereas the unit nonresponse rate of sample members with a smartphone preference amounted to 71 percent. The effect size was on a low level (Φ = -.11). In the smartphone Web survey, unit nonresponse rates also differed significantly between sample members with a smartphone preference (assigned to their preferred device) and sample members with a PC/tablet computer preference (assigned to their non-preferred device) (χ^2 (1, 1,542) = 4.88, p < .05). Contrary to expectations, the unit nonresponse rate of sample members with a smartphone preference was significantly higher (66 percent) than the unit nonresponse rate of sample members with a PC/tablet computer preference (60 percent). The effect size was on a very low level (Φ = .06). The effect of being assigned to the preferred device had a significant effect on unit nonresponse rates of sample members in both subgroups. However, overall the allocation to their preferred device revealed no significant effect on unit nonresponse rates of sample members because the direction of the effect was different in the subgroups. Overall, both effects canceled each other out (suppressor effect). These findings already indicated a strong interaction effect between the device treatment of the second Web survey wave of Study 1 and the allocation to their preferred device on unit nonresponse rates (see Table 9).

As mentioned before, in the first study the allocation to their preferred device was not an experimentally assigned factor and the comparisons of sample members assigned to respond with their preferred and sample members assigned to respond with their non-preferred device showed small differences between both groups (see Chapter 7.3.1). Furthermore, device preference is an attitude of respondents that cannot be randomly assigned. Thus, multivariate logistic regression analyses accounting for variables predicting differences between both groups and variables associated with device preference were conducted to ensure that the effect of being assigned to the preferred device on unit nonresponse rates of sample members is not due to differences of sample compositions. Furthermore, the interaction term of the device treatment of the second Web survey wave and the allocation to their preferred device was implemented in multivariate logistic regression analyses to examine the eleventh hypothesis whether the effect of device preference on unit nonresponse rates is stronger for the smartphone Web survey than for the PC/tablet computer Web survey.

Table 9: Multivariate logistic regression models with the dependent variable unit nonresponse (Study 1)

	Model 1 (n=2,914)		**Model 2 (n=2,914)**		**Model 3 (n=2,914)**	
	OR	SE	OR	SE	OR	SE
Intercept	3.06**	1.07	2.43***	0.21	3.13**	1.10
Experimental condition						
Preferred device (EG)	0.88	0.07	0.61***	0.07	0.61***	0.07
Non-preferred device (CG)	--	--	--	--	--	--
Device treatment						
Smartphone Web survey	0.89	0.07	0.61***	0.07	0.62***	0.07
PC Web survey	--	--	--	--	--	--
Interaction effect						
Preferred*Smartphone	--	--	2.12***	0.33	2.07***	0.37
Age (continuous)	0.99	0.01			0.99	0.01
Gender						
male	1.06	0.09			1.06	0.09
female	--	--			--	--
Educational background (continuous)	0.91*	0.04			0.92*	0.04
Income (continuous)	1.00*	0.00			1.00*	0.00
HH size						
single-person HH	0.92	0.09			0.92	0.09
multi-person HH	--	--			--	--
Internet hours (continuous)						
PC	1.01	0.01			1.02	0.01
Tablet	0.99	0.03			1.00	0.03
Smartphone	1.03*	0.01			1.02	0.01
Email usage						
PC	0.89	0.08			1.00	0.09
Tablet	0.84	0.18			0.93	0.21
Smartphone	--	--			--	--
Attitude towards surveys (continuous)	1.03	0.08			1.03	0.08
Topic interest (continuous)	1.00	0.00			1.00	0.00
Pseudo r^2 **-2 LL**	Quality indicators for multivariate logistic regression models are not reported, because analyses are based on multiple imputed data.					

Note. Multivariate logistic regression models with the dummy variable "unit nonrespondents" (0=non-conforming/conforming respondents; 1=unit nonrespondents) as dependent variable were computed. The table shows coefficients with ***p < .001, **p < .01, *p < .05, ^{+}p < .10. "--" identifies the reference categories.

Results of multivariate logistic regression analyses confirmed descriptive analyses. Model 1 shows that differences of unit nonresponse rates between sample members assigned to their preferred device and sample members asked to use their non-preferred device for Web survey participation remained non-significant when variables predicting differences between experimental conditions and device preference were included (see Table 9). Furthermore, unit nonresponse rates did not differ significantly between sample members assigned to a smartphone and sample members assigned to a PC/tablet computer. Only, the educational background of sample members measured by the highest education of their parents and monthly available finical resources of sample members revealed a significant effect on unit nonresponse. The likelihood that sample members refused to participate in the Web survey was significantly higher among sample members with low educated parents than among sample members with high educated parents. Contrary, less affluent sample members were significantly less likely unit nonrespondents than highly affluent sample members. At last, the number of hours sample members spend on the Internet using a smartphone was associated with the likelihood that sample members refuse to participate in the Web survey. Sample members were significantly more likely unit nonrespondents the more hours they spend on the Internet using a smartphone.

The second model (see Table 9) confirmed descriptive analyses of the PC/tablet computer Web survey. In the PC/tablet computer Web survey, sample members with a smartphone preference were significantly more likely to participate than sample members with a PC/tablet computer preference (OR=0.61, SE=.07, p<.001). Furthermore, in the smartphone Web survey, sample members with a smartphone preference were more likely unit nonrespondents than sample members with a PC/tablet computer preference (OR=0.61*2.12=1.29). In line with descriptive analyses the effect is also significant as shown by Model 1 in Appendix D, Table 20. Model 2 also revealed that sample members who prefer a PC/tablet computer but were assigned to use a smartphone for Web survey participation were significantly less likely unit nonrespondents than sample members who prefer a smartphone but were assigned to use a PC/tablet computer for Web survey participation (OR=0.61, SE=.07, p<.001). These findings were contrary to explanations for Hypothesis 11 assuming that responding with a PC/tablet computer is less burdensome for sample members with a smartphone preference than responding with a smartphone for sample members with a PC/tablet computer preference. Although, the interaction effect on unit nonresponse was significant, Hypothesis 11 has to be rejected. The assumption was that the direction of the effect of being assigned to the preferred device on unit nonresponse was the same for sample members assigned to respond with a smartphone and sample members assigned to respond with a PC/tablet computer and that only the magnitude of the effect differs. However, the interaction term rather showed a significant effect on unit nonresponse, because the direction of the effect of being assigned to the preferred device on unit nonresponse differed between the PC/tablet computer Web survey and the smartphone Web survey. While findings revealed a positive effect within the smartphone Web survey, the effect was negative in the PC/tablet computer Web survey. In the smartphone Web survey, the likelihood that sample members with a smartphone preference refuse to participate was 29 percent (1.29-1*100) higher than the likelihood that sample members with a PC/tablet computer preference refuse to participate. In the PC/tablet computer Web survey, the likelihood that sample members with a PC/tablet computer preference refuse to participate was 64 percent ((1/0.61-1)*100) lower than the likelihood that sample members with a smartphone preference refuse to participate. Thus, even if the significant interaction effect was caused by the magnitude of the effect of being assigned to the preferred device on unit nonresponse, Hypothesis 11 has to be rejected, because the magnitude of the effect was stronger in the PC/tablet computer Web survey than in the smartphone Web survey.

The last model (Model 3) extended Model 2 by variables predicting differences between experimental conditions and device preference which have already been used in Model 1. The effect of being assigned to the preferred device on unit nonresponse rates in the PC/tablet computer Web survey remains significant, thus, the effect did not occur due to differences of sample compositions. Also, the difference of unit nonresponse rates between sample members with a smartphone preference who were assigned to use a PC/tablet computer for Web survey participation and sample members with a PC/tablet computer preference who were assigned to use a smartphone for Web survey participation stayed significant. Finally, the interaction term between the assignment to their preferred device and device treatment remained significant when accounting for predictors of differences of experimental conditions and device preference. Out of the predictor variables only the educational background of sample members and their monthly available financial resources had a significant effect on unit nonresponse. The effects were the same as in Model 1. Sample members with low educated parents were more likely unit nonrespondents than sample members with high educated parents and the likelihood that sample members refused to participate in the Web survey increased with their degree of affluence.

Model 4 in Appendix D, Table 20, revealed that also in the smartphone Web survey the effect of being assigned to the preferred device on unit nonresponse rates remains significant when accounting for variables predicting differences between experimental conditions and device preference. Thus, in the smartphone Web survey the effect was also not due to differences of sample compositions.

Rates of non-conforming respondents

In total, 14 percent of sample members did not respond with the device they were assigned to and the rate of non-conforming respondents is comparable to other studies (Antoun, 2015a; Toninelli & Revilla, 2016). Furthermore, the rate of non-conforming respondents is associated with the device treatment. In the PC/tablet computer Web survey, 10 percent of respondents self-selected to use a smartphone. Whereas, in the smartphone Web survey, the percentage of sample members who decided to use a PC/tablet computer for participation was significantly higher (18 percent) than in the PC/tablet computer Web survey (χ^2 (1, 3,089) = 41.85, $p < .001$). The effect size was on a low level ($\Phi = -.12$).

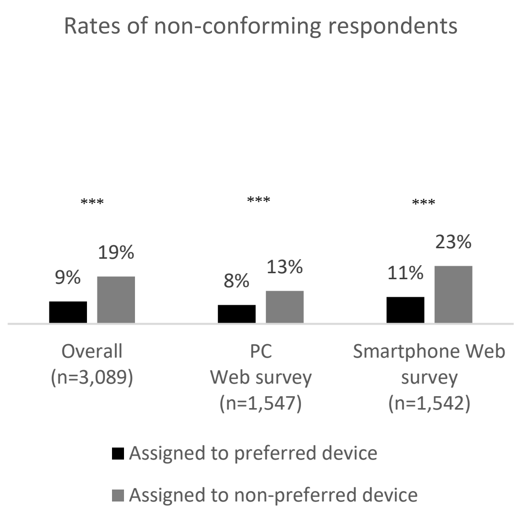

Figure 9: The effect of being assigned to the preferred device on rates of non-conforming respondents of the second Web survey wave of Study 1 overall and for the two device treatments
***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$

According to the second hypothesis rates of non-conforming respondents were expected to be higher among sample members assigned to respond with their non-preferred device than among sample members assigned to respond with their preferred device. Overall, rates of non-conforming respondents differed significantly between sample members assigned to their preferred device and sample members assigned to their non-preferred device (χ^2 (1, 3,089) = 64.61, $p < .001$). As expected, 19 percent of sample members assigned to their non-preferred device did not conform the device allocation whereas the rate of non-conforming respondents of sample members assigned to their preferred device amounted to only 9 percent. The effect size was on a moderate level ($\Phi = -.15$). Rates of non-conforming respondents also differed significantly as a function of device allocation in the PC/tablet computer Web survey (χ^2 (1, 1,547) = 13.46, $p < .001$). In the PC/tablet computer Web survey, rates of non-conforming respondents of sample members with a smartphone preference were 5 percentage points higher (13 percent) than rates of non-conforming respondents of sample members with a PC/tablet computer preference (8 percent). The effect size was on a low level ($\Phi = -.09$). In the smartphone Web survey, the difference of rates of non-conforming respondents between sample members with a smartphone preference and sample members with a PC/tablet computer was also significant (χ^2 (1, 1,542) = 38.86, $p < .001$). As expected, sample members with a smartphone preference who were asked to use a smartphone for Web survey participation were less likely non-conforming respondents (11 percent) than sample members with a PC/tablet computer preference who were assigned to participate with a smartphone in the second Web survey wave of Study 1 (23 percent).

Next, multivariate logistic regression analyses accounting for predictors of differences between experimental conditions and device preference were calculated. The interaction term of device treatment and the allocation to their preferred device was also included to examine the eleventh hypothesis. Result of multivariate logistic regression analyses confirmed results of descriptive analyses (see Table 10). The likelihood that sample members self-selected to participate in the Web survey with a different device than they were assigned to was significantly lower among sample members assigned to their preferred device than among sample members assigned to their non-preferred device (Model 1: OR=.47, SE=.06, p<.001). Furthermore, logistic regression analyses also confirmed that sample members assigned to a smartphone for Web survey participation were significantly more likely non-conforming respondents than sample members assigned to a PC/tablet computer (Model 1: OR=1.82, SE=.21, p<.001). Both effects stayed significant when including variables predicting differences between experimental conditions and device preference (see Table 10, Model 1). Thus, effects were not due to differences of sample compositions. None of the control variables showed a significant effect on rates of non-conforming respondents.

Table 10: Multivariate logistic regression models with the dependent variable non-conformed responding (Study 1)

	Model 1 (n=2,914)		**Model 2 (n=2,914)**		**Model 3 (n=2,914)**	
	OR	SE	OR	SE	OR	SE
Intercept	0.11***	0.05	0.14***	0.02	0.11***	0.05
Experimental condition						
Preferred device (EG)	0.47***	0.06	0.58**	0.10	0.60**	0.11
Non-preferred device (CG)	--	--	--	--	--	--
Device treatment						
Smartphone Web survey	1.82***	0.21	2.09***	0.30	2.15***	0.34
PC Web survey	--	--	--	--	--	--
Interaction effect						
Preferred*Smartphone	--	--	0.69	0.16	0.65	0.17
Age (continuous)	1.00	0.01			1.00	0.01
Gender						
male	1.09	0.13			1.09	0.13
female	--	--			--	--
Educational background (continuous)	1.04	0.06			1.04	0.06
Income (continuous)	1.00	0.00			1.00	0.00
HH size						
single-person HH	0.82	0.12			0.82	0.12
multi-person HH	--	--			--	--
Internet hours (continuous)						
PC	0.98	0.02			0.98	0.02
Tablet	1.04	0.04			1.04	0.04
Smartphone	0.98	0.02			0.98	0.02
Email usage						
PC	1.00	0.13			0.93	0.12
Tablet	1.07	0.32			1.00	0.30
Smartphone	--	--			--	--
Attitude towards surveys (continuous)	1.10	0.12			1.10	0.12
Topic interest (continuous)	1.00	0.00			1.00	0.00
Pseudo r² **Log likelihood**	Quality indicators for multivariate logistic regression models are not reported, because analyses are based on multiple imputed data.					

Note. Multivariate logistic regression models with the dummy variable "non-conforming respondents" (0=unit nonrespondents/conforming respondents; 1=non-conforming respondents) as dependent variable were computed. The table shows coefficients with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

The second model (see Table 10) included only a dummy variable indicating whether sample members were assigned to their preferred device, another dummy variable indicating whether sample members were assigned to use a smartphone or a PC/tablet computer and the interaction term of both variables. Due to the interaction term, results revealed the effect of variables on rates of non-conforming respondents for specific subgroups rather than the overall main effects. Again, multivariate logistic regression models confirmed findings of descriptive analyses. In the PC/tablet computer Web survey, sample members with a PC/tablet computer preference significantly less likely self-selected to use a smartphone than sample members with a smartphone preference (Model 2: OR=.58, SE=.10, p<.01). Accordingly, in the smartphone Web survey sample members with a smartphone preference significantly less likely self-selected to use a PC/tablet computer than sample members with a PC/tablet computer preference (OR=0.58*0.69=0.40). The effect was also significant as shown by Model 3 in Appendix D, Table 20. Furthermore, Model 2 also indicates that sample members with a PC/tablet computer preference who are assigned to use a smartphone for Web survey participation are significantly more likely non-conforming respondents than sample members with a smartphone preference who are assigned to use a PC/tablet computer for Web survey participation (Model 2: OR=2.09, SE=.30, p<.001). These findings are in line with explanations of Hypothesis 6. However, the interaction term did not reveal a significant effect. Thus, the effect of being assigned to the preferred device on rates of non-conforming respondents did not differ significantly between the smartphone Web survey and the PC/tablet computer Web survey. The statistically significant effects remained significant when accounting for characteristics of sample members predicting differences between experimental conditions and device preference (see Model 3 in Table 10 and Model 4 in Appendix D, Table 20). Thus, the effects were not due to differences of sample compositions.

Conformance rate

Finally, 22 percent of sample members started the Web survey with the assigned device which is a common response rate in Web surveys. Among sample members who were assigned to the PC/tablet computer Web survey 25 percent of sample members started the Web survey using a PC/tablet computer. The percentage of sample members who were assigned to use a smartphone for Web survey participation and started the survey with the assigned device was significantly lower (20 percent) than the conformance rate in the PC/tablet computer Web survey (χ^2 (1, 3,089) = 12.47, p < .001). The effect size was on a very low level (Φ = .06). These findings are also in line with previous research showing that response rates of smartphone respondents are lower than response rates of PC/tablet computer respondents (de Bruijne & Wijnant, 2013; Mavletova, 2013; Wells et al., 2014).

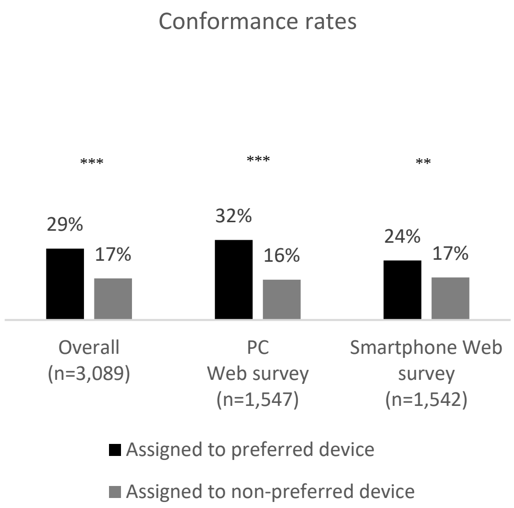

Figure 10: The effect of being assigned to the preferred device on conformance rates of the second Web survey wave of Study 1 overall and for the two device treatments
****p* < .001, ***p* < .01, **p* < .05, ⁺*p* < .10

According to the third hypothesis conformance rates are expected to be higher among sample members assigned to their preferred device than among sample members assigned to their non-preferred device. Overall, the effect of being assigned to the preferred device on conformance rates was significant (χ^2 (1, 3,089) = 62.73, p < .001). As expected, the conformance rate of sample members assigned to their preferred device was 12 percentage points higher (29 percent) than the conformance rate of sample members assigned to their non-preferred device (17 percent). The effect size was on a low level (Φ = -.14). In the PC/tablet computer Web survey, the conformance rate of sample members with a PC/tablet computer preference was also significantly higher (32 percent) than the conformance rate of sample members with a smartphone preference (16 percent) (χ^2 (1, 1,547) = 50.11, p < .001). The effect size was on a moderate level (Φ = -.18). Finally, in the smartphone Web survey, conformance rates also differed significantly as a function of being assigned to the preferred device (χ^2 (1, 1,542) = 11.06, p < .01). The conformance rate of sample members with smartphone preference was significantly higher (24 percent) than the conformance rate of sample members with a PC/tablet computer preference (17 percent). The effect size was on a low level (Φ = -.09).

Furthermore, multivariate logistic regression analyses were conducted to ensure that effects of being assigned to the preferred device on conformance rates of sample members were not due to differences of sample compositions. Results of multivariate logistic regression analyses confirm descriptive analyses (see Table 11). Overall, sample members who were assigned to their preferred device started the Web survey significantly more likely with the assigned device than sample members who were assigned to their non-preferred device (Model 1: OR=1.93, SE=.18, p<.001). In line with previous research, the conformance rate of sample members assigned to a smartphone was significantly lower than the conformance rate of sample members assigned to a PC/tablet computer (Model 1: OR=.79, SE=.07, p<.01). These effects stayed statistically significant when accounting for characteristics of sample members predicting differences between experimental conditions and device preference. Thus, effects of descriptive analyses were not due to differences of sample compositions (see Table 11, Model 1). Regarding the characteristics of sample members, the educational background of sample members, their monthly available financial resources and the household size revealed a significant effect on conformance rates. Conformance rates of sample members with high educated parents were significantly higher than conformance rates of sample members with low educated parents. Furthermore, conformance rates of sample members significantly increased with their degree of affluence. Finally, the likelihood that sample members started the Web survey with the assigned device was significantly higher among sample members living in a single-person household than among sample members living in a multi-person household.

Table 11: Multivariate logistic regression models with the dependent variable conformance (Study 1)

	Model 1 (n=2,914)		**Model 2 (n=2,914)**		**Model 3 (n=2,914)**	
	OR	SE	OR	SE	OR	SE
Intercept	0.17***	0.07	0.20***	0.02	0.17***	0.07
Experimental condition						
Preferred device (EG)	1.93***	0.18	2.44***	0.32	2.37***	0.33
Non-preferred device (CG)	--	--	--	--	--	--
Device treatment						
Smartphone Web survey	0.79**	0.07	1.04	0.15	1.00	0.15
PC Web survey	--	--	--	--	--	--
Interaction effect						
Preferred*Smartphone	--	--	0.61**	0.11	0.66*	0.14
Age (continuous)	1.01	0.01			1.01	0.01
Gender						
male	0.87	0.08			0.87	0.08
female	--	--			--	--
Educational background (continuous)	1.10*	0.05			1.10*	0.05
Income (continuous)	1.00*	0.00			1.00*	0.00
HH size						
single-person HH	1.26*	0.14			1.27*	0.15
multi-person HH	--	--			--	--
Internet hours (continuous)						
PC	1.00	0.02			0.99	0.02
Tablet	0.98	0.03			0.98	0.03
Smartphone	0.98	0.01			0.99	0.01
Email usage						
PC	1.12	0.12			1.04	0.11
Tablet	1.18	0.30			1.11	0.28
Smartphone	--	--			--	--
Attitude towards surveys (continuous)	0.90	0.08			0.90	0.08
Topic interest (continuous)	1.00	0.00			1.00	0.00
Pseudo r^2 **Log likelihood**	Quality indicators for multivariate logistic regression models are not reported, because analyses are based on multiple imputed data.					

Note. Multivariate logistic regression models with the dummy variable "conforming respondents" (0=unit nonrespondents/non-conforming respondents; 1=conforming respondents) as dependent variable were computed. The table shows coefficients with ***p < .001, **p < .01, *p < .05, ^{+}p < .10. "--" identifies the reference categories.

The second model shows the effect of being assigned to the preferred device on conformance rates of sample members who were assigned to use a PC/tablet computer for Web survey participation. Findings confirmed descriptive analyses. The conformance rate of sample members with a PC/tablet computer preference who were assigned to use a PC/tablet computer for Web survey participation was higher than the conformance rate of sample members with a smartphone preference who were assigned to use a PC/tablet computer for Web survey participation (OR=1.93, SE=.18, p<.001). In the smartphone Web survey, the effect was also significant (see Model 5 in Appendix D, Table 20). The conformance rate of sample members with a smartphone preference who were assigned to use a smartphone for Web survey participation was higher than the conformance rate of sample members with a PC/tablet computer preference who were assigned to use a smartphone for Web survey participation (OR = 1.93*0.79 = 1.10). The dummy variable indicating whether sample members were assigned to a smartphone or a PC/tablet computer was not statistically significant. Thus, the conformance rate of sample members with a smartphone preference who were assigned to use a PC/tablet computer for Web survey participation did not differ significantly from the conformance rate of sample members with a PC/tablet computer preference who were assigned to use a smartphone for Web survey participation. These findings were contrary to explanations of the eleventh hypothesis. However, the interaction term of the dummy variable indicating whether sample member were assigned to their preferred device and the dummy variable indicating whether sample members were assigned to use a smartphone or a PC/tablet computer for Web survey participation was significant (OR = 0.61, SE = .11, $p < .01$). The effect of the assignment to their preferred device on conformance rates was positive within both subgroups, the smartphone Web survey and the PC/tablet computer Web survey. In the PC/tablet computer Web survey, the likelihood that sample members with a PC/tablet computer preference started the Web survey with a PC/tablet computer was 93 percent higher than the likelihood that sample members with a smartphone preference participated in the Web survey with a PC/tablet computer. Whereas, in the smartphone Web survey, the likelihood that sample members with a smartphone preference participated in the Web survey with a smartphone was only 10 percent higher than the likelihood that sample members with a PC/tablet computer preference started the Web survey with a smartphone. Thus, as expected the effect of being assigned to the preferred device on conformance rates differed significantly between sample members assigned to a smartphone and sample members assigned to a PC/tablet computer. However, contrary to expectations the effect was stronger in the PC/tablet computer Web survey than in the smartphone Web survey. The statistically significant effects remained significant when accounting for characteristics of sample members predicting differences between experimental conditions and device preference (see Model 3 in Table 11 and Model 6 in Appendix D, Table 20). Thus, the effects were not due to differences of sample compositions. Regarding the characteristics of sample members only the educational background, the monthly available financial resources and the household size indicated a significant effect on conformance rates. The direction of effects was the same as described in Model 1.

8.1.3 Data quality

Survey breakoff[5]

Overall, 11 percent of respondents abandoned the second Web survey wave of Study 1. The breakoff rate was slightly higher among smartphone respondents (12 percent) than among PC/tablet computer respondents (11 percent) but the difference was not significant.

According to Hypothesis 4 breakoff rates of sample members responding with the preferred device were expected to be lower than breakoff rates of sample members responding with their non-preferred device. Contrary to expectations, findings of the Pearson's chi-squared test revealed that respondents using their preferred device were significantly more likely to abandon the Web survey (14 percent) than respondents using their non-preferred device (7 percent) (χ^2 (1, 693) = 6.35, p < .05) (see Figure 11). The effect size was on a low level (Φ = .10). The tendency is similar in the PC/tablet Web survey and in the smartphone Web survey. In the PC/tablet computer Web survey, 12 percent of respondents with a PC/tablet computer preference abandoned the Web survey, whereas only 7 percent of respondents with a smartphone preference abandoned the Web survey. However, the difference of 5 percentage points between breakoff rates was not significant. In the smartphone Web survey, the breakoff rate of respondents with a smartphone preference was significantly higher (16 percent) than the breakoff rate of

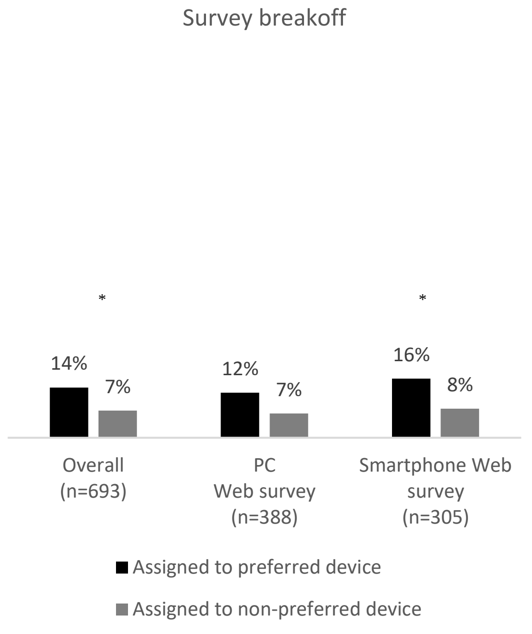

Figure 11: The effect of responding with the preferred device on survey breakoff, overall and for both subgroups
***p < .001, **p < .01, *p < .05, ^+p < .10

[5] Survey breakoff analyses are based on respondents who started the Web survey with the assigned device (n=693). Unit nonrespondents and non-conforming respondents are excluded from analyses.

respondents with a PC/tablet computer preference (8 percent) (χ^2 (1, 305) = 4.81, $p < .05$). The effect size was on a low level ($\Phi = .13$).

Multivariate logistic regression analyses confirmed results of descriptive analyses and when accounting for variables predicting device preference, unit nonresponse and non-conformed responding the effect of responding with the preferred device on breakoff rates remained significant. Thus, the effect was not due to differences of sample compositions (see Model 1 in Appendix D, Table 21). Furthermore, multivariate logistic regression analyses also confirm that the likelihood for survey breakoff did not differ between PC/tablet computer respondents with a PC/tablet computer prefernce and PC/tablet computer respondents with a smartphone preference (see Model 2 in Appendix D, Table 21). Even when accounting for variables predicting device preference, unit nonresponse and non-conformed responding the allocation to their preferred device had no significant effect on survey breakoff (see Model 3 in Appendix D, Table 21). Finally, multivariate logistic regression analyses confirmed the significant effect of responding with the preferred device on survey breakoff among smartphone respondents (see Model 4 in Appendix D, Table 21). The effect remained significant when controlling for variables predicting device preference, unit nonresponse and non-conformed responding, thus, the effect was not due to differences of sample compositions (see Model 5 in Appendix D, Table 21).

Out of the variables predicting device preference, unit nonresponse and non-conformed responding only two had a significant effect on survey breakoff. Highly affluent respondents were significantly more likely to abandon the Web survey than less affluent respondents. Furthermore, the likelihood that respondents abandoned the Web survey significantly increased with the time respondents access the Internet at a smartphone (see Model 1, Model 3 and Model 5 in Appendix D, Table 21).

Item nonresponse[6]

Overall, 42 percent of respondents did not skip any question in the Web survey. Thus, the item nonresponse rate was on average on a very low level (2 percent). Therefore, analyses were based on a dummy variable indicating whether respondents answered all survey questions or skipped at least one survey item rather than using the item nonresponse rate.

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[6] Respondents who abandoned the Web survey are excluded for analyses on item missing and all further analyses on data quality of respondents (n=615).

Findings revealed that slightly more PC/tablet computer respondents skipped at least one survey item (59 percent) than smartphone respondents (56 percent). However, the difference of 3 percentage points was not significant.

According to the Hypothesis 5 the likelihood that sample members skip survey questions without reporting an answer is higher among respondents responding with their non-preferred device than among respondents responding with the preferred device. However, responding with their preferred device was not associated with item nonresponse (see Figure 12). Contrary to expectations, item nonresponse was more likely among respondents who completed the Web survey with their preferred device (60 percent) than among respondents who answered the Web survey with their non-preferred device (54 percent). However, the difference of 6 percentage points was not significant. The tendency was similar in the PC/tablet computer Web survey and in the smartphone Web survey but differences were also not significant.

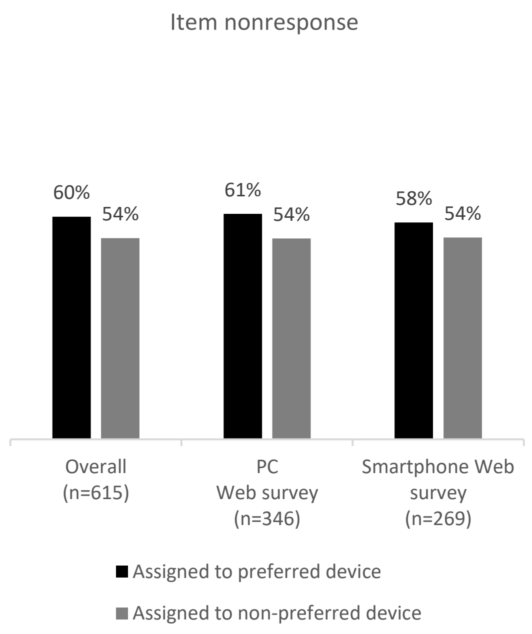

Figure 12: The effect of responding with the preferred device on item nonresponse, overall and for both subgroups
***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$

Multivariate logistic regression analyses confirm descriptive analyses. Responding with the preferred device had no significant effect on the respondents' likelihood to skip survey questions without reporting an answer. Even when controlling for variables predicting unit nonresponse, non-conformed responding and device preference the effect of responding with the preferred device on item nonresponse remained non-significant (see Model 1 in Appendix D, Table 22). In the PC/tablet computer Web survey and in the smartphone Web survey responding with the preferred device had also no significant effect on item nonresponse and the effects remained non-significant when controlling for variables predicting unit nonresponse, non-conformed responding and device preference (see Model 2 to Model 5 in Appendix D, Table 22). Accordingly, the interaction term between the device treatment and the allocation to their preferred device also showed no significant effect (see Model 2 and Model 4 in Appendix D, Table 22).

From the control variables only the respondents' interest in the survey topic showed a significant effect on item nonresponse (see Model 1, Model 3 and Model 5 in Appendix D, Table 22). Respondents with a high interest in the survey topic were less likely item nonrespondents than respondents with a low interest in the survey topic.

Response time

The average response time of respondents who completed the second Web survey wave of Study 1 was 1,103 seconds (18 minutes)[7]. The average response time did not differ between respondents assigned to respond with a smartphone (1,105 seconds/18 minutes) and respondents assigned to respond with a PC/tablet computer Web survey (1,101 seconds/18 minutes).

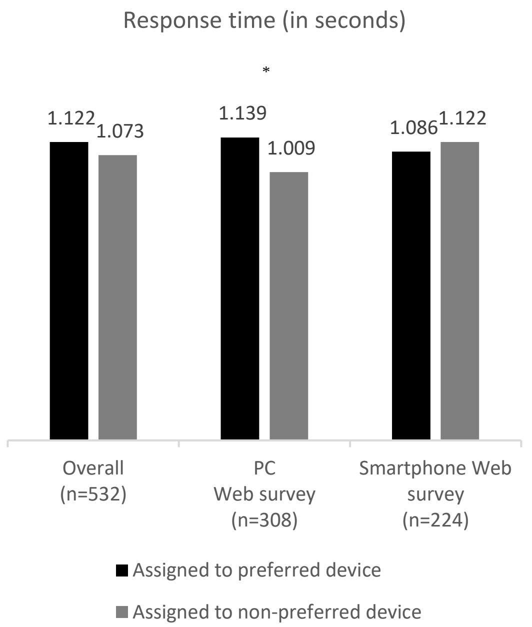

Figure 13: The effect of responding with the preferred device on response time, overall and for both subgroups
***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$

According to the sixth hypothesis the completion time of respondents who complete the Web survey with their preferred device is expected to be longer than the completion time of respondents who answer the Web survey with their non-preferred device. As expected, the average response time of respondents assigned to respond with their preferred device was slightly higher (1,122 seconds/19 minutes) than the average response time of respondents assigned to their non-preferred device (1,073 seconds/18 minutes) but the difference was not statistically significant. However,

[7] Respondents who abandoned the Web survey but completed it to a subsequent date (n=52) and outliers (2*stddev+mean) separately defined for respondents with a smartphone preference who were assigned to respond with a smartphone, respondents with a smartphone preference assigned to respond with a PC/tablet computer, respondents with a PC/tablet computer assigned to respond with a PC/tablet computer and respondents with a PC/tablet computer preference assigned to a smartphone were excluded from analyses (n=31).

in the PC/tablet computer Web survey, the average response time differed significantly between respondents with a PC/tablet computer preference and respondents with s smartphone preference ($F (1, 308) = 4.60$, $p < .05$). As expected, the average response time of respondents with a PC/tablet computer preference assigned to respond with a PC/tablet computer was significantly longer (1,139 seconds/19 minutes) than the average response time of respondents with a smartphone preference who were assigned to respond with a PC/tablet computer (1,009 seconds/17 minutes). But the effect size was on a very low level ($eta^2 = .02$). In the smartphone Web survey, the tendency was contrary to expectations. The average response time of respondents with a smartphone preference who were assigned to respond with a smartphone was shorter (1,086 seconds/18 minutes) than the average response time of respondents with a PC/tablet computer preference who were assigned to respond with a smartphone (1,122 seconds/19 minutes). However, the difference was not statistically significant.

Multivariate linear regression analyses confirmed descriptive analyses. Overall, responding with the preferred device had no effect the completion time of respondents even when accounting for variables predicting unit nonresponse, non-conformed responding and device preference (see Model 1 in Appendix D, Table 23). In the PC/tablet computer Web survey, responding with the preferred device had a significant effect on the completion times of respondents (see Model 2 in Appendix D, Table 23) but the effect was only marginally significant when including the control variables (see Model 3 in Appendix D, Table 23). Thus, the effect may be due to differences of sample compositions. Furthermore, multivariate linear regression analyses indicated that the completion time of smartphone respondents with a PC/tablet computer preference was significantly higher than the completion time of PC/tablet computer respondents with a smartphone preference (see Model 2 and Model 4 in Appendix D, Table 23). These findings were also contrary to explanations of Hypothesis 11 assuming that response burden is lower for PC/tablet computer respondents with a smartphone preference than for smartphone respondents with a PC/tablet computer preference, which was expected to result in more optimizing respondents and longer completion times among the former group. However, the effect became non-significant when accounting for control variables (see Model 3 and Model 5 in Appendix D, Table 23). The interaction effect was also significant in Model 2 and Model 4 (in Appendix D, Table 23). Contrary to expectations the interaction effect was significant because the direction of the effect of responding with the preferred device on completion times differed between smartphone respondents and

PC/tablet computer respondents rather than the magnitude. However, the interaction effect became also non-significant when accounting for control variables (see Model 3 and Model 5 in Appendix D, Table 23).

Considering the control variables age, the number of Internet hours on a tablet and topic interest are associated with the respondents' completion time (see Model 1, Model 3 and Model 5 in Appendix D, Table 23). The completion time of older respondents is significantly longer than the completion time of younger respondents, the number of Internet hours spend on a tablet decreases the completion time of respondents and the completion time of respondents with a high interest in the survey topic is longer than the completion time of respondents with a low interest in the survey topic.

Next, speeding at questionnaire level was used to gain more insights on the effect of responding with the preferred device on the respondents' completion times. The 10 percent quantile of the completion time of all respondents was used to identify speeders[8]. The percentage of speeding was slightly lower among smartphone respondents (9 percent) than among PC/tablet computer respondents (11 percent) but the difference was not statistically significant.

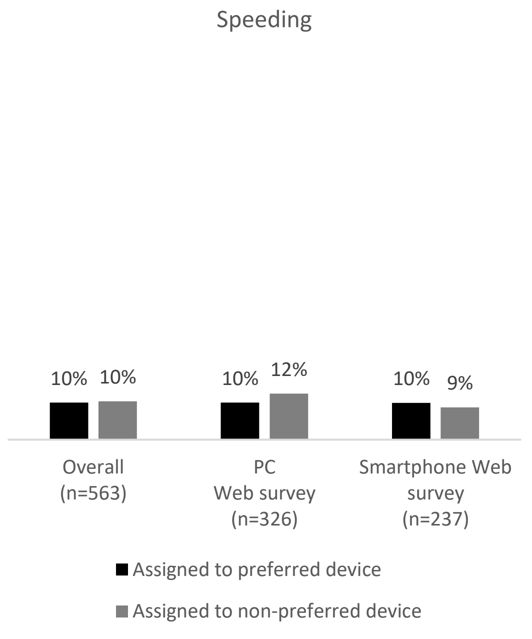

Figure 14: The effect of responding with their preferred device on speeding, overall and for both subgroups
***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$

The percentage of speeding did also not differ between respondents using their preferred device and respondents using their non-preferred device (overall, in the smartphone Web survey and in the PC/tablet computer Web survey).

Multivariate logistic regression analyses confirmed descriptive analyses. Even multivariate logistic regression analyses accounting for variables predicting unit nonresponse, non-

[8] The overall 10 percent quantile was used rather than group specific 10 percent quantiles to enable identifying differences between respondents assigned to respond with their preferred device and respondents assigned to respond with their non-preferred device as well as between respondents assigned to respond with a smartphone and respondents assigned to respond with a PC/tablet computer.

conformed responding and device preference did not reveal any effect of responding with the preferred device on speeding (see Model 1 to Model 5 in Appendix D, Table 24)Table 23. Only the number of Internet hours respondents spend on a tablet and the respondents' topic interest were associated with speeding at questionnaire level. Speeding was more likely among respondents who spend more time on their tablet to access the Internet than among respondents who spend less time on their tablet to access the Internet. Furthermore, even though completion times of respondents with a high level of topic interest were longer than completion times of respondents with a low level of topic interest, respondents with a high level of topic interest were also more likely to speed than respondents with a low level of topic interest (see Model 1, Model 3 and Model 5 in Appendix D, Table 24).

Finally, response times of specific questions were assessed, because analyses of the overall response time do not consider that satisficing response behavior in one question may be compensated by optimizing response behavior in another question. Two grid questions positioned at the beginning and in the middle of the questionnaire were chosen for analyses[9]. Grid questions were selected for analyses because the task difficulty of this question type is on a high level, increasing the likelihood that respondents use a satisficing response behavior. The first grid question asked respondents to rate the likelihood of various political and societal events and the second grid question was on the respondents' attitude towards immigrants. A five-point scale was used for both grid questions. The first question consisted of 10 items whereas the second grid question included 5 items. Thus, the task difficulty of the first question was higher than the task difficulty of the second question.

The average response time of the first question was 88 seconds whereas the average response time of the second grid question was only 35 seconds[10]. In both questions, the average response time of respondents who used a PC/tablet computer was shorter (1st grid: 87 sec.; 2nd grid: 33 sec.) than the average response time of respondents

[9] A third grid question positioned between the two grid questions was asked in the questionnaire but was not used for analyses of response times, because results of this grid question were in line with results of the first grid question used for analyses of response times.

[10] Outliers (2*stddev+mean) separately defined for respondents with a smartphone preference who were assigned to respond with a smartphone, respondents with a smartphone preference assigned to respond with a PC/tablet computer, respondents with a PC/tablet computer assigned to respond with a PC/tablet computer and respondents with a PC/tablet computer preference assigned to a smartphone were excluded from analyses (1st grid: n=26; 2nd grid: n=17).

using a smartphone (1^{st} grid: 89 sec.; 2^{nd} grid: 37 sec.). In the second grid question, the difference of the average response time between respondents using a smartphone and respondents using a PC/tablet computer was statistically significant (F (1, 598) = 5.34, p < .05). The effect size was on a very low level (eta² = .01).

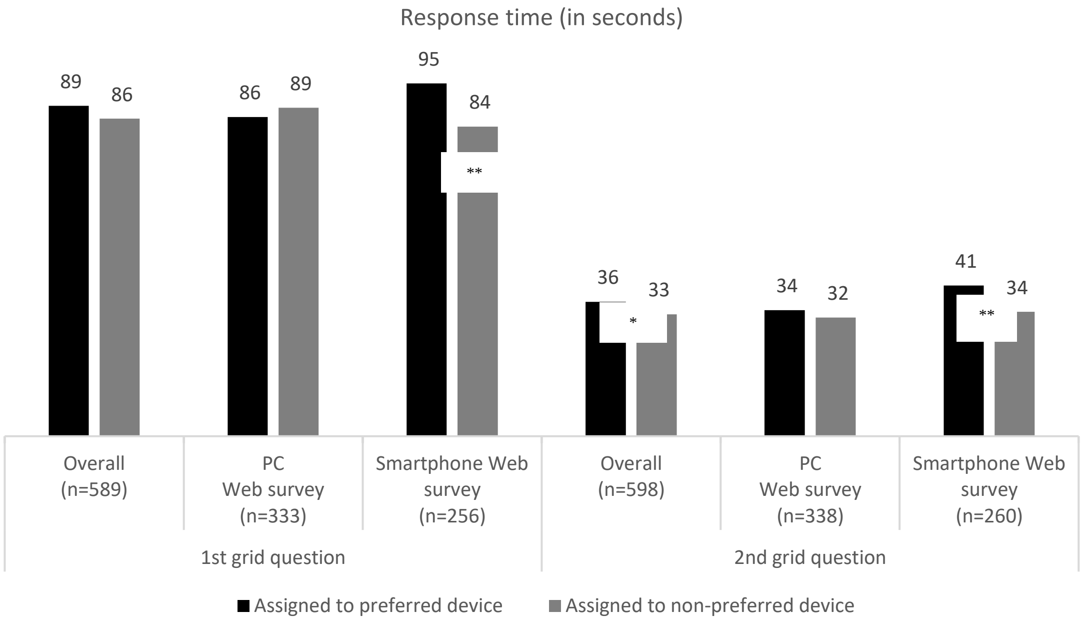

Figure 15: The effect of responding with the preferred device on the response time of two grid questions respectively, overall and for both subgroups
****p* < .001, ***p* < .01, **p* < .05, ^{+}p < .10

As expected, the average response time of respondents answering the Web survey with their preferred device was longer (1^{st} grid: 89 sec.; 2^{nd} grid: 36 sec.) than the average response time of respondents completing the Web survey with their non-preferred device (1^{st} grid: 86 sec.; 2^{nd} grid: 33sec.) (see Figure 15). In the second grid question, the average response time differed significantly between respondents assigned to respond with their preferred device and respondents assigned to respond with their non-preferred device (F (1, 598) = 4.83, p < .05). The effect size was on a very low level (eta² = .01). Furthermore, the average response time of respondents with a PC/tablet computer preference who were assigned to respond with a PC/tablet computer and respondents with a smartphone preference who were assigned to respond with a PC/tablet computer did not differ significantly. However, in the smartphone Web survey, the average response time differed significantly between respondents with a smartphone preference and respondents with a PC/tablet computer preference (1^{st} grid: F (1, 256) = 7.23, p < .01; 2^{nd} grid: F (1, 260) = 10.89, p < .01). As expected, respondents who completed the Web survey with their non-preferred device were on average significantly faster (1^{st} grid: 84 sec.; 2^{nd} grid:

34 sec.) than respondents who answered the Web survey with their preferred device (1st grid: 95 sec.; 2nd grid: 41 sec.). The effect size was on a very low level for both grid questions (1st grid: $eta^2 = .03$; 2nd grid: eta = .04).

Multivariate linear regression analyses confirmed descriptive analyses and findings revealed that significant effects remained significant when accounting for variables predicting unit nonresponse, non-conformed responding and device preference (see Model 1 to Model 5 in Appendix D, Table 25 and Table 26). The interaction effect of the device treatment and the allocation to their preferred device was significant for the first grid question and remained significant when accounting for control variables (Model 2 to Model 5 in Appendix D, Table 25). The interaction effect revealed that the effect of responding with the preferred device on the respondents' response time of the first grid question was stronger among smartphone respondents than among PC/tablet computer respondents confirming the eleventh hypothesis. The respondents' attitude towards survey in general had a significant effect on the respondents' response time in both grid questions. The response time of respondents with a high attitude towards surveys was significantly shorter than the response time of respondents with a low attitude towards surveys (see Model 1, Model 3 and Model 5 in Appendix D, Table 25 and Table 26). Furthermore, in the first grid question the response time of respondents was also affected by the time respondents spend on the Internet using a tablet. Response times of respondents who spend much time on the Internet using a tablet were lower than response times of respondents who spend less time on the Internet using a tablet (see Model 1, Model 3 and Model 5 in Appendix D, Table 25). Finally, in the second grid question age was associated with the respondents' response time. Response times of older respondents were significantly longer than response times of younger respondents (see Model 1, Model 3 and Model 5 in Appendix D, Table 26).

The last indicator used for analyses of the effect of responding with the preferred device on response times was speeding at question level. The 10 percent quantile of the respective response time was used to identify speeding in both grid questions. In the first grid question, the percentage of speeders did not differ significantly between smartphone respondents (10 percent) and PC/tablet computer respondents (11 percent). However, in the second grid question significantly more PC/tablet computer respondents were speeders (18 percent) than smartphone respondents (10 percent) (χ^2 (1, 615) = 7.91, $p < .01$). The effect size was on a low level ($\Phi = -.11$). Findings of the effect of responding with the preferred device on speeding revealed that respondents who completed the Web survey with their preferred device were less likely speeding than respondents who answered the Web survey with their non-preferred device. This tendency was also shown for PC/tablet computer respondents and smartphone respondents respectively. However, overall, in the PC/tablet computer Web survey and in the smartphone Web survey differences were not significant.

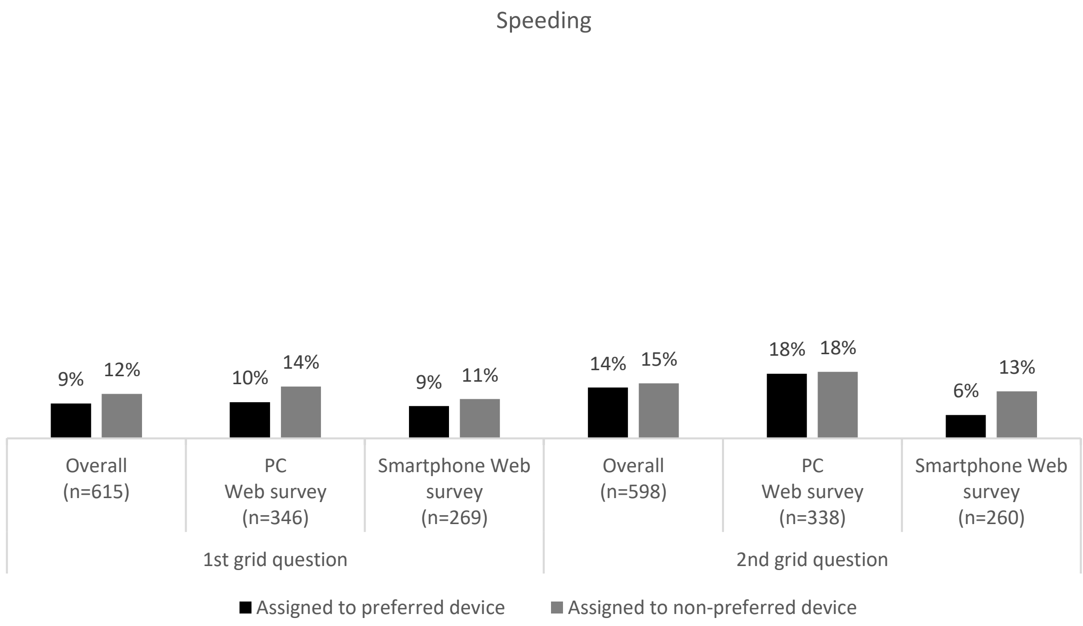

Figure 16: The effect of responding with the preferred device on speeding of two grid questions respectively, overall and for both subgroups
***$p < .001$, **$p < .01$, *$p < .05$, $^+p < .10$

Multivariate logistic regression analyses confirmed findings of descriptive analyses and revealed that with one exception findings did not change even when accounting for variables predicting unit nonresponse, non-conformed responding and device preference (see Model 1 to Model 5 in Appendix D, Table 27 and Table 28). In the second grid question, the difference of the likelihood of speeding between smartphone respondents with a smartphone preference and smartphone respondents with a PC/tablet computer preference became significant when accounting for control variables (see Model 5 in Appendix D, Table 28). As expected, in the smartphone Web survey, the likelihood of speeding was lower among respondents who completed the Web survey on their preferred device than among respondents who answered the Web survey with their non-preferred device. Finally, in the first grid question topic interest was associated with the likelihood of speeding and in the second grid question age was associated with the likelihood of speeding. In the first grid question, the likelihood of speeding was significantly higher among respondents with a high level of topic interest than among respondents with a low level of topic interest (see Model 1, Model 3 and Model 5 in Appendix D, Table 27). In the second grid question, the likelihood of speeding significantly decreased with the respondents' age (see Model 1, Model 3 and Model 5 in Appendix D, Table 28).

Survey focus

The next indicator of data quality used for analyses of the effect of responding with the preferred device was the respondents' survey focus. A variable counting how often the Web survey page was inactive while respondents completed the survey was used to analyze the respondents' survey focus. On average, respondents left the Web survey page 12 times. Findings of a one-way ANOVA revealed that there was a significant difference between smartphone respondents and PC/tablet computer respondents ($F(1, 615) = 147.46$, $p < .001$). Smartphone respondents left the Web survey page less often (5 times) than PC/tablet computer respondents (18 times). The effect size was on a moderate level ($eta^2 = .19$).

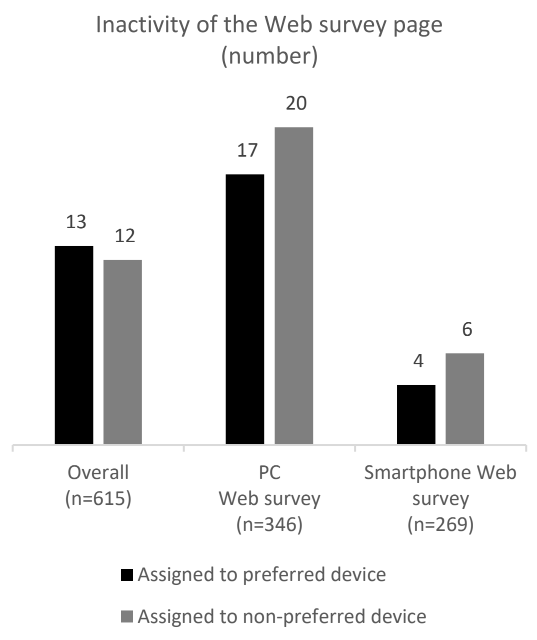

Figure 17: The effect of responding with the preferred device on survey focus, overall and for both subgroups
***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$

According to Hypothesis 7, respondents who complete the Web survey with their preferred device are expected to leave the Web survey page less often than respondents who answer the Web survey with their non-preferred device. Overall, respondents using their preferred device left the Web survey page slightly more often (13 times) than respondents answering the Web survey with their non-preferred device (12 times) but the difference was not significant (see Figure 17). Contrary but as expected, in the PC/tablet computer Web survey and in the smartphone Web survey respondents using their preferred device for Web survey participation left the Web survey less often (17 times and 4 times, respectively) than respondents using their non-preferred device (20 times and 6 times, respectively). However, differences were not significant.

Findings of multivariate linear regression analyses showed that when accounting for variables predicting unit nonresponse, non-conformed responding and device preference responding with the preferred device was associated with the respondents' survey focus. As expected, respondents who responded with their preferred device left the Web survey significantly less often than respondents who responded with their non-preferred device (see Model 1 in Appendix D, Table 29). In the PC/tablet computer Web survey, the effect of responding with the preferred device on the respondents' survey focus was marginally significant. PC/tablet computer respondents with a PC/tablet computer preference left the Web survey less often than PC/tablet computer respondents with a smartphone preference. The effect remained marginally significant when accounting for control variables (see Model 2 and Model 3 in Appendix D, Table 29). In the smartphone Web survey, responding with the preferred device had no effect on the respondents' survey focus even when accounting for control variables (see Model 4 and Model 5 in Appendix D, Table 29). No interaction effect between the device treatment and the allocation to their preferred device was found. Furthermore, findings of multivariate regression analyses confirmed that smartphone respondents left the Web survey significantly less often than PC/tablet computer respondents. No interaction effect was found between the device treatment and the allocation to their preferred device. The time respondents spend on the Internet using a tablet was also associated with the respondents' survey focus. Respondents who use the tablet more often to access the Internet significantly left the Web survey significantly less often than respondents who spend less time on the Internet using a tablet. However, the effect was only significant for the first model (in Appendix D, Table 29).

Degree of differentiation

According to Hypothesis 8 the assumption was that respondents assigned to respond with their preferred device differentiate less in grid questions than respondents assigned to respond with their non-preferred device. For two of three grid questions no significant effect of the assignment to their preferred device on the degree of differentiation in grid questions was found. Thus, results are only presented for the grid question on the respondents' attitudes towards refugees. The question was positioned in the middle of the questionnaire between the two grid questions used for analyses of response times. A five-point scale was used and the grid question consisted of ten rating scale items. Thus, the degree of differentiation ranged from 0 (indicating a low degree of differentiation) to 0.8 (indicating a high degree of differentiation).

The average degree of differentiation for the grid question was .63 and did not differ between smartphone respondents and PC/tablet computer respondents. Determining the effect of responding with the preferred device on the degree of differentiation findings of a one-way ANOVA indicated that the degree of differentiation differed significantly between respondents who completed the Web survey with their preferred device and respondents who completed the Web survey with their non-preferred device (F (1, 592) = 5.05, $p < .05$). Contrary to expectations, respondents using their preferred device yielded a significantly lower degree of differentiation (.62) than respondents using their non-preferred device (.64) (see Figure 18). The effect size was on a very low level ($eta^2 = .01$). Furthermore, the degree of differentiation of the grid questions did not differ between respondents with a PC/tablet computer preference who were assigned to respond with a PC/tablet computer and respondents with a smartphone preference who were assigned to respond with a PC/tablet computer. Thus, the overall significant effect was primary due to the significant difference between smartphone respondents with a smartphone preference and smartphone respondents with a PC/tablet computer preference (F (1, 260) = 6.40, $p < .05$). Contrary to expectations, respondents with a smartphone preference responding with a smartphone differentiated

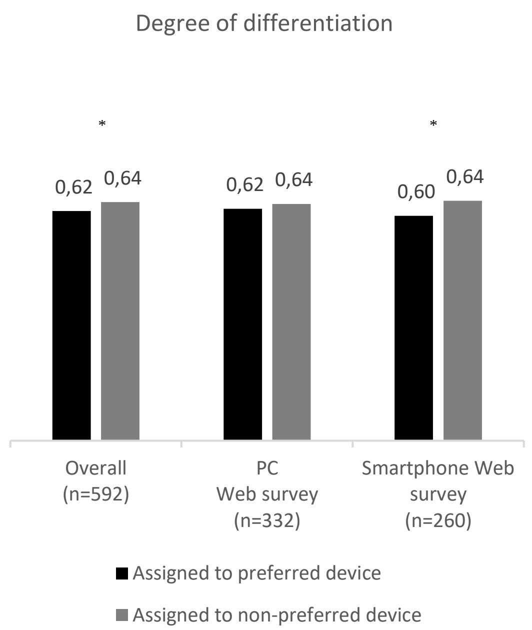

Figure 18: The effect of responding with their preferred device on the degree of differentiation, overall and for both subgroups
***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$

significantly less in the grid question (.60) than respondents with a PC/tablet computer preference responding with a smartphone (.64). The effect of responding with the preferred device on the degree of differentiation was on a very low level (eta² = .02).

Findings of multivariate linear regression analyses confirmed results of descriptive analyses and showed that effects of responding with the preferred device on the degree of differentiation remained significant when accounting for variables predicting unit nonresponse, non-conformed responding and device preference. Contrary to expectations, respondents who used their preferred device for Web survey participation differentiated significantly less in the grid question than respondents who used their non-preferred device for Web survey participation (see Model 1 in Appendix D, Table 30). No effect of responding with the preferred device on the degree of differentiation was found in the PC/tablet computer Web survey (see Model 2 and Model 3 in Appendix D, Table 30). However, in the smartphone Web survey respondents with a smartphone preference differentiated less than respondents with a PC/tablet computer preference (see Model 4 and Model 5 in Appendix D, Table 30). Control variables showed no significant effect on the degree of differentiation.

To gain further insights on the effect of responding with the preferred device on the degree of differentiation in grid questions straightlining was used as second indicator. Analyses are based on the same grid question that was used for analyses on the degree of differentiation. In this grid question, two percent applied a straightlining response strategy. The percentage of straightlining did not differ significantly between smartphone respondents and PC/tablet respondents.

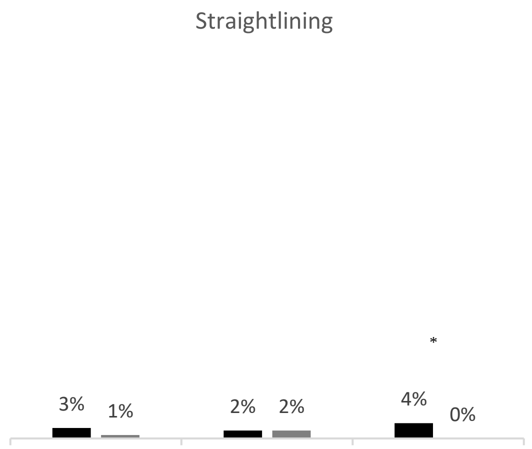

Figure 19: The effect of responding with the preferred device on straightlining, overall and for both subgroups
***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$

The assumption was, that respondents who use their preferred device for Web survey participation were less likely to straightline than respondents who used their non-preferred device. Overall and in the PC/tablet computer Web survey, the percentage of straightlining did not differ between respondents using their preferred device and respondents using their non-preferred device. However, in the smartphone Web survey the percentage of straightlining was higher among respondents with a smartphone preference (4 percent) than among respondents with a PC/tablet computer preference (0 percent). Findings of the Pearson's chi-squared test revealed that the difference was significant (χ^2 (1, 260) = 5.77, p < .05). The effect size was on a moderate level (Φ = .15).

Multivariate logistic regression analyses only assessed the overall effect, because multivariate logistic regression models including the interaction term of the allocation to their preferred device and the device treatment did not converge (see Table 31 in Appendix D). Findings confirmed that responding with the preferred device had not effect on straightlining and findings did not change when accounting for variables predicting unit nonresponse, non-conformed responding and device preference. Furthermore, no control variables were associated with straightlining (see Model 1 in Appendix D, Table 31).

Length of answers to narrative open-ended questions

The length of answers to narrative open-ended questions was used as second last indicator of data quality. Respondents who completed the Web survey with their preferred device were expected to report on average shorter answers to narrative open-ended questions than respondents who answered the Web survey with their non-preferred device (Hypothesis 9). Answers of three narrative open-ended questions were assessed but findings of only one question revealed a significant effect of responding with the preferred device on the length of answers to narrative open-ended questions. The narrative open-ended question was on the respondents' associations with the term "globalization". Overall, the respondents' answers to the first narrative open-ended

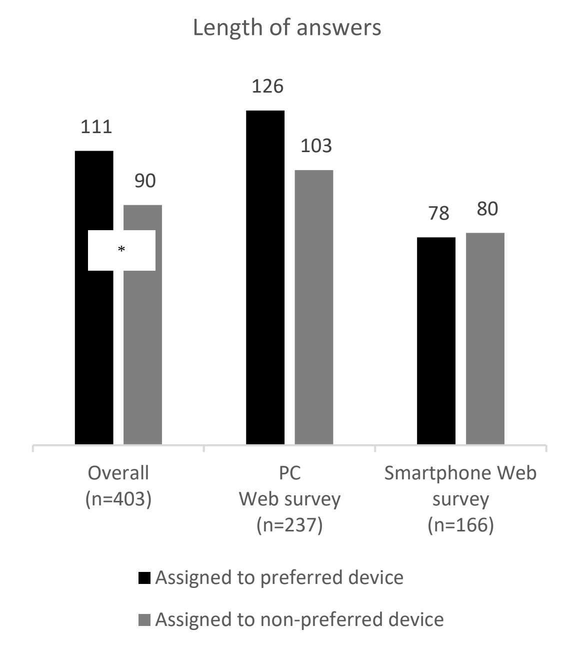

Figure 20: The effect of responding with their preferred device on the length of answers to narrative open-ended questions, overall and for both subgroups
***p < .001, **p < .01, *p < .05, ^+p < .10

question were on average 103 characters long[11]. In line with previous findings, respondents using a smartphone reported on average significantly shorter answers (79 characters) than respondents using a PC/tablet computer (119 characters) ($F(1, 403) = 22.07$, $p < .001$). The effect size was on a very low level ($eta^2 = .05$).

Determining the effect of using a preferred device for survey participation on the length of answers to narrative open-ended questions findings of a one-way ANOVA revealed a significant main effect ($F(1, 403) = 5.27$, $p < .05$). As expected, respondents using their preferred device reported on average significantly longer answers (111 characters) than respondents using their non-preferred device (90 characters). The effect size was on a very low level ($eta^2 = .01$). The tendency was similar for respondents assigned to a PC/tablet computer. Respondents with a PC/tablet computer preference reported on average longer answers (126 characters) than respondents with a smartphone preference (103 characters) but the difference was not significant. Among respondents assigned to a smartphone the average length of answers to the first narrative open-ended question did not differ between respondents with a smartphone preference (78 characters) and respondents with a PC/tablet computer preference (80 characters).

Findings of multivariate regression analyses confirmed results of overall descriptive analyses but showed that the effect became non-significant when accounting for variables predicting unit nonresponse, non-conformed responding and device preference. Thus, the effect of responding with the preferred device was due to differences of sample compositions (see Model 1 in Appendix D, Table 32). In line with descriptive analyses the device used by respondents had a strong effect on the length of answers in the narrative open-ended question. Contrary to descriptive findings, responding with the preferred device had a significant effect on the length of answers. PC/tablet computer respondents with a PC/tablet computer preference reported significantly longer answers than PC/tablet computer respondents with a smartphone preference (see Model 2 in Appendix D, Table 32). No effect on the length of answers was found for the interaction term between device treatment and experimental conditions. However, the effect was due to differences of sample compositions and became non-significant when including control

[11] Outliers (2*stddev+mean) separately defined for respondents with a smartphone preference who were assigned to respond with a smartphone, respondents with a smartphone preference assigned to respond with a PC/tablet computer, respondents with a PC/tablet computer assigned to respond with a PC/tablet computer and respondents with a PC/tablet computer preference assigned to a smartphone were excluded from analyses (n=18).

variables in multivariate regression models (see Model 3 in Appendix D, Table 32). No effect of responding with the preferred device on the length of answers was found in the smartphone Web surveys (see Model 4 and Model 5 in Appendix D, Table 32). Furthermore, gender and topic interest were associated with the length of answers in narrative open-ended questions. Male respondents reported shorter answers than female respondents and respondents with a high interest in the survey topic reported significantly longer answers than respondents with a low interest in the survey topic (see Model 1, Model 3 and Model 5 in Appendix D, Table 32).

Primacy effects

The last indicator used to analyze the respondents' data quality are primacy effects. Respondents who were assigned to respond with their preferred device were expected to be more prone to the order of items in a multiple-response question resulting in larger primacy effects than respondents who were assigned to respond with their non-preferred device (see Hypothesis 10). Four multiple-response questions were asked in the second Web survey wave of Study 1 each presenting the items to half of the respondents in the original order and to the other half of respondents in the reversed order. The primacy effect reached statistical significance for three of the four multiple-response questions. Findings of the three multiple-response questions which reached statistical significance were similar, thus, results are presented for only one of the three multiple-response questions. The multiple-response question was on institutions which profit from globalization and respondents were asked to mark the institutions which profit the most from globalization.

Table 12: Size of primacy effect (percentage points) by device treatment and experimental conditions (the assignment to their preferred device)

	PC Web survey	**Smartphone Web survey**	**Total**
Assigned to preferred device	15**	11	13**
Assigned to non-preferred device	12	11	11^{+}
Total	14**	10^{+}	12**

Note. Displayed is the percentage point difference of the proportion of respondents selecting at least one item of Item 1 to Item 5 when they are presented at the first half of the list (original order) minus the proportion of respondents selecting at least one item of Item 1 to Item 5 when they are presented at the second half of the list (reversed order). Pearson's chi-sqaured tests with the independent variable "item order" and the dependent dummy variable indicating whether respondents were assigned to respond with their preferred device or non-preferred device were conducted (overall, for the smartphone Web survey and the PC/tablet computer Web survey). The table shows the size of primacy effects (percentage points) with ***p < .001, **p < .01, *p < .05, ^{+}p < .10.

Overall, 80 percent of respondents selected at least one item of Item 1 to Item 5 when all the ten items were presented in the original order (Item 1 to Item 10). Contrary, only 68 percent of respondents selected at least one item of Item 1 to Item 5 when all the ten items were presented in the reversed order (Item 10 to Item 1). Findings of the Pearson's chi-squared test revealed that the difference of 12 percentage points (see Table 12) was statistically significant (χ^2 (1, 610) = 11.39, $p < .01$). The effect size was on a low level (Φ = -.14). Similar were findings of respondents assigned to respond with their preferred device. 79 percent of respondents selected at least one item of Item 1 to Item 5 when items were presented in the original order, whereas only 66 percent of respondents selected at least one item of Item 1 to Item 5 when items were presented in the reversed order. According to the Pearson's chi-squared test, the percentage difference of 13 percentage points was significant (χ^2 (1, 371) = 7.97, $p < .01$). The effect size was on a moderate level (Φ = -.15). Contrary to expectations, respondents who completed the Web survey with their non-preferred device were less prone to the order of items. The primacy effect still appeared but it did not reach statistical significance. 82 percent of respondents selected at least one item of Item 1 to Item 5 when items were presented in the original order whereas only 71 percent of respondents selected at least one item of Item 1 to Item 5 when items were presented in the reversed order. The difference is still remarkable (11 percentage points) but only marginally significant (χ^2 (1, 239) = 3.49, $p < .10$). Thus, findings of Pearson's chi-squared tests further support the tenth hypothesis. However, findings of a multivariate logistic regression analysis[12] revealed that the primacy effect of respondents who answered the Web survey with their preferred device was not larger than the primacy effect of respondents who completed the Web survey with their non-preferred device.

In the PC/tablet computer Web survey, findings on primacy effects were similar to overall findings. 82 percent of PC/tablet computer respondents selected at least one item of Item 1 to Item 5 when items were presented in the original order whereas only 68 percent of PC/tablet computer respondents selected at least one item of Item 1 to Item 5 when items were presented in the reversed order. Findings of the Pearson's chi-squared test revealed that the difference (14 percentage points) was significant (χ^2 (1, 343) = 8.69, $p < .01$). The effect size was on a moderate level (Φ = -.16). Among PC/tablet computer

[12] A multivariate logistic regression analysis with the dependent dummy variable indicating whether or not respondents have selected at least one item of Item 1 to Item 5, the independent dummy variable "item order", the independent dummy variable indicating whether respondents were assigned to respond with their preferred device or non-preferred device and the interaction term of both independent dummy variables was computed. Results of descriptive analyses were confirmed. The interaction effect of both independent dummy variables on the dependent variable was not significant.

respondents with a PC/tablet computer preference, the primacy effect (15 PP) was also significant (χ^2 (1, 244) = 6.82, $p < .01$) and the effect size was also on a moderate level ($\Phi = -.17$). As expected, the primacy effect (12 PP) was not significant among PC/tablet computer respondents with a smartphone preference. Thus, findings of Pearson's chi-squared tests provide some evidence for Hypothesis 10a. However, findings of a multivariate logistic regression analysis[13] revealed that the primacy effect of PC/tablet computer respondents with a PC/tablet computer preference was not larger than the primacy effect of PC/tablet computer respondents with a smartphone preference.

Finally, findings of Pearson's chi-squared tests revealed that smartphone respondents were less prone to the order of items in a multiple-response question. 78 percent of smartphone respondents selected at least one item of Item 1 to Item 5 when items were presented in the original order whereas only 68 percent of smartphone respondents selected at least on item of Item 1 to Item 5 when items were presented in the reversed order. However, the difference (10 PP) was only marginally significant (χ^2 (1, 267) = 3.51, $p < .10$). Furthermore, the primacy effect of smartphone respondents with a smartphone preference (10 PP) as well as the primacy effect of smartphone respondents with a PC/tablet computer preference (10 PP) were not significant. Thus, Hypothesis 10b needs to be rejected.

Finally, results of multivariate logistic regression analyses accounting for variables predicting unit nonresponse, non-conformed responding and device preference revealed that overall the likelihood that respondents selected Item 1 to Item 5 was significantly lower when items were presented in the reversed order (see Model 1 in Appendix D, Table 33). Findings also indicated that the difference of primacy effects between respondents using their preferred device for Web survey participation and respondents using their non-preferred device did not vary significantly between

[13] A multivariate logistic regression analysis with the dependent dummy variable indicating whether or not respondents have selected at least one item of Item 1 to Item 5, the independent dummy variable "item order", the independent dummy variable indicating whether respondents were assigned to respond with their preferred device or non-preferred device and the interaction term of both independent dummy variables was computed among PC/tablet computer respondents. Results of descriptive analyses were confirmed. The interaction effect of both independent dummy variables on the dependent variable was not significant.

smartphone respondents and PC/tablet computer respondents (Hypothesis 11) (see Model 2 to Model 5 in Appendix D, Table 33)[14].

8.1.4 Summary

Findings of the first study showed that being assigned to the preferred device had a significant effect on conformance rates of sample members. Sample members assigned to their preferred device were more likely to participate in the Web survey with the assigned device than sample members assigned to their non-preferred device. The effect remained significant when accounting for variables predicting differences between experimental conditions and device preference. Thus, the effect was not due to differences of sample compositions. However, findings on the effect of being assigned to the preferred device on unit nonresponse and non-conformed responding showed that the increase of conformance rates when assigned to their preferred device was primary due to a decrease of rates of non-conforming respondents. The effect of being assigned to the preferred device on unit nonresponse rates remained inconclusive. Overall, being assigned to the preferred device had no significant effect on unit nonresponse rates.

Effects of responding with the preferred device on indicators of data quality were also inconclusive. A lot of indicators of data quality were not affected significantly by responding with the preferred device. Only survey breakoff, response time, survey focus and the degree of differentiation showed some significant effects. In general, findings on the response time of respondents indicated that as expected, the response time of respondents who complete the Web survey with their preferred device was longer than the response time of respondents who answered the Web survey with their non-preferred device. Especially on question level and for smartphone respondents, responding with the preferred device significantly increased response times of respondents. Furthermore, smartphone respondents with a smartphone preference were also less likely speeding than smartphone respondents with a PC/tablet computer preference. Findings of the effect of responding with the preferred device on the respondents' survey focus were also

[14] The dependent variable was a dummy variable indicating whether respondents selected at least of item of half of the items that were presented at the beginning of the list in the original order and at the end of the list in the reversed order. Thus, significant effects of control variables referred to the likelihood of the selection of at least one item of a specific group of items rather than to primacy effects. Therefore, significant effects of control variables in multivariate logistic regression analyses are not reported.

significant and as expected. Overall respondents' who completed the Web survey with their preferred device left the Web survey less often than respondents who answered the Web survey with their non-preferred device. However, findings on survey breakoff and the degree of differentiation indicated that the data quality among respondents using their preferred device for Web survey participation was lower than among respondents using their non-preferred device. Overall and among smartphone respondents, effects reached statistically significance. Respondents using their preferred device for Web survey participation were more likely to abandon the Web survey and differentiated less in grid questions than respondents using their non-preferred device.

The interaction effect between the experimental conditions and the device treatment was only significant for analyses on unit nonresponse, conformance rates and response time at question level. Contrary to expectations, the interaction effect indicated that the effect of being assigned to the preferred device on unit nonresponse rates and conformance rates was stronger among PC/tablet computer respondents than among smartphone respondents. However, findings on the respondents' response time at question level confirmed assumptions of Hypothesis 11. The effect of responding with the preferred device on the respondents' response time at question level was stronger among smartphone respondents than among PC/tablet computer respondents.

8.2 Study 2

8.2.1 Device preference

In the second study, only 19 percent of sample members of the second Web survey wave had self-selected to use a smartphone to complete the first Web survey wave and 81 percent had chosen to participate with a PC/tablet computer in the first Web survey wave. Thus, according to the present operationalization of device preference (see Chapter 7.5) 19 percent of sample members of the second Web survey wave of Study 2 preferred a smartphone for Web survey participation whereas the majority of sample members preferred a PC/tablet computer for Web survey participation (81 percent). Compared to the first study the percentage of sample members with a smartphone preference was considerably lower in the second study. However, due to the more heterogeneous sample of the second Web survey wave of Study 2 the percentage of sample members with a smartphone preference seems reasonable and is comparable to previous findings on device preference in online panels (Revilla, Toninelli, Ochoa, et al., 2016). Furthermore, according to Respondi members of their online panel are used to complete Web surveys on a PC/tablet computer which also explains the lower rate of sample members with a smartphone preference.

Table 13: Odds ratios of characteristics of sample members with a smartphone preference relative to sample members with a PC/tablet computer preference (Study 2)

	Odds ratio (OR)	**Standard error (SE)**
Intercept	.00	6.16
Age (continuous)	.73***	.07
Gender		
female	--	--
male	.69*	.19
Education (continuous)	$.86^{+}$	.09
Income (continuous)	1.04	.07
Device usage – frequency (continuous)		
PC	.68***	.09
Tablet	.94	.08
Smartphone	8.62*	1.02
Device knowledge (continuous)		
PC	.75	.19
Tablet	1.04	.15
Smartphone	1.31	.19
Internet usage – hours (continuous)		
PC	.85***	.04
Tablet	.86*	.07
Smartphone	1.13***	.03
Email use		
PC	.26***	.20
Tablet	.23***	.39
Smartphone	--	--

Note. Multivariate logistic regression models with the dummy variable “smartphone preference” (0=PC/tablet computer preference; 1=smartphone preference) as dependent variable were computed. The table shows coefficients with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. “--“ identifies the reference categories.

Findings of a multivariate logistic regression analysis indicated that sample members with a smartphone preference differed significantly from sample members with PC/tablet computer preference regarding various characteristics. In line with previous findings, the likelihood that sample members preferred a smartphone to a PC/tablet computer for Web survey participation was significantly higher among younger sample members than among older sample members (OR = .73, SE = .07, p < .001). Gender had also a significant effect on device preference. Female respondents were significantly more likely to prefer a smartphone to a PC/tablet computer for Web survey participation than male sample members (OR = .69, SE = .19, p < .05). Finally, various indicators of the sample members’ device literacy and Internet literacy showed significant effects. The likelihood that sample members prefer a smartphone for Web survey participation significantly decreased with the frequency of the sample members' general PC usage (OR = .75, SE = .09, $p < .001$) and significantly increased with the frequency of the sample members' general smartphone usage. The frequency of the sample members' general tablet computer usage had no significant effect on the sample members' device preference. Accordingly, the number of hours sample members spend on the Internet using a PC significantly decreased the likelihood that sample members prefer a smartphone (OR = .85, SE = .04, $p < .001$) whereas the number of hours sample members spend on the Internet using a smartphone significantly increased the likelihood that sample members prefer a smartphone (OR = 1.13, SE = .03, $p < .001$). The number of hours sample members spend on the Internet using a tablet computer affected the sample members' device preference similar to the Internet frequency sample members spend on a PC. The likelihood that sample members prefer a smartphone to a PC/tablet computer for Web survey participation significantly decreased with the number of hours sample members spend on the Internet using a tablet computer (OR = .86, SE = .07, $p < .05$). At last, sample members who most often use a PC/tablet computer to write emails significantly less likely preferred a smartphone for Web survey participation than sample members who most often use a smartphone to write emails (PC: OR = .26, SE = .20, $p < .001$; tablet: OR = .23, SE = .39, $p < .001$).

8.2.2 Survey participation

Unit nonresponse rates

Overall, 15 percent of sample members of the second Web survey wave of Study 2 refused to participate. In the PC/tablet computer Web survey, also 15 percent of sample members refused to participate. Unit nonresponse rates of sample members assigned to respond with a smartphone were slightly higher (16 percent) but did not differ significantly from the unit nonresponse rate of sample members assigned to a PC/tablet computer.

According to the first hypothesis, unit nonresponse rates of sample members assigned to their preferred are expected to be lower than unit nonresponse rates of sample members assigned to respond with their non-preferred device. Findings of Study 2 on unit nonresponse rates were similar to results on unit nonresponse rates of Study 1. Figure 21 indicates that unit nonresponse rates of sample members assigned to their preferred device amounted to 14 percent whereas 17 percent of sample members who were assigned to their non-preferred device refused to participate in the second Web survey wave of Study 2. However, according to findings of the Pearson's chi-squared test the difference of 3 percentage points between the unit nonresponse rate of sample members assigned to their preferred device and the unit nonresponse rate of sample members assigned to their non-preferred device was not significant. The difference of unit nonresponse rates between sample members with a PC/tablet computer preference who were assigned to a PC/tablet computer and sample members with a smartphone preference who were assigned to a PC/tablet computer was larger than the overall difference and statistically significant (χ^2 (1, 676) = 15.80, p < .001). As expected, in the PC/tablet computer Web survey the unit nonresponse rate of sample members who were assigned to their preferred device was significantly lower (12 percent) than the unit nonresponse rate of sample members who were assigned to their non-preferred device (26 percent). The effect size was on a moderate level (Φ = -.15). In the smartphone Web survey, the effect of the assignment to their preferred device on unit nonresponse rates was also significant (χ^2 (1, 679) = 4.46, p < .05). However, contrary to expectations the unit nonresponse rate was significantly higher among sample members with a smartphone preference (22 percent) than among sample members with a PC/tablet computer preference (15 percent). The effect size was on a low level (Φ = .08). Findings revealed that the effect of being assigned to the preferred device on unit nonresponse rates was significant in both subgroups, the PC/tablet computer Web survey and the smartphone Web survey. However, the direction of the effect differed between subgroups. Thus, overall results indicated no significant effect of the assignment to their preferred device on unit nonresponse rates (suppressor effect). These findings already suggested a strong interaction effect between the assignment to their preferred device and the device treatment of the second Web survey wave on unit nonresponse rates (see Table 14).

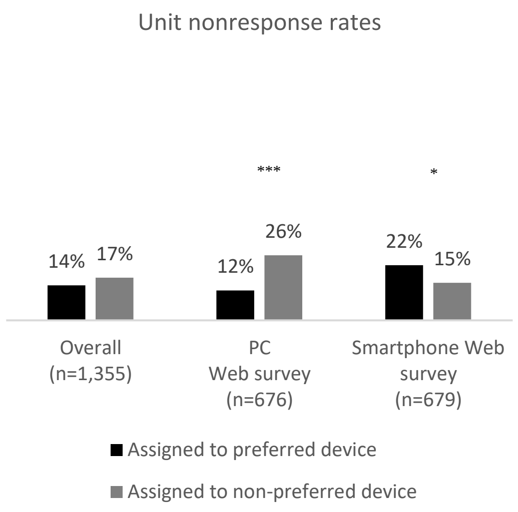

Figure 21: The effect of being assigned to the preferred device on unit nonresponse rates of the second wave of Study 2, overall and for the two device treatments
***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$

Although, the assignment to their preferred device was an experimentally assigned factor in the second study and the comparison of characteristics between sample members assigned to their preferred device and sample members assigned to their non-preferred device did not indicate any differences (see Chapter 7.3.2), multivariate logistic regression analyses were conducted to provide consistency of analyses and to account for variables predicting device preference (see Chapter 8.2.1), because the respondents' device preference is an attitude of respondents that cannot be randomly assigned. Furthermore, multivariate logistic regression model also included the interaction term between the dummy variable indicating whether sample members were assigned to respond with their preferred device and the dummy variable indicating whether sample members were assigned to respond with a smartphone or a PC/tablet computer to assess the eleventh hypothesis.

Findings of multivariate logistic regression analyses confirmed results of descriptive analyses. The likelihood that sample members refused to participate in the Web survey did not differ between sample members assigned to respond with their preferred device and sample members assigned to respond with their non-preferred device. Furthermore, the likelihood that sample members refused to participate in the Web survey did not differ between sample members assigned to respond with a smartphone and sample members assigned to respond with a PC/tablet computer. Results of the first multivariate logistic regression model revealed that both effects remained non-significant when accounting for socio-demographic characteristics, the device literacy and the Internet literacy of sample members (see Table 14). Regarding the control variables three variables indicated a significant effect on unit nonresponse. The likelihood that sample members refused to participate in the Web survey decreased significantly with age (OR=.74, SE=.06, $p<.001$). Thus, the likelihood of unit nonresponse was significantly higher among young sample members than among older sample members. Education was the second socio-demographic variable that indicated a significant effect on unit nonresponse. Sample members with a low educational level refused significantly more likely to participate in the Web survey than sample members with a high educational level (OR=.72, SE=.08, $p<.001$). Finally, sample members who assessed themselves as advanced PC user refused significantly more likely to participate in the Web survey than sample members who assessed themselves as PC beginner (OR=1.63, SE=.19, $p<.01$).

Table 14: Multivariate logistic regression models with the dependent variable unit nonresponse (Study 2)

	Model 1 (n=1,230)		**Model 2 (n=1,230)**		**Model 3 (n=1,230)**	
	OR	SE	OR	SE	OR	SE
Intercept	.07	2.00	.36***	.21	.08	1.99
Experimental condition						
Preferred device (EG)	.84	.19	.40***	.25	.67	.29
Non-preferred device (CG)	--	--	--	--	--	--
Device treatment						
Smartphone Web survey	.88	.19	.44**	.25	.71	.28
PC Web survey	--	--	--	--	--	--
Interaction effect						
Preferred*Smartphone	--	--	4.39***	.36	1.61	.45
Age (continuous)	.74***	.07			.75***	.07
Gender						
male	.87	.17			.88	.17
female	--	--			--	--
Education (continuous)	.72***	.08			.72***	.08
Income (continuous)	1.06	.06			1.06	.06
Device usage - frequency (continuous)						
PC	.86⁺	.09			.87	.09
Tablet	1.02	.07			1.02	.07
Smartphone	1.50	.31			1.48	.31
Device knowledge (continuous)						
PC	1.63**	.19			1.65**	.19
Tablet	1.22	.14			1.22	.14
Smartphone	.69⁺	.19			.69*	.19
Internet usage - hours (continuous)						
PC	1.00	.04			1.00	.04
Tablet	.99	.05			1.00	.05
Smartphone	1.03	.02			1.02	.02
Email usage						
PC	.69⁺	.22			.73	.23
Tablet	.72	.36			.78	.37
Smartphone	--	--			--	--
Attitude towards surveys (continuous)	1.31	.18			1.32	.18
Topic interest (continuous)	1.08	.07			1.08	.07
Nagelkerke's r²	.11		.02		.11	
-2 LL	965		1,025		963	

Note. Multivariate logistic regression models with the dummy variable "unit nonrespondents" (0=non-conforming/conforming respondents; 1=unit nonrespondents) as dependent variable were computed. The table shows coefficients with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

Findings of the second Model revealed that the likelihood that sample members refused to participate in the Web survey differed significantly between sample members with a PC/tablet computer preference who were assigned to respond with a PC/tablet computer and sample members with a smartphone preference who were assigned to respond with a PC/tablet computer (OR=.40, SE=.25, p<.001). In the PC/tablet computer Web survey, sample members with a PC/tablet computer preference refused significantly less likely to participate in the Web survey than sample members with a smartphone preference. Contrary, sample members with a smartphone preference who were assigned to respond with a smartphone refused more likely to participate in the Web survey than sample members with a PC/tablet computer preference who were assigned to respond with a smartphone (OR=0.40*4.39=1.76) and the difference was also statistically significant (see Model 1 in Appendix E, Table 34). Furthermore, findings of Model 2 also revealed that the likelihood to refuse Web survey participation differed significantly between sample members with a PC/tablet computer preference who were assigned to respond with a smartphone and sample members with a smartphone preference who were assigned to respond with a PC/tablet computer (OR=.44, SE=.25, p<.01). The likelihood that sample members with a smartphone preference refused to participate in the PC/tablet computer Web survey was significantly higher than the likelihood that sample members with a PC/tablet computer preference refused to participate in the smartphone Web survey. These findings were contrary to explanations of the eleventh hypothesis, assuming that responding with a PC/tablet computer is less burdensome for sample members with a smartphone preference than responding with a smartphone for sample members with a PC/tablet computer preference. Although, the interaction effect on unit nonresponse was significant (OR=4.39, SE=.36, p<.001), Hypothesis 11 has to be rejected, because the interaction effect reached statistical significance due to the controversial direction of the effect rather than due to differences in the magnitude of the effect. The significant interaction effect indicated that the effect of the assignment to their preferred device on unit nonresponse differed significantly between the smartphone Web survey and the PC/tablet computer Web survey. While findings revealed a positive effect of being assigned to the preferred device on unit nonresponse rates within the smartphone Web survey, the effect was negative in the PC/tablet computer Web survey. In the smartphone Web survey, the likelihood that sample members with a smartphone preference refused to participate was 76 percent higher than the likelihood that that sample members with a PC/tablet computer preference refused to participate. In the PC/tablet computer Web survey, the likelihood that sample members with a smartphone preference refused to participate was 150 percent higher than the likelihood that sample members with a smartphone preference refused to participate. Thus, even when considering differences of the magnitude of the effect between sample members assigned to respond with a smartphone and sample members assigned to respond with a PC/tablet computer, Hypothesis 11 has to be rejected. The effect of being assigned to respond with their preferred device on unit nonresponse was stronger in the PC/tablet computer Web survey than in the smartphone Web survey.

Rates of non-conforming respondents

Overall, 21 percent of sample members tried to access the Web survey with a different device than they were assigned to or started the Web survey with the assigned device but finished the Web survey with a different device than they were assigned to. Sample members who were assigned to a PC/tablet computer for Web survey participation were less likely to respond with a different device than they were assigned to. In the PC/tablet computer Web survey, only 7 percent of sample members were non-conforming respondents. However, in the smartphone Web survey, the rate of non-conforming respondents was on a very high level (35 percent) and differed significantly from the rate of non-conforming respondents of sample members assigned to a PC/tablet computer (χ^2 (1, 1,355) = 162.31, p < .001). The effect size was on a high level (Φ = -.35).

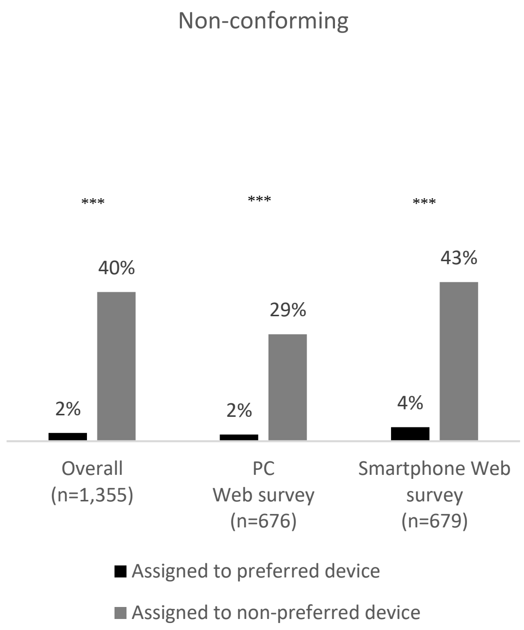

Figure 22: The effect of being assigned to the preferred device on rates of non-conforming respondents of the second wave of Study 2, overall and for the two device treatments
***p < .001, **p < .01, *p < .05, ^{+}p < .10

According to Hypothesis 2 the effect of the assignment to their preferred device on rates of non-conforming respondents was expected to be similar to the effect on unit nonresponse rates. Rates of non-conforming respondents were assumed to be lower among sample members assigned to their preferred device than among sample members assigned to their non-preferred device. As expected, the rate of non-conforming respondents was significantly higher among sample members assigned to their non-preferred device (40 percent) than among sample members assigned to their preferred device (2 percent). Findings of the Pearson's chi-squared test revealed that the difference was statistically significant (χ^2 (1, 1,355) = 290.93, p < .001) and the effect of the assignment to their preferred device on rates of non-conforming respondents was on a high level (Φ = -.46). The effect of being assigned to the preferred device on rates of non-conforming respondents was also significant among PC/tablet computer respondents (χ^2 (1, 676) = 116.36, $p < .001$). As expected, sample members with a PC/tablet computer preference who were assigned to respond with a PC/tablet computer were significantly less likely non-conforming respondents (2 percent) than sample members with a smartphone preference who were assigned to respond with a PC/tablet computer (29 percent). The effect size was on a high level (Φ = -.42). Accordingly, rates of non-conforming respondents of sample members with a smartphone preference who were assigned to a smartphone were also lower (4 percent) than rates of non-conforming respondents of sample members with a PC/tablet computer preference who were assigned to a smartphone (43 percent). According to the Pearson's chi-squared test the difference of 39 percentage points was statistically significant (χ^2 (1, 679) = 70.08, $p < .001$). The effect size was on high level (Φ = -.32).

To show that the effect of the assignment to their preferred device on rates of non-conforming respondents was not due to differences of sample compositions, logistic regression analyses were conducted controlling for variables predicting device preference. Results of logistic regression analyses confirmed results of descriptive analyses (see Table 15). Rates of non-conforming respondents of sample members assigned to their preferred device were significantly lower than rates of non-conforming respondents of sample members assigned to their non-preferred device. Furthermore, rates of non-conforming respondents were significantly higher among sample members assigned to a smartphone than among sample members assigned to a PC/tablet computer. Both effects stayed significant when accounting for variables predicting device preference (see Model 1). Thus, the overall effect of the assignment to their preferred device on rates of non-conforming respondents was not due to differences of sample compositions. Regarding the control variables only two variables indicated a significant effect on rates of non-conforming respondents. The likelihood that sample members used a different device than they were assigned to significantly increased with age. Older sample members were more likely to respond with a different device than they were assigned to than younger sample members (OR=1.15, SE=.07, $p<.05$). The second control variable which revealed a significant effect on rates of non-conforming respondents was income. The likelihood that sample members used a different device than they were assigned to significantly decreased with income. Sample members with a low income were more likely non-conforming respondents than sample members with a high income (OR=.85, SE=.07, p<.05).

Table 15: Multivariate logistic regression models with the dependent variable non-conformed responding (Study 2)

	Model 1 (n=1,230)		**Model 2 (n=1,230)**		**Model 3 (n=1,230)**	
	OR	SE	OR	SE	OR	SE
Intercept	1.62	1.68	.36***	.21	1.71	1.70
Experimental condition						
Preferred device (EG)	.05***	.32	.05***	.40	.04***	.43
Non-preferred device (CG)	--	--	--	--	--	--
Device treatment						
Smartphone Web survey	2.02**	.24	2.12**	.23	1.77*	.27
PC Web survey	--	--	--	--	--	--
Interaction effect						
Preferred*Smartphone			1.19	.61	1.98	.68
Age (continuous)	1.15*	.07			1.16*	.07
Gender						
male	.83	.17			.84	.17
female	--	--			--	--
Education (continuous)	1.12	.08			1.12	.08
Income (continuous)	.85*	.07			.85*	.07
Device usage - frequency (continuous)						
PC	.86	.10			.87	.10
Tablet	1.02	.07			1.02	.07
Smartphone	.79	.25			.78	.25
Device knowledge (continuous)						
PC	1.11	.18			1.12	.18
Tablet	.92	.15			.92	.15
Smartphone	.90	.18			.89	.18
Internet usage - hours (continuous)						
PC	1.00	.03			1.00	.03
Tablet	1.05	.06			1.05	.06
Smartphone	.96	.03			.95	.03
Email usage						
PC	1.28	.25			1.33	.25
Tablet	1.72	.41			1.80	.41
Smartphone	--	--			--	--
Attitude towards surveys (continuous)	1.06	.18			1.06	.18
Topic interest (continuous)	1.09	.07			1.09	.07
Nagelkerke's r²	.40		.36		.40	
-2 LL	896		929		895	

Note. Multivariate logistic regression models with the dummy variable "non-conforming respondents" (0=unit nonrespondents/conforming respondents; 1=non-conforming respondents) as dependent variable were computed. The table shows coefficients with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

The second model included the dummy variable indicating whether sample members were assigned to their preferred device, another dummy variable indicating whether sample members were assigned to a smartphone or a PC/tablet computer and the interaction term of both dummy variables. Thus, the reference group changed. Results of Model 2 revealed that sample members with a PC/tablet computer preference who were assigned to a PC/tablet computer were significantly less likely non-conforming respondents than sample members with a smartphone preference who were assigned to use a PC/tablet computer for Web survey participation (OR=.05, SE=.40, p<.001). The effect was similar in the smartphone Web survey. Sample members with a smartphone preference who were assigned to use a smartphone for Web survey participation were less likely non-conforming respondents than sample members with a PC/tablet computer preference who were assigned to respond with a smartphone (OR=0.05*1.19=.06). As shown by Model 3 in Appendix E, Table 34, the effect was also significant. Furthermore, results of the second model also revealed that sample members with a PC/tablet computer preference who were assigned to a smartphone were significantly more likely non-conforming respondents than sample members with a smartphone preference who were assigned to respond with a PC/tablet computer (OR=2.12, SE=.23, p<.01). These findings were in line with explanations of Hypothesis 11. However, contrary to expectations the effect of the assignment to their preferred device on rates of non-conforming respondents did not differ significantly between sample members assigned to a smartphone and sample members assigned to a PC/tablet computer, as shown by the non-significant interaction term. Finally, findings of the third multivariate logistic regression model revealed that the effects of the second model stayed significant when accounting for predictors of device preference. Thus, the effect of being assigned to respond with their preferred device on rates of non-conforming respondents within the PC/tablet computer Web survey was not due to differences of sample compositions. As shown by Model 4 in Appendix E, Table 34, the effect of the assignment to their preferred device on rates of non-conforming respondents within the smartphone Web survey also remained significant when controlling for indicators predicting device preference. Thus, in the smartphone Web survey the effect of the assignment to respond with their preferred device was also not due to differences of sample compositions.

Conformance rates

Overall, 64 percent of sample members conformed the device assignment and used the device they were assigned to for Web survey participation. Compared to probability based Web surveys, the conformance rate was really high but taking into account that the Web survey was conducted among members of an online panel the conformance rate seems reasonable. In the PC/tablet computer Web survey, the conformance rate was higher (79 percent) than the overall conformance rate. The conformance rate of sample members assigned to respond with a smartphone was 30 percentage points lower (49 percent) than the conformance rate of sample members assigned to a PC/tablet computer. According to findings of the Pearson's chi-squared test, the difference of conformance rates was significant (χ^2 (1, 1,355) = 129.99, $p < .001$) and the effect size was on a moderate level ($\Phi = -.31$).

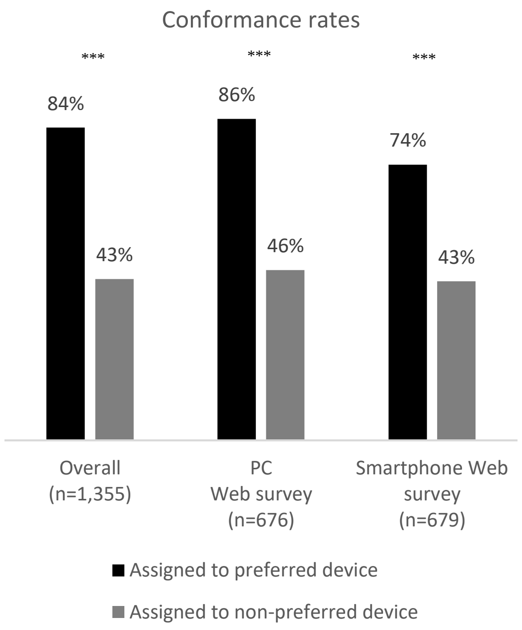

Figure 23: The effect of being assigned to the preferred device on conformance rates of the second Web survey wave of Study 2 overall and for the two device treatments
***$p < .001$, **$p < .01$, *$p < .05$, $^+p < .10$

The conformance rate is the inverse to unit nonresponse rates and rates of non-conforming respondents. Thus, considering the first and the second hypotheses, conformance rates of sample members assigned to their preferred device are expected to be higher than conformance rates of sample members assigned to respond with their non-preferred device (Hypothesis 3). Comparing conformance rates between sample members assigned to their preferred device and sample members assigned to their non-preferred device, findings of the Pearson's chi-squared test revealed a statistically significant effect (χ^2 (1, 1,355) = 241.77, $p < .001$). As expected, sample members assigned to their preferred device were significantly more likely to respond with the device they were assigned to (84 percent) than sample members assigned to their non-preferred device (43 percent). The effect of the assignment to their preferred device on conformance rates was on a high level ($\Phi = .42$). In the PC/tablet computer Web survey, conformance rates also differed significantly between sample members assigned to their preferred device and sample members assigned to respond with their non-preferred device (χ^2 (1, 676) = 101.88, $p < .001$). As expected, conformance rates were significantly higher among sample members with a PC/tablet computer preference who were assigned to a PC/tablet computer (86 percent) than among sample members with a smartphone preference who were assigned to a PC/tablet computer (46 percent). The effect was on a high level (Φ = .39). Finally, within the smartphone Web survey, conformance rates also differed significantly between sample members with a smartphone preference and sample members with a PC/tablet computer preference (χ^2 (1, 679) = 41.58, $p < .001$). As expected, Sample members with a smartphone preference who were assigned to respond with a smartphone were significantly more likely to respond with a smartphone (74 percent) than sample members with a PC/tablet computer preference who were assigned to respond with a smartphone (43 percent). The effect size was on a moderate level (Φ = .25).

Table 16: Multivariate logistic regression models with the dependent variable conformance (Study 2)

	Model 1 (n=1,230)		Model 2 (n=1,230)		Model 3 (n=1,230)	
	OR	SE	OR	SE	OR	SE
Intercept	0.72	1.33	0.90	0.19	0.71	1.33
Experimental condition						
Preferred device (EG)	5.26***	0.17	6.70***	0.23	5.73***	0.25
Non-preferred device (CG)	--	--	--	--	--	--
Device treatment						
Smartphone Web survey	0.61**	0.16	0.85	0.21	0.66⁺	0.24
PC Web survey	--	--	--	--	--	--
Interaction effect						
Preferred*Smartphone			0.56⁺	0.32	0.83	0.40
Age (continuous)	1.09	0.05			1.09	0.05
Gender						
male	1.21	0.14			1.20	0.14
female	--	--			--	--
Education (continuous)	1.15*	0.06			1.15*	0.06
Income (continuous)	1.07	0.05			1.07	0.05
Device usage - frequency (continuous)						
PC	1.23*	0.08			1.22*	0.08
Tablet	0.97	0.06			0.97	0.06
Smartphone	0.94	0.20			0.94	0.20
Device knowledge (continuous)						
PC	0.67**	0.15			0.67**	0.15
Tablet	0.95	0.12			0.95	0.12
Smartphone	1.34*	0.15			1.35*	0.15
Internet usage - hours (continuous)						
PC	1.00	0.03			1.00	0.03
Tablet	0.97	0.05			0.97	0.05
Smartphone	1.01	0.02			1.01	0.02
Email usage						
PC	1.08	0.19			1.05	0.20
Tablet	0.80	0.32			0.78	0.32
Smartphone	--	--			--	--
Attitude towards surveys (continuous)	0.79	0.14			0.79	0.14
Topic interest (continuous)	0.90⁺	0.06			0.90⁺	0.06
Nagelkerke's r²	.27		.23		.27	
-2 LL	1,337		1,377		1,336	

Note. Multivariate logistic regression models with the dummy variable "conforming respondents" (0=unit nonrespondents/non-conforming respondents; 1=conforming respondents) as dependent variable were computed. The table shows coefficients with ***p < .001, **p < .01, *p < .05, ⁺p < .10. "--" identifies the reference categories.

To show that the effect of the assignment to their preferred device on conformance rates was not due to differences of sample compositions, multivariate logistic regression analyses were conducted controlling for variables predicting device preference. Findings of logistic regression analyses confirmed results of descriptive analyses of the effect of the assignment to their preferred device on conformance rates of sample members.

Sample members who were assigned to respond with their preferred device were significantly more likely to respond with the assigned device than sample members assigned to their non-preferred device. Furthermore, the likelihood that sample members assigned to respond with a smartphone used a smartphone for Web survey participation was significantly lower than the likelihood that sample members assigned to respond with a PC/tablet computer used a PC/tablet computer. Both effects stayed significant when accounting for indicators predicting device preference (see Model 1 in Table 16). Thus, the effect of the assignment to their preferred device on conformance rates was not due to differences of sample compositions. Regarding the variables predicting device preference few variables indicated a significant effect on conformance rates. The likelihood that sample members responded with the device they were assigned to significantly increased with education (OR=1.15, SE=.06, $p<.05$). Sample members with a high education significantly more likely conformed the device allocation than sample members with a low education. Furthermore, indicators on the sample members' device literacy showed significant effects on conformance rates. The likelihood that sample members responded with the device they were assigned to significantly increased with the frequency of the sample members' PC usage (OR=1.23, SE=.08, $p<.05$). Sample members who reported to use a PC more often significantly more likely responded with the assigned device than sample members who reported that they use a PC less often. Finally, self-reports on the sample members' PC and smartphone knowledge revealed significant effects on conformance rates. Sample members who assessed themselves as PC beginners responded significantly more likely with the assigned device than sample members who assessed themselves as advanced PC users (OR = .67, SE = .15, $p < .01$). Contrary but more plausible, sample members who assessed themselves as smartphone beginners responded significantly less likely with the device they were assigned to than sample members who assessed themselves as advanced smartphone users (OR = 1.34, SE = .15, $p < .05$).

The second model checked descriptive analyses of the effect of being assigned to the preferred device on conformance rates for PC/tablet computer respondents and assessed Hypothesis 11. The model included a dummy variable indicating whether sample were assigned to respond with their preferred device, another dummy variable indicating whether sample members were assigned to a smartphone or a PC/tablet computer and the interaction term of both dummy variables. At first, results of Model 2 confirmed descriptive analyses, that sample members with a PC/tablet computer preference who were assigned to respond with a PC/tablet computer used significantly more likely a PC/tablet computer than sample members with a smartphone preference who were assigned to respond with a PC/tablet computer (OR=6.70, SE=.23, p<.001). The effect was similar among sample members assigned to respond with a smartphone. Sample members with a smartphone preference who were assigned to use a smartphone responded more likely with a smartphone than sample members with a PC/tablet computer preference who were assigned to respond with a smartphone (OR=6.70*0.56=3.75). The difference was also significant as shown by Model 5 in Appendix E, Table 34. The dummy variable indicating whether sample members were assigned to respond with a smartphone or a PC/tablet computer did not reveal a significant effect on conformance rates. This finding indicated that the likelihood to respond with the assigned device did not differ between sample members with a smartphone preference who were assigned to a PC/tablet computer and sample members with a PC/tablet computer preference who were assigned to a smartphone. This finding did not confirm explanations of Hypothesis 11. Furthermore, the interaction term did not show a significant effect on conformance rates. Thus, Hypothesis 11 needs to be rejected. The effect of being assigned to respond with their preferred device on conformance rates did not differ significantly between sample members assigned to respond with a smartphone and sample members assigned to respond with a PC/tablet computer. Findings of Model 3 revealed that in the PC/tablet computer Web survey the effect of the assignment to their preferred device on conformance rates remained significant when accounting for variables predicting device preference. Thus, in the PC/tablet computer Web survey, the effect of the assignment to their preferred device on conformance rates was not due to differences of sample compositions. The same was shown for the smartphone Web survey (see Model 6 in Appendix E, Table 34).

8.2.3 Data quality

Survey breakoff

The efficacy analysis (see Chapter 7.6) and some previous studies (Antoun, 2015a; Revilla & Couper, 2017) suggest that non-conforming respondents are noncompliant and count as nonrespondents. Therefore, analyses on the effect of responding with the preferred device are based on respondents who conformed the survey researcher’s device allocation.

Only 9 respondents (1 percent) abandoned the second Web survey wave of Study 2. Given the low breakoff rate, no further analyses on breakoff rates were conducted. However, among respondents who completed the survey 40 respondents (5 percent) abandoned the Web survey and completed it on a subsequent date. Contrary to survey breakoffs, these respondents are stronger motivated because they return to the Web survey to complete it. However, these respondents are similar to survey breakoffs because at a certain point in the Web survey the cognitive effort respondents need to involve answering survey questions exceeded their threshold and they decide to interrupt responding to the Web survey. Thus, in Study 2 interruption rates were analyzed rather than breakoff rates.

Smartphone respondents interrupted their participation in the Web survey less often (3 percent) than PC/tablet computer respondents (6 percent). However, according to the Pearson's chi-squared test the difference of 3 percentage points was not significant. In line with Hypothesis 4, respondents using their preferred device for Web survey participation are expected to interrupt responding to the Web survey less often than respondents who respond the Web survey with their non-preferred device. Findings revealed a marginal significant effect (χ^2 (1, 853) = 3.72, $p < .10$). Contrary to expectations, more respondents completing the Web survey with their preferred device interrupted the Web survey (6 percent) than respondents completing the Web survey with their non-preferred device (3 percent) (see Figure 24). The tendency was similar among PC/tablet computer respondents and smartphone respondents. More PC/tablet computer respondents with a PC/tablet computer preference interrupted their Web survey participation (6 percent) than PC/tablet computer respondents with a smartphone preference (3 percent). Accordingly, more smartphone respondents with a smartphone preference interrupted their Web survey participation

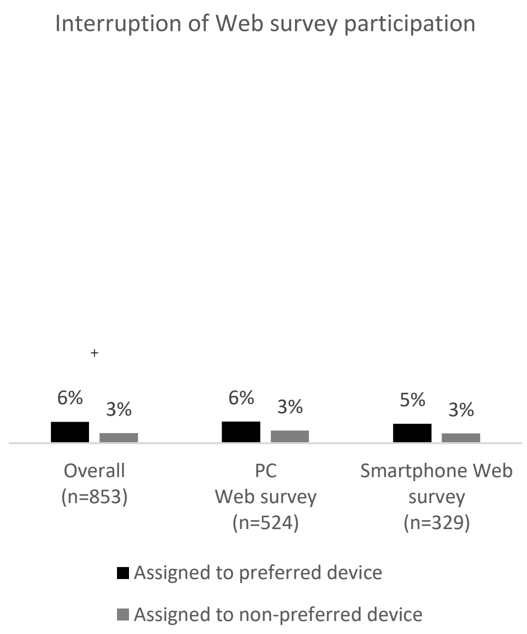

Figure 24: The effect of responding with the preferred device on interruptions of the respondents' Web survey participation, overall and for both device treatments

***$p < .001$, **$p < .01$, *$p < .05$, $^+p < .10$

(5 percent) than smartphone respondents with a PC/tablet computer preference (3 percent). However, findings of the Pearson's chi-squared test revealed that both differences were not significant.

Findings of multivariate logistic regression analyses confirmed results of descriptive analyses. When accounting for variables predicting unit nonresponse, non-conformed responding and device preference the overall effect of responding with the preferred device on survey interruption became significant (see Model 1 in Appendix E, Table 35). No effect of responding with the preferred device on survey interruption was found among PC/tablet computer respondents (see Model 2 and Model 3 in Appendix E, Table 35). In the smartphone Web survey, the effect of responding with the preferred device on survey interruption became marginally significant when accounting for control variables (see Model 5 in Appendix E, Table 35). Contrary to expectations smartphone respondents with a smartphone preference were more likely to leave the Web survey than smartphone respondents with a PC/tablet computer preference. Furthermore, age, gender and some indicators of the respondents' Internet literacy showed significant effects on survey interruption (see Model 1, Model 3 and Model 5 in Appendix E, Table 35).

Item nonresponse[15]

More than 80 percent of respondents provided answers to all questions of the second Web survey wave of Study 2. Thus, on average the item nonresponse rate was on a very low level (0.5 percent). Therefore, a dichotomous variable differentiating between respondents who answered all survey questions and respondents who skipped at least one survey question was used to examine the effect of responding with the preferred device on item nonresponse. Smartphone respondents were more likely item

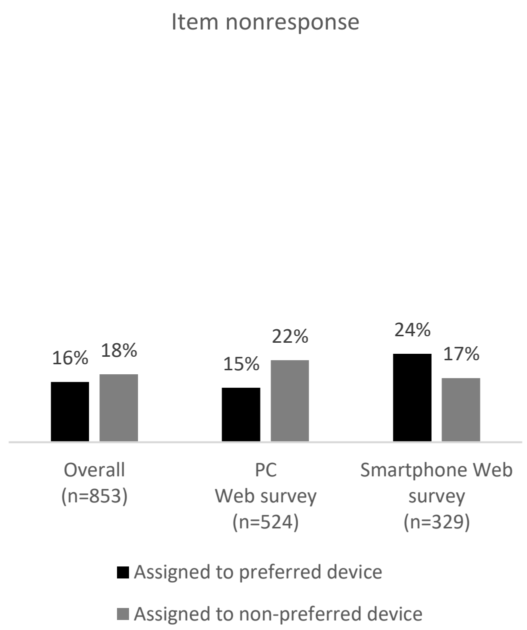

Figure 25: The effect of responding with the preferred device on item nonresponse, overall and for both device treatments
***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$

[15] Respondents who abandoned the Web survey were excluded for analyses on item missing and all further analyses on data quality of respondents (n=853).

nonrespondents (19 percent) than PC/tablet computer respondents (16 percent). However, the difference of 3 percentage points was not significant.

According to the fifth hypothesis, respondents using their preferred device for Web survey participation were expected to be less likely item nonrespondents than respondents who responded with their non-preferred device. However, Pearson's chi-squared tests indicated that responding with the preferred device did not have a significant effect on item nonresponse. Respondents who completed the Web survey with their preferred device were less likely item nonrespondents (16 percent) than respondents who answered the Web survey with their non-preferred device (18 percent). The same tendency was shown for the subgroup of PC/tablet computer respondents. PC/tablet computer respondents with a PC/tablet computer preference were less likely unit nonrespondents (15 percent) than PC/tablet computer respondents with a smartphone preference (22 percent). Finally, results of smartphone respondents differed from overall results and results of PC/tablet computer respondents. Contrary to expectations, smartphone respondents with a smartphone preference were more likely item nonrespondents (24 percent) than smartphone respondents with a PC/tablet computer preference (17 percent).

Findings of multivariate regression analyses confirm results of descriptive analyses. Even when accounting for predictors of unit nonresponse, non-conformed responding and device preference no effect is found for responding with the preferred device on item nonresponse (see Model 1 to Model 5 in Appendix E, Table 36). However, the interaction term of device allocation and experimental conditions was significant and remained significant when accounting for control variables (see Model 2 to Model 5 in Appendix E, Table 36). These findings indicated that the effect of responding with the preferred device on item nonresponse differed between smartphone respondents and PC/tablet respondents. However, contrary to expectations, the interaction effect was significant because responding with the preferred device decreased the likelihood of item nonresponse in the PC/tablet computer Web survey but increased the likelihood of item nonresponse in the smartphone Web survey. No effect on item nonresponse was found for control variables (see Model 1, Model 3 and Model 5 in Appendix E, Table 36).

Response time

At first, the mean response time of respondents for the whole questionnaire was assessed. Overall, the average response time of all respondents was 568 seconds (9 minutes)[16]. In line with previous studies the average response time of smartphone respondents was longer (601 seconds/10 minutes) than the average response time of PC/tablet computer respondents (546 seconds/9minutes). According to a one-way ANOVA the difference was statistically significant (F (1, 776) = 9.89, p < .01). The effect size was on a low level (eta² = .01).

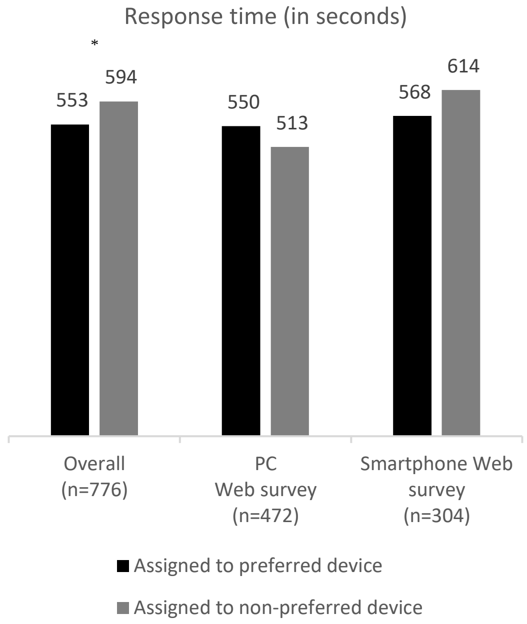

Figure 26: The effect of responding with the preferred device on response time, overall and for both device treatments
***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$

According to the sixth hypothesis completion times of respondents who use their preferred device for responding are expected to be higher than completion times of respondents who use their non-preferred device for Web survey participation. Findings of a one-way ANOVA revealed that the average response time of respondents using their preferred device differed significantly from the average response time of respondents answering the Web survey with their non-preferred device (F (1, 776) = 5.23, p < .05) (see Figure 26). Contrary to expectations, the average response time of respondents answering the Web survey with their preferred device was shorter (553 seconds/9 minutes) than the average response time of respondents using their non-preferred device (594 seconds/10 minutes). The effect size was on a low level (eta² = .01). The tendency differed between smartphone respondents and PC/tablet computer respondents. As expected, the average response time of PC/tablet computer respondents with a PC/tablet computer preference was longer (550 seconds/ 9 minutes) than the average response time

[16] Respondenwho abandoned the Web survey but completed it to a subsequent date (n=40) and outliers (2*stddev+mean) separately defined for respondents with a smartphone preference who responded with a smartphone, respondents woth a smartphone preference who responded with a PC/tablet computer, respondents with a PC/tablet computer preference who responded with a PC/tablet computer and respondents with a PC/tablet computer who responded with a smartphone were excluded from analyses (n=37).

of PC/tablet computer respondents with a smartphone preference (513 seconds/ 9 minutes). Contrary, the average response time of smartphone respondents with a smartphone preference was shorter (568 seconds/ 9 minutes) than the average response time of smartphone respondents with a PC/tablet computer preference (614seconds/10 minutes). However, difference of the average response time between respondents answering with their preferred device and respondents completing the Web survey with their non-preferred device neither differed significantly among smartphone respondents nor among PC/tablet computer respondents.

Findings of multivariate linear regression analyses showed that the overall effect of responding with the preferred device on the completion time of respondents became non-significant when accounting for variables predicting unit nonresponse, non-conformed responding and device preference (see Model 1 in Appendix E, Table 37). Thus, the effect of responding with the preferred device on completion times of respondents was due to differences of sample compositions. Furthermore, in the smartphone Web survey and in the PC/tablet computer Web survey no effect of responding with the preferred device on completion times of respondents was found even when accounting for control variables (see Model 2 to Model 5 in Appendix E, Table 37). Moreover, findings revealed that the interaction term between the experimental conditions and device treatment was not significant. Finally, age, education and the respondents' smartphone literacy were associated with completion times of respondents (see Model 1, Model 3 and Model 5 in Appendix E, Table 37). Age had a positive effect on completion times of respondents and education and smartphone literacy had a negative effect on completion times of respondents.

Next, the 10 percent quantile of response time at questionnaire level was used to identify speeders[17]. The percentage of speeding differed significantly between PC/tablet computer respondents and smartphone respondents (χ^2 (1, 813) = 12.41, $p < .001$). Less smartphone respondents were speeding (5 percent) than PC/tablet computer respondents (13 percent). The effect size was on a low level ($\Phi = -.12$).

[17] The overall 10 percent quantile was used rather than group specific 10 percent quantiles to enable identifying differences between respondents answering the Web survey with their preferred device and respondents completing the Web survey with their non-preferred device as well as between smartphone respondents and PC/tablet computer respondents.

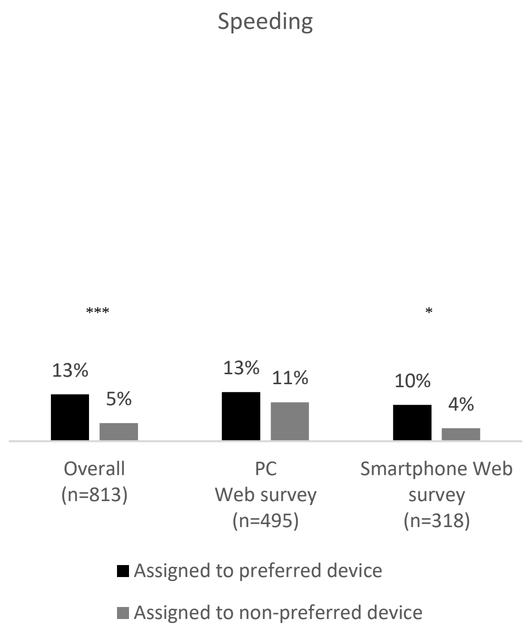

Figure 27: The effect of responding with the preferred device on speeding, overall and for both device treatments
****p* < .001, ***p* < .01, **p* < .05, [+]*p* < .10

Furthermore, the likelihood of speeding also differed significantly between respondents who completed the Web survey on their preferred device and respondents who used their non-preferred device (χ^2 (1, 813) = 12.18, p < .001). Contrary to expectations, respondents who answered the Web survey with their preferred device were significantly more likely speeders (13 percent) than respondents who completed the Web survey with their non-preferred device (5 percent). The effect size was on a low level (Φ = .12). The tendency was the same among PC/tablet computer respondents and smartphone respondents. PC/tablet computer respondents with a PC/tablet computer preference were more likely speeding (13 percent) than PC/tablet computer respondents with a smartphone preference (11 percent). However, the difference of two percentage points was not statistically significant. Accordingly, smartphone respondents with a smartphone preference were more likely speeding (10 percent) than smartphone respondents with a PC/tablet computer preference (4 percent) and findings of the Pearson's chi-squared test revealed that the difference of 6 percentage points was statistically significant (χ^2 (1, 318) = 5.04, p < .05). The effect size was on a low level (Φ = .13).

Multivariate logistic regression analyses revealed that the overall effect of responding with the preferred device on speeding was due to differences of sample compositions, because the effect of responding with the preferred device became non-significant when controlling for variables predicting unit nonresponse, non-conformed responding and device preference (see Model 1 in Appendix E, Table 38). No effects of responding with the preferred device on speeding were found for smartphone respondents and PC/tablet computer respondents respectively, even when accounting for control variables. Moreover, the interaction effect was also not significant (see Model 2 to Model 5 Appendix E, Table 38). From the control variables the degree of the respondents' process orientation and age were associated with speeding (see Model 1, Model 3 and

Model 5 Appendix E, Table 38). Respondents with a high level of process orientation were more likely to speed than respondents with a low level of process orientation. Furthermore, older respondents were less likely to speed than younger respondents

Finally, in line with analyses of the first study the respondents' response time and speeding at question level were assessed to gain some further insights for Hypothesis 6. Respondents often switch from an optimizing response strategy to a satisficing response strategy. Thus, analyses of response times of single questions may provide more insights than analyses of completion times of the whole questionnaire. As mentioned in Chapter 5.2.2, the likelihood that respondents use a satisficing response strategy increases with the degree of task difficulty. Therefore, grid questions were chosen for analyses, because the task difficulty of grid questions is on a high level compared to other question types. Two grid questions were asked in the second Web survey wave of Study 2. Results were similar for both grid questions. Thus, results of only one grid question are presented. The grid question was positioned in the middle of the questionnaire and measured the respondents' political alienation. A five-point scale was used and respondents were asked to report their attitude towards 10 items.

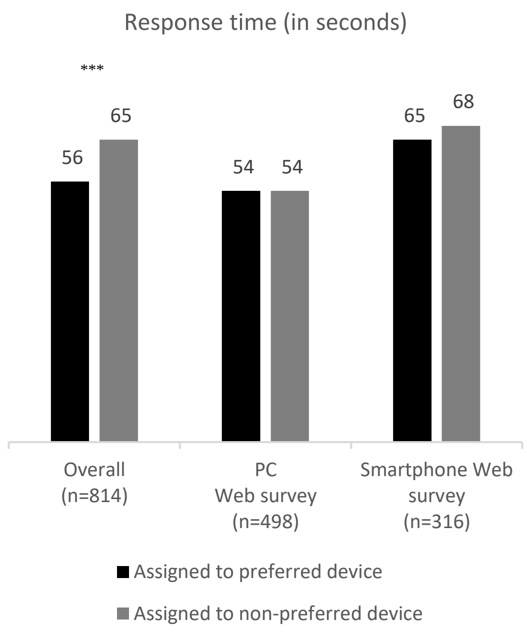

Figure 28: The effect of responding with the preferred device on response time, overall and for both device treatments
***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$

In line with findings on response times of the whole questionnaire, the average response time of smartphone respondents was higher (67 seconds) than the average response time of PC/tablet computer respondents (54 seconds). According to the Pearson's chi-squared test the difference reached statistical significance (F (1, 814) = 44.47, p < .001). The effect size was on a very low level (eta² = .05).

Furthermore, responding with the preferred device had also a significant effect on the average response time of respondents (F (1,814) = 20.68, p < .001). Contrary to expectations, the average response time of respondents who answered the Web survey with their preferred device was lower (56 seconds) than the average response time of respondents who completed the Web survey with their non-preferred device (65 seconds) (see Figure 28). The effect size was on a very low level ($eta^2 = .03$). In the PC/tablet computer Web survey, the average response time of respondents with a PC/tablet computer preference (54 seconds) did not differ from the average response time of respondents with a smartphone preference (54 seconds). In the smartphone Web survey, the effect was also contrary to expectations. The average response time of smartphone respondents with a smartphone preference was slightly shorter (65 seconds) than the average response time of smartphone respondents with a PC/tablet computer preference (68 seconds). However, findings of a one-way ANOVA revealed that the difference was not significant.

According to findings of multivariate linear regression analyses responding with the preferred device had no effect on response times at question level. Even the overall effect of descriptive analyses became non-significant when accounting for variables predicting unit nonresponse, non-conformed responding and device preference (see Model 1, Appendix E, Table 39). Thus, the effect was due to differences of sample compositions. The interaction term between the device allocation and experimental conditions showed also no significant effect on the respondents' response time at question level (see Model 2 to Model 5 Appendix E, Table 39). Only the device respondents used to complete the Web survey showed a significant effect on response times at question level. In line with descriptive analyses the response time of smartphone respondents was longer than the response time of PC/tablet computer respondents. Finally, the respondents' process orientation, the respondents' content orientation, age, education and the respondents' smartphone literacy had a significant effect on response times at question level (see Model 1, Model 3 and Model 5 Appendix E, Table 39). Response times of respondents with a high process orientation were lower than response times of respondents with a low process orientation. Accordingly, respondents with a high content orientation took longer to complete the question than respondents with a low content orientation. Age revealed a positive effect on the respondents' response time, whereas education and the respondents' smartphone literacy had a negative effect on the response time at question level.

The last indicator which was used to assess the sixth hypothesis was speeding at question level. The 10 percent quantile was used to identify speeding. The percentage of speeders of PC/tablet computer respondents was higher (14 percent) than the percentage of speeders of smartphone respondents (3 percent). The difference of 11 percentage points was statistically significant (χ^2 (1, 853) = 27.96, p < .001). The effect size was on a moderate level (Φ = -.18).

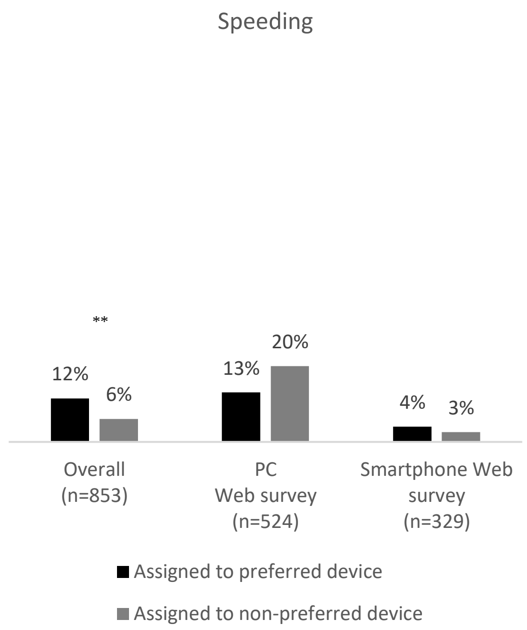

Figure 29: The effect of responding with the preferred device on speeding, overall and for both device treatments
****p* < .001, ***p* < .01, **p* < .05, $^{+}$*p* < .10

Furthermore, the effect of responding with the preferred device on speeding was also significant (χ^2 (1, 853) = 6.67, p < .01). Contrary to expectations, respondents who completed the Web survey with their preferred device were more likely speeding (12 percent) than respondents who answered the Web survey with their non-preferred device (6 percent). The effect size was on a low level (Φ = .09). As expected, in the PC/tablet computer Web survey responding with the preferred device had a negative effect on speeding. PC/tablet computer respondents with a PC/tablet computer preference were less likely speeding (13 percent) than PC/tablet computer respondents with a smartphone preference (20 percent). However, the difference was not significant. In the smartphone Web survey, the percentage of speeders did not differ between respondents with a smartphone preference (4 percent) and respondents with a PC/tablet computer preference (3 percent).

Similar to findings of multivariate linear regression analyses on response times at question level multivariate logistic regression analyses on speeding also revealed no significant effect for responding with the preferred device. Again, the overall significant effect of descriptive analyses became non-significant when accounting for variables predicting unit nonresponse, non-conformed responding and device preference (see Model 1 in Appendix E, Table 40). Furthermore, no effects of responding with the preferred device on speeding were found among smartphone respondents and PC/tablet computer respondents respectively (see Model 2 to Model 5 in Appendix E, Table 40). Moreover, the interaction effect was also not significant. Only the device respondents used for responding had a significant effect on speeding. Smartphone respondents were significantly less likely to speed than PC/tablet computer respondents even when including control variables in multivariate logistic regression analyses. From the control variables the respondents' process and content orientation, age, gender, education, the respondents' smartphone literacy and the respondents Internet literacy on PCs and tablets showed a significant effect on speeding. Male respondents were more likely to speed than female respondents. The respondents' process orientation, education, smartphone literacy and Internet literacy on PCs and tablets increased the likelihood of speeding. Whereas, the respondents' content orientation and age decreased the likelihood of speeding (see Model 1, Model 3 and Model 5 in Appendix E, Table 40).

Survey focus

On average respondents left the Web survey page 1.3 times. In line with results of Study 1 smartphone respondents left the Web survey page less often (0.5 times) than PC/tablet computer respondents (1.8 times). Findings of a one-way ANOVA revealed that the difference was significant ($F(1,853) = 21.09$, $p < .001$). The effect size was on a very low level ($eta^2 = 0.2$).

According to the seventh hypothesis respondents who completed the Web survey with their preferred device were expected to leave the Web survey less often than respondents who answered the Web survey with their non-preferred device. Contrary to expectations, respondents who answered the Web survey with their preferred device left the Web survey significantly more often (1.66 times) than respondents who completed the Web survey with their non-preferred device (0.64 times) ($F(1, 853) = 13.01$, $p < .001$). However, the effect size was on a very low level ($eta^2 = 0.02$). The tendency

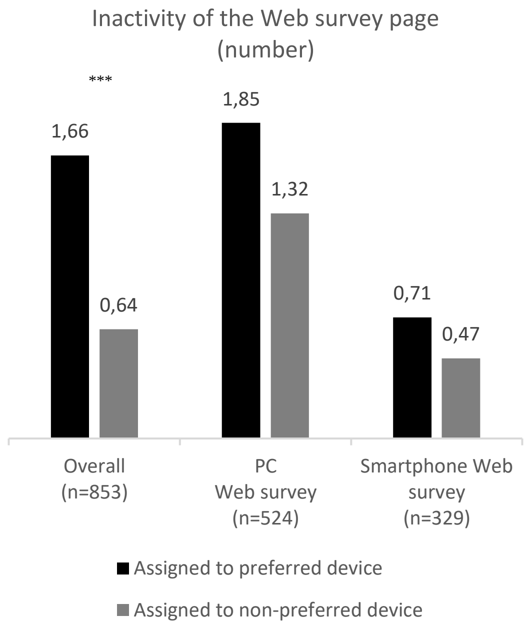

Figure 30: The effect of responding with the preferred device on survey focus, overall and for both device treatments
$***p < .001$, $**p < .01$, $*p < .05$, $^{+}p < .10$

was the same for PC/tablet computer respondents and for smartphone respondents. PC/tablet computer respondents with a PC/tablet computer preference left the Web survey page more often (1.85 times) than PC/tablet computer respondents with a smartphone preference (1.32 times). Accordingly, smartphone respondents with a smartphone preference left the Web survey page more often (0.71 times) than smartphone respondents with a PC/tablet computer preference (0.47 times). However, the difference was neither significant for smartphone respondents nor for PC/tablet computer respondents.

Findings of multivariate linear regression analyses confirmed results of descriptive analyses. However, when accounting for variables predicting unit nonresponse, non-conformed responding and device preference the overall effect of responding with the preferred device was only marginally significant (see Model 1 in Appendix E, Table 41). Furthermore, in the PC/tablet computer Web survey the effect of responding with the preferred device on the respondents' survey focus became marginally significant when accounting for control variables. Contrary to expectations, PC/tablet computer respondents with a PC/tablet computer preference left the Web survey more often than PC/tablet computer respondents with a smartphone preference (see Model 3 in Appendix E, Table 41). No effect was found among smartphone respondents (see Model 4 and Model 5 in Appendix E, Table 41) and the interaction effect was also not significant (see Model 2 to Model 5 in Appendix E, Table 41). From the control variables the respondents' process and content orientation, age, gender and income were associated with the respondents' survey focus. Male respondents left the Web survey less often than female respondents. Furthermore, the respondents' content orientation and age had a negative effect on the number of times respondents left the Web survey and the respondents' process orientation and income showed a positive effect on the number of times respondents left the Web survey page.

Degree of Differentiation

The next indicator of data quality considered for analyses of the effect of responding with the preferred device on data quality of respondents was the degree of differentiation in grid questions. As mentioned above, two grid questions were asked in the second Web survey wave of Study 2. Results are only presented for the second grid question because analyses of the first grid question indicated that responding with the preferred device did not have any significant effect on the degree of differentiation. The second grid question was positioned at the end of the questionnaire. Respondents were asked to report their attitude towards foreigners. A five-point scale was used and the grid question consisted of 8 rating scale items. Thus, the degree of differentiation ranged from 0 (indicating a low degree of differentiation) to 0.86 (indicating a high degree of differentiation).

Results of the second grid question indicated that the average degree of differentiation of all respondents was on a high level (.61). the degree of differentiation of smartphone respondents was higher (.62) than the degree of differentiation of PC/tablet computer respondents (.60). According to a one-way ANOVA the difference was marginally significant (F (1, 842) = 3.16, p < .10). This finding might be due to the different format of rating scale items used in smartphone Web surveys (item-by-item format) and PC/tablet computer Web surveys (grid).

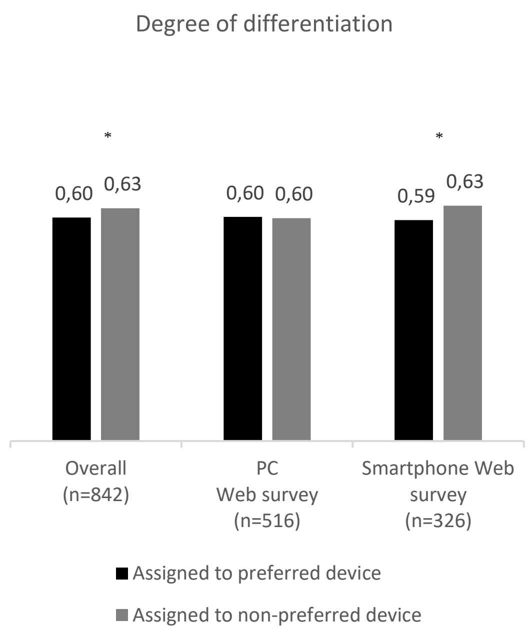

Figure 31: The effect of responding with the preferred device on the degree of differentiation, overall and for both subgroups
$^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$, $^{+}p < .10$

According to Hypothesis 8 respondents who complete the Web survey with their preferred device are expected to differentiate more in grid questions than respondents who answer the Web survey with their non-preferred device. Assessing the effect of responding with the preferred device on the degree of differentiation, findings of a one-way ANOVA revealed a significant effect (F (1, 842) = 5.08, p < .05). Contrary to expectations, respondents who completed the Web survey with their preferred device differentiated less in the grid question (0.60) than respondents who answered the Web survey with their non-preferred device (0.63) (see Figure 31). However, the effect size was on a very low level (eta² = .01). Furthermore, the degree of differentiation did not differ between PC/tablet computer respondents with a PC/tablet computer preference (.60) and PC/tablet computer respondents with a smartphone preference (.60). Thus, the overall effect of responding with the preferred device on the degree of differentiation was mainly due to smartphone respondents. Contrary to expectations, smartphone respondents with a smartphone preference differentiated less (.59) than smartphone respondents with PC/tablet computer preference (.63). Findings of a one-way ANOVA revealed that the difference was significant ($F (1, 326) = 5.02$, $p < .05$). The effect size was on a low level ($eta^2 = .02$).

However, findings of multivariate linear regression analyses revealed that the effects of responding with the preferred device on the degree of differentiation were due to differences of sample compositions, because effects of descriptive analyses became non-significant when accounting for predictors of unit nonresponse, non-conformed responding and device preference (see Model 1 and Model 5 in Appendix E, Table 42). The interaction effect was also not significant (see Model 2 to Model 5 in Appendix E, Table 42). From the control variables the respondents' content and process orientation, smartphone literacy and Internet literacy with a tablet revealed significant effects on the degree of differentiation (see Model 1, Model 3 and Model 5 in Appendix E, Table 42). The respondents' process orientation, smartphone literacy and Internet literacy with a tablet significantly decreased the degree of differentiation, whereas the respondents' content orientation significantly increased the degree of differentiation.

The extreme form of nondifferentiation is straightlining, which is used as second indicator to determine the effect of responding with the preferred device on the degree of differentiation in grid questions. Again, results are only presented for the second grid question because findings of the first grid question did not reveal any significant effect. Overall, in the second grid question, four percent of all respondents used the straightlining response strategy. The percentage of straightlining was somewhat lower among smartphone respondents (3 percent) than among PC/tablet computer respondents (5 percent) but the difference was not significant.

Contrary to expectations, the percentage of straightlining of respondents who answered the Web survey with their preferred device was higher (5 percent) than the percentage of straightlining of respondents who

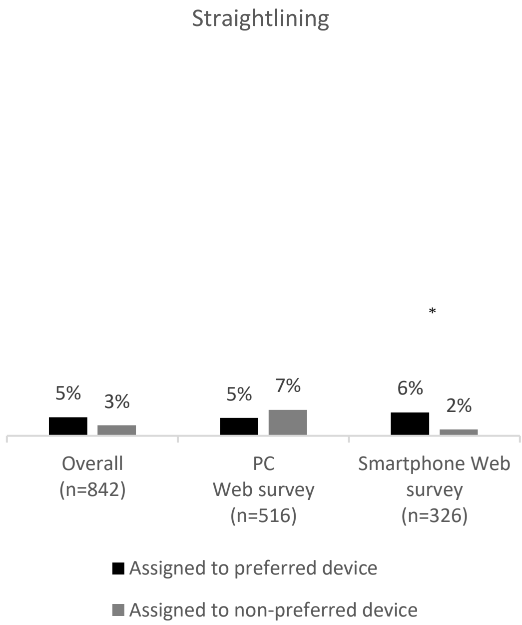

Figure 32: The effect of responding with the preferred device on straightlining, overall and for both device treatments
$***p < .001$, $**p < .01$, $*p < .05$, $^{+}p < .10$

answered the Web survey with their non-preferred device (3 percent) (see Figure 32). However, the difference of 2 percentage points was not significant. The tendency was different in the PC/tablet computer Web survey. PC/tablet computer respondents with a PC/tablet computer preference less likely used the straightlining response strategy (5 percent) than PC/tablet computer respondents with a smartphone preference (7 percent) but the difference was not significant. The effect of responding with the preferred device on straightlining was only significant among smartphone respondents (χ^2 (1, 326) = 4.64, $p < .05$). The effect was on a low level ($\Phi = .12$). As expected, smartphone respondents with a smartphone preference more likely used a straightlining response strategy (6 percent) than smartphone respondents with a PC/tablet computer preference (2 percent).

Multivariate logistic regression analyses confirmed results of descriptive analyses. Even when accounting for variables predicting unit nonresponse, non-conformed responding and device preference responding with the preferred device showed no effect on straightlining (see Model 1 and Model 3 in Appendix E, Table 43). Furthermore, the significant effect in the smartphone Web survey became also non-significant when including control variables in the multivariate logistic regression model (see Model 5 in Appendix E, Table 43). The interaction effect was also not significant. However, the device respondents used for responding showed a significant effect on straightlining. In line with findings of descriptive analyses the likelihood for straightlining was significantly lower among smartphone respondents than among PC/tablet computer respondents (Model 1 in Appendix E, Table 43). From the control variables the respondents' content and process orientation, Internet literacy with a tablet and the respondents' attitude towards survey revealed a significant effect on straightlining (Model 1, Model 3 and Model 5 in Appendix E, Table 43). The respondents' content orientation and attitude towards surveys decreased the likelihood of straightlining and the respondents' process orientation and Internet literacy with a tablet increased the likelihood of straightlining.

Length of answers to narrative open-ended questions

For analyses of the effect of responding with the preferred device on the length of answers to open-ended questions only substantive answers were considered. Respondents who completed the Web survey on their preferred device were expected to report on average longer answers than respondents who answered the Web survey with their non-preferred device (Hypothesis 9). Two narrative open-ended questions were asked in the second

Web survey wave of Study 2. One-way ANOVAs were conducted for both narrative open-ended questions, but results are only presented for one question, because findings of both questions were similar. The narrative open-ended question was positioned in the middle of the questionnaire and asked respondents to report important political issues of Germany. Responses were on average 50 characters long[18]. In line with previous findings, responses of smartphone respondents were shorter (41 characters) than responses of PC/tablet computer respondents (56 characters). Findings of a one-way ANOVA revealed that the difference was significant (F (1, 742) = 15.09, p < .001). The effect size was on a low level (eta² = .02).

Responding with the preferred device also showed a significant effect on the length of answers to narrative open-ended questions (F (1, 742) = 8.43, p < .01). As expected, answers of respondents who completed the Web survey with their preferred device were on average longer (54 characters) than answers of respondents who completed the Web survey with their non-preferred device (43 characters). The effect was on a very low level (eta² = .01). The tendency was similar for PC/tablet computer respondents and smartphone respondents. PC/tablet computer respondents with a PC/tablet computer preference reported on average longer answers (56 characters) than PC/tablet computer respondents with a smartphone preference (52 characters). Accordingly, smartphone respondents with a smartphone preference reported on average longer answers (43 characters) than smartphone respondents with a PC/tablet computer preference (40 characters). However, the difference of the length of answers between respondents answering the Web survey with their

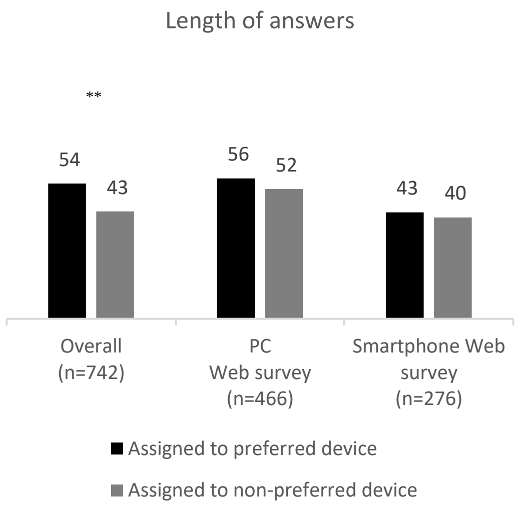

Figure 33: The effect of responding with the preferred device on the length of answers to narrative open-ended questions, overall and for both device treatments
****p* < .001, ***p* < .01, **p* < .05, [+]*p* < .10

[18] Outliers (2*stddev+mean) separately defined for respondents with a smartphone preference who were assigned to respond with a smartphone, respondents with a smartphone preference assigned to respond with a PC/tablet computer, respondents with a PC/tablet computer assigned to respond with a PC/tablet computer and respondents with a PC/tablet computer preference assigned to a smartphone were excluded from analyses (n=28).

preferred device and respondents answering the Web survey with their non-preferred device was neither significant for PC/tablet computer respondents nor for smartphone respondents.

Findings of multivariate linear regression analyses revealed that when accounting for variables predicting unit nonresponse, non-conformed responding and device preference the overall significant effect of responding with the preferred device on the length of answers to narrative open-ended questions became non-significant. Thus, the effect was due to differences of sample compositions (see Model 1 Appendix E, Table 44). Moreover, responding with the preferred device did not affect the length of answers to narrative open-ended questions among smartphone respondents and PC/tablet respondents respectively even when accounting for control variables. Furthermore, the interaction effect was not significant (see Model 2 to Model 5 Appendix E, Table 44). In line with descriptive analyses, the length of answers to narrative open-ended questions differed significantly between smartphone respondents and PC/tablet computer respondents and the effect remained significant when accounting for control variables. Answers of smartphone respondents are significantly shorter than answers of PC/tablet computer respondents (see Model 1 Appendix E, Table 44). From the control variables only the respondents' process orientation and education were associated with the length of answers to narrative open-ended questions. The respondents' process orientation had a significant negative effect on the length of answers and the respondents' education revealed a significant positive effect on the length of answers (see Model 1, Model 3 and Model 5 Appendix E, Table 44).

Primacy effects

At last, primacy effects were used to determine the effect of responding with the preferred device on the respondents' data quality. Primacy effects were expected to be larger among respondents who answered the Web survey with their non-preferred device than among respondents who completed the Web survey with their preferred device (Hypothesis 10). A few multiple response questions were asked in the second Web survey wave of Study 2 but only in two multiple response questions the item order was experimentally varied. In the first multiple response question, the question format was also an experimental condition. Therefore, the second multiple response question is used to assess the effect of responding with the preferred device on primacy effects. The multiple response question was on actions that would make foreigners feel more comfortable in Germany and respondents were asked to mark the most important ones.

Overall, 88 percent of respondents selected at least one item of Item 1 to Item 5 when all eleven items were asked in the original order (Item 1 to Item 11). Contrary, only 76 percent of respondents selected at least one item of Item 1 to Item 5 when items were asked in the reversed order (Item 11 to Item 1). Findings of the Pearson's chi-squared test revealed that the difference of 12 percentage points (see Table 17) was statistically significant (χ^2 (1, 852) = 21.13, $p < .001$). The effect was on a moderate level ($\Phi = -.16$). Similar were findings of respondents who completed the Web survey with their preferred device. More respondents selected at least one item of Item 1 to Item 5 when items were presented in the original order (87 percent) than when items were presented in the reversed order (76 percent). According to findings of the Pearson's chi-squared test the difference of 11 percentage points was significant (χ^2 (1, 561) = 11.61, $p < .01$). The effect was on a low level ($\Phi = -.14$). As expected, the primacy effect was even stronger among respondents who completed the Web survey with their non-preferred device (13 percentage points). 89 percent of respondents who answered the Web survey with their non-preferred device selected at least one item of Item 1 to Item 5 when items were presented in the original order, whereas only 76 percent of respondents who completed the Web survey with their non-preferred device selected at least one item of Item 1 to Item 5 when items were presented in the reversed order. Findings of the Pearson's chi-squared test revealed that the difference was significant (χ^2 (1, 291) = 9.80, $p < .01$). The effect was on a moderate level ($\Phi = -.18$). However, multivariate logistic regression analysis[19] revealed that the strength of the primacy effect did not differ between respondents who completed the Web survey with their preferred device and respondents who answered the Web survey with their non-preferred device. Thus, Hypothesis 10 needs to be rejected.

[19] A multivariate logistic regression analysis with the dependent dummy variable indicating whether or not respondents have selected at least one item of Item 1 to Item 5, the independent dummy variable "item order", the independent dummy variable indicating whether respondents were assigned to respond with their preferred device or non-preferred device and the interaction term of both independent dummy variables was computed. Results of descriptive analyses were confirmed. The interaction effect of both independent dummy variables on the dependent variable was not significant.

Table 17: Size of primacy effect (percentage points) by device treatment and experimental conditions (the assignment to their preferred device)

	PC Web survey	**Smartphone Web survey**	**Total**
Assigned to preferred device	11**	13⁺	11**
Assigned to non-preferred device	11	14**	13**
Total	11**	14***	12***

Note. Displayed is the percentage point difference of the proportion of respondents selecting at least one item of Item 1 to Item 5 when they are presented at the first half of the list (original order) minus the proportion of respondents selecting at least one item of Item 1 to Item 5 when they are presented at the second half of the list (reversed order). Pearson's chi-squared tests with the independent variable "item order" and the dependent dummy variable indicating whether respondents were assigned to respond with their preferred device or non-preferred device were conducted (overall, for the smartphone Web survey and the PC/tablet computer Web survey). The table shows the size of primacy effects (percentage points) with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$.

Primacy effects also occurred among PC/tablet computer respondents. 86 percent of PC/tablet computer respondents selected at least one item of Item 1 to Item 5 when items were presented in the original order whereas only 75 percent of PC/tablet computer respondents selected at least one item of Item 1 to Item 5 when items were presented in the reversed order. Findings of the Pearson's chi-squared test revealed that the difference of 11 percentage points was significant (χ^2 (1, 524) = 10.17, p < .01). The effect was on a low level (Φ = -.14). Among PC/tablet computer respondents with a PC/tablet computer preference the primacy effect (11 PP) was also significant (χ^2 (1, 465) = 9.07, p < .01) and the effect was on a low level (Φ = -.14). Contrary, among PC/tablet computer respondents with a smartphone preference the primacy effect (11 PP) was not significant. Finally, results of a multivariate logistic regression analysis[20] revealed that the strength of the primacy effect did not differ significantly between PC/tablet computer respondents with a PC/tablet computer preference and PC/tablet computer respondents with a smartphone preference. Thus, Hypothesis 10a needs to be rejected.

Finally, primacy effects were strongest among smartphone respondents (14 PP). Significantly more smartphone respondents selected at least one item of Item 1 to Item 5 when items were presented in the original order (91 percent) than when items were presented in the reversed order (77 percent). Findings of the Pearson's chi-squared test revealed that the difference was statistically significant (χ^2 (1, 328) = 12.16, p < .001).

[20] A multivariate logistic regression analysis with the dependent dummy variable indicating whether or not respondents have selected at least one item of Item 1 to Item 5, the independent dummy variable "item order", the independent dummy variable indicating whether respondents were assigned to respond with their preferred device or non-preferred device and the interaction term of both independent dummy variables was computed among PC/tablet computer respondents. Results of descriptive analyses were confirmed. The interaction effect of both independent dummy variables on the dependent variable was not significant.

The effect was on a moderate level (Φ = -.19). As expected, but contrary to findings among PC/tablet computer respondents, smartphone respondents with a smartphone preference were less prone to the item order in the multiple response question than smartphone respondents with a PC/tablet computer preference. According to findings of the Pearson's chi-squared test the primacy effect (13PP) of smartphone respondents with a smartphone preference was only marginally significant (χ^2 (1, 96) = 3.42, $p < .10$). Whereas the primacy effect (14PP) of smartphone respondents with a PC/tablet computer preference was statistically significant (χ^2 (1, 232) = 9.09, $p < .01$). The effect was on a moderate level (Φ = -.20). Thus, findings of Pearson's chi-squared tests provide initial evidence for Hypothesis 10b. However, multivariate logistic regression analyses[21] revealed that the strength of primacy effects did not differ between smartphone respondents with a smartphone preference and smartphone respondents with a PC/tablet computer preference.

Findings of multivariate logistic regression analyses revealed that even when accounting for predictors of unit nonresponse, non-conformed responding and device preference the likelihood that respondents selected at least one item of Item 1 to Item 5 was significantly lower when items were presented in the reversed order than when items were presented in the original order (see Model 1 in Appendix E, Table 45). Furthermore, multivariate logistic regression analyses indicated that the effect of responding with the preferred device on the size of primacy effects did not differ between smartphone respondents and PC/tablet computer respondents (see Model 2 to Model 5 in Appendix E, Table 45).

8.2.4 Motives of Web survey participation

In the second study, multivariate regression analyses accounting for variables predicting unit nonresponse, non-conformed responding and device preference also included variables on the respondents' content and process orientation. According to the uses and

[21] A multivariate logistic regression analysis with the dependent dummy variable indicating whether or not respondents have selected at least one item of Item 1 to Item 5, the independent dummy variable "item order", the independent dummy variable indicating whether respondents were assigned to respond with their preferred device or non-preferred device and the interaction term of both independent dummy variables was computed among smartphone respondents. Results of descriptive analyses were confirmed. The interaction effect of both independent dummy variables on the dependent variable was not significant.

gratification theory, respondents with a high level of process orientation participate in Web surveys because they simply enjoy browsing, whereas respondents with a high level of content orientation participate in Web surveys because they are interested in the informational content of Web surveys. According to Hypothesis 12 respondents who respond with the preferred device are expected to more likely participate in Web surveys due to process orientated gratifications, whereas respondents who respond with the non-preferred device are assumed to more likely participate in Web surveys due to content orientated gratifications.

In the first study, some analyses indicated that respondents who completed the Web survey with their preferred device provided lower data quality than respondents who answered the Web survey with their non-preferred device and the assumption was that these effects were due to differences in sample compositions with respect to the respondents' content and process orientation. This assumption was examined by including indicators of the respondents' content and process orientation in multivariate regression analyses in the second study. Most effects of responding with the preferred device on indicators of data quality became non-significant when multivariate regression analyses accounted for control variables. However, a stepwise inclusion of control variables showed that the respondents' content and process orientation did not influence the effect of responding with the preferred device on data quality indicators. Thus, Hypothesis 12 has to be rejected. Instead, in most cases including the dummy variable indicating whether respondents participated with a smartphone or a PC/tablet computer influenced effects of responding with their preferred device on data quality indicators. These findings indicated that the device respondents use for responding has a stronger effect on data quality than their device preference.

Finally, results of indicators of the respondents' content and process orientation revealed that data quality was lower for respondents with a high degree of process orientation than for respondents with a low degree of process orientation. Accordingly, data quality of respondents with a high degree of content orientation was higher than data quality of respondents with a low degree of content orientation.

8.2.5 Summary

In line with results of Study 1 findings of Study 2 revealed that being assigned to the preferred device significantly increased the likelihood that sample members participated in the Web survey with the assigned device. Findings of multivariate logistic regression analyses revealed that effects remained significant when accounting for variables predicting device preference. Thus, effects were not due to differences of sample compositions. However, findings on the effect of the allocation to the preferred device on unit nonresponse rates remain inconclusive. Overall, being assigned to the preferred device showed no significant effect on unit nonresponse rates indicating that the increase of conformance rates among sample members assigned to their preferred device was primary due to a decrease of rates of non-conforming respondents.

Furthermore, descriptive analyses showed some significant effects of responding with the preferred device on indicators of data quality. However, most effects were due to differences of sample compositions and became non-significant in multivariate regression analyses when accounting for variables predicting unit nonresponse, non-conformed responding and device preference. Only effects on survey interruption and the respondents' survey focus remained (marginally) significant when accounting for control variables. However, both effects indicated that respondents who completed the Web survey with their preferred device provided lower data quality than respondents who answered the Web survey with their non-preferred device. Thus, findings on survey focus were contradictory to findings on survey focus in the first study.

The interaction effect of device treatment and experimental conditions was only significant for the effect of responding with the preferred device on item nonresponse. However, contrary to expectations the interaction effect was significant because the direction of the effect differed rather than the magnitude. Responding with the preferred device decreased the likelihood of item nonrespondents in the PC/tablet computer Web survey but increased the likelihood of item nonrespondents in the smartphone Web survey.

Finally, findings of multivariate regression analyses accounting for control variables and the respondents' content and process orientation revealed that the respondents' content and process orientation did not influence the effect of responding with the preferred device on indicators of data quality.

9 Summary and Conclusion

The aims of this thesis were to examine whether assigning sample members to their preferred device increases conformance rates compared to assigning sample members to their non-preferred device and whether sample members responding with the preferred device provide data of higher quality. For analyses two studies were conducted (see Chapter 7.2). Both studies used a two-wave Web survey design. The respondents' device preference was measured in the respective first Web survey wave and the respective second Web survey wave was used to examine the effect on nonresponse and measurement. Study one was conducted among former university applicants of the Darmstadt University of Technology in March 2016 (n=6,111) and January 2018 (n=615) and Study 2 was conducted among members of a non-probability online panel in May 2018 (n=1,653) and June 2018 (n=853).

Web surveys encouraging sample members to respond with one specific device have shown that some sample members do not follow instructions and respond with a different device than requested (non-conforming respondents) (de Bruijne & Wijnant, 2014a, 2014b; Revilla, Toninelli, Ochoa, et al., 2016; Wells et al., 2013). The assumption is that people have a device preference for Web survey participation and are not willing to respond with a different device. Therefore, most Web surveys use a responsive questionnaire design that accommodates all devices and gives sample members the opportunity to choose their preferred device for Web survey participation. Such mixed-device Web surveys are a specific type of concurrent mixed-mode surveys (de Leeuw & Toepoel, 2018). While mixed-device Web surveys offer sample members the opportunity to choose the device for participation, concurrent mixed-mode surveys offer sample members the opportunity to choose the survey mode for participation. Concurrent mixed-mode surveys were conducted assuming that they increase response rates compared to unimode surveys, because sample members can participate in their preferred mode. However, previous research revealed that response rates of concurrent mixed-mode surveys were lower than response rates of unimode surveys indicating that the opportunity to choose from a range of survey modes may have increased complexity and burden of survey participation and dissuaded sample members from responding (Medway & Fulton, 2012; Millar & Dillman, 2011).

On the one hand, the possibility to respond with their preferred device seems to be an aspect of survey design that increases benefits of Web survey participation. On the other hand, requesting sample members to use a specific device for responding may increase costs of Web survey participation because a choice between devices may increase complexity and burden of responding (Dhar, 1997; Iyengar & Lepper, 2000; Medway & Fulton, 2012; Millar & Dillman, 2011; Schwartz, 2004). According to the social exchange theory and the leverage-salience theory, sample members participate in surveys if benefits outweigh costs of survey participation (see Chapter 4.2). Thus, researchers should aim at increasing benefits and decreasing costs of survey participation to increase the likelihood of responding. As mentioned above, in Web surveys encouraging sample members to respond with one specific device some sample members did not conform instructions. However, these Web surveys did not consider the device preference of sample members and the assumption is that sample members who were accidentally requested to use their preferred device conform instructions whereas sample members who were requested to respond with their non-preferred device were non-conforming and responded with a different device (their preferred device) or refused to participate. In this thesis, sample members of mixed-device Web surveys using a responsive questionnaire design were randomly assigned to respond either with a PC/tablet computer or with a smartphone. The device preference of sample members was known from a subsequent Web survey wave. Thus, sample members assigned to their preferred device and sample members assigned to their non-preferred device could be identified. This thesis experimentally assessed the effect of assigning sample members to their preferred device on unit nonresponse, non-conformed responding, and conformance.

Data quality of respondents is affected by their motivation, their ability and the task difficulty (see Chapter 5.2.2). To provide data of high quality, respondents have to involve a lot of cognitive effort when answering questions. According to one of the most prominent models of the question-answer process, respondents have to go through four stages to arrive at a thorough answer: they have to understand and interpret the question meaning, retrieve all relevant information to compute a judgment, format and edit their answer (see Chapter 5.1). However, a lot of respondents are not willing to involve a lot of cognitive effort to answer survey questions. Thus, they either superficially go through the different stages of the question-answer process or even skip single stages. According to the satisficing framework, respondents who are less motivated and respondents with a low level of cognitive sophistication are more likely to superficially process the different stages or even shortcut the question-answer process (see Chapter 5.2). Moreover, respondents more likely satisfice within difficult tasks. In Web surveys, respondents have to expend cognitive effort operating the device and answering the questions. Thus, respondents who have to expend less cognitive effort operating the device can expend more cognitive effort answering the questions resulting in higher data quality. The same task is more difficult for respondents who have to involve a lot of cognitive effort operating the device than for respondents who have to expend little cognitive effort operating the device. The assumption is that people prefer devices for Web survey participation that are less burdensome and more motivating. Thus, the task difficulty of responding is lower for respondents who complete the Web survey with their preferred device than for respondents who answer the Web survey with their non-preferred device. Moreover, the degree of motivation is higher for respondents who use their preferred device for responding than for respondents who use their non-preferred device for responding. Therefore, this thesis assessed the effect of responding with the preferred device on data quality.

In the remaining of this chapter, the main findings of respondents being assigned to and responding with their preferred device on nonresponse and measurement are summarized and discussed. A more general discussion of the findings follows and finally, limitations of this thesis and an outlook on future research are presented.

9.1 Main findings and implications

In general, findings revealed that assigning sample members to their preferred device increased the sample members' conformance with the device request. Furthermore, responding with the preferred device did not affect most indicators of data quality and effects on the remaining indicators of data quality were inconclusive. Thus, overall responding with the preferred device seems to have no effect on data quality or at least only a small effect. In the following, the main findings of both studies are summarized and discussed separately for each dependent variable.

Unit nonresponse. If sample members are invited to a Web survey, multiple decisions influence whether they participate in the Web survey. Survey design aspects that are known to sample members before starting the Web survey such as the research organization, survey topic, survey duration and incentives influence the decision of sample members (see Chapter 4). According to the social exchange theory, sample members compare benefits of survey participation to costs of survey participation and they participate in surveys if benefits outweigh costs (see Chapter 4.2.1). In the present Web surveys, email invitations of sample members assigned to respond with a smartphone and email invitations of sample members assigned to respond with a PC/tablet computer were identical with one exception. Email invitations of sample members assigned to respond with a smartphone provided the instruction that sample members should use their smartphone for participation. Accordingly, email invitations of sample members assigned to respond with a PC/tablet computer provided the instruction that sample members should use their PC/tablet computer for participation (see Appendix A). The assumption was that sample members who were assigned to their preferred device evaluate the device allocation as additional benefit resulting in lower unit nonresponse rates among sample members assigned to their preferred device than among sample members assigned to their non-preferred device.

The findings on unit nonresponse revealed that being assigned to the preferred device failed to decrease unit nonresponse rates. However, separate analyses of sample members assigned to a PC/tablet computer and sample members assigned to a smartphone indicated that being assigned to the preferred device had an effect on unit nonresponse rates. In the PC/tablet computer Web survey, the effect was as expected. Being assigned to the preferred device decreased unit nonresponse rates. Contrary, in the smartphone Web survey, being assigned to the preferred device increased unit nonresponse rates. Previous research has shown that characteristics of respondents with a smartphone preference coincide with characteristics of hard-to-survey populations[22] (Lugtig et al., 2016). Thus, in the smartphone Web survey higher unit nonresponse rates of sample members assigned to their preferred device might be due to the fact that sample members with a smartphone preference are more likely hard-to-survey than sample members with a PC/tablet computer preference. However, in the second study effects of being assigned to their preferred device on unit nonresponse rates in the smartphone Web survey and the PC/tablet computer Web survey became non-significant when multivariate logistic regression analyses accounted for variables predicting device preference. Thus, effects in

[22] Hard-to-survey populations are people who are hard to sample, recruit, contact, persuade to take part and are willing to participate but nonetheless hard to interview (Tourangeau, 2014).

the second study were due to differences of sample compositions. However, effects of the first study remained significant.

Non-conforming responding. In Web surveys that encourage sample members to participate with one specific device, sample members who ignore instructions and respond with a different device are called non-conforming respondents. The assumption was that sample members who are invited to respond with their non-preferred device are more likely to open the email invitation on a different device (their preferred device). They are not willing to switch their device for Web survey participation because it would increase the burden of responding. Thus, rates of non-conforming respondents were expected to be higher among sample members assigned to their non-preferred than among sample members assigned to their preferred device.

The findings on rates of non-conforming respondents revealed that being assigned to the preferred device significantly increased the likelihood that sample members responded with the requested device. Separate analyses for sample members assigned to respond with a PC/tablet computer and sample members assigned to respond with a smartphone also showed a significant effect of being assigned to the preferred device on rates of non-conforming respondents. Findings remained significant when accounting for variables predicting device preference.

Conformance. Conformance rates are response rates with the additional restriction that respondents used the assigned device for responding. Conformance rates are the counterpart to unit nonresponse rates and rates of non-conforming respondents. Therefore, the assumption was that conformance rates of sample members assigned to their preferred device are higher than conformance rates of sample members assigned to their non-preferred device, because unit nonresponse rates and rates of non-conforming respondents of sample members assigned to their preferred device were expected to be lower.

As expected, findings indicated that conformance rates of sample members assigned to their preferred device were higher than conformance rates of sample members assigned to their non-preferred device. Furthermore, the effect of being assigned to the preferred device on conformance rates was also significant and as expected for sample members assigned to their PC/tablet computer and sample members assigned to their smartphone respectively. The effects stayed significant when accounting for variables predicting device preference. However, findings on unit nonresponse rates and rates of non-conforming respondents revealed that higher conformance rates of sample members assigned to their preferred device were primary due to a reduction of non-conforming respondents especially among sample members assigned to their smartphone. Thus, the decision whether to participate in the Web survey seems to be independent from the device allocation whereas the decision whether to respond with the requested device is strongly affect by the device allocation at least for sample members assigned to their smartphone.

Survey breakoff. Survey breakoff occurs if the cumulative cognitive effort respondents have spent to answer survey questions exceeds the threshold of cognitive effort respondents are willing to spend on survey participation in total. As a result, respondents abandon the survey rather than completing it. In Web surveys, respondents have to involve cognitive effort operating the device and answering survey questions. The assumption was that respondents who complete the Web survey with their preferred device have to involve less cognitive effort operating the device. Thus, more cognitive effort remains for answering survey questions. Therefore, respondents who complete the Web survey with their preferred device are expected to reach their threshold of cognitive effort they are willing to spend for survey participation less often than sample members who answer the Web survey with their non-preferred device. The assumption is that survey breakoff rates of sample members who use their preferred device for responding less likely abandon the Web survey than sample members who complete the Web survey with their non-preferred device.

Contrary to expectations, survey breakoff rates of respondents who completed the Web survey with their non-preferred device were lower than survey breakoff rates of respondents who answered the Web survey with their preferred device. The tendency appeared also for smartphone respondents and PC/tablet computer respondents respectively, but the difference was only significant for smartphone respondents. Smartphones can be used for various activities and respondents with a smartphone preference may use more activities on their smartphone than respondents who prefer a different device. This assumption could explain why smartphone respondents with a smartphone preference abandon the Web survey more often than smartphone respondents with a PC/tablet computer preference. The effects remain or even increase when accounting for variables predicting device preference, unit nonresponse and non-conformed responding.

Item nonresponse. A less aggravated form of partial nonresponse in terms of survey breakoff is item nonresponse. In the present analyses item nonresponse refers to the respondent’s failure to provide an answer to one or more survey questions. In Web surveys used for present analyses respondents were able to skip questions without being prompted to provide an answer. Item nonresponse is a strong form of satisficing because respondents skip the retrieval and judgment stage of the question-answer process. As mentioned above, respondents using their non-preferred device have less cognitive effort available for answering survey questions and thus, try to minimize their cognitive effort for responding by skipping question without answering them. Thus, the likelihood that respondents skip survey questions without answering them was expected to be lower among respondents using their preferred device than among respondents using their non-preferred device.

The findings on item nonresponse revealed that responding with the preferred device did not affect whether respondents skipped at least one question without answering it. Thus, with respect to item nonresponse data quality of respondents using their preferred device for responding did not differ from data quality of respondents using their non-preferred device for responding.

Response time. Response times are often used in survey research as indicator of the respondent’s response strategy (Callegaro, Yang, et al., 2009; Lynn & Kaminska, 2012; Stieger & Reips, 2010; Zhang & Conrad, 2013). Optimizing respondents thoroughly go through the different stages of the question-answer process when answering survey questions, whereas satisficing respondents superficially process the different stages or even shortcut the question-answer process. Thus, response times of optimizing respondents are expected to be higher than response times of satisficing respondents (Callegaro, Yang, et al., 2009; Smyth et al., 2006; Toepoel et al., 2008; Tourangeau et al., 2009). Contrary to this assumption, longer response times can also indicate that respondents have difficulties answering survey questions (Bassili & Fletcher, 1991; Draisma & Dijkstra, 2004; Heerwegh, 2003). Therefore, fast responses can be used as indicator of satisficing or of simpler mental processes. However, speeding – extremely fast responses – is a more distinct indicator of satisficing (Greszki et al., 2014; Zhang & Conrad, 2013). Speeding thresholds are set on a very low level. Thus, responses can only be selected arbitrarily. Four indicators were used for analyses on response times. Response times and speeding at questionnaire level and at question level were examined. While response times and speeding at questionnaire level only identify respondents who constantly satisfice, response times and speeding at question level provides insights on all satisficing respondents for this specific question even if they used an optimizing response strategy for subsequent or remaining questions.

The overall effect of responding with the preferred device on completion times of respondents was contrary to expectations and only significant in the second study. In the first study the effect of responding with the preferred device on completion times was only significant for PC/tablet computer respondents and the effects was as expected. Respondents using their preferred device had higher completion times than respondents using their non-preferred device. Furthermore, the effect of responding with the preferred device on speeding at questionnaire level was only significant in the second study (overall and among smartphone respondents). Contrary to expectations, respondents using their preferred device were more likely to speed than respondents using their non-preferred device. However, effects of responding with the preferred device on the mean time of survey completion and speeding at questionnaire level became non-significant when accounting for variables predicting device preference, unit nonresponse and non-conformed responding. Thus, effects were due to differences of sample compositions and not due to the allocation to their preferred device.

As expected, findings at question level indicate that responding with the preferred device increased the response time of grid questions among smartphone respondents. Response times of smartphone respondents with a smartphone preference were longer than response times of smartphone respondents with a PC/tablet computer preference. These effects were not due to differences of sample compositions. Analyses on speeding at question level confirmed results of response times at question level. Smartphone respondents with a smartphone preference were less likely to speed than smartphone respondents with a PC/tablet computer preference. Analyses on completion times and speeding at question level were conducted for three grid questions. Among smartphone respondents the effect of responding with the preferred device on speeding was significant but only for one of the three questions. The effect was only significant when accounting for variables predicting unit nonresponse, non-conformed responding and device preference. Thus, findings at question level indicated that respondents using their preferred device were less likely satisficing respondents than respondents using their non-preferred device at least among smartphone respondents. No effect was found for PC/tablet computer respondents.

Survey focus. PC/tablet computers and smartphones easily allow respondents to temporarily leave the Web survey page and switch to another window or browser tab. The inactivity of the Web survey page indicates that respondents engage in other activities. Previous research has shown that secondary activities or distractions decrease data quality of respondents (Kennedy, 2010; Sendelbah et al., 2016). Furthermore, older respondents find it more difficult to suppress distractions than younger respondents indicating that the likelihood that respondents engage in secondary activities is higher among respondents with a low level of cognitive ability and for more difficult tasks. Therefore, respondents completing the Web survey with their preferred device were expected to leave the Web survey page less often than respondents answering the Web survey with their non-preferred device. To measure the survey focus of respondents, the JavaScript tool SurveyFocus was implemented in Web surveys providing paradata on the inactivity of the Web survey page (Schlosser & Höhne, 2018). A variable indicating how often respondents left the Web survey page within the whole questionnaire was used for analyses.

Contrary to expectations, in the second study respondents who completed the Web survey with their preferred device were more likely to leave the Web survey than respondents who answered the Web survey with their non-preferred device. However, the effect became marginally significant when accounting for variables predicting device preference, unit nonresponse, and non-conformed responding. In the first study, responding with the preferred device did not reveal a significant effect on the respondents' survey focus. However, when accounting for control variables responding with the preferred device showed a significant effect on survey focus. In line with expectations but contrary to findings of Study 1, respondents using their preferred device left the Web survey less often than respondents using their non-preferred device.

Degree of differentiation. The degree of differentiation indicates whether respondents strongly or rarely differentiated between several rating scale items. According to the satisficing framework, respondents who use the same or nearly the same response option for all rating scale items seem to use shortcuts within the second and third stage of the question-answer process (Krosnick, 1991). Respondents with a high level of differentiation are expected to reconsider all rating scale options for each item when answering rating scale items, whereas respondents with a low level of differentiation are assumed to consider only a minimum of rating scale options when evaluating rating scale items. Respondents who complete the Web survey with their non-preferred device have less cognitive effort available for answering survey questions. Thus, they are more likely to shortcut the question-answer process when answering rating scale items resulting in a lower degree of differentiation or even straightlining. Straightlining respondents select the same answer category for all items (Baker et al., 2010; Kaminska et al., 2010).

Contrary to expectations, respondents who completed the Web surveys with their preferred device differentiated less than respondents who completed the Web survey with their non-preferred device. Responding with the preferred device had no effect on the degree of differentiation for PC/tablet computer respondents. However, smartphone respondents with a smartphone preference differentiated less than smartphone respondents with a PC/tablet computer preference. Effects in the first study were not due to differences of sample compositions. Results on survey focus have shown that respondents using their preferred device are more often distracted from responding than respondents who complete the Web survey with their non-preferred device. According to Lynn and Kaminska (2012), distractions affect the processing of the second stage of the question-answer process. Thus, respondents using their preferred device for Web survey participation may differentiate less because they are more often distracted. On the other hand, previous research has shown that nondifferentiation was not associated with multitasking (Sendelbah et al., 2016).

Findings on straightlining indicated that the percentage of straightlining was higher among smartphone respondents with a smartphone preference than among smartphone respondents with a PC/tablet computer preference. These findings are in line with results on the degree of differentiation. However, when accounting for variables predicting device preference, unit nonresponse and non-conformed responding effects of responding with the preferred device on straightlining became non-significant. Thus, effects were due to differences of sample compositions.

Length of answers. For narrative open-ended questions respondents have to involve a lot of cognitive effort for the formatting stage, because respondents have to format their answer in their own words instead of selecting a predefined response option. Since respondents who complete the Web surveys with their non-preferred device have less cognitive effort available for responding, they were expected to provide shorter answers to narrative open-ended questions to keep their cognitive effort for responding on a low level.

As expected, findings revealed that responding with the preferred device increased the length of answers to narrative open-ended questions. However, multivariate regression analyses accounting for variables predicting unit nonresponse, non-conformed responding and device preference revealed that both effects were due to differences of sample compositions.

Primacy effects. Finally, the last indicator of data quality describes the respondent’s tendency to rather select a response option listed first than a response option listed last. Primacy effects occur because satisficing respondents minimize their cognitive effort by recalling just enough information to find the first acceptable answer rather than recalling all relevant information necessary to provide an optimal answer (Krosnick, 1991). Satisficing respondents select the first acceptable answer rather than processing all response categories to identify their optimal answer. Findings of an eye-tracking study revealed that respondents drew more attention to response options at the beginning of the list than to response options at the end of the list (Galesic et al., 2008). Respondents who completed the Web surveys with their preferred device were expected to involve more cognitive effort in answering survey questions than respondents who answered the Web surveys with their non-preferred device. Thus, the assumption was that responding with the preferred device decreased the likelihood of primacy effects.

The findings revealed that primacy effects occurred for respondents who completed the Web surveys with their preferred device as well as for respondents who answered the Web surveys with their non-preferred device. However, the size of primacy effects did not differ between respondents using their preferred device and respondents answering the Web surveys with their non-preferred device.

Interaction effects. For all analyses, interaction effects between a dummy variable indicating whether respondents were assigned to their PC/tablet computer or smartphone and a dummy variable indicating whether respondents were assigned to their preferred or non-preferred device were assessed. The assumption was that the effect of being assigned to the preferred device on survey participation behaviors and the effect of responding with the preferred device on data quality differed between PC/tablet computer respondents and smartphone respondents. People with a smartphone preference were expected to have less difficulties to respond with a PC/tablet computer than people with a PC/tablet computer preference who are requested to respond with a smartphone, because the technical affinity of people with a smartphone preference is probably large enough to answer Web surveys on a PC/tablet computer. Contrary, the technical affinity of people with a PC/tablet computer preference may not be sufficient to answer Web surveys on a smartphone without expending additional cognitive effort operating the smartphone. Thus, the effect of being assigned to the preferred device on survey participation behaviors was expected to be stronger among sample members being assigned to respond with a smartphone and the effect of responding with the preferred device on indicators of data quality was expected to be stronger among smartphone respondents. Findings of multivariate regression analyses revealed only few significant interaction effects. In the first study, the interaction effect was significant for analyses on unit nonresponse, conformance rates and response times at question level. In the second study, the interaction effect was only significant for analyses on item nonresponse. However, only the interaction effect on response times at question level was as expected and showed that the effect of responding with the preferred device on response time at question level was stronger among smartphone respondents than among PC/tablet computer respondents. Contrary to expectation, the other interaction effects were either significant because the effect of responding with the preferred device on the respective indicator of data quality was stronger for PC/tablet computer respondents than for smartphone respondents or because the direction of the effect of responding with the preferred device differed between smartphone respondents and PC/tablet computer respondents.

Uses and gratifications theory. Findings of the first study revealed that respondents who completed the Web survey with their preferred device provided lower data quality than respondents who answered the Web survey with their non-preferred device regarding two indicators of data quality, survey breakoff and degree of differentiation. These findings were contrary to expectations and the assumption was that these findings were due to differences of sample compositions regarding the respondents' motives of Web survey participation which were not assessed in the first study.

According to the uses and gratifications theory, people access the Internet due to content or process orientated motives (Song et al., 2004). People with content orientated motives are more interested in the informational content of Web sites, whereas people with process orientated motives access the Internet to enjoy random browsing. They spend less attention to the informational content of Web sites (Rodgers & Thorson, 2000).

The assumption was that sample members who were assigned to their preferred device, decided to conform, and responded with their preferred device were more likely to participate in the Web survey due to process orientated motives, whereas sample members who were assigned to their non-preferred device, decided to conform, and responded with their non-preferred device were more likely to participate in the Web survey due to content orientated motives. Process orientated respondents spend less cognitive effort on the informational content of Web surveys which could explain their lower data quality.

Contrary to expectations, multivariate regression analyses accounting for the degree of the respondents' content and process orientation showed that effects of responding with the preferred device on indicators of data quality were not affected by the respondents' content and process orientation. However, in line with the uses and gratifications paradigm findings showed that the data quality of respondents with a high level of content orientation was higher than of respondents with a low level of content orientation. Accordingly, data quality of respondents with a high level of process orientation was lower than data quality of respondents with a low level of process orientation.

9.2 General discussion

In survey research, a common assumption is that people have a positive attitude towards one survey mode and a neutral or negative attitude towards the other survey modes (Groves & Kahn, 1979). Based on the assumption that people have a mode preference, response rates of concurrent mixed-mode surveys were expected to be higher than response rates of surveys with a unimode design, because concurrent mixed-mode surveys offer sample members the opportunity to respond in their preferred survey mode. Whether mode preference increases response rates in the preferred mode compared to a non-preferred mode was also empirically assessed. Findings confirmed the assumption and revealed that response rates in the preferred mode were higher than response rates in the non-preferred mode (Olson et al., 2012). Furthermore, there is also some evidence that respondents who participate in their preferred mode provide higher data quality than respondents who participate in their non-preferred mode (Smyth, Olson, & Kasabian, 2014).

Mixed-device Web surveys are a specific type of concurrent mixed-mode surveys (de Leeuw & Toepoel, 2018). Web surveys encouraging sample members to respond with one specific device have shown that some sample members are not willing to use the assigned device and respond with a different device (de Bruijne & Wijnant, 2014a, 2014b; Revilla, Toninelli, Ochoa, et al., 2016; Wells et al., 2013). These non-conforming respondents indicate that people have a device preference for Web survey participation and are not willing to respond with a different device. Whether conformance rates of Web surveys can be increased by assigning sample members to their preferred device compared to assigning sample members to their non-preferred device was empirically assessed in this thesis. Results revealed that conformance rates of sample members assigned to their preferred device were higher than conformance rates of sample members assigned to their non-preferred device. However, being assigned to the preferred device did not affect unit nonresponse rates. Only rates of non-conforming respondents were affected. Thus, conformance rates of sample members assigned to their preferred device were higher due to a decrease of non-conformed responding rather than unit nonresponse. Furthermore, responding with the preferred device revealed effects on some indicators of data quality. However, findings were inconclusive. As expected, some indicators revealed that responding with the preferred device increased data quality of respondents (Study 1: response time and survey focus). Whereas other indicators of data quality were negatively affected by respondents who used their preferred device for Web survey participation (Study 1: survey breakoff and degree of differentiation; Study 2: survey interruption and survey focus). Although effects on some indicators of data quality were significant, the few effects on indicators of data quality were low in magnitude and compensated each other. Results of this thesis confirmed that the effect of the assignment to the preferred device on conformance rates was stronger than the effect of responding with the preferred device on data quality. Thus, assigning sample members to their preferred device increases conformance rates without affecting measurement or at least only to a small extent.

Against this backdrop, it seems reasonable that most mixed-mode Web surveys use a responsive questionnaire design. However, research on concurrent mixed-mode surveys has also shown that response rates of concurrent mixed-mode surveys were lower than response rates of surveys with a unimode design (Medway & Fulton, 2012; Millar & Dillman, 2011). These findings led to the assumption that a choice of survey modes increases complexity and burden of survey participation, dissuading sample members from responding. Thus, also in mixed-device Web surveys using a responsive questionnaire design, the opportunity to choose a device for participation may be too demanding for sample members negatively affecting response rates. However, considering the phenomenon of non-conforming respondents and findings of this thesis, sample members should not be assigned to any device. If the device preference of sample members is available, they should be assigned to their preferred device. Thus, response burden of mixed-device Web surveys may be even further decreased, if in addition to a responsive questionnaire design sample members are assigned to their preferred device. Only few sampling frames will provide information on the device preference of sample members. However, in longitudinal studies and in online panels this information might be available from an earlier survey or characteristics of sample members that correlate with device preference such as the devices used most often to read and write emails from a rich sampling frame can be used to assign sample members to their preferred device.

9.3 Limitations and Further Research

Both presented studies have certain limitations which are discussed in this chapter. The first study was conducted among a relatively homogeneous and, at the same time, young and highly educated sample of former university applicants of the Darmstadt University of Technology. Both factors, age and education, suggest that their device-literacy and Internet-literacy was higher compared to the general population. Thus, the effect of being assigned to the preferred device on conformance rates may be underestimated and even stronger in a more heterogeneous population, because a high degree of device-literacy and Internet-literacy decrease the likelihood that people mind participating with a different device than their preferred device. Furthermore, university applicants are highly motivated respondents, decreasing the likelihood that respondents satisfice. Therefore, the effect of responding with the preferred device on data quality may also be stronger in a more general population.

Moreover, in the first study the between-wave interval of two years should be treated with caution. Previous research has shown that in online panels a high proportion of respondents consistently used the same device for Web survey participation (Lugtig & Toepoel, 2015; Struminskaya et al., 2015). Both studies examined six Web survey waves with a periodicity of one month. However, even if the device preference for Web survey participation seems to be relatively stable for a period of half a year, two years are a very long time especially for attitudes towards technical devices. The rapid development of technical equipment provides a lot of innovations in a minimum of time which may also change the attitude of people towards technical devices. Thus, in the second study the device preference measured in the first wave may have changed until the field period of the second wave. The assumption is that changes are more likely among sample members with a PC/tablet computer preference. The popularity of smartphones increases further and further and some respondents who preferred a PC in 2016 may have preferred a smartphone for Web survey participation at the beginning of 2018. Vice versa, respondents who already preferred a smartphone over a PC/tablet computer in 2016 are expected to less likely change their attitude. Thus, results of PC/tablet computer respondents with a PC/tablet computer preference and results of smartphone respondents with a PC/tablet computer preference should be treated with caution.

Both limitations were addressed in the second study. At first, the second study was conducted among a more heterogeneous sample regarding their age, gender, and education. Both survey waves of the second study were conducted among members of a nonprobability online panel. For the first wave cross quotas for age (18-29, 30-39, 40-49, 50-59, 60+) and gender and independent quotas for education (low, medium, high) were used and quotas were met. Thus, the sample composition of respondents of the first survey wave of the second study corresponded to the general population regarding the distribution of the three variables. Accordingly, the sample of the second study was more heterogeneous at least regarding their gender, age and education. However, quotas referred to the general population and not the Internet population. Thus, even though the sample of the second study is more heterogeneous regarding age, gender and education it is not a representative sample of the Internet population regarding these characteristics of sample members. Moreover, the between-wave interval of the second study was shorter. A periodicity of two weeks was chosen to increase the likelihood that device preferences of the sample of the second study did not change between both survey waves.

In general, in both studies the device which respondents used to answer the first survey wave was used to define the respondent’s device preference. However, previous research has shown that depending on the survey length, the survey topic and the situational context respondents prefer different devices for Web survey participation (Revilla, Toninelli, Ochoa, et al., 2016). Thus, further research on device preference in Web surveys can increase the reliability of the respondents’ device preference when measures of device preference also consider factors of the survey request and the situational context.

The first aim of both studies was to analyze the effect of being assigned to the preferred device on survey participation behaviors. In both studies, frame data did not provide any information on the device preference of sample members. Thus, two-wave Web surveys were conducted. The respective first wave was used to measure the device preference of respondents and the respective second wave was used to measure the effect on survey participation behaviors and data quality. As mentioned above, the first study was conducted among former university applicants of the Darmstadt University of Technology and respondents of the first wave were asked for their permission to be contacted for a second survey wave. Thus, sample members of the second survey wave were a more cooperative sample than sample members of the first survey wave. Both survey waves of the second study were conducted in a nonprobability online panel. Members of nonprobability online panels volunteered to be contacted for Web surveys. Thus, panel members of nonprobability online panels are also a more cooperative sample than sample members of probability online panels and for sure of cross-sectional surveys using a probability-based sample. Accordingly, unit nonrespondents and non-conforming respondents of the second wave of both studies may differ from unit nonrespondents and non-conforming respondents of cross-sectional studies using a probability-based sample at least regarding their cooperativeness. Thus, nonresponse rates of the present studies are probably underestimated.

The second aim of both studies was to measure the effect of responding with the preferred device on measurement. Findings were inconclusive and further research is needed before firm recommendations can be made for researchers. To gain better insights into the effect of responding with the preferred device on measurement error, further research could use a more direct measure of measurement error rather than indirect measures such as survey breakoff, item nonresponse, response time, survey focus, degree of differentiation, length of answers and primacy effects. Measurement describes the deviation between the respondent’s true value of a theoretical concept and the observed value (Biemer & Lyberg, 2003; Groves et al., 2009). Direct measures of measurement error require rich frame data providing the respondent’s true value for survey questions. In the present studies, frame data did not provide the required information for direct measures of measurement error. Thus, indirect measures of measurement error were used.

Moreover, present nonresponse and measurement analyses rely on the common cause model, according to which the same factor affects both survey participation behaviors and measurement error. The assumption is that sample members assess the allocation to their preferred device as benefit of survey participation increasing conformance rates and at the same time responding with the preferred device increases the cognitive effort respondents can involve in answering survey questions, because responding with the preferred device requires less cognitive effort operating the device. The assumption seems to be quite strong, but it must be considered that sample members could also prefer devices for Web survey participation that simplify satisficing. Accordingly, the assumption would have been that data quality of respondents completing the Web survey with their preferred device would not differ from data quality of respondents using their non-preferred device. As mentioned above, findings on measurement were inconclusive and further research is needed to understand the effect of responding with the preferred device on measurement.

Finally, findings of this thesis allow the conclusion that in mixed-device Web surveys assigning sample members to their preferred device has advantages compared to assigning sample members to their non-preferred device. However, this thesis did not assess whether assigning sample members of mixed-device Web surveys to their preferred device has also advantages compared to mixed-device Web surveys that leave the decision which device to use for participation to sample members. Findings of concurrent mixed-mode surveys provide some evidence that the allocation to the sample members' preferred device in mixed-device Web surveys could decrease the response burden even further compared to mixed-device Web surveys which leave the decision which device to use for participation to sample members, because the opportunity to choose the device for Web survey participation at their own convenience may increase complexity and burden of responding dissuading sample members from answering the Web survey. However, further research is needed to empirically assess, if in mixed-device Web surveys assigning sample members to their preferred device is beneficial to offering sample members the opportunity to select their preferred device at their own convenience.

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Appendix A: Wording of email invitations

Study 1: Sample members assigned to respond with a PC/tablet computer

“Bitte nehmen Sie mit Ihrem Desktop, Laptop oder Tablet Computer an der Befragung teil. Wenn Sie diese Zuweisung befolgen, unterstützen Sie zusätzlich unsere Onlineforschung.”

Translation by the author: “Please use your desktop, laptop or tablet computer to complete the survey. If you follow this instruction you will additionally support our Online research.”

Study 1: Sample members assigned to respond with a smartphone

“Bitte nehmen Sie mit Ihrem Smartphone an der Befragung teil. Wenn Sie diese Zuweisung befolgen, unterstützen Sie zusätzlich unsere Onlineforschung.”

Translation by the author: “Please use your smartphone to complete the survey. If you follow this instruction you will additionally support our Online research.”

Study 2: Sample members assigned to respond with a PC/tablet computer

“Hinweis: Bitte nehmen Sie über einen Desktop PC oder ein Tablet teil!“

Translation by the author: “Note: Please participate with a desktop PC or a tablet!”

Study 2: Sample members assigned to respond with a smartphone

“Hinweis: Bitte nehmen Sie über ein Smartphone teil!“

Translation by the author: “Note: Please participate with a smartphone!”

Appendix B: Quota assignment of the first wave of Study 2

Table 18: Cross quotas for age and gender

Age	Gender	Quotas
18-29	male	8.7%
18-29	female	7.9%
30-39	male	7.6%
30-39	female	7.4%
40-49	male	8.3%
40-49	female	8.2%
50-59	male	9.5%
50-59	female	9.5%
60 and older	male	14.8%
60 and older	female	18.1%

Table 19: Quotas for education

Education	Quotas
Low	37.0%
Medium	30.8%
High	32.2%

Appendix C: Rating scale items on the respondents' content-orientation and process-orientation

Original wording in German:

Motive	Rating scale items
Escapism (process-orientation)	Das Internet regt meine Emotionen und Gefühle an.
	Im Internet fühle ich mich wie in einer anderen Welt.
Information (content-orientation)	Im Internet erfahre ich viel Neues.
	Die Informationen, die ich im Internet erhalten kann, sind sehr nützlich.
	Das Internet ist ein gutes Informationsmedium.

Translation by the author:

Motive	Rating scale items
Escapism (process-orientation)	The Internet stimulates my emotions and feelings.
	On the Internet, I have the impression to be in a different world.
Information (content-orientation)	On the Internet, I get a lot of new information.
	Information from the Internet are very useful.
	The Internet is a good information medium.

Appendix D: Multivariate regression analyses of Study 1

Table 20: Multivariate logistic regression models for the PC/tablet computer subsample with the dependent variable unit nonresponse, non-conformed responding and conformance (Study1)

	Unit nonrespondents				Non-conforming respondents				Conforming respondents			
	Model 1 (n=2,914)		Model 2 (n=2,914)		Model 3 (n=2,914)		Model 4 (n=2,914)		Model 5 (n=2,914)		Model 6 (n=2,914)	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	1.49***	0.10	1.94+	0.70	0.30***	0.02	0.24**	0.12	0.21***	0.02	0.17***	0.07
Experimental condition												
Preferred device (EG)	1.29*	0.14	1.27*	0.15	0.40***	0.06	0.39***	0.07	1.49**	0.20	1.55**	0.22
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--	--	--
Device treatment												
Smartphone Web survey	--	--	--	--	--	--	--	--	--	--	--	--
PC Web survey	1.63***	0.18	1.61***	0.19	0.48***	0.07	0.46***	0.07	0.96	0.13	1.00	0.15
Interaction effect												
Preferred*PC	0.47***	0.07	0.48***	0.09	1.46	0.34	1.53	0.40	1.63**	0.30	1.53*	0.32
Age (continuous)			0.99	0.01			1.00	0.01			1.01	0.01
Gender												
male			1.06	0.09			1.09	0.13			0.87	0.08
female			--	--			--	--			--	--
Education (continuous)			0.92*	0.04			1.04	0.06			1.10*	0.05
Income (continuous)			1.00*	0.00			1.00	0.00			1.00*	0.00
HH size												
single-person HH			0.92	0.09			0.82	0.12			1.27*	0.15
multi-person HH			--	--			--	--			--	--

Internet hours (continuous)												
PC			1.02	0.01			0.98	0.02			0.99	0.02
Tablet			1.00	0.03			1.04	0.04			0.98	0.03
Smartphone			1.02	0.01			0.98	0.02			0.99	0.01
Email usage												
PC			1.00	0.09			0.93	0.12			1.04	0.11
Tablet			0.93	0.21			1.00	0.30			1.11	0.28
Smartphone			--	--			--	--			--	--
Attitude towards surveys (continuous)			1.03	0.08			1.10	0.12			0.90	0.08
Topic interest (continuous)			1.00	0.00			1.00	0.00			1.00	0.00
Pseudo r^2 **Log likelihood**	Quality indicators for multivariate logistic regression models are not reported, because analyses are based on multiple imputed data.											

Note. Model 1-2: Multivariate logistic regression models with the dummy variable “unit nonrespondents” (0=non-conforming/conforming respondents; 1=unit nonrespondents) as dependent variable were computed. Model 3-4: Multivariate logistic regression models with the dummy variable “non-conforming respondents” (0=unit nonrespondents/conforming respondents; 1=non-conforming respondents) as dependent variable were computed. Model 5-6: Multivariate logistic regression models with the dummy variable “conforming respondents” (0=unit nonrespondents/non-conforming respondents; 1=conforming respondents) as dependent variable were computed. The table shows odds ratio with ***p < .001, **p < .01, *p < .05, ^{+}p < .10, “--“ identifies the reference categories.

Table 21: Multivariate logistic regression models with the dependent variable survey breakoff (Study 1)

	Model 1 (n=660)		**Model 2 (n=660)**		**Model 3 (n=660)**		**Model 4 (n=660)**		**Model 5 (n=660)**	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	0.00***	0.01	0.07***	0.03	0.00***	0.01	0.09***	0.03	0.01***	0.01
Experimental condition										
Preferred device (EG)	2.24**	0.68	1.83	0.80	1.85	0.87	2.21*	0.84	2.61*	1.12
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	1.54	0.44	1.24	0.61	1.22	0.64	--	--	--	--
PC Web survey	--	--	--	--	--	--	0.80	0.40	0.82	0.43
Interaction effect										
Preferred*Smartphone			1.21	0.70	1.41	0.94				
Preferred*PC							0.83	0.48	0.71	0.47
Age (continuous)	1.01	0.02			1.01	0.02			1.01	0.02
Gender										
male	0.95	0.26			0.95	0.26			0.95	0.26
female	--	--			--	--			--	--
Education (continuous)	1.01	0.14			1.01	0.14			1.01	0.14
Income (continuous)	1.00*	0.00			1.00*	0.00			1.00*	0.00
HH size										
single-person HH	0.86	0.29			0.86	0.29			0.86	0.29
multi-person HH	--	--			--	--			--	--
Internet hours (continuous)										
PC	1.01	0.04			1.02	0.04			1.02	0.04
Tablet	0.89	0.10			0.90	0.10			0.90	0.10
Smartphone	1.14**	0.04			1.13**	0.04			1.13**	0.04

Email usage										
PC	1.69	0.54			1.79^{+}	0.61			1.79^{+}	0.61
Tablet	2.42	1.78			2.58	1.91			2.58	1.91
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	1.58^{+}	0.42			1.57^{+}	0.42			1.57^{+}	0.42
Topic interest (continuous)	1.00	0.00			1.00	0.00			1.00	0.00
Pseudo r^2 **Log likelihood**	Quality indicators for multivariate logistic regression models are not reported, because analyses are based on multiple imputed data.									

Note. Multivariate logistic regression models with the dummy variable "survey breakoff" (0=completes; 1=survey breakoffs) as dependent variable were computed. The table shows odds ratio with ***p < .001, **p < .01, *p < .05, ^{+}p < .10. "--" identifies the reference categories.

Table 22: Multivariate logistic regression models with the dependent variable item missing (Study 1)

	Model 1 (n=660)		**Model 2 (n=660)**		**Model 3 (n=660)**		**Model 4 (n=660)**		**Model 5 (n=660)**	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	2.59	2.02	1.20	0.25	2.52	1.97	1.21	0.21	2.75	2.17
Experimental condition										
Preferred device (EG)	1.27	0.23	1.29	0.31	1.57^{+}	0.42	1.14	0.29	1.00	0.28
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	0.86	0.16	1.01	0.27	1.09	0.31	--	--	--	--
PC Web survey	--	--	--	--	--	--	0.99	0.27	0.92	0.26
Interaction effect										
Preferred*Smartphone			0.89	0.31	0.64	0.26				
Preferred*PC							1.12	0.40	1.56	0.64
Age (continuous)	1.00	0.02			1.00	0.02			1.00	0.02
Gender										
male	1.12	0.20			1.13	0.21			1.13	0.21
female	--	--			--	--			--	--
Education (continuous)	0.99	0.09			0.98	0.09			0.98	0.09
Income (continuous)	1.00	0.00			1.00	0.00			1.00	0.00
HH size										
single-person HH	0.91	0.20			0.91	0.20			0.91	0.20
multi-person HH	--	--			--	--			--	--
Internet hours (continuous)										
PC	1.00	0.03			0.99	0.03			0.99	0.03
Tablet	1.10	0.08			1.10	0.08			1.10	0.08
Smartphone	0.97	0.03			0.98	0.03			0.98	0.03

Email usage										
PC	0.86	0.17			0.79	0.17			0.79	0.17
Tablet	0.74	0.37			0.66	0.34			0.66	0.34
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	1.09	0.21			1.09	0.21			1.09	0.21
Topic interest (continuous)	0.99***	0.00			0.99***	0.00			0.99***	0.00
Pseudo r² **Log likelihood**	Quality indicators for multivariate logistic regression models are not reported, because analyses are based on multiple imputed data.									

Note. Multivariate logistic regression models with the dummy variable "item missing" (0=no item missing value; 1=at least one item missing value) as dependent variable were computed. The table shows odds ratio with ***p < .001, **p < .01, *p < .05, ^{+}p < .10. "--" identifies the reference categories.

Table 23: Multivariate linear regression models with the dependent variable response time at questionnaire level (Study 1)

	Model 1 (n=660)		**Model 2 (n=660)**		**Model 3 (n=660)**		**Model 4 (n=660)**		**Model 5 (n=660)**	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	676.50***	189.36	1004.96***	51.10	669.41	189.51	1144.78***	44.90	791.64***	191.63
Experimental condition										
Preferred device (EG)	45.04	43.89	137.18*	60.92	87.49^{+}	62.22	-51.42	66.79	-7.27	69.87
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	72.72	44.33	139.83*	68.03	122.23	67.90	--	--	--	--
PC Web survey	--	--	--	--	--	--	-139.83*	68.03	-122.23^{+}	67.90
Interaction effect										
Preferred*Smartphone			-188.60*	90.40	-94.76	98.47				
Preferred*PC							188.60*	90.40	94.76	98.47
Age (continuous)	11.53*	4.71			11.49*	4.71			11.49*	4.71
Gender										
male	-48.96	43.71			-46.33	43.80			-46.33	43.80
female	--	--			--	--			--	--
Education (continuous)	9.71	22.64			8.42	22.68			8.42	22.68
Income (continuous)	-0.05	0.08			-0.05	0.08			-0.05	0.08
HH size										
single-person HH	48.83	51.47			50.09	51.49			50.09	51.49
multi-person HH	--	--			--	--			--	--
Internet hours (continuous)										
PC	10.78	6.73			9.71	6.83			9.71	6.83
Tablet	-40.32**	13.87			-41.17**	13.90			-41.17**	13.90
Smartphone	-6.37	8.15			-5.40	8.21			-5.40	8.21

Email usage										
PC	32.79	47.54			14.92	51.03			14.92	51.03
Tablet	124.24	116.06			101.68	118.41			101.68	118.41
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	-43.44	45.56			-43.15	45.57			-43.15	45.57
Topic interest (continuous)	1.40***	0.26			1.37***	0.26			1.37***	0.26
R^2	R^2 of multivariate linear regression models is not reported, because analyses are based on multiple imputed data.									

Note. Multivariate linear regression models with the numeric variable "response time at questionnaire level" as dependent variable were computed. The table shows standardized coefficients with $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

Table 24: Multivariate logistic regression models with the dependent variable speeding at questionnaire level (Study 1)

	Model 1 (n=660)		**Model 2 (n=660)**		**Model 3 (n=660)**		**Model 4 (n=660)**		**Model 5 (n=660)**	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	2.18	2.44	0.18***	0.05	2.12	2.38	0.23***	0.05	3.08	3.48
Experimental condition										
Preferred device (EG)	1.03	0.24	1.01	0.34	1.27	0.46	1.14	0.36	0.84	0.30
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	1.15	0.27	1.24	0.44	1.45	0.55	--	--	--	--
PC Web survey	--	--	--	--	--	--	0.80	0.29	0.69	0.26
Interaction effect										
Preferred*Smartphone			1.12	0.52	0.66	0.35				
Preferred*PC							0.89	0.41	1.51	0.81
Age (continuous)	0.96	0.03			0.96	0.03			0.96	0.03
Gender										
male	1.15	0.27			1.15	0.27			1.15	0.27
female	--	--			--	--			--	--
Education (continuous)	0.85	0.10			0.85	0.10			0.85	0.10
Income (continuous)	1.00	0.00			1.00	0.00			1.00	0.00
HH size										
single-person HH	1.44	0.39			1.45	0.39			1.45	0.39
multi-person HH	--	--			--	--			--	--
Internet hours (continuous)										
PC	0.97	0.04			0.96	0.04			0.96	0.04
Tablet	1.19*	0.08			1.18*	0.08			1.18*	0.08
Smartphone	1.03	0.04			1.04	0.05			1.04	0.05

Email usage										
PC	0.76	0.19			0.71	0.19			0.71	0.19
Tablet	0.31	0.24			0.28	0.22			0.28	0.22
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	0.96	0.24			0.95	0.24			0.95	0.24
Topic interest (continuous)	1.00**	0.00			1.00**	0.00			1.00**	0.00
Pseudo r² **Log likelihood**	Quality indicators for multivariate logistic regression models are not reported, because analyses are based on multiple imputed data.									

Note. Multivariate logistic regression models with the dummy variable "speeding at questionnaire level" (0=no speeding; 1=speeding) as dependent variable were computed. The table shows odds ratio with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

Table 25: Multivariate linear regression models with the dependent variable response time at question level (Study 1)

	Model 1 (n=660)		**Model 2 (n=660)**		**Model 3 (n=660)**		**Model 4 (n=660)**		**Model 5 (n=660)**	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	94.70***	13.53	89.09***	3.66	95.70***	13.51	84.19***	3.09	91.01***	13.65
Experimental condition										
Preferred device (EG)	3.42	3.16	-3.31	4.34	-3.28	4.62	10.53*	4.56	10.93*	4.93
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	2.95	3.17	-4.89	4.79	-4.69	4.98	--	--	--	--
PC Web survey	--	--	--	--	--	--	4.89	4.79	4.69	4.98
Interaction effect										
Preferred*Smartphone			13.84*	6.29	14.21*	7.16				
Preferred*PC							-13.84*	6.29	-14.21*	7.16
Age (continuous)	0.55	0.34			0.55	0.34			0.55	0.34
Gender										
male	-1.88	3.14			-2.19	3.14			-2.19	3.14
female	--	--			--	--			--	--
Education (continuous)	-0.55	1.62			-0.34	1.62			-0.34	1.62
Income (continuous)	-0.01	0.01			-0.01	0.01			-0.01	0.01
HH size										
single-person HH	-1.83	3.74			-1.88	3.73			-1.88	3.73
multi-person HH	--	--			--	--			--	--
Internet hours (continuous)										
PC	-0.29	0.53			-0.10	0.54			-0.10	0.54
Tablet	-2.17*	1.04			-2.08*	1.04			-2.08*	1.04
Smartphone	0.55	0.60			0.42	0.60			0.42	0.60

Email usage										
PC	-3.06	3.40			-0.27	3.66			-0.27	3.66
Tablet	8.16	8.69			12.13	8.90			12.13	8.90
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	-7.87*	3.26			-7.79*	3.25			-7.79*	3.25
Topic interest (continuous)	0.02	0.02			0.03	0.02			0.03	0.02
R^2	R^2 of multivariate linear regression models is not reported, because analyses are based on multiple imputed data.									

Note. Multivariate linear regression models with the numeric variable “response time at question level” as dependent variable were computed. The table shows standardized coefficients with ****p* < .001, ***p* < .01, **p* < .05, $^+p < .10$. “--“ identifies the reference categories.

Table 26: Multivariate linear regression models with the dependent variable response time at question level (Study 1)

	Model 1 (n=660)		**Model 2 (n=660)**		**Model 3 (n=660)**		**Model 4 (n=660)**		**Model 5 (n=660)**	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	29.27***	6.86	32.16***	1.91	29.73***	6.85	33.54***	1.62	30.71***	6.93
Experimental condition										
Preferred device (EG)	4.34**	1.62	2.08	2.26	1.06	2.34	7.24**	2.36	8.05**	2.51
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	4.76**	1.62	1.38	2.51	0.98	2.54	--	--	--	--
PC Web survey	--	--	--	--	--	--	-1.38	2.51	-0.98	2.54
Interaction effect										
Preferred*Smartphone			5.16	3.26	6.99^{+}	3.63				
Preferred*PC							-5.16	3.26	-6.99^{+}	3.63
Age (continuous)	0.68***	0.16			0.69***	0.16			0.69***	0.16
Gender										
male	0.56	1.60			0.41	1.60			0.41	1.60
female	--	--			--	--			--	--
Education (continuous)	-0.96	0.81			-0.83	0.82			-0.83	0.82
Income (continuous)	0.00	0.00			0.00	0.00			0.00	0.00
HH size										
single-person HH	-0.51	1.90			-0.55	1.90			-0.55	1.90
multi-person HH	--	--			--	--			--	--
Internet hours (continuous)										
PC	0.21	0.25			0.29	0.26			0.29	0.26
Tablet	-0.80	0.53			-0.74	0.53			-0.74	0.53
Smartphone	-0.19	0.30			-0.26	0.30			-0.26	0.30

Email usage										
PC	-1.59	1.75			-0.26	1.88			-0.26	1.88
Tablet	0.58	4.44			2.28	4.52			2.28	4.52
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	-4.61**	1.69			-4.64**	1.68			-4.64**	1.68
Topic interest (continuous)	0.01	0.01			0.01	0.01			0.01	0.01
R^2	R^2 of multivariate linear regression models is not reported, because analyses are based on multiple imputed data.									

Note. Multivariate linear regression models with the numeric variable “response time at question level” as dependent variable were computed. The table shows standardized coefficients with ***p < .001, **p < .01, *p < .05, ^{+}p < .10. “--“ identifies the reference categories.

Table 27: Multivariate logistic regression models with the dependent variable speeding at question level (Study 1)

	Model 1 (n=660)		**Model 2 (n=660)**		**Model 3 (n=660)**		**Model 4 (n=660)**		**Model 5 (n=660)**	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	0.62	0.83	0.15***	0.05	0.61	0.82	0.12***	0.03	0.51	0.68
Experimental condition										
Preferred device (EG)	0.73	0.21	0.66	0.25	0.83	0.34	0.72	0.32	0.62	0.30
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	0.72	0.21	0.75	0.31	0.82	0.36	--	--	--	--
PC Web survey	--	--	--	--	--	--	1.34	0.55	1.22	0.53
Interaction effect										
Preferred*Smartphone			1.09	0.63	0.75	0.51				
Preferred*PC							0.92	0.53	1.33	0.90
Age (continuous)	0.96	0.04			0.96	0.04			0.96	0.04
Gender										
male	1.12	0.33			1.12	0.34			1.12	0.34
female	--	--			--	--			--	--
Education (continuous)	0.83	0.12			0.83	0.12			0.83	0.12
Income (continuous)	1.00	0.00			1.00	0.00			1.00	0.00
HH size										
single-person HH	0.80	0.30			0.79	0.30			0.79	0.30
multi-person HH	--	--			--	--			--	--
Internet hours (continuous)										
PC	0.98	0.05			0.98	0.05			0.98	0.05
Tablet	1.02	0.10			1.01	0.10			1.01	0.10
Smartphone	1.03	0.06			1.04	0.06			1.04	0.06

Email usage										
PC	1.07	0.34			1.01	0.35			1.01	0.35
Tablet	0.87	0.75			0.82	0.72			0.82	0.72
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	1.18	0.36			1.18	0.36			1.18	0.36
Topic interest (continuous)	1.00*	0.00			1.00*	0.00			1.00*	0.00
Pseudo r^2 **Log likelihood**	Quality indicators for multivariate logistic regression models are not reported, because analyses are based on multiple imputed data.									

Note. Multivariate logistic regression models with the dummy variable “speeding at question level” (0=no speeding; 1=speeding) as dependent variable were computed. The table shows odds ratio with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. “--“ identifies the reference categories.

Table 28: Multivariate logistic regression models with the dependent variable speeding at question level (Study 1)

	Model 1 (n=660)		**Model 2 (n=660)**		**Model 3 (n=660)**		**Model 4 (n=660)**		**Model 5 (n=660)**	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	2.10	2.78	0.23***	0.06	2.22	2.97	0.13***	0.04	1.43	1.94
Experimental condition										
Preferred device (EG)	0.72	0.19	0.89	0.28	1.02	0.35	0.47	0.22	0.37*	0.19
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	0.41**	0.11	0.59	0.22	0.64	0.25	--	--	--	--
PC Web survey	--	--	--	--	--	--	1.69	0.63	1.56	0.61
Interaction effect										
Preferred*Smartphone			0.53	0.30	0.36	0.23				
Preferred*PC							1.88	1.07	2.75	1.76
Age (continuous)	0.91*	0.04			0.90*	0.04			0.90*	0.04
Gender										
male	0.78	0.20			0.78	0.20			0.78	0.20
female	--	--			--	--			--	--
Education (continuous)	0.86	0.11			0.85	0.11			0.85	0.11
Income (continuous)	1.00	0.00			1.00	0.00			1.00	0.00
HH size										
single-person HH	1.24	0.37			1.24	0.37			1.24	0.37
multi-person HH	--	--			--	--			--	--
Internet hours (continuous)										
PC	0.99	0.04			0.98	0.04			0.98	0.04
Tablet	1.01	0.09			1.01	0.09			1.01	0.09
Smartphone	0.99	0.05			1.00	0.05			1.00	0.05

Email usage										
PC	1.03	0.29			0.86	0.26			0.86	0.26
Tablet	0.53	0.44			0.43	0.36			0.43	0.36
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	1.55	0.41			1.56	0.42			1.56	0.42
Topic interest (continuous)	1.00	0.00			1.00	0.00			1.00	0.00
Pseudo r² **Log likelihood**	Quality indicators for multivariate logistic regression models are not reported, because analyses are based on multiple imputed data.									

Note. Multivariate logistic regression models with the dummy variable "speeding at question level" (0=no speeding; 1=speeding) as dependent variable were computed. The table shows odds ratio with ****p* < .001, ***p* < .01, **p* < .05, ^{+}p < .10. "--" identifies the reference categories.

Table 29: Multivariate linear regression models with the dependent variable page-defocusing on questionnaire level (Study 1)

	Model 1 (n=660)		Model 2 (n=660)		Model 3 (n=660)		Model 4 (n=660)		Model 5 (n=660)	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	21.56***	5.07	20.43***	1.38	21.69***	5.08	6.21***	1.17	7.01	5.13
Experimental condition										
Preferred device (EG)	-2.40*	1.19	-3.02^{+}	1.64	-3.35^{+}	1.74	-2.34	1.72	-1.33	1.85
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	-13.60***	1.19	-14.23***	1.81	-14.68***	1.87	--	--	--	--
PC Web survey	--	--	--	--	--	--	14.23***	1.81	14.68***	1.87
Interaction effect										
Preferred*Smartphone			0.68	2.38	2.03	2.68				
Preferred*PC							-0.68	2.38	-2.03	2.68
Age (continuous)	-0.20^{+}	0.12			-0.20^{+}	0.12			-0.20^{+}	0.12
Gender										
male	0.84	1.18			0.81	1.18			0.81	1.18
female	--	--			--	--			--	--
Education (continuous)	0.75	0.60			0.79	0.61			0.79	0.61
Income (continuous)	0.00	0.00			0.00	0.00			0.00	0.00
HH size										
single-person HH	-1.11	1.41			-1.13	1.41			-1.13	1.41
multi-person HH	--	--			--	--			--	--
Internet hours (continuous)										
PC	-0.12	0.19			-0.09	0.19			-0.09	0.19
Tablet	-0.78*	0.39			-0.76^{+}	0.40			-0.76^{+}	0.40
Smartphone	-0.29	0.23			-0.31	0.23			-0.31	0.23

Email usage										
PC	1.20	1.28			1.58	1.38			1.58	1.38
Tablet	-0.65	3.25			-0.15	3.32			-0.15	3.32
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	-0.27	1.23			-0.27	1.23			-0.27	1.23
Topic interest (continuous)	0.01	0.01			0.01	0.01			0.01	0.01
R^2	R^2 of multivariate linear regression models is not reported, because analyses are based on multiple imputed data.									

Note. Multivariate linear regression models with the numeric variable “page-defocusing on questionnaire level” as dependent variable were computed. The table shows standardized coefficients with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. “--“ identifies the reference categories.

Table 30: Multivariate linear regression models with the dependent variable degree of differentiation (Study 1)

	Model 1 (n=660)		**Model 2 (n=660)**		**Model 3 (n=660)**		**Model 4 (n=660)**		**Model 5 (n=660)**	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	0.576***	0.050	0.633***	0.013	0.574***	0.050	0.647***	0.011	0.586***	0.050
Experimental condition										
Preferred device (EG)	-0.025*	0.012	-0.011	0.016	-0.008	0.017	-0.048**	0.017	-0.044*	0.018
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	-0.007	0.012	0.014	0.018	0.013	0.018	--	--	--	--
PC Web survey	--	--	--	--	--	--	-0.014	0.018	-0.013	0.018
Interaction effect										
Preferred*Smartphone			-0.037	0.023	-0.036	0.026				
Preferred*PC							0.037	0.023	0.036	0.026
Age (continuous)	0.000	0.001			0.000	0.001			0.000	0.001
Gender										
male	0.004	0.012			0.005	0.012			0.005	0.012
female	--	--			--	--			--	--
Education (continuous)	0.007	0.006			0.006	0.006			0.006	0.006
Income (continuous)	0.000	0.000			0.000	0.000			0.000	0.000
HH size										
single-person HH	-0.002	0.014			-0.002	0.014			-0.002	0.014
multi-person HH	--	--			--	--			--	--
Internet hours (continuous)										
PC	-0.003	0.002			-0.003	0.002			-0.003	0.002
Tablet	-0.001	0.004			-0.001	0.004			-0.001	0.004
Smartphone	0.002	0.002			0.002	0.002			0.002	0.002

Email usage										
PC	0.023^{+}	0.013			0.016	0.014			0.016	0.014
Tablet	0.039	0.032			0.030	0.033			0.030	0.033
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	0.012	0.012			0.012	0.012			0.012	0.012
Topic interest (continuous)	0.000	0.000			0.000	0.000			0.000	0.000
R^2	R^2 of multivariate linear regression models is not reported, because analyses are based on multiple imputed data.									

Note. Multivariate linear regression models with the numeric variable “degree of differentiation” as dependent variable were computed. The table shows standardized coefficients with ***p < .001, **p < .01, *p < .05,^{+}p < .10. “--“ identifies the reference categories.

Table 31: Multivariate logistic regression models with the dependent variable straightlining (Study 1)

	Model 1 (n=660)		Model 2 (n=660)		Model 3 (n=660)		Model 4 (n=660)		Model 5 (n=660)	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	64.76	230.70								
Experimental condition										
Preferred device (EG)	2.97	2.39								
Non-preferred device (CG)										
Device treatment										
Smartphone Web survey	0.99	0.67								
PC Web survey										
Interaction effect										
Preferred*Smartphone										
Preferred*PC										
Age (continuous)	0.78^{+}	0.11								
Gender										
male	1.77	1.21								
female										
Education (continuous)	0.60^{+}	0.17								
Income (continuous)	1.00	0.00								
HH size										
single-person HH	1.02	0.84								
multi-person HH										
Internet hours (continuous)										
PC	1.02	0.08								
Tablet	1.06	0.16								
Smartphone	1.06	0.12								

Multivariate logistic regression models did not converge if the interaction term between the experimental conditions and the device treatment was included.

Email usage										
PC	0.62	0.42								
Tablet	omitted									
Smartphone	--	--								
Attitude towards surveys (continuous)	0.36	0.26								
Topic interest (continuous)	1.00	0.00								
Pseudo r² **Log likelihood**	Quality indicators for multivariate logistic regression models are not reported, because analyses are based on multiple imputed data.									

Note. Multivariate logistic regression models with the dummy variable "straightlining" (0=no straightlining; 1=straightlining) as dependent variable were computed. The table shows odds ratio with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

Table 32: Multivariate linear regression models with the dependent variable length of answers (Study 1)

	Model 1 (n=660)		Model 2 (n=660)		Model 3 (n=660)		Model 4 (n=660)		Model 5 (n=660)	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	103.63**	38.24	103.06***	10.46	103.57**	38.28	80.55***	9.38	74.15^{+}	39.42
Experimental condition										
Preferred device (EG)	12.27	9.12	24.57*	12.41	16.36	13.29	-3.31	13.62	7.24	15.00
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	-34.23***	9.16	-22.51	14.05	-29.42*	14.61	--	--	--	--
PC Web survey	--	--	--	--	--	--	22.51	14.05	29.42*	14.61
Interaction effect										
Preferred*Smartphone			-27.88	18.43	-9.12	21.57				
Preferred*PC							27.88	18.43	9.12	21.57
Age (continuous)	1.03	0.83			1.02	0.84			1.02	0.84
Gender										
male	-25.83**	9.15			-25.51**	9.19			-25.51**	9.19
female	--	--			--	--			--	--
Education (continuous)	-0.66	4.68			-0.85	4.71			-0.85	4.71
Income (continuous)	-0.02	0.02			-0.02	0.02			-0.02	0.02
HH size										
single-person HH	-10.15	11.14			-10.14	11.16			-10.14	11.16
multi-person HH	--	--			--	--			--	--
Internet hours (continuous)										
PC	1.02	1.39			0.88	1.43			0.88	1.43
Tablet	-4.51	3.63			-4.62	3.64			-4.62	3.64
Smartphone	-0.92	1.86			-0.81	1.88			-0.81	1.88

Email usage										
PC	10.16	9.90			8.27	10.86			8.27	10.86
Tablet	6.32	24.95			3.59	25.81			3.59	25.81
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	-10.92	9.69			-10.78	9.71			-10.78	9.71
Topic interest (continuous)	0.18**	0.06			0.18**	0.06			0.18**	0.06
R^2	R^2 of multivariate linear regression models is not reported, because analyses are based on multiple imputed data.									

Note. Multivariate linear regression models with the numeric variable "length of answers" as dependent variable were computed. The table shows standardized coefficients with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

Table 33: Multivariate logistic regression models on primacy effects (Study 1)

	Model 1 (n=660)		**Model 2 (n=660)**		**Model 3 (n=660)**		**Model 4 (n=660)**		**Model 5 (n=660)**	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	25.66***	23.58	5.67***	2.51	29.09**	28.33	4.29***	1.27	19.54**	18.06
Item order										
Original	--	--	--	--	--	--	--	--	--	--
Reversed	0.50*	0.16	0.48	0.26	0.41	0.23	0.54	0.22	0.56	0.24
Experimental condition										
Preferred device (EG)	0.72	0.23	0.74	0.37	0.63	0.33	--	--	--	--
Non-preferred device (CG)	--	--	--	--	--	--	0.70	0.29	0.75	0.32
Device treatment										
Smartphone Web survey	0.83	0.18	0.76	0.40	0.67	0.37	1.32	0.70	1.49	0.82
PC Web survey	--	--	--	--	--	--	--	--	--	--
Interaction effect										
Reversed*Preferred	0.94	0.39	0.97	0.60	1.11	0.71	1.05	0.61	0.90	0.53
Reversed*Smartphone			1.13	0.76	1.38	0.96				
Reversed*PC							0.89	0.60	0.73	0.51
Preferred*Smartphone			0.95	0.61	1.19	0.83				
Preferred*PC							1.06	0.69	0.84	0.58
Reversed*Preferred*Smartphone			1.09	0.92	0.81	0.70				
Reversed*Preferred*PC							0.92	0.78	1.24	1.08
Age (continuous)	0.95*	0.02			0.95*	0.02			0.95*	0.02
Gender										
male	1.08	0.22			1.08	0.22			1.08	0.22
female	--	--			--	--			--	--
Education (continuous)	0.86	0.09			0.86	0.09			0.86	0.09
Income (continuous)	1.00^{+}	0.00			1.00^{+}	0.00			1.00^{+}	0.00

HH size										
single-person HH	1.00	0.24			1.00	0.24			1.00	0.24
multi-person HH	--	--			--	--			--	--
Internet hours (continuous)										
PC	1.01	0.03			1.01	0.03			1.01	0.03
Tablet	0.96	0.06			0.96	0.06			0.96	0.06
Smartphone	0.97	0.04			0.97	0.04			0.97	0.04
Email usage										
PC	0.96	0.22			0.98	0.24			0.98	0.24
Tablet	1.30	0.75			1.33	0.78			1.33	0.78
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	0.83	0.18			0.84	0.18			0.84	0.18
Topic interest (continuous)	1.00**	0.00			1.00**	0.00			1.00**	0.00
Pseudo r² **Log likelihood**	Quality indicators for multivariate logistic regression models are not reported, because analyses are based on multiple imputed data.									

Note. Multivariate logistic regression models with the dummy variable "selection of at least one item of the first half of items in the original order/the second half of items in the reversed order" (0=no; 1=yes) as dependent variable were computed. The table shows odds ratio with ***p < .001, **p < .01, *p < .05, ^{+}p < .10. "--" identifies the reference categories.

Appendix E: Multivariate regression analyses of Study 2

Table 34: Multivariate logistic regression models for the PC/tablet computer subsample with the dependent variables unit nonresponse, non-conformed responding and conformance (Study 2)

	Unit nonrespondents				Non-conforming respondents				Conforming respondents			
	Model 1 (n=1,230)		Model 2 (n=1,230)		Model 3 (n=1,230)		Model 4 (n=1,230)		Model 5 (n=1,230)		Model 6 (n=1,230)	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	0.16***	-1.85	0.05	2.00	0.76**	0.09	3.02	1.71	0.76**	0.09	0.47	1.34
Experimental condition												
Preferred device (EG)	1.75*	0.56	1.07	0.30	0.06***	0.47	0.07***	0.49	3.75***	0.23	4.79***	0.26
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--	--	--
Device treatment												
Smartphone Web survey	--	--	--	--	--	--	--	--	--	--	--	--
PC Web survey	2.28**	0.82	1.41	0.28	0.47**	0.23	0.57*	0.27	1.18	0.21	1.51^{+}	0.24
Interaction effect												
Preferred*PC	0.23***	-1.48	0.62	0.45	0.84	0.61	0.51	0.68	1.79^{+}	0.32	1.20	0.40
Age (continuous)			0.75***	0.07			1.16*	0.07			1.09	0.05
Gender												
male			0.88	0.17			0.84	0.17			1.20	0.14
female			--	--			--	--			--	--
Education (continuous)			0.72***	0.08			1.12	0.08			1.15*	0.06
Income (continuous)			1.06	0.06			0.85*	0.07			1.07	0.05

Device usage - frequency (continuous)												
PC			0.87	0.09			0.87	0.10			1.22*	0.08
Tablet			1.02	0.07			1.02	0.07			0.97	0.06
Smartphone			1.48	0.31			0.78	0.25			0.94	0.20
Device knowledge (continuous)												
PC			1.65**	0.19			1.12	0.18			0.67**	0.15
Tablet			1.22	0.14			0.92	0.15			0.95	0.12
Smartphone			0.69*	0.19			0.89	0.18			1.35*	0.15
Internet usage - hours (continuous)												
PC			1.00	0.04			1.00	0.03			1.00	0.03
Tablet			1.00	0.05			1.05	0.06			0.97	0.05
Smartphone			1.02	0.02			0.95	0.03			1.01	0.02
Email usage												
PC			0.73	0.23			1.33	0.25			1.05	0.20
Tablet			0.78	0.37			1.80	0.41			0.78	0.32
Smartphone			--	--			--	--			--	--
Attitude towards surveys (continuous)			1.32	0.18			1.06	0.18			0.79	0.14
Topic interest (continuous)			1.08	0.07			1.09	0.07			0.90^{+}	0.06
Nagelkerke's r²	.02		.11		.36		.40		.23		.27	
-2LL	1,025		963		929		895		1,377		1,336	

Note. Model 1-2: Multivariate logistic regression models with the dummy variable "unit nonrespondents" (0=non-conforming/conforming respondents; 1=unit nonrespondents) as dependent variable were computed. Model 3-4: Multivariate logistic regression models with the dummy variable "non-conforming respondents" (0=unit nonrespondents/conforming respondents; 1=non-conforming respondents) as dependent variable were computed. Model 5-6: Multivariate logistic regression models with the dummy variable "conforming respondents" (0=unit nonrespondents/non-conforming respondents; 1=conforming respondents) as dependent variable were computed. The table shows odds ratio with ***p < .001, **p < .01, *p < .05, ^{+}p < .10. "--" identifies the reference categories.

Table 35: Multivariate logistic regression analyses with the dependent variable survey breakoff (Study 2)

	Model 1 (n=784)		**Model 2 (n=784)**		**Model 3 (n=784)**		**Model 4 (n=784)**		**Model 5 (n=784)**	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	0.00	4.09	0.02	1.01	0.00	4.13	0.02	0.45	0.00	4.06
Experimental condition										
Preferred device (EG)	3.63	0.60	3.09	1.03	3.61	1.10	2.52	0.65	3.64	0.74
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	1.54	0.54	1.30	1.11	1.53	1.17	--	--	--	--
PC Web survey	--	--	--	--	--	--	0.77	1.11	0.65	1.17
Interaction effect										
Preferred*Smartphone			0.81	1.22	1.01	1.35				
Preferred*PC							1.23	1.22	0.99	1.35
Process orientation (continuous)	1.59	0.25			1.59	0.25			1.59	0.25
Content orientation (continuous)	0.90	0.36			0.90	0.36			0.90	0.36
Age (continuous)	0.69	0.15			0.69	0.15			0.69	0.15
Gender										
male	0.26	0.41			0.26	0.41			0.26	0.41
female	--	--			--	--			--	--
Education (continuous)	1.11	0.17			1.11	0.17			1.11	0.17
Income (continuous)	0.93	0.14			0.93	0.14			0.93	0.14
Device usage - frequency (continuous)										
PC	0.94	0.27			0.94	0.27			0.94	0.27
Tablet	0.91	0.19			0.91	0.20			0.91	0.20
Smartphone	1.19	0.51			1.19	0.51			1.19	0.51

Device knowledge (continuous)										
PC	1.17	0.45			1.17	0.45			1.17	0.45
Tablet	1.31	0.33			1.31	0.33			1.31	0.33
Smartphone	1.34	0.44			1.34	0.45			1.34	0.45
Internet usage - hours (continuous)										
PC	1.10	0.07			1.10	0.07			1.10	0.07
Tablet	0.65	0.33			0.65	0.33			0.65	0.33
Smartphone	0.83	0.10			0.83	0.10			0.83	0.10
Email usage										
PC	4.15	0.80			4.15	0.80			4.15	0.80
Tablet	23.07	1.18			23.09	1.19			23.09	1.19
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	1.28	0.43			1.28	0.43			1.28	0.43
Topic interest (continuous)	1.13	0.16			1.13	0.16			1.13	0.16
Nagelkerke's r² **-2LL**		.20 238		.02 281		.20 238		.02 281		.20 238

Note. Multivariate logistic regression models with the dummy variable "unit nonrespondents" (0=non-conforming/conforming respondents; 1=unit nonrespondents) as dependent variable were computed. The table shows odds ratio with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

Table 36: Multivariate logistic regression analyses with the dependent variable item missing (Study 2)

	Model 1 (n=784)		**Model 2 (n=784)**		**Model 3 (n=784)**		**Model 4 (n=784)**		**Model 5 (n=784)**	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	1.22	2.05	0.32	0.32	1.73	2.06	0.21	.18	.96	1.12
Experimental condition										
Preferred device (EG)	1.00	0.25	0.55	0.35	0.55	0.37	1.55	.31	.15	1.64
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	1.20	0.25	0.66	0.37	0.65	0.39	--	--	--	--
PC Web survey	--	--	--	--	--	--	1.52	.37	.26	1.55
Interaction effect										
Preferred*Smartphone			2.80	0.46	2.97	0.54				
Preferred*PC							0.36	.47	.04	.34
Process orientation (continuous)	0.99	0.12			0.99	0.12			.95	.99
Content orientation (continuous)	0.74	0.17			0.73	0.17			.06	.73
Age (continuous)	0.94	0.08			0.96	0.08			.57	.96
Gender										
male	0.90	0.20			0.92	0.20			.68	.92
female	--	--			--	--			--	--
Education (continuous)	1.07	0.09			1.08	0.09			.37	1.08
Income (continuous)	0.98	0.07			0.98	0.07			.77	.98
Device usage - frequency (continuous)										
PC	1.04	0.13			1.08	0.13			.55	1.08
Tablet	0.94	0.09			0.95	0.09			.57	.95
Smartphone	1.08	0.27			1.04	0.27			.89	1.04

Device knowledge (continuous)										
PC	0.91	0.22			0.93	0.22			.74	.93
Tablet	1.18	0.17			1.17	0.17			.36	1.17
Smartphone	0.99	0.22			0.97	0.22			.88	.97
Internet usage - hours (continuous)										
PC	1.02	0.04			1.03	0.04			.41	1.03
Tablet	1.03	0.09			1.03	0.09			.73	1.03
Smartphone	0.98	0.03			0.97	0.03			.39	.97
Email usage										
PC	0.77	0.26			0.87	0.27			.60	.87
Tablet	0.65	0.53			0.77	0.53			.62	.77
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	0.83	0.22			0.82	0.22				
Topic interest (continuous)	0.93	0.08			0.93	0.08			.38	.82
Nagelkerke's r²		.02		.01		.03		.01		.03
-2LL		709		714		705		714		705

Note. Multivariate logistic regression models with the dummy variable "item missing" (0=no item missing value; 1=at least one item missing value) as dependent variable were computed. The table shows odds ratio with ***p < .001, **p < .01, *p < .05, ^{+}p < .10. "--" identifies the reference categories.

Table 37: Multivariate linear regression models with the dependent variable response time at questionnaire level (Study 2)

	Model 1 (n=716)		**Model 2 (n=716)**		**Model 3 (n=716)**		**Model 4 (n=716)**		**Model 5 (n=716)**	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	536.87	173.38	505.90	33.56	529.17	173.86	605.13	16.65	625.33	172.25
Experimental condition										
Preferred device (EG)	10.35	23.17	40.06	35.59	28.58	36.49	-29.46	31.83	-5.37	33.59
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	77.12	23.34	99.23	37.46	96.16	37.57	--	--	--	--
PC Web survey	--	--	--	--	--	--	-99.23	37.46	-96.16	37.57
Interaction effect										
Preferred*Smartphone			-69.52	47.74	-33.95	52.49				
Preferred*PC							69.52	47.74	33.95	52.49
Process orientation (continuous)	-10.96	10.47			-11.12	10.48			-11.12	10.48
Content orientation (continuous)	15.85	15.45			16.00	15.46			16.00	15.46
Age (continuous)	26.31	6.96			25.82	7.00			25.82	7.00
Gender										
male	-27.87	17.74			-27.99	17.75			-27.99	17.75
female	--	--			--	--			--	--
Education (continuous)	-15.67	8.00			-15.91	8.01			-15.91	8.01
Income (continuous)	-6.72	6.33			-6.86	6.34			-6.86	6.34
Device usage - frequency (continuous)										
PC	-11.03	11.81			-12.25	11.96			-12.25	11.96
Tablet	1.05	8.10			0.68	8.12			0.68	8.12
Smartphone	12.51	21.85			13.39	21.91			13.39	21.91

Device knowledge (continuous)										
PC	23.87	19.58			23.24	19.61			23.24	19.61
Tablet	10.47	15.63			10.74	15.65			10.74	15.65
Smartphone	-49.36	19.21			-48.55	19.26			-48.55	19.26
Internet usage - hours (continuous)										
PC	-4.95	3.55			-5.19	3.57			-5.19	3.57
Tablet	-12.45	7.49			-12.47	7.49			-12.47	7.49
Smartphone	-1.35	2.93			-1.19	2.94			-1.19	2.94
Email usage										
PC	0.83	24.31			-2.90	24.99			-2.90	24.99
Tablet	36.00	45.66			31.16	46.29			31.16	46.29
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	12.37	18.93			12.46	18.94			12.46	18.94
Topic interest (continuous)	-12.55	7.29			-12.50	7.30			-12.50	7.30
R^2		.08		.01		.08		.01		.08

Note. Multivariate linear regression models with the numeric variable "response time at questionnaire level" as dependent variable were computed. The table shows standardized coefficients with $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

Table 38: Multivariate logistic regression analyses with the dependent variable speeding at questionnaire level (Study 2)

	Model 1 (n=749)		**Model 2 (n=749)**		**Model 3 (n=749)**		**Model 4 (n=749)**		**Model 5 (n=749)**	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	0.01	2.66	0.13	0.43	0.01	2.66	0.04	0.36	0.00	2.69
Experimental condition										
Preferred device (EG)	1.70	0.38	1.18	0.46	1.50	0.52	2.32	0.54	1.99	0.60
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	0.37	0.38	0.32	0.56	0.31	0.62	--	--	--	--
PC Web survey	--	--	--	--	--	--	3.13	0.56	3.19	0.62
Interaction effect										
Preferred*Smartphone			1.96	0.70	1.33	0.84				
Preferred*PC							0.51	0.70	0.75	0.84
Process orientation (continuous)	1.46	0.17			1.47	0.17			1.47	0.17
Content orientation (continuous)	0.86	0.24			0.86	0.24			0.86	0.24
Age (continuous)	0.67	0.10			0.67	0.10			0.67	0.10
Gender										
male	1.67	0.28			1.68	0.28			1.68	0.28
female	--	--			--	--			--	--
Education (continuous)	1.14	0.12			1.14	0.12			1.14	0.12
Income (continuous)	1.09	0.09			1.09	0.09			1.09	0.09
Device usage - frequency (continuous)										
PC	1.11	0.18			1.12	0.19			1.12	0.19
Tablet	0.94	0.13			0.95	0.13			0.95	0.13
Smartphone	1.03	0.33			1.03	0.33			1.03	0.33

Device knowledge (continuous)										
PC	0.69	0.30			0.69	0.30			0.69	0.30
Tablet	0.94	0.23			0.94	0.23			0.94	0.23
Smartphone	1.58	0.29			1.56	0.30			1.56	0.30
Internet usage - hours (continuous)										
PC	1.09	0.05			1.09	0.05			1.09	0.05
Tablet	1.17	0.10			1.17	0.10			1.17	0.10
Smartphone	1.01	0.04			1.01	0.04			1.01	0.04
Email usage										
PC	1.11	0.39			1.13	0.39			1.13	0.39
Tablet	0.79	0.73			0.82	0.73			0.82	0.73
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	1.43	0.27			1.44	0.27			1.44	0.27
Topic interest (continuous)	0.99	0.11			0.99	0.11			0.99	0.11
Nagelkerke's r²		.19		.04		.19		.04		.19
-2LL		414		472		414		472		414

Note. Multivariate logistic regression models with the dummy variable "speeding at questionnaire level" (0=no speeding; 1=speeding) as dependent variable were computed. The table shows odds ratio with $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

Table 39: Multivariate linear regression analyses with the dependent variable response time at question level (Study 2)

	Model 1 (n=750)		Model 2 (n=750)		Model 3 (n=750)		Model 4 (n=750)		Model 5 (n=750)	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	49.05	20.13	52.62	3.74	50.02	20.19	66.98	1.90	63.67	20.01
Experimental condition										
Preferred device (EG)	1.62	2.57	0.95	3.96	-0.61	4.05	-0.75	3.54	3.51	3.71
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	15.97	2.59	14.36	4.19	13.64	4.18	--	--	--	--
PC Web survey	--	--	--	--	--	--	-14.36	4.19	-13.64	4.18
Interaction effect										
Preferred*Smartphone			-1.70	5.32	4.12	5.80				
Preferred*PC							1.70	5.32	-4.12	5.80
Process orientation (continuous)	-3.46	1.15			-3.43	1.15			-3.43	1.15
Content orientation (continuous)	3.48	1.74			3.44	1.74			3.44	1.74
Age (continuous)	2.58	0.77			2.65	0.77			2.65	0.77
Gender										
male	-1.28	1.97			-1.25	1.97			-1.25	1.97
female	--	--			--	--			--	--
Education (continuous)	-2.08	0.90			-2.04	0.90			-2.04	0.90
Income (continuous)	0.51	0.71			0.52	0.71			0.52	0.71
Device usage - frequency (continuous)										
PC	1.00	1.27			1.13	1.28			1.13	1.28
Tablet	-0.86	0.90			-0.82	0.90			-0.82	0.90
Smartphone	2.06	2.64			1.96	2.65			1.96	2.65

Device knowledge (continuous)										
PC	1.69	2.18			1.79	2.18			1.79	2.18
Tablet	1.59	1.73			1.57	1.73			1.57	1.73
Smartphone	-6.14	2.18			-6.25	2.18			-6.25	2.18
Internet usage - hours (continuous)										
PC	-0.44	0.40			-0.41	0.40			-0.41	0.40
Tablet	-0.57	0.85			-0.57	0.85			-0.57	0.85
Smartphone	-0.20	0.34			-0.22	0.34			-0.22	0.34
Email usage										
PC	-3.15	2.74			-2.68	2.82			-2.68	2.82
Tablet	1.35	5.02			2.01	5.10			2.01	5.10
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	-1.69	2.15			-1.70	2.15			-1.70	2.15
Topic interest (continuous)	-0.92	0.81			-0.91	0.81			-0.91	0.81
R^2		.13		.05		.13		.05		.13

Note. Multivariate linear regression models with the numeric variable "response time at question level" as dependent variable were computed. The table shows standardized coefficients with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

Table 40: Multivariate logistic regression analyses with the dependent variable speeding at question level (Study 2)

	Model 1 (n=784)		**Model 2 (n=784)**		**Model 3 (n=784)**		**Model 4 (n=784)**		**Model 5 (n=784)**	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	.09	3.05	.23	.35	.09	3.05	.03	.41	.01	3.08
Experimental condition										
Preferred device (EG)	.85	.38	.68	.38	.82	.47	1.22	.72	.92	.79
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	.11	.45	.13	.54	.10	.62	--	--	--	--
PC Web survey	--	--	--	--	--	--	7.69	.54	9.63	.62
Interaction effect										
Preferred*Smartphone			1.81	.81	1.11	.96				
Preferred*PC							.55	.81	.90	.96
Process orientation (continuous)	1.99	.19			2.00	.19			2.00	.19
Content orientation (continuous)	.43	.25			.43	.25			.43	.25
Age (continuous)	.73	.10			.74	.10			.74	.10
Gender										
male	1.87	.29			1.88	.29			1.88	.29
female	--	--			--	--			--	--
Education (continuous)	1.33	.13			1.33	.13			1.33	.13
Income (continuous)	.97	.10			.97	.10			.97	.10
Device usage - frequency (continuous)										
PC	1.14	.18			1.14	.19			1.14	.19
Tablet	.99	.13			.99	.13			.99	.13
Smartphone	1.27	.42			1.27	.42			1.27	.42

Device knowledge (continuous)										
PC	.56	.31			.56	.31			.56	.31
Tablet	.85	.25			.85	.25			.85	.25
Smartphone	2.13	.31			2.12	.31			2.12	.31
Internet usage - hours (continuous)										
PC	1.11	.05			1.12	.05			1.12	.05
Tablet	1.28	.10			1.28	.10			1.28	.10
Smartphone	.96	.05			.96	.05			.96	.05
Email usage										
PC	.70	.39			.70	.40			.70	.40
Tablet	.71	.65			.72	.67			.72	.67
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	.95	.29			.95	.29			.95	.29
Topic interest (continuous)	.90	.12			.90	.12			.90	.12
Nagelkerke's r²		.27		.08		.27		.08		.27
-2LL		396		474		396		474		396

Note. Multivariate logistic regression models with the dummy variable "speeding at question level" (0=no speeding; 1=speeding) as dependent variable were computed. The table shows odds ratio with $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

Table 41: Multivariate linear regression analyses with the dependent variable page-defocusing on questionnaire level (Study 2)

	Model 1 (n=784)		**Model 2 (n=784)**		**Model 3 (n=784)**		**Model 4 (n=784)**		**Model 5 (n=784)**	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	4.73	2.77	.98	.53	4.56	2.78	.39	.27	3.98	2.75
Experimental condition										
Preferred device (EG)	.64	.37	.86	.56	.97	.58	.40	.50	.36	.52
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	-.92	.37	-.59	.60	-.58	.59	--	--	--	--
PC Web survey	--	--	--	--	--	--	.59	.60	.58	.59
Interaction effect										
Preferred*Smartphone			-.47	.75	-.61	.82				
Preferred*PC							.47	.75	.61	.82
Process orientation (continuous)	.41	.17			.40	.17			.40	.17
Content orientation (continuous)	-.68	.25			-.67	.25			-.67	.25
Age (continuous)	-.53	.11			-.54	.11			-.54	.11
Gender										
male	-.60	.28			-.61	.28			-.61	.28
female	--	--			--	--			--	--
Education (continuous)	.03	.13			.03	.13			.03	.13
Income (continuous)	.34	.10			.34	.10			.34	.10
Device usage - frequency (continuous)										
PC	-.04	.18			-.06	.18			-.06	.18
Tablet	-.03	.13			-.04	.13			-.04	.13
Smartphone	.12	.36			.13	.36			.13	.36

Device knowledge (continuous)										
PC	.25	.31			.24	.31			.24	.31
Tablet	-.11	.25			-.11	.25			-.11	.25
Smartphone	-.03	.31			-.02	.31			-.02	.31
Internet usage - hours (continuous)										
PC	.07	.06			.07	.06			.07	.06
Tablet	-.05	.12			-.05	.12			-.05	.12
Smartphone	-.06	.05			-.05	.05			-.05	.05
Email usage										
PC	.70	.39			.63	.40			.63	.40
Tablet	.66	.72			.56	.73			.56	.73
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	-.51	.31			-.51	.31			-.51	.31
Topic interest (continuous)	-.16	.11			-.17	.11			-.17	.11
R^2		.09		.02		.09		.02		.09

Note. Multivariate linear regression models with the numeric variable “page-defocusing on questionnaire level” as dependent variable were computed. The table shows standardized coefficients with ***p < .001, **p < .01, *p < .05, ^{+}p < .10. “--“ identifies the reference categories.

Table 42: Multivariate linear regression analyses with the dependent variable degree of differentiation (Study 2)

	Model 1 (n=773)		**Model 2 (n=773)**		**Model 3 (n=773)**		**Model 4 (n=773)**		**Model 5 (n=773)**	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	.444	.111	.592	.021	.440	.111	.633	.011	.475	.110
Experimental condition										
Preferred device (EG)	-.009	.015	.010	.023	-.002	.023	-.029	.020	-.015	.021
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	.027	.015	.041	.024	.035	.024	--	--	--	--
PC Web survey	--	--	--	--	--	--	-.041	.024	-.035	.024
Interaction effect										
Preferred*Smartphone			-.039	.030	-.014	.033				
Preferred*PC							.039	.030	.014	.033
Process orientation (continuous)	-.016	.007			-.016	.007			-.016	.007
Content orientation (continuous)	.030	.010			.030	.010			.030	.010
Age (continuous)	.008	.004			.008	.004			.008	.004
Gender										
male	-.004	.011			-.005	.011			-.005	.011
female	--	--			--	--			--	--
Education (continuous)	.008	.005			.008	.005			.008	.005
Income (continuous)	.003	.004			.003	.004			.003	.004
Device usage - frequency (continuous)										
PC	-.009	.007			-.010	.007			-.010	.007
Tablet	.006	.005			.006	.005			.006	.005
Smartphone	.002	.014			.002	.014			.002	.014

Device knowledge (continuous)										
PC	.010	.013			.010	.013			.010	.013
Tablet	.009	.010			.009	.010			.009	.010
Smartphone	-.027	.012			-.026	.012			-.026	.012
Internet usage - hours (continuous)										
PC	-.001	.002			-.001	.002			-.001	.002
Tablet	-.020	.005			-.020	.005			-.020	.005
Smartphone	.002	.002			.002	.002			.002	.002
Email usage										
PC	.017	.016			.015	.016			.015	.016
Tablet	.009	.029			.007	.029			.007	.029
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	.021	.012			.021	.012			.021	.012
Topic interest (continuous)	.004	.005			.004	.005			.004	.005
R^2		.06		.01		.06		.01		.06

Note. Multivariate linear regression models with the numeric variable “degree of differentiation” as dependent variable were computed. The table shows standardized coefficients with ***p < .001, **p < .01, *p < .05, ^+p < .10. “--“ identifies the reference categories.

Table 43: Multivariate logistic regression analyses with the dependent straightlining (Study 2)

	Model 1 (n=773)		**Model 2 (n=773)**		**Model 3 (n=773)**		**Model 4 (n=773)**		**Model 5 (n=773)**	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	20.45	3.45	0.08	-2.48	24.54	3.45	0.02	0.50	5.84	3.43
Experimental condition										
Preferred device (EG)	1.32	0.50	0.59	-0.53	1.00	0.66	2.51	0.72	2.02	0.85
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	0.35	0.53	0.24	-1.44	0.24	0.83	--	--	--	--
PC Web survey	--	--	--	--	--	--	4.23	0.73	4.20	0.83
Interaction effect										
Preferred*Smartphone			4.27	1.45	2.02	1.15				
Preferred*PC							0.23	0.92	0.49	1.15
Process orientation (continuous)	1.92	0.28			1.93	0.28			1.93	0.28
Content orientation (continuous)	0.34	0.37			0.34	0.38			0.34	0.38
Age (continuous)	0.77	0.15			0.77	0.15			0.77	0.15
Gender										
male	0.99	0.40			1.00	0.40			1.00	0.40
female	--	--			--	--			--	--
Education (continuous)	0.87	0.18			0.87	0.18			0.87	0.18
Income (continuous)	0.96	0.15			0.96	0.15			0.96	0.15
Device usage - frequency (continuous)										
PC	1.16	0.24			1.21	0.25			1.21	0.25
Tablet	0.69	0.22			0.69	0.22			0.69	0.22
Smartphone	0.93	0.41			0.92	0.41			0.92	0.41

Device knowledge (continuous)										
PC	0.66	0.42			0.66	0.41			0.66	0.41
Tablet	0.91	0.37			0.89	0.37			0.89	0.37
Smartphone	2.21	0.43			2.18	0.44			2.18	0.44
Internet usage - hours (continuous)										
PC	1.01	0.07			1.01	0.07			1.01	0.07
Tablet	1.40	0.12			1.41	0.12			1.41	0.12
Smartphone	0.93	0.07			0.92	0.07			0.92	0.07
Email usage										
PC	0.55	0.49			0.58	0.51			0.58	0.51
Tablet	0.47	1.10			0.53	1.11			0.53	1.11
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	0.38	0.43			0.37	0.44			0.37	0.44
Topic interest (continuous)	1.13	0.16			1.13	0.16			1.13	0.16
Nagelkerke's r²		.20		.02		.21		.02		.21
-2LL		219		262		219		262		219

Note. Multivariate logistic regression models with the dummy variable "straightlining" (0=no straightlining; 1=straightlining) as dependent variable were computed. The table shows odds ratio with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

Table 44: Multivariate linear regression analyses with the dependent variable length of answer (Study 2)

	Model 1 (n=686)		Model 2 (n=686)		Model 3 (n=686)		Model 4 (n=686)		Model 5 (n=686)	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	68.29	39.19	54.21	7.29	68.57	39.36	40.27	3.70	54.65	39.01
Experimental condition										
Preferred device (EG)	2.69	5.24	2.87	7.72	2.17	8.17	2.69	7.10	3.14	7.62
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	-13.37	5.28	-13.94	8.18	-13.92	8.43	--	--	--	--
PC Web survey	--	--	--	--	--	--	13.94	8.18	13.92	8.43
Interaction effect										
Preferred*Smartphone			-0.18	10.49	0.97	11.78				
Preferred*PC							0.18	10.49	-0.97	11.78
Process orientation (continuous)	-6.16	2.34			-6.16	2.34			-6.16	2.34
Content orientation (continuous)	0.53	3.49			0.51	3.50			0.51	3.50
Age (continuous)	0.79	1.54			0.81	1.55			0.81	1.55
Gender										
male	-6.33	3.94			-6.31	3.94			-6.31	3.94
female	--	--			--	--			--	--
Education (continuous)	3.54	1.79			3.55	1.80			3.55	1.80
Income (continuous)	-2.13	1.42			-2.13	1.42			-2.13	1.42
Device usage - frequency (continuous)										
PC	0.08	2.70			0.11	2.73			0.11	2.73
Tablet	2.36	1.80			2.37	1.81			2.37	1.81
Smartphone	-1.27	4.98			-1.30	4.99			-1.30	4.99

Device knowledge (continuous)										
PC	7.07	4.41			7.09	4.42			7.09	4.42
Tablet	-3.58	3.47			-3.59	3.47			-3.59	3.47
Smartphone	-1.04	4.24			-1.06	4.25			-1.06	4.25
Internet usage - hours (continuous)										
PC	-0.06	0.79			-0.05	0.80			-0.05	0.80
Tablet	-1.96	1.70			-1.96	1.71			-1.96	1.71
Smartphone	0.11	0.69			0.11	0.70			0.11	0.70
Email usage										
PC	-4.92	5.58			-4.80	5.75			-4.80	5.75
Tablet	-9.12	10.43			-8.97	10.61			-8.97	10.61
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	0.03	4.27			0.02	4.28			0.02	4.28
Topic interest (continuous)	-2.66	1.60			-2.66	1.60			-2.66	1.60
R^2		.04		.02		.04		.02		.04

Note. Multivariate linear regression models with the numeric variable "length of answers" as dependent variable were computed. The table shows standardized coefficients with ***p < .001, **p < .01, *p < .05, ^{+}p < .10. "--" identifies the reference categories.

Table 45: Multivariate logistic regression analyses on primacy effects (Study 2)

	Model 1 (n=783)		**Model 2 (n=783)**		**Model 3 (n=783)**		**Model 4 (n=783)**		**Model 5 (n=783)**	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Intercept	.88	1.95	9.54	1.09	.53	2.12	24.11	.65	1.50	1.98
Item order										
Original	--	--	--	--	--	--	--	--	--	--
Reversed	.40	.34	.54	.68	.59	.70	.35	.38	.35	.39
Experimental condition										
Preferred device (EG)	1.06	.71	1.38	1.16	1.58	1.19	1.58	1.42	1.75	1.44
Non-preferred device (CG)	--	--	--	--	--	--	--	--	--	--
Device treatment										
Smartphone Web survey	1.47	.26	2.53	1.27	2.81	1.30	--	--	--	--
PC Web survey	--	--	--	--	--	--	.40	1.27	.36	1.30
Interaction effect										
Reversed*Preferred	1.10	.41	.85	.72	.78	.74	.94	.80	.89	.82
Reversed*Smartphone			.63	.78	.60	.80				
Reversed*PC							1.58	.78	1.67	.80
Preferred*Smartphone			1.14	1.83	1.11	1.89				
Preferred*PC							.87	1.83	.90	1.89
Reversed*Preferred*Smartphone			1.10	1.08	1.14	1.11				
Reversed*Preferred*PC							.91	1.08	.87	1.11
Process orientation (continuous)	.98	.12			.98	.12			.98	.12
Content orientation (continuous)	1.14	.17			1.13	.17			1.13	.17
Age (continuous)	1.09	.08			1.10	.08			1.10	.08
Gender										
male	1.05	.20			1.06	.20			1.06	.20
female	--	--			--	--			--	--

Education (continuous)	**1.00**	**.09**			**1.00**	**.09**			**1.00**	**.09**
Income (continuous)	.91	.07			.91	.07			.91	.07
Device usage - frequency (continuous)										
PC	1.01	.13			1.01	.13			1.01	.13
Tablet	1.05	.09			1.06	.09			1.06	.09
Smartphone	1.23	.23			1.22	.23			1.22	.23
Device knowledge (continuous)										
PC	1.24	.22			1.24	.22			1.24	.22
Tablet	.97	.17			.96	.17			.96	.17
Smartphone	1.00	.21			1.00	.21			1.00	.21
Internet usage - hours (continuous)										
PC	1.00	.04			1.00	.04			1.00	.04
Tablet	1.01	.10			1.01	.10			1.01	.10
Smartphone	.99	.03			.99	.03			.99	.03
Email usage										
PC	.70	.29			.71	.29			.71	.29
Tablet	.96	.53			.98	.54			.98	.54
Smartphone	--	--			--	--			--	--
Attitude towards surveys (continuous)	1.10	.21			1.08	.21			1.08	.21
Topic interest (continuous)	1.09	.08			1.10	.08			1.10	.08
Nagelkerke's r²		.07		.05		.07		.05		.07
-2LL		717		727		716		727		716

Note. Multivariate logistic regression models with the dummy variable "selection of at least one item of the first half of items in the original order/the second half of items in the reversed order" (0=no; 1=yes) as dependent variable were computed. The table shows odds ratio with ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$. "--" identifies the reference categories.

Appendix F: Statement of Academic Honesty

Hiermit erkläre ich, dass ich die beigefügte Dissertation selbstständig verfasst und keine anderen als die angegebenen Hilfsmittel genutzt habe. Alle wörtlich oder inhaltlich übernommenen Stellen habe ich als solche gekennzeichnet.

Ich versichere außerdem, dass ich die beigefügte Dissertation nur in diesem und keinem anderen Promotionsverfahren eingereicht habe und dass diesem Promotionsverfahren keine endgültig gescheiterten Promotionsverfahren vorausgegangen sind.

Darmstadt, den 23.11.2018

Appendix G: Curriculum Vitate

seit 01/2014	Technische Universität Darmstadt Wissenschaftliche Mitarbeiterin im Fachbereich Gesellschafts- und Geschichtswissenschaften, Institut für Soziologie, Empirische Sozialforschung
02/2010-09/2010	University of New South Wales
10/2006-03/2013	Technische Universität Darmstadt Diplom Soziologie