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Sensitive Topics in PC Web and Mobile Web Surveys: Is There a Difference?

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A large number of findings in survey research suggest that responses to sensitive questions are situational and can vary in relation to context. The methodological literature demonstrates that social desirability biases are less prevalent in self-administered surveys, particularly in Web surveys, when there is no interviewer and less risk of presenting oneself in an unfavorable light. Since there is a growing number of users of mobile Web browsers, we focused our study on the effects of different devices (PC or cell phone) in Web surveys on the respondents' willingness to report sensitive information. To reduce selection bias, we carried out a two-wave cross-over experiment using a volunteer online access-panel in Russia. Participants were asked to complete the questionnaire in both survey modes: PC and mobile Web survey. We hypothesized that features of mobile Web usage may affect response accuracy and lead to more socially desirable responses compared to the PC Web survey mode. We found significant differences in the reporting of alcohol consumption by mode, consistent with our hypothesis. But other sensitive questions did not show similar effects. We also found that the presence of familiar bystanders had an impact on the responses, while the presence of strangers did not have any significant effect in either survey mode. Contrary to expectations, we did not find evidence of a positive impact of completing the questionnaire at home and trust in data confidentiality on the level of reporting. These results could help survey practitioners to design and improve data quality in Web surveys completed on different devices.
Keywords: Web surveys, mobile Web surveys, data quality, sensitive questions, perceived privacy, presence of bystanders, interview setting.

1 Introduction

There is no agreement of opinion on what constitutes a sensitive topic, and the definition of a sensitive question can vary in different contexts. However, there is a shared view that questions can be classified as sensitive if they are intrusive, have highly undesirable or desirable answers, or if respondents have concerns about disclosing information to third parties (Tourangeau et al., 2000). In other words, questions are sensitive if there are social norms which define highly desirable or undesirable attitudes and behaviors, if they ask private information which is seen as an invasion of privacy, or if they put the respondent at a risk of losing reputation, employment, or bringing any other harm in the case of information disclosure.

Two potential sources of bias in sensitive questions are nonresponse and measurement errors. Individuals may refuse to participate in the survey (unit nonresponse), decline some tasks (item nonresponse), or provide an answer that presents them in a better light (measurement error). General concerns about privacy and confidentiality may have small but significant effects on unit nonresponse (Singer et al., 1993; Singer et al., 2003). Survey results may be biased if there is a correlation between response propensity and the respondent's true answer. The research evidence showed that the link between item nonresponse and measurement error in surveys with sensitive questions is item specific: the relative magnitude of measurement error tends to be larger in questions that ask about socially undesirable behavior, and the relative magnitude of nonresponse error is likely to be larger in items that ask about socially desirable behaviors (Sakshaug et al., 2010; Tourangeau et al., 2010).

In this paper, we focus on measurement error. Reporting error in sensitive questions may vary under different techniques of asking questions such as randomized response technique (Lensvelt-Mulders et al., 2005; Zdep & Rhodes, 1979), item count technique (Droitcour et al., 1991) or bogus pipeline (Tourangeau et al., 1997b); under different question wording and formats such as open- versus closed-ended questions (Bradburn, 1989), direct questions about the respondents themselves or about their friends (Sudman et al., 1977), direct questions or time-use items (Presser & Stinson, 1998); under different question order and contexts (Presser, 1990); in different settings of data collection like school-based versus household-based surveys among ado-

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lescents (Kann et al., 2002); whether third persons like a spouse (Aquilino, 1993) or parents (Aquilino et al., 2000) are present while the respondent answers questions; and, finally, under the modes of survey administration (Tourangeau & Smith, 1996).

A large body of methodological research has demonstrated that social desirability bias, which is a tendency to present oneself in a favorable light, is less likely in self-administered surveys (Schaeffer, 2000; Tourangeau & Yan, 2007). Social desirability bias can be manifested as underreporting of socially undesirable behaviors and overreporting of socially desirable behaviors. Individuals tend to give more honest responses when the questionnaire is self-administered, and they are less concerned about losing face or receiving interviewer disapproval when telling the truth. Higher levels of reporting of alcohol consumption (Duffy & Waterto, 1984), drug use (Aquilino & Lo Sciuto, 1990), abortions (Fu et al., 1998), and lower level of socially desirable behavior like attendance at religious services (Presser & Stinson, 1998), voting (Stocké, 2007), or higher academic performance (Kreuter et al., 2008) were found in self-administered rather than interviewer-administered surveys. Self-administered surveys also demonstrate a lower gender discrepancy in self-reports on sexual behavior. Tourangeau & Smith (1996) showed that self-administered surveys increase the number of partners reported by women and decrease the number of sexual partners reported by men.

There is some evidence that Web surveys produce more honest responses to sensitive items compared to interviewer-administered survey modes (Kreuter et al., 2008). Comparisons of computer-assisted and paper-and-pencil self-administered surveys showed that computerization per se did not have consistent effects on the level of reporting to sensitive items (Halifors et al., 2000; Richman et al., 1999). Other experiments revealed age (Wright et al., 1998) and gender-related differences (Webb et al., 1999) in reporting levels between paper- and computer-based surveys. Studies which examined the difference between variations of computer-assisted self-interviewing (CASI), such as the difference between text-CASI and audio-CASI did not find an effect of audio on willingness of respondents to disclose sensitive information (Couper et al., 2003, 2009; Tourangeau & Smith, 1996). Web-based surveys produced similar response distributions to sensitive items compared to mail surveys (Eaton et al., 2010; Mccabe, 2004; Uriell & Dudley, 2009).

With the proliferation of mobile Web browsers (on smart phone, tablets, and other devices), there is growing interest in the effects that using such devices to complete Web surveys may have on survey responses (see Buskirk & Andrus, 2012b; Guidry, 2012; McClain et al., 2012; Peytchev & Hill, 2010). In this paper, we compare two self-administered Web survey modes in terms of levels of reporting in sensitive questions: Web surveys conducted via PC and Web surveys conducted via cell phones.

Our research focuses on the effect of the device used to complete Web surveys on the answers to sensitive questions. Though both survey modes are Web-based and self-administered, we expect that the social context in which a survey is completed may affect the reporting of socially sensitive information. Given the nature of mobile devices – that they are designed for use in public rather than private places – we hypothesize that surveys completed on such devices may show higher rates of social desirability bias than those completed on a PC-based browser. As with most other studies of social desirability effects, we focus on the relative differences in reporting rates between the two modes. That is, we examine relative bias, rather than the accuracy of responses.

To test the hypothesis, we carried out an experiment in Russia using a volunteer online access panel. Since nonresponse and selection bias can be different in the two survey modes, we conducted a two-wave cross-over design. The sample was restricted to those who had access to both types of devices and who expressed willingness to complete the Web survey using a cell phone. Since about half of mobile Web users in Russia access the Internet via feature phones (see Yandex Report, 2012), the mobile version of the Web questionnaire could be filled out via both feature phones and smartphones. Respondents were randomly assigned either to a mobile or PC Web survey in the first wave. In the second wave we changed the survey mode for those who completed the first wave: those who filled out the questionnaire via PC in the first wave were invited to complete the survey via mobile phone, and vice versa. A total of 884 respondents completed both waves of the experiment.

2. Theoretical Background and Hypotheses

Our research is based on two related hypotheses. The basic research question is aimed at comparing the responses to sensitive questions between two self-administered Web surveys conducted via cell phones and via PC. Our comparison is based on the assumption that higher rates of reporting of undesirable behaviors reflect higher quality data (i.e., the "more is better" assumption).

H1. Since cell phones are more likely to be used in public places or in the presence of third parties, we hypothesize that surveys completed on mobile phones may show higher rates of social desirability bias than those completed on a PC-based browser.

People use mobile devices in a variety of contexts. Mobile phones are perceived as devices that liberate people from the place-centeredness logic, decreasing the physical constraints on users (Palen et al., 2000). Mobile phones can be used anytime and anywhere, which means that the context of using mobile Internet in terms of time, place, and social environment is more varied than that of fixed PC Internet (Kim et al., 2005). Although the context can be very diverse, empirical studies showed that the most typical places for mobile Web usage are home and office (Kaikkonen, 2009; Kim et al., 2005). Another typical pattern is using mobile Web while commuting or waiting. Individuals use it to "kill" time or to avoid embarrassment staring at others and showing "civil inattention" when there is little or nothing to do (Roto, 2006; Sellen & Murphy, 2002). We suggest that the greater diversity of social contexts may lead to more socially desirable

responses in mobile rather than PC Web surveys.

It could be argued that a cell phone is a more private device than a PC, which might mitigate the effect of device. While a PC is likely to be shared with other family members, a mobile phone is more likely to be a personal device. However, mobile sharing is not a rare practice: in the USA, about 15% of the mobile-only users share it with other family members (Carley-Baxter et al., 2010), and in Germany up to 44% of the mobile users share their phone with others (Busse & Fuchs, 2013). In addition, the small screen sizes of mobile devices may make it harder for bystanders to see what a respondent is entering, further increasing the privacy of the device relative to a PC. Thus, a competing hypothesis is that the mobile phone is a more private device and hence may increase reporting of socially undesirable behaviors relative to a PC.

H2. In both survey modes we expect that higher levels of perceived privacy and trust in confidentiality of the survey mode, a home-based setting (versus office, university or other place), and the absence of third parties during completion of the questionnaire increase respondent candor and level of reporting. This hypothesis focuses on the mechanism by which the device may affect reporting.

There are several studies that suggest that the presence of others – even in self-completion surveys – may engender socially desirable responding. Aquilino et al. (2000) found that the use of computer-assisted self-administered questionnaires significantly diminished but did not eliminate bystander effects in sensitive in-home surveys compared to paper-and-pencil self-administered surveys. There was some evidence that the pattern of effect depends on the identity of the bystander. In their survey on drug and alcohol use, Aquilino et al. found that parental presence tended to have substantial negative effects on responses for adolescent respondents, while sibling or child presence had a small impact on the level of reporting, and spouse or partner presence had no overall impact. In their meta-analysis, Tourangeau & Yan (2007) also found that parental presence reduced socially undesirable responses, while the presence of children did not seem to have an effect, and the presence of a spouse either did not have a significant impact or was likely to have a positive influence on the level of reporting. The results suggest that there would be no effect or a slightly positive impact on socially undesirable responses if a bystander has prior knowledge of the information requested in a survey. Thus, the presence of others who know the information may even slightly increase the honesty of responses. The presence of strangers as opposed to known others in the home is uncommon, so no studies to our knowledge have explored the effect of strangers on socially desirable responding (but see Couper, et al., 2003).

In our experiment, since the survey can be completed in any location, bystanders can be both familiar and unfamiliar to the respondents. The number of bystanders could also be large compared to in-home interviews. Since strangers are unlikely to use the information they could have learned during the interview, respondents may not experience any negative consequences from revealing the information to strangers. In their laboratory-based experiment which compared text-, audio-, and text-and-audio-CASI survey modes in reporting of sensitive information, Couper et al. (2003) did not find an effect of intrusion of a stranger who entered the room when respondents were answering sensitive questions. Though respondents indicated that the condition was less private compared to the condition with no intrusion, the presence of a stranger tended to have no impact on the level of reporting. In our experiment, we expect that the presence of bystanders may elicit response effects in both survey modes. We expect negative effects when present third parties were familiar to the respondents, and small or no impact if strangers were present during the self-completion interview.

Even if there are no bystanders present, interview settings themselves may have an impact on responses through the association with physically non-present significant others who might disapprove of the respondents answers (Aquilino et al., 2000). Certain settings can be associated with particular individuals or authorities, which may affect survey responses. Some experiments revealed that school-based self-administered surveys may have higher validity in surveys on drug and alcohol use compared to in-home surveys for adolescent respondents (Sudman, 2001). Since companies may record the Internet activities of the employees, the confidentiality concerns may likely produce higher nonresponse rates or misreporting on sensitive questions if respondents complete the PC Web questionnaire in workplace settings (Couper, 2000). At the same time, Tourangeau et al. (1997a) found no difference in the level of reporting on sexual behavior between in-home interviews and interviews completed outside the home. Still, we expect that completion of the questionnaire in the respondents' homes may likely yield more candid reporting of sensitive information compared to other settings.

The decision to participate in the survey and the willingness to report sensitive information truthfully depends on the degree of privacy the survey mode offers. Self-administered surveys may be perceived to provide higher level of data confidentiality. Singer et al. (2003) showed that those who expressed more concerns about privacy and lower level of trust were less likely to return their census forms by mail than those who had fewer confidentiality concerns. These findings suggest that respondents who trust that the survey mode offers a high degree of privacy would tend to have more honest reporting, other things being equal.

3. Experimental Design

Members of a volunteer online access panel were randomly invited to the PC Web-based recruitment questionnaire in which they were invited to take part in the main Web survey via cell phone or PC. A screening survey was conducted to identify respondents eligible for the study. If the respondents had been using mobile Internet within the last 30 days and were willing to participate in the mobile Web survey, they were invited to complete the main survey. To measure the differences between the survey modes, we designed a cross-over experiment. Some respondents were

Table 1 Completion Rates by Mode

	Mobile Web %	PC Web %	Mobile Web n	PC Web n
First Wave				
Number of invitations			2,564	1,479
Absorption Rate	88.5	99.4	2,269	1,470
Start Rate	31.2	73.8	801	1,091
Completion Rate	27.0	71.6	692	1,059
Screened out Rate	4.9	5.2	34	55
Breakoff Rate	13.6	2.9	109	32
Number of completes			658	1,004
Excluded from the analysis				
Number of screened out (in another survey mode)				7
Number of breakoffs (tried to start in another survey mode)				24
Number of completes in another survey mode				61
Second Wave				
Number of invitations			996	657
Absorption Rate	92.6	98.9	922	650
Start Rate	38.0	88.4	378	581
Completion Rate	33.1	87.5	330	575
Breakoff Rate	12.7	1.0	48	6
Number of completes			330	575
Excluded from the analysis				
Number of breakoffs (tried to start in another survey mode)				12
Number of completes in another survey mode				27

randomly assigned to complete the main questionnaire in the first wave using PC browsers, while the rest were assigned to complete the survey on mobile browsers. In the second wave we changed the survey mode for the respondents: those who participated in the mobile Web survey in the first wave were invited to complete the questionnaire via PC, and vice versa. In both waves, mobile respondents were invited by SMS to complete the survey, and PC respondents were invited by e-mail. Kinesis software (see http://www.kinesissurvey.com) was used to program both versions of the questionnaire. Applying Buskirk & Andrus's (2012a) taxonomy of online mobile surveys, the mobile version used in the experiment can be described as administered in an application-like format via mobile browsers. This type of mobile Web survey allows control of the questionnaire layout, provides a uniform design across different operating systems, and gives the user the experience of an application rather than of a mobile browser.

Since we were interested in the changes between survey modes but not differences within individuals in the time period, the time between the waves was designed to be as short as possible to minimize the probability of changes in the responses to sensitive items within individuals. We decided that a period of about a month would be optimal to minimize conditioning effects and the probability of changing response values, on the one hand, and to maximize response rates in the second wave, on the other hand.

In both survey modes and in both waves the respondents were invited to complete a survey with an expected length of 10 minutes.

4 Data Collection

The experiment was carried out in Russia from April 12 to July 10, 2012 by Online Market Intelligence (OMI, see http://www.omirussia.ru/en/online_panels/consumer_panels/). At the recruitment stage, we initially contacted the respondents by e-mail and determined whether they used mobile Internet and were willing to participate in a mobile Web survey. The invitations were sent randomly to the participants in the OMI volunteer online access panel stratified according to the gender and age profile of the mobile Web population in Russia in 2011. If the respondents agreed to participate in the main survey, they were asked to provide their cell phone numbers.

In the recruitment stage, 75,257 invitations were sent to the panelists. The participation rate was 28.5%. Among those who completed the recruitment and screening survey, 27.3% (that is, 5,859 respondents, or 7.8% of those invited) were eligible for the study, agreed to participate in the experiment, and provided their mobile phone numbers.

Given the large number of eligible panel members, a random subset of those eligible for the study was selected for the main study. In the first wave (April 12-April 24, 2012) 2,564 invitations were sent by SMS in the mobile Web survey mode, and 1,479 invitations by e-mail to those assigned to the PC Web survey (Table 1). More cases were randomly assigned to the mobile Web mode given our expectations of lower completion rates in this mode. The absorption rate (percentage of the invitations delivered; see Callegaro

& DiSogra, 2008) was higher for the e-mail invitation than for SMS: 99.4% and 88.5%, respectively. The completion rate is calculated as the percentage of completed interviews (including those that, for various reasons, were screened out) divided by the total number of invitations. By identifying and analyzing user agent string information (see Callegaro, 2010) we verified if respondents filled out the questionnaire in the survey mode to which they were assigned. We excluded from the analysis those respondents who were assigned to the mobile Web survey but attempted or completed the survey via PC (a total of 61 completed interviews, 24 breakoffs, and 7 screened out).

In the first wave of the main experiment, the completion rate to the PC Web survey was significantly higher than in the mobile environment: 73.8% and 31.2%, respectively (Table 1). The breakoff rate in the mobile-based survey was almost five times higher compared to the computer-based Web survey: 13.6% and 2.9%, respectively. The differences in both the completion and breakoff rates are consistent with the findings of Buskirk & Andrus (2012b), Guidry (2012), and McClain et al. (2012). In the first wave, 1,004 respondents completed the online survey interview via PC, while 658 did so on a mobile phone.

In the second wave (May 29-July 10, 2012), 996 invitations were sent to complete the survey via cell phone, and 657 invitations to fill out the questionnaire on a PC. This number is slightly lower than the number of completed interviews in the first wave because of the failure to identify panelists' IDs in some cases, i.e., we were unable to link the individual Web survey invitation ID with the respondent's ID in the panel, which made it impossible to link their responses across the two waves. As in the first wave we excluded from the analysis those who were assigned to the mobile Web survey mode but attempted or completed the survey via PC (27 completed interviews and 12 breakoffs). While the completion rate in the PC Web survey was 88.4%, it was significantly lower in the mobile Web survey (38.0%). The breakoff rate was almost 12 percentage points higher in the mobile survey mode. In total, 330 respondents completed the mobile survey and 575 completed it on a PC in the second wave.

Across both waves, 82% of the respondents used a smartphone (74% with touchscreen, 8% without touchscreen) to complete the mobile questionnaire, while 18% used feature phones. There was a higher breakoff rate among feature phone users (28%) compared to smartphone users (10%) in the mobile Web survey mode. However, most of the breakoffs occurred on the first screens prior to the sensitive questions.

We merged the data from the two waves based on the panelists' IDs and managed to link information for 884 respondents, 319 among those who completed the survey via cell phone in the first wave and via PC in the second wave, and 565 respondents who completed the survey on a cell phone in the first wave and on a PC in the second wave (Table 2). Several cases were excluded from the merged file either due to the failure to identify panelists' IDs or due to mismatches between the IDs in the first and second wave.

Table 2 Number of the Respondents in the Two Waves

	Mobile Web	PC Web	Total
Wave I	565	319	884
Wave II	319	565	884

5 Questionnaire

The questionnaire in the first wave had 83 items. It included demographic variables, mobile Web usage patterns, the willingness of respondents to participate in different types of mobile Web surveys, monthly household income, and blocks of sensitive questions about attitudes towards deviant practices, attitudes towards immigrants, deviant behavior, alcohol-related behavior, and alcohol consumption. In addition, we asked respondents to what extent the questions were sensitive for them, their degree of trust in the confidentiality of their responses, whether third parties were present during an interview, if respondents felt uneasy while completing the survey, and, finally, where they completed the questionnaire. The median time of completing the questionnaire was 9.1 minutes in the PC Web group, and 20.5 minutes in the mobile group.

The questionnaire in the second wave included 72 items. The core of the questionnaire with income question, attitudes towards deviant practices, and behavioral blocks about deviant behavior, alcohol-related behavior, and alcohol consumption repeated the first wave. To minimize conditioning effects some questions were replaced. As in the first wave we also measured contextual variables such as the place of completing the questionnaire, presence of third parties, level of trust in survey confidentiality, and sensitivity of the questions. The median time to complete the questionnaire in the second wave was 6.6 minutes in the PC Web group, and 15.6 minutes in the mobile Web group.

Longer completion times on mobile devices were found in other studies comparing PC and mobile Web survey modes (Comer & Saunders, 2012; Peterson, 2012; Zahariev et al., 2009). Peterson (2012) and Comer & Saunders (2012) suggest that longer times in the mobile Web mode are due to network latency (25%-65% longer compared to PC) rather than respondent difficulty completing the survey. The median completion time in the mobile Web mode calculated based on both waves was lower for smartphone owners (17.7 minutes) compared to feature phone respondents (24.5 minutes). Significantly more feature phone owners ($p<0.01$) were not satisfied with the speed of Internet connection (17%) compared to smartphone users (11%), and found it difficult to complete the survey via phone (8% among feature phone users vs 3% among smartphone users, $p<0.01$). However, there was no difference between the level of satisfaction of completing the survey via phone and PC (5% of the respondents in both modes did not like filling out the questionnaire).

The questions on deviant behavior, alcohol-related behavior, and alcohol consumption have been validated in Russia by Myagkov and his colleagues (Myagkov, 2012; Myagkov et al., 2010; Myagkov & Zhuravleva, 2011). They

Table 3 Sensitive Indices by Mode

	Mobile Web	PC Web
Mean rate of positive attitudes towards deviant practices	41.32 (20.43)	41.28 (21.03)
Mean rate of deviant behavior	31.46 (19.00)	31.30 (18.35)
Mean rate of alcohol-related behavior	39.57 (30.38)	40.02 (30.93)
Mean daily alcohol consumption (grams)	6.65 (9.68)	7.57 (10.36)
Mean daily alcohol consumption among males (grams)	8.72 (11.02)	9.96 (12.03)
Mean daily alcohol consumption among females (grams)	4.08 (6.87)	4.64 (6.79)
Median monthly household income	30,000-40,000 roubles (answer category=6)	40,000-50,000 roubles (answer category=7)

Standard errors in parentheses

found underreporting in most of the items, and revealed that there might be overreporting of alcohol consumption among younger age groups, and overreporting of income among low-income groups (Myagkov et al., 2010). Moore et al. (2000) showed in their extensive review of the literature on income measurement error that although there might be overreporting in income question, net income bias tends to be towards underreporting.

6 Sensitive Indices

We compared responses in the two survey modes based on five blocks of questions: (1) attitudes towards deviant practices, (2) deviant behavior, (3) alcohol-related behavior, (4) alcohol consumption, and (5) monthly household income (see Table 3). Consistent with other studies that use similar measures – such as the Marlowe-Crowne scale (Crowne & Marlowe, 1964) or the balanced inventory of desirable responding (Paulhus, 1984), we create additive indices of responses to the sets of items.

1. The rate of positive attitudes towards deviant practices. This index is based on fifteen items about attitudes towards deviant practices, that is, whether behaviors (e.g., abortion, lying in one's own interest, having casual sex, use of marijuana or hashish, etc.) can or cannot be justified. The count of socially undesirable answers ("always can be justified" or "can be justified"=1, "cannot be justified" or "can never be justified"=0; see Appendix) was calculated for each respondent, and transformed to a rate from 0 (no behaviors justified) to 100 (all 15 behaviors justified).
2. The rate of deviant behavior. The summary measure of deviant behavior was created by summing the number of positive responses to fifteen deviant behavior indicators (e.g., whether respondents have stolen anything from a shop, have used marijuana/hashish/ecstasy, have ever offered a bribe for some services, have ever been treated for a venereal disease, etc.; see details in Appendix). The count of positive responses was calculated, and transformed to a 0-100 rate.
3. The rate of alcohol-related behavior. This index is based on nine items on alcohol-related behavior (e.g., whether respondents have ever been drunk during several days, have forgotten some events the next day after they were drinking alcohol, etc.). The rate of alcohol-related behavior was created based on the count of socially undesirable behaviors reported (see details in Appendix), again transformed to a 0-100 rate.
4. Daily alcohol consumption (quantity-frequency index). Alcohol consumption was measured using a beverage-specific quantity-frequency index. For three types of beverages (beer, wine/sparkling wine, spirits) respondents were asked for the quantity and frequency of their consumption over the last 30 days. The quantity question was about the usual number of drinks the respondent had. The question was closed-ended, and the response categories were coded in the widely-used units of consumption: 0.5 l glasses or bottles for beer, 200 ml. glasses for wine, and 50 g for spirits (see Kraus & Augustin, 2001; Myagkov & Zhuravleva, 2011). The open-ended frequency question was about the number of times the respondent drank the particular type of beverage in the last 30 days. Quantities of consumed beverages were converted into pure alcohol using ethanol contents in one liter of beer, wine, and spirits (40 g, 92 g, and 320 g, respectively). Consumption was measured by multiplying quantity and frequency for each type of beverage, summed up, and calculated per day for each respondent. This daily index has a range from (0) when no alcohol consumption was reported to (+127) g. We removed from the analysis 2.7% of the responses with extremely high index values (z-score higher than +3).
5. Monthly household income. We asked respondents to report the household income group (counting all

wages, salaries, pensions and income from other sources of all members of the household) to which they belonged. There were 13 income groups and a "Difficult to answer (Don't know)" response category. We removed from the analysis the "Difficult to answer" responses (3.4%, with an equal split between two survey modes). This measure has a range from 0 to 13. We treat the outcome as a continuous variable, since the distribution is approximately normal (Figure 1 in the Appendix).

Table 3 shows the distributions of the indices by mode.

7 Results

Based on the analysis of responses from the two waves, we can conclude that mobile Web gives respondents more opportunity to complete the questionnaire at any convenient place. Thus, 45% of mobile Web respondents reported completing the survey outside the home, compared to 29% of PC Web respondents (see "Waves I and II" in Table 4). As a result, more surveys were completed in the presence of third parties in the mobile than in the PC Web condition (29% versus 16%). Moreover, significantly more participants in the mobile Web survey filled out the questionnaire in the presence of strangers compared to the PC Web survey: 25% versus 9%, respectively, among those who completed the survey in the presence of bystanders. Apparently, most of the interviews in the presence of strangers were completed outside the home and office, particularly in transportation settings or another public places (77% of the interviews in the presence of strangers). Those completing the survey on a mobile device reported lower levels of perceived privacy than those who completed it on a PC (63% versus 75%), but these proportions are relatively high in both cases. In both survey modes the respondents who filled out the questionnaire outside the home were less likely to trust in the confidentiality of the survey mode ($p < 0.05$).

Nonresponse Error

A concern with any study that has differential nonresponse between the modes is that nonresponse error – rather than measurement error – may account for any observed differences in response distributions. The cross-over design provides some protection for this, but these analyses are restricted to those who responded to both waves. As an additional check, we examined if there are significant differences between respondents and nonrespondents in the second wave, based on their first-wave responses. In other words, it is possible that those who reported more socially undesirable attitudes and behavior in the PC mode in the first wave may be less likely to respond when invited to the mobile Web survey in the second wave.

To test this, we ran a multivariate logistic regression among those who completed the questionnaire via PC in the first wave. The outcome was the response to wave 2 (yes/no), with the responses on the sensitive indices from the first wave as predictors. A separate model was estimated for monthly income as there was some missing data for this item. Age and gender were included as control variables. We expected that if there were differences between the respondents and nonrespondents, the latter would have higher levels of sensitive reporting in the first wave. However, the results did not support our hypothesis (Table 5). Contrary to expectations, nonrespondents to the mobile Web survey in the second wave reported slightly lower monthly household income and lower scores on the attitude index in the first wave than respondents to the mobile Web survey.

Measurement Error

Since we assume that the residual errors within an individual between two waves are correlated, we applied linear mixed models (see West et al., 2007) to examine measurement differences between the two survey modes, using maximum likelihood (ML) estimator. Models were estimated in SPSS, using the MIXED command. These are random intercept models, where there is a single random effect associated with each subject, accounting for the within-subject correlation in the two measures. Fixed effects of mode (level 1), and wave, gender, and age (all at level 2) are estimated.

The basic models (as shown in Table 6) have the following form:

$$Y_{it} = \beta_{00} + \beta_1 \text{Mode}_{ti} + \beta_2 \text{Wave}_i + \beta_3 \text{Gender}_i + \beta_4 \text{Age}_i + u_{0i} + \epsilon_{ti} \quad ,$$

where Y_{ti} is the response to the each of the measures (e.g., deviant behavior) at time t for respondent i, β_1 is the fixed effect of mode (mobile=1, PC=0), β_2 is the fixed effect for the wave (first wave=1, second wave=0), β_3 (males=1, females=0) and β_4 (18-34=1, 35 or older=0) are the fixed effects of the covariates, and u_{0i}, and ϵ_{ti} are the random effects at each of the two levels.

Two of the five indices revealed significant differences in the direction predicted by our main hypothesis (Table 6). Respondents in the PC-based Web survey indicated higher levels of alcohol consumption and income. While males report significantly higher levels of alcohol consumption and alcohol-related behavior (consistent with the literature), we found no significant interactions with mode on either measure. Higher levels of reporting on both alcohol measures were also found in the second wave, but again we found no significant interactions with mode. Examining the cross-classification of responses to the 13 categories of income, we found that 62.6% of respondents chose the same category in both modes, while 23.3% chose a higher income category on the PC, and 14.0% chose a higher category on the mobile Web mode.

No impact of survey mode was found for the other indices. Additionally, for these three indices we tested all attitude and behavioral items separately; however, we did not find any systematic differences between survey modes for the individual items. Moreover, since men tend to have more permissive sexual attitudes and have higher reports of some sexual behavior than women (Oliver & Hyde, 1993), we tested if there is an interaction between gender and survey mode in the

Table 4 Differences in Context Variables by Mode and Wave

		Mobile Web	PC Web	Chi-square $df = 1$
Wave I				
Place where the respondent filled in the questionnaire	At home	56.2	77.0	48.276***
	Outside the home	43.8	23.0	
The presence of third persons	Not present	69.1	82.7	43.476***
	Present	30.9	17.3	
Trust in confidentiality of the survey mode	Do not trust	41.2	20.2	29.595***
	Trust	58.8	79.8	
The sensitivity of the questions	Not sensitive	44.6	41.1	8.489**
	Sensitive	55.4	58.9	
Feeling uneasy answering the questionnaire	Did not feel uneasy	77.6	78.8	1.537
	Feeling uneasy	22.4	21.2	
N		648	996	
Wave II				
Place where the respondent filled in the questionnaire	At home	51.7	68.5	24.454***
	Outside the home	48.3	31.5	
The presence of third persons	Not present	72.4	84.8	19.718***
	Present	27.6	15.2	
Trust in confidentiality of the survey mode	Do not trust	28.8	27.4	0.200
	Trust	71.2	72.6	
The sensitivity of the questions	Not sensitive	41.1	34.2	4.189*
	Sensitive	58.9	65.8	
Feeling uneasy answering the questionnaire	Did not feel uneasy	79.0	74.0	2.794
	Feeling uneasy	21.0	26.0	
N		319	565	
Waves I and II				
Place where the respondent filled in the questionnaire	At home	55.1	71.0	79.387***
	Outside the home	44.9	29.0	
The presence of third persons	Not present	70.8	83.9	41.445***
	Present	29.2	16.1	
Trust in confidentiality of the survey mode	Do not trust	37.2	25.2	85.206***
	Trust	62.8	74.8	
The sensitivity of the questions	Not sensitive	43.3	36.5	2.007
	Sensitive	56.7	63.5	
Feeling uneasy answering the questionnaire	Did not feel uneasy	78.1	75.6	0.329
	Feeling uneasy	21.9	24.4	
N		884	884	

* $p < 0.05$, ** $p < .01$, *** $p < 0.001$ (two tailed)

sexual attitude and behavior items. Though males tended to have more positive attitudes and higher levels of reporting of having casual sex, more negative attitudes towards homosexuality, and lower levels of reporting same-sex experiences, no gender differences were found in the attitudes or level of reporting of being unfaithful to the partner, and no significant differences in the items on sexual behavior between survey mode and gender were detected.

Given that we found nonresponse error in the income question in the second wave, we also performed OLS regressions separately for each wave. The OLS regression predicting the income group with controls for age and gender did not show significant effects of the survey mode in the first wave; however, there was a significant impact of mode in the second wave ($p<0.05$). The repeated measurement analysis for the respondents who completed both waves of the experiment revealed that those who changed survey mode from mobile to PC Web indicated a higher income group in the second wave when they filled out the questionnaire on PC. At the same time, no response effects were found for those who

Table 5 Logistic Regression Coefficients Predicting Nonresponse in the Second Wave (among those who completed the survey via PC in the first wave)

	Predicting Nonresponse in the second wave =1		Predicting Nonresponse in the second wave =1	
	Coef.	S.E.	Coef.	S.E.
Intercept	1.515***	0.245	1.530***	0.272
Positive attitude towards deviant practices	−0.012***	0.004		
Deviant behavior	0.007	0.005		
Alcohol-related behavior	−0.003	0.003		
Daily alcohol consumption	0.003	0.004		
Monthly household income			−0.065*	0.031
Males	−0.295*	0.144	−0.246	0.140
Age group: 18-34	−0.324	0.177	−0.298	0.176
	996		963	

* $p < 0.05$, *** $p < 0.001$

changed survey mode from PC to mobile Web. The changes could be due to some context variables like completing the questionnaire outside the home or in the presence of third people. Thus, as a next step we included context variables in the model.

We included such context variables as the place of completing the questionnaire (at home or outside the home), the presence of bystanders, level of trust in confidentiality of the survey mode, sensitivity of the questions, and feeling uneasy while participating in the survey, in linear fixed-effects models. We found the same survey mode differences in monthly household income and alcohol consumption (Table 7). On average, PC respondents reported about 21 g more alcohol consumption for the last 30 days. We also examined if there were significant interactions between the survey mode and context variables, but found no consistent effects across the five indices.

In two of the five indices only one context variable ("feeling uneasy") showed a significant effect. According to our expectations, this variable may be a consequence rather than a cause of their answers to the sensitive questions: those respondents whose response values were not socially desirable were more likely to feel uneasy answering the questionnaire. Other effects were quite different among all five indices. The trust in data confidentiality variable did not have an impact on the level of reporting. Contrary to our expectations, those who completed the questionnaire outside the home in both survey modes were more likely to report higher levels of alcohol consumption. This suggests that self-administered Web surveys completed outside the home may produce higher levels of reporting for some sensitive items.

A negative effect of the presence of third parties was found for the income question. Those who completed the survey in the presence of bystanders reported lower levels of income. We examined if the effect was significant for both familiar bystanders and strangers. A negative effect was found only if bystanders were familiar to the respondents and not significant if bystanders were strangers. The finding supports our hypothesis. At the same time, a positive effect of the presence of third parties was found for the attitude index. The effect was also significant only for familiar bystanders. An alternative explanation for these findings could be satisficing, particularly primacy effects. There is evidence from a number of studies that visually presented categories may produce primacy effects, where respondents favor those items presented earlier in the list (Krosnick & Alwin, 1987).

To separate out response-order effects from social desirability bias, we embedded an experiment in the attitude questions to explore the presence of primacy effects and different social contexts in the two survey modes. Half of the respondents were assigned to receive the response categories in the standard order, while the other half received them in the reverse order. The standard order significantly increased the number of approving attitude responses (presented as the first two answers on the screen), providing evidence of primacy effects. However, we found no interactions between the order of the responses and other variables such as survey mode, level of trust in data confidentiality, presence of bystanders, and place of completing the questionnaire. Thus, we cannot conclude that completing the questionnaire outside the home or in the presence of bystanders resulted in stronger primacy effects.

8 Discussion and Conclusion

Our analyses were organized around a comparison of two self-administered Web survey modes in terms of levels of reporting on sensitive questions. We investigated if there was an effect of the device used to complete the Web survey on the tendency to give more socially desirable responses. We expected that the social context of mobile Web surveys would affect the reporting of socially sensitive information. Since mobile phones are used in very diverse contexts and designed for use in public places, we expected that Web surveys completed on cell phones may show higher rates of social desirability bias than those completed on a PC. To avoid selection bias when respondents could have some observed

Table 6 Linear Mixed Model Coefficients Predicting Sensitive Indices

	Positive attitude towards deviant practices	Deviant behavior	Monthly Alcohol-related behavior	Daily alcohol consumption	Household income
Intercept	43.439***	31.703***	36.449***	5.831***	6.810***
	(1.533)	(1.194)	(1.145)	(0.730)	(0.164)
Mobile Web	0.010	−0.179	−0.375	−0.705*	−0.173**
	(0.590)	(0.927)	(0.624)	(0.306)	(0.053)
First wave	0.147	1.198	−0.405	−0.860**	−0.215***
	(0.590)	(0.927)	(0.624)	(0.306)	(0.053)
Males	−1.001	1.981*	11.562***	4.745***	−0.123
	(1.250)	(0.897)	(0.897)	(0.594)	(0.134)
Age group: 18-34	−2.246	−2.668**	−3.803	−0.598	−0.242
	(1.426)	(1.005)	(2.086)	(0.678)	(0.154)
N	1,768	1,768	1,768	1,720	1,708

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

and unobserved differences between the two survey modes, we conducted a two-wave cross-over design, so that all participants of the experiment completed the questionnaire in both survey modes, with the order randomized. Significant differences were found for two of the five sensitive indices we examined. Clear measurement differences were observed in the level of reporting of alcohol consumption. Some differences were found in the monthly household income reported by the respondents. Though this difference appears to be mainly due to nonresponse in the second wave of the experiment, the repeated measures analysis revealed that changing the survey mode from mobile to PC Web significantly increased the level of income reported in the PC Web survey mode.

Comparing the two survey modes, we expected that a home-based setting (versus office, university or other place), no presence of third parties during completion of the questionnaire, and higher levels of perceived privacy would increase respondent candor. The results showed that respondents tended to trust in data confidentiality more when they completed the questionnaire on a PC rather than via cell phone. However, we did not find an effect of perceived privacy or an interaction of privacy and survey mode on the level of reporting.

We found that more surveys were completed outside the home and in public places in the mobile Web survey. Apparently, as a consequence, more respondents filled out the questionnaire in the presence of bystanders in the mobile environment. Contrary to our expectations, we found that completing the questionnaire in a home-based setting did not appear to result in higher levels of reporting of socially undesirable behaviors and attitudes in self-administered Web-based surveys. An alternative hypothesis may be related to selection bias – those who chose to complete the survey outside the home may be more comfortable with answering such questions than those who chose to complete the survey in a more private setting.

We found a positive effect of the presence of bystanders on the responses to the attitude questions, and a negative effect for the income question. In both indices an effect was significant only if the bystanders were familiar to the respondent, and not significant if they were strangers. A positive effect in the attitude index is consistent with the hypothesis that the presence of third parties who have some factual or shared knowledge may likely increase the accuracy or honesty of responses (Aquilino et al., 2000). Since the attitude questions included such practices as cheating on taxes, accepting a bribe in the course of the duties, and paying cash for services to avoid taxes, the presence of familiar bystanders could foster the effect of justifying these practices which are part of everyday life in Russia. A negative effect of presence of bystanders was found for the income question. In line with expectations, the presence of familiar bystanders was likely to yield reporting of a lower income category, while the presence of strangers did not have any impact on responses.

We examined whether survey mode differences found in the experiment were due to satisficing strategies or some differences in the level of reporting between survey modes. We investigated whether social contexts foster primacy effects. Though primacy effects were found in both survey modes, no interactions between survey mode, presence of third people, the place of completing the questionnaire, and primacy effects were found. That is, we found no evidence of differential satisficing by device used, or by the context in which the survey was completed.

Our study suffers from several limitations. The study is restricted to members of a volunteer online opt-in panel in Russia. The fact that they are members of a panel may mean that they already trust the survey organization, which may dampen any effects of the device. Similarly, we were unable to measure the extent to which they shared their device (PC or mobile), and this could affect the results we found. Higher rates of nonresponse, higher breakoff rates, and longer completion times were found for the mobile Web mode, consis-

Table 7 Linear Mixed Model Coefficients Predicting Sensitive Indices (including context variables)

	Postive Attitude towards deviant practices	Deviant behavior	Alcohol related behavior	Daily alcohol consumption	Monthly household income
Intercept	44.088***	31.675***	34.870***	4.858***	6.882***
	(1.835)	(1.531)	(2.467)	(0.874)	(0.188)
Mobile Web	−0.867	−0.396	−0.343	−0.812*	−0.173**
	(0.622)	(0.953)	(0.667)	(0.321)	(0.056)
First wave	−0.041	1.133	−0.384	−0.767*	−0.211***
	(0.594)	(0.931)	(0.632)	(0.308)	(0.053)
Males	−1.471	2.055*	12.202***	4.753***	−0.131
	(1.246)	(0.910)	(1.786)	(0.598)	(0.134)
Age group: 18-34	−2.224	−2.635**	−3.522	−0.597	−0.231
	(1.416)	(1.016)	(2.070)	(0.679)	(0.154)
Trust inconfidentiality of the survey mode	−2.506*	0.106	1.035	0.196	0.043
	(0.978)	(0.980)	(1.150)	(0.494)	(0.094)
Bystanders	2.589**	1.599	0.491	−0.055	−0.189*
	(0.978)	(1.083)	(1.110)	(0.112)	(0.091)
Completing the questionnaire outside the home	1.634	0.008	0.157	0.936	0.114
	(0.857)	(0.946)	(0.977)	(0.436)	(0.080)
Feeling uneasy	−1.565	0.351	4.890***	1.336*	−0.113
	(1.041)	(1.053)	(1.220)	(0.528)	(0.099)
Sensitive questions	0.029	−0.742	−1.713	0.291	−0.133
	(0.868)	(0.915)	(1.004)	(0.440)	(0.083)
"Standard" order of the responses[a]	1.967**				
	(0.740)				
N	1,768	1,768	1,720	1,708	1,768

[a] The experiment with the response order (standard or reverse) was conducted only in attitude questions

Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

tent with the emerging literature on mobile Web. Despite these limitations, our study represents a first examination of possible social desirability biases of mobile Web versus PC Web surveys.

Our findings offer rather limited support for the main hypothesis; however, we suggest that differences between PC and mobile-based Web surveys may depend on the types of questions being compared. We observed clear differences between the two survey modes in the alcohol consumption reported by respondents. Differences did not emerge for the attitude and behavioral questions. Where we did find differences, the PC Web mode seemed to produce higher reports of socially undesirable behaviors to the sensitive items.

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Appendix

Index of attitude towards deviant practices

For each of the following actions, please indicate whether you think it can always be justified, never be justified, or something in between?

1. Lying in your own interest
2. Cheating on taxes if you have a chance
3. Someone accepting a bribe in the course of their duties
4. Paying cash for services to avoid taxes
5. Prostitution
6. Married men/women having an affair
7. Homosexuality
8. Having casual sex
9. Avoiding a fare on public transport
10. Shoplifting
11. Using marijuana or hashish
12. Abortion
13. Euthanasia (terminating the life of the incurably sick)
14. Suicide
15. Scientific experiments on human embryos
    - ☐ Always can be justified (1)
    - ☐ Can be justified (1)
    - ☐ Can not be justified (0)
    - ☐ Never can be justified (0)

Index of deviant behavior

1. Have you ever stolen anything from a shop?
2. Have you ever used marijuana, hashish or ecstasy?
3. Have you or your relatives ever paid a bribe for some services?
4. Have you ever failed to report a crime committed by others to the authorities
5. Have you ever found a wallet or purse and kept it?
6. Have you had ever casual sex?
7. Have you ever been unfaithful to your husband /wife boyfriend/girlfriend?
8. Have you ever simulated illness to receive sick leave?
9. Have you ever tried to commit suicide?
10. Have you ever taken money or things from other people without permission and have not confessed?
11. Have you ever been treated for a venereal disease?
12. Do you like to watch pornographic films, web-sites, or magazines?
13. Have you ever had a same-sex experience?
14. Have you ever accepted a bribe?
15. Have you ever taken out a loan, knowing that you can not pay back the money?
    - ☐ Yes (1)
    - ☐ No (0)

Index of alcohol-related behavior

1. Have you ever been drunk for several days?
2. Have you ever had sex while under the influence of alcohol?
3. Have you ever felt ashamed the next day for what you had done while drinking?
4. Have you ever drunk alcohol alone?
5. Have you ever felt you needed a drink first thing in the morning to steady your nerves or to get rid of a hangover?
6. Have you ever forgotten some events the next day after you were drinking alcohol?
7. Have you ever missed classes or work because of drinking?
8. Have you ever drunk so much alcohol that you could not control yourself?
9. Have you ever lost control of how much alcohol you drunk?
    - ☐ Yes (1)
    - ☐ No (0)

Index of alcohol consumption

A1 How many times did you drink beer in the last 30 days? (if you did not drink beer, please insert “0”)

B1 On the days when you drink beer, how much do you usually drink? (in bottles 0.5 l.)
- ☐ Not more than 1 bottle 0,5 l.
- ☐ On average 2 bottles 0,5 l.
- ☐ On average 3 bottles 0,5 l.
- ☐ In On average 4 bottles 0,5 l.
- ☐ On average 5 or more bottles 0,5 l.
- ☐ I do not drink beer

A2 How many times did you drink wine or sparkling wine in the last 30 days? (if you did not drink wine or sparkling wine, please insert “0”)

B2 On the days when you drink wine or sparkling wine, how much do you usually drink? (in glasses 200 ml.)
- ☐ Not more than 1 wineglass 200 ml.
- ☐ On average 2 wineglasses 200 ml.
- ☐ On average 3 wineglasses 200 ml.
- ☐ On average 4 wineglasses 200 ml.
- ☐ On average 5 or more wineglasses 200 ml.
- ☐ I do not drink wine or sparkling wine

A3 How many times did you drink spirits (e.g. vodka, cognac, whisky) in the last 30 days? (if you did not drink spirits, please insert “0”)

B3 On the days when you drink spirits, how much do you usually drink? (in grams)
- ☐ Not more than 50 grams
- ☐ About 100 grams
- ☐ About 150 grams
- ☐ About 200 grams
- ☐ About 300 grams

☐ About 400 grams
☐ About 500 grams and more
☐ I do not drink spirits

Distribution of Monthly household income