

# Web Surveys Optimized for Smartphones: Are there Differences Between Computer and Smartphone Users?

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## Abstract

This paper shows that computer users and smartphone users taking part in a web survey optimized for smartphones give responses of almost the same quality. Combining a design of one question in each page and innovative page navigation methods, we can get high quality data by both computer and smartphone users. The two groups of users are also compared with regard to their precisely measured item response times. The analysis shows that using a smartphone instead of a computer increases about 20% the geometric mean of item response times. The data analyzed in this paper were collected by a smartphone-friendly web survey. All question texts are short and the response buttons are large and easy to use. As a result, there are no significant interactions between smartphone use and either the length of the question or the age of the respondent. Thus, the longer response times among smartphone users should be explored in other causes, such as the likelihood of smartphone users being distracted by their environment.

*Keywords:* web surveys, mobile surveys, AJAX navigation, data quality, item response times, smartphones



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# 1 Introduction

The aim of this paper is to study the differences between computer and smartphone users when they complete web surveys optimized for smartphones. The comparison is done on two dimensions. The first dimension refers to the quality of the responses, e.g. the frequencies of no answers or neutral responses. The second dimension refers to the time the respondents spend to answer the questions, i.e. the item response times.

The most recent studies on the effects of mobile use on data quality report limited differences between mobile and computer respondents. Mavletova (2013), analyzing an experiment in Russia, reports that computer respondents type longer responses on open-ended questions. On the other hand, she finds that mobile and computer users have similar levels of socially undesirable and non-substantive responses. In addition, the two groups do not differ significantly in terms of primacy effects. De Bruijne and Wijnant (2013) after running an experiment with participants randomly assigned to three modes (mobile, computer and a hybrid) have not found any significant differences. Toepoel and Lugtig (2014) have not found differences between mobile and desktop users with regard to item nonresponse, the length of answers to a short open-ended question and the number of responses in a check-all-that-apply question. Finally, Wells, Bailey, and Link (2014) have randomly assigned roughly 1,500 online U.S. panelists and smartphone users to either a mobile application or a computer. They have not found any significant response-order effects across modes. However, they report that computer respondents provide significantly longer responses than mobile respondents.

Many web survey researchers have reported that the number of people who use mobile devices to take part in web surveys is increasing rapidly. In addition, the time spent on a web survey is crucial for the quality of the collected data. Longer web surveys suffer from larger break-off rates and greater probability of lower quality responses. Therefore, many recent publications deal with the time spent on responding to web surveys while using mobile devices. Both Mavletova (2013) and De Bruijne and Wijnant (2013) report that mobile device users need more time to complete the questionnaire than computer users. Conversely, Toepoel and Lugtig (2014) find that total response times are almost the same across devices.

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## 2 Designing for Smartphone Users

Previous studies on measurement effects have found minimal differences between mobile and computer respondents. The most challenging difference concerns the length of open-ended responses. Nowadays, people become more and more experienced in typing texts using the small keys of their smartphones. Nevertheless, it is still much easier to type using a regular full-size keyboard than using a keypad on a mobile device. As a result, we should continue to expect longer responses on open-ended questions by computer users, especially when the response needs more than 3-4 words.

A good web survey design can remove most of the remaining differences. Survey design always plays an important role. According to Stapleton (2013), horizontal orientation of response choices may increase satisficing by smartphone users, i.e. they are more likely to select one of the first response choices. Vertical scrolling seems to be better than horizontal scrolling. In fact, Mavletova and Couper (2014) argue in favor of using a vertical scrolling design and they report that it leads to significantly faster completion times, and fewer technical problems. As they argue, the smaller number of interactions with the server reduces the risk of dropped connections. On the contrary, Wells, Bailey, and Link (2014) argue in favor of minimal vertical scrolling and support the idea of using one question per page, short questions and short sets of response lists.

A solution that gets the best from both worlds is the use of Asynchronous JavaScript and XML (AJAX) technology. By using AJAX, survey designers can display one question per page while minimizing the risk of failed connections with the server. This is achieved by downloading all pages to the users' browser during the first connection with the server. Then, AJAX takes care of the navigation from page to page. In that way, there is only a second and final connection with the server when the user submits the completed questionnaire. Furthermore, with AJAX technology we avoid any lags between pages<sup>1</sup>. This means that we can have accurate measurement of the time spent between clicks.

## 3 Data

The findings presented in this paper are based on the analysis of the paradata collected in May 2014 by the Greek Voting Advice Application (VAA) HelpMeVote - VoteMatch Greece (Andreadis, 2013). Voting advice applications are special types of opt-in web surveys that help users find their proximities with the political parties.

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<sup>1</sup> Couper and Peterson (2015) refer to two kinds of times: between-page (transmission) time and within-page (response) time. Using the AJAX navigation system the former time is zero.

These applications can attract thousands or even millions of users during the pre-electoral period. HelpMeVote is the Greek partner in the multi-national European project VoteMatch (votematch.eu). The target of this project is to run VAAs for the European Parliament elections.

HelpMeVote follows the best practices used in both web and mobile survey design. It runs both on computers and on smartphones. It automatically scales to any screen size and it supports both touch and mouse events. It displays one question per page and supports AJAX navigation. It uses large font size, short texts and the response options are displayed vertically with large buttons.

The questionnaire includes 31 Likert type questions. Each question is displayed on a separate page. Respondents have six answer choices: there are five buttons to express their level of agreement with a statement and a “No answer” button. When a respondent clicks on a button, the timestamp is recorded in a hidden input field and the user is forwarded to the next page. Besides the 31 main questions, HelpMeVote users are asked to fill-in a form. This form includes questions about their gender, age group, education level, and voting behavior. Finally, HelpMeVote captures the user-agent header field, which enables the detection of the users’ browser and device type (i.e. smartphone, computer, etc). When the respondent submits the survey, everything is stored to a database. Thus, each database record includes the user responses, the timestamps and the device type.

The HelpMeVote/VoteMatch Greece dataset includes about 80,000 completed questionnaires. The largest part of the dataset consists of computer users (80.7%) and smartphone users (13.5%). The rest of the respondents have used other mobile devices (mostly tablets). The focus of this paper is on the comparison between smartphone and computer users when both groups use a smartphone-friendly web survey. Therefore, users of other mobile devices were not included in the analysis.

## **4 Methods and Variables**

### **4.1 Quality of Responses**

HelpMeVote does not include any open-ended items. Thus, the hypothesis that computer respondents provide longer responses cannot be tested. On the other hand, computer and smartphone users of HelpMeVote can be compared for other data quality patterns.<sup>2</sup> For instance, if smartphone users selected more non-substantive responses (i.e. “Neither agree nor disagree” or “No answer”) than computer users, this would suggest that smartphone users provide data of lower quality. Similarly

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<sup>2</sup> For a list of mode effects related to data quality see Bethlehem and Biffignandi, 2011, p.245

smartphone users can be tested for primacy effects (i.e. selecting the first response choice more often) or any other response-order effects.

When a chi-square test is applied on a large sample, it will almost always give a small p-value. Even when there is no practical difference between expected and observed frequencies, the test will reject the hypothesis of independence. In addition, running a separate test for each of the 31 items included in HelpMeVote would result in multiple comparisons and incorrect rejection of the null hypothesis. Thus, it would be more likely to classify nonsignificant differences as significant.

The aforementioned problems are avoided by creating six new variables. The value of each new variable reflects the number of times the respondent has chosen the corresponding response option (“Frequency of Strongly Disagree” to “Frequency of Strongly Agree” and “Frequency of No Answer”). The range of values of these new variables is from 0 to 31. Each of these variables takes the minimum value (0) when the respondent does not select the corresponding answer in any of the 31 questions. Similarly, it takes the maximum value (31) when the respondent selects the same answer for all questions. With these variables it is easy to analyze mode effects between mobile and computer users. For instance, a comparison of the average values of the variable “Frequency of Strongly Disagree” between mobile and computer users will show if there is a different primacy effect between modes. Similarly, a comparison of the average values of the variables: “Frequency of Neither agree nor disagree” and “Frequency of No Answer” between the two groups will reveal if smartphone users select non-substantive responses more often than computer users.

## 5 Item Response Times

The analysis of item responses times is much more complicated for two reasons. First, item response times depend on characteristics of both the respondents and the items. As a result, there is a need for a multi-level analysis of the item response times. Second, there is need for data cleaning in order to deal with extremely short or extremely long item response times.

### 5.1 Multilevel Model

Item response times depend on characteristics of the respondent, e.g. gender, age, education, interest in the theme of the survey and knowledge about the survey topics. Attributes of the items such as the length or the difficulty of the item have also an impact on item response times. Thus, item response times are usually analyzed with a multilevel model. The usual approach is to consider a hierarchical model where the items are nested within the respondents (Van der Linden, 2008), but

there are examples of reversed roles, i.e. the respondents are nested within items (Swanson et al., 2001). Using a non-hierarchical model would underestimate the standard errors of regression coefficients and make nonsignificant coefficients to appear as significant (Hox, 2002; Gelman & Hill, 2006).

For the multilevel analysis, the dataset has to be reshaped in its long format. This way, each of the about 80,000 cases is multiplied by 31 (i.e. the total the number of the items). The outcome of this procedure is a dataset of about 2.5 million cases. Analysis of this huge dataset is difficult even when a strong workstation is used. To overcome this problem, a random sample corresponding to 10% of the complete dataset was selected. The distributions of the main variables are very similar in the sample and in the initial dataset. Replications of the same analysis presented in this paper on other 10% random samples have given very similar findings. The used sample is available by OpenICPSR (Andreadis, 2014b).

## 5.2 Data Cleaning

Andreadis (2012, 2014a) proposes a method to flag items that were responded in extremely short time. The method is based on the types of reading and the corresponding reading speeds presented by Carver (1992). Scanning is the fastest type of reading. When respondents scan a question, they do not dedicate adequate time to understand the meaning of the text. In addition, according to Bassili and Fletcher (1991), answers to simple attitude questions take between 1.4 and 2 seconds. Adding the minimum needed time to read and comprehend a question and the minimum needed time to answer the question, we get the following formula:  $\text{threshold} = 1.4 + [\text{number of characters in the item}] / 39.375$ . Users with extremely short times in more than one third of their responses were removed from the dataset. This decision is justified on the hypothesis that these users have responded without paying attention to the questions; these users usually maintain the same attitude throughout the questionnaire.

On the other hand, it is very rare to observe a user spending extremely long to answer most questions. This delay is often a result of an external distraction (e.g. an incoming email, phone call, door knocking, etc). Thus, the recorded time is not the actual time spent on the question. Instead, it is the sum of the time spent on answering the question, plus an unknown amount of time caused by some external distraction. After applying the logarithmic function to the response times to reduce skewness, the extreme values have been identified with the use of boxplot statistics (Tukey, 1977; Hoaglin, Mosteller, & Tukey, 1983; McGill, Tukey & Larsen, 1978). These values were coded as missing (Andreadis, 2015).

### 5.3 Other Data Preparations

In the following models the logarithm of the response times is used as the dependent variable (i.e. the outcome). Since the main task of this paper is to compare the response times between smartphone and computer users, the binary variable “smartphone” is included into the model as the main treatment variable. This variable gets the value 1 if the respondent is a smartphone user and the value 0 if the respondent is a computer user.

The control variables on the user level are the following: education, gender, age, political interest and a variable (Decided) that gets the value 1 if the respondents had already made their vote choice when they used the VAA and 0 otherwise. Education is used as a categorical variable with five levels: Primary, Lower secondary, Upper secondary, Tertiary and Postgraduate studies. Primary education is used as the reference level and all other levels are compared with it. The expectation is that the higher the education levels are, the less the response time should be. The remaining variables are used as dummy variables. Gender gets the value 0 for female and 1 for male respondents. Some studies have found that female respondents spend more time on web surveys, thus a similar finding is expected from the present analysis. Age gets the value 1 if the respondent is older than 49 years old, and 0 otherwise. According to the literature, older people are expected to spend more time than younger people. For the analysis of item response times, the cases with missing values on the demographic variables have been filtered out. There are two reasons which give support to this decision. First, the percentage of missing values is small. Second, the application of advanced imputation methods, such as imputing the missing value with the predicted value of a regression, would be challenging. Demographic variables (e.g. age) may serve as good predictors of some attitudinal variables (e.g. more conservative views). Trying the opposite, i.e. using attitudinal variables to predict demographic variables would be odd, because attitudinal variables do not have an impact on demographics, such as age or gender.

The variable political interest gets the value 1 if the respondent has indicated an interest in politics. Citizens interested in politics and voters who have already decided about their vote choice should be more familiar with the major issues of the electoral competition. Thus, they are expected to have a clear, pre-formulated opinion about the statements. As a result, they are expected to need less time than people not interested in politics and people who had not decided about their vote choice when they used HelpMeVote.

The control variables on the item level are: the length of the statement (see Andreadis, 2012 and 2014a) and a dummy variable that takes the value of 1 when the statement is about a European Union issue and 0 when the statement is about a national issue. Greek voters are less informed about EU policy issues than they

are on national issues. Thus, they are expected to need more time to express their opinion on EU issues.

## 6 Findings

### 6.1 Quality of Responses

Table 1 shows the mean values estimated over the 31 Likert type items of the frequencies of each response option. The p-values in this table show that even with a huge sample of thousands of cases, none of the differences between modes are significant at the 0.01 significance level. At the 0.05 level, one of the differences would be considered as statistically significant, but its magnitude is small and less important for any practical purpose.

The average smartphone respondent and the average computer respondent give similar answers. Both of them select the answer “Strongly Disagree” in 4-5 questions, the answer “Disagree” in 6-7 questions, the answer “Neither ... nor” in 4-5 questions, the answer “Agree” in 8-9 questions and the answer “Strongly Agree” in 5-6 questions.

The lack of significant measurement effects is consistent with the findings of previous studies, discussed in the previous sections. According to the t-test output presented in Table 1, there are no significant differences in responses across modes in terms of primacy effects or of response-order effects in general. In addition, there are no significant differences in non-substantive responses across modes. Of course, these findings are not based on an experiment. HelpMeVote users are free to choose the device they use. Thus, it is possible that the effects of self-selection and measurement differences counteract.

Both computer and smartphone users select the response “Agree” more frequently than any other response option. Some scholars may consider this finding as an indicator of acquiescence bias. On the other hand, this could be a result of the specific set of questions, i.e. another set of questions including less popular policy statements could have more “Disagree” and less “Agree” answers. Another observation is that both groups of HelpMeVote users tend to select the less extreme responses (“Disagree” and “Agree”) more often than the corresponding extreme responses (“Strongly Disagree” and “Strongly Agree”). For both groups, the frequency of middle category “Neither agree nor disagree” is lower than the expected frequency for a single point when a uniform discrete distribution of 31 5-point items is considered. Finally, the average user of both groups has selected the “No Answer” button in less than one out of 31 items. This is an indicator of lack of satisficing. In general, the data quality is very high in both groups.



Table 1 T-tests for the estimation of mode (computer vs mobile) effects

	Computer		Mobile		t-test	
	Mean	SD	Mean	SD	t	p
Frequency of Strongly Disagree	4.76	4.38	4.47	4.01	2.23	0.03
Frequency of Disagree	6.31	3.59	6.35	3.32	-0.33	0.74
Frequency of Neither ... nor	4.79	3.71	4.84	3.35	-0.46	0.65
Frequency of Agree	8.59	4.51	8.80	4.30	-1.47	0.14
Frequency of Strongly agree	5.75	4.29	5.63	3.87	0.93	0.35
Frequency of No Answer	0.80	3.21	0.92	3.62	-1.13	0.26

## 6.2 Item Response Times

Table 2 shows the multilevel regression model for the logarithm of item response times. The table includes the estimated coefficients and the exponential coefficients along with the outcome of the significance tests. Since the dependent variable is the logarithm of the item response times, the interpretation of the estimated regression coefficients is the following: Suppose that the estimated coefficient for an independent variable  $X$  is  $b$ . This means that when  $X$  increases by one unit the logarithm of the item response time is expected to increase by  $b$  units. Consequently, the item response time will be multiplied by  $e^b$ . According to Table 2 the constant term of the model is estimated at 2.01. This is the expected mean of the logarithm of the item response times. The exponential value of 2.01 is 7.47. This is the geometric mean of item response times, i.e. the average respondent needs about 7.5 seconds to respond to one item.

The interpretation of the coefficient of the treatment variable shows the impact of using a smartphone on the response times: the coefficient is 0.181 and its exponential value is 1.198. This means that switching from computer to smartphone the geometric mean of response times is expected to increase by 19.8%. An estimate of the treatment effect in seconds is given by the following calculation:  $7.47 * 19.8\% = 1.5$  seconds. This means that the average smartphone user spends about 1.5 seconds more than the average computer user on an item.

The coefficient for the length of the statement is 0.006 and its exponential value is 1.006. This means that, while holding all other predictors constant, for every additional character in the question, the geometric mean of response times increases by 0.6%. According to the model, if a statement refers to a EU policy issue the respondents need more time to give their answer. The corresponding coefficient is 0.104 and its exponential value is 1.11 showing an 11% increase in the geometric mean of response times when switching from a national issue to a EU issue.

Table 2 Multilevel model coefficients and exponential coefficients

Logarithm of times	Coef.	Exp(b)	Std. Err.	z	P>z
Smartphone	0.181	1.198	0.018	9.96	0.000
<b>Item characteristics</b>					
Length	0.006	1.006	0.000	104.98	0.000
EU issue	0.104	1.110	0.002	48.86	0.000
<b>Respondent characteristics</b>					
Male	-0.095	0.909	0.010	-9.94	0.000
Age over 49	0.192	1.212	0.040	4.79	0.000
Education		1.000			
Lower secondary	-0.086	0.918	0.063	-1.35	0.176
Upper Secondary	-0.245	0.783	0.055	-4.49	0.000
Tertiary	-0.335	0.715	0.054	-6.17	0.000
Postgraduate studies	-0.440	0.644	0.055	-8.05	0.000
Political interest	-0.075	0.928	0.010	-7.30	0.000
Decided	-0.055	0.946	0.009	-5.96	0.000
<b>Interactions</b>					
Smartphone#Age	-0.072	0.931	0.041	-1.73	0.084
Smartphone#Length	-0.000	1.000	0.000	-2.36	0.018
Constant	2.010	7.463	0.055	36.44	0.000

The coefficient for male is -0.095 and its exponential value is 0.909. This means that the geometric mean of response times in the group of men is 90.9% of the geometric mean of response times in the group of women. In other words, switching from female to male respondents, the response time is expected to decrease by 9.1%. Following the same model, when we switch from undecided people to people who have already made their choice the geometric mean of response times decreases by 5.4%. Similarly, moving from people who are not interested in politics to people who are interested in politics the geometric mean is expected to decrease by 7.2%. On the other hand, the exponentiated coefficient for older people is 1.21 showing a 21% increase in the geometric mean of response times when switching from younger people to users over 49 years old. Finally, when we switch from primary education to higher education levels, the response time decreases; only the difference between primary and lower secondary education is not statistically significant. The largest difference is observed between the two extreme education levels: the ratio of geometric means between postgraduate studies and primary education is 0.64 indicating that the time spent by the most educated users is 64.4% the time spent by the less educated users, i.e. a decrease of 35.6%.

Finally, the model includes the interaction terms between smartphone use and age, and smartphone use and the length of the question. None of these interaction terms have a significant impact on the item response times at the 0.01 significance level. If the time difference was caused by an unfriendly design, this difference would probably be higher in older people. But the interaction between smartphone use and age is not significant. Therefore, the longer time of smartphone users cannot be attributed to the unfriendliness of the web survey. The lack of a significant interaction between smartphone use and the length of the question does not allow the attribution of the longer times of smartphone users to the smaller display of their devices. This was an expected finding because the survey was carefully designed to fit on the small screens of mobile devices. Thus, all questions are short and the variability of their length is small.

### 6.3 Validity of the Model and Sensitivity Analysis

According to Table 3, the variance of the random intercept is 0.11 and the estimated error variance is 0.2. The likelihood ratio test shows that the random intercept variance is large. This verifies that the decision to use a multilevel model was correct. Indeed, if a single level model had been used, non significant differences (e.g. the response time difference between primary and lower secondary education levels) would appear as significant.<sup>3</sup>

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3 In addition, it was checked whether a different model should be applied instead of the multilevel model. Some of the respondents' characteristics, such as age and education level, known to affect response times, (Yan and Tourangeau, 2008; Couper and Kreuter, 2013), have been reported also to affect mobile web access (Fuchs and Busse, 2009; De Bruijne and Wijnant 2013; Gummer and Roßmann, 2015). This means that, the treatment variable of the model (mobile) is endogenous and it depends on variables that also affect the outcome (e.g. age). This means that an endogenous treatment-effects model should be employed (Greene, 2012; Heckman, 1978; Maddala, 1983; Wooldridge, 2010). In addition, a multilevel model is necessary. Bauer (2003) and Curran (2003) show how to estimate multilevel linear models as structural equation models. It seems that the only feasible way to estimate an endogenous treatment-effects multi-level regression model is to use a generalized structural equation model (Skrondal & Rabe-Hesketh, 2004). Since the treatment is endogenous, it is necessary to test if the correlation between the error terms of the equations of the generalized structural equation model is significant. The value of the correlation coefficient  $\rho$  is 0.01 and the corresponding test shows that it is not significantly different from 0 ( $p=0.937$ ). This means that the estimates of a simple multilevel model can be accepted (Andreadis, 2015).

*Table 3* Variances of the multilevel model

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]
Variance of the random intercept	0.110	0.002	0.106 0.114
Error variance	0.202	0.001	0.201 0.203

## 7 Discussion

This paper advances mobile survey research in various ways. Firstly, it shows that creating a web survey suitable for both smartphone and computer users involves good design choices. These design choices (such as the one question per page design) facilitate mobile users to give responses that do not differ from the responses given by computer users. In addition, a good survey design results in high quality data from both groups of users. As the findings presented in this paper show, the data quality of smartphone respondents does not differ significantly from the data quality of the computer respondents. In both groups the level of the data quality is very high and there are no signs of satisficing.

The lack of data quality differences presented in this paper is not based on an experiment. Respondents self-select the device they use to participate in Help-MeVote. Thus, the effects of self-selection may counteract any measurement differences. It is reasonable to believe that respondents have chosen the device that they feel more comfortable to use, and they use it without problems. If the devices were assigned to respondents randomly, the findings could be different. This is a limitation of the presented study. However, the focus of this paper is not on what would happen in a lab after forcing respondents to use a specific device. The focus is rather on what happens in the real world, where respondents are free to choose the device they prefer.

Secondly, this paper offers an innovative method to prepare a dataset of response times for statistical analysis by treating the low and the high extreme values differently. It shows how to flag users who have been answering so fast that they should be removed by the dataset. Moreover, it proposes a way to deal with the extremely large response times by identifying the actual extremes instead of trimming the dataset using arbitrary selected thresholds that lack any theoretical justification.

Finally, this paper offers a precise and thoroughly tested estimate of the impact of using a smartphone on item response times. The comparison was made between computer and smartphone users when they use a smartphone friendly web survey. The analysis has shown that using a smartphone instead of a computer increases the

geometric mean of item response times by 19.8%. This increase was estimated after taking into account item and user characteristics that are known to affect response times, and using the most suitable statistical model.

Explaining why smartphone users need more time than desktop users is not an easy task. There are many potential causes that could explain this difference between the devices, but some of them can be excluded by the design features of HelpMeVote. One of the possible causes is the (usually) slower Internet connections of smartphones. A slower Internet connection would lead to longer transmission times. This could explain the difference between the devices in other studies. However, this factor is not relevant for the data presented in this paper, because there is no lag between pages in HelpMeVote.

Smartphone users may have difficulties responding to a web survey that is not smartphone friendly. For instance, sometimes respondents have to zoom in to read a text written with small fonts. They may have to scroll horizontally in order to read the question. In other cases, respondents have to type their answers. All these actions could delay smartphone users and they could be used to explain longer times in other studies. However, these actions are not required by the smartphone users of HelpMeVote, because it is a smartphone friendly web survey. It uses large fonts and buttons and short question texts. It requires no horizontal scrolling and no typing. As a result, these possible obstacles do not apply to HelpMeVote users. This argument is further supported by the lack of any significant interaction between smartphone use and the age of the respondents. If smartphone users needed more time due to similar difficulties, the situation would probably be worse when older people are involved and the interaction would be significant.

There are two potential causes that could explain the difference between smartphone and computer users of HelpMeVote. It is possible that smartphone users may need more time because they have to scroll vertically before answering the question. Of course, the lack of a significant interaction between smartphone use and the length of the question hinders any blaming on vertical scrolling. But this finding is a result of the small variability of the length of the questions in HelpMeVote. If the variability was larger, the outcome would probably be different. Unfortunately, it is not easy to know if a respondent had to scroll vertically to give a response. This would require the knowledge of the screen resolution of each device and its orientation<sup>4</sup> during all the time the user was completing the survey. For instance, the owner of an Apple iPhone 5 holding the device on its vertical orientation would be able to answer all HelpMeVote questions without any scrolling. On the other hand, if the horizontal orientation of the same device was used, then the respondent would have to scroll vertically most of the times. The recording of the

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4 Many smartphones can determine their orientation and automatically rotate the display to present a wide-screen view of the web content. In this case, the vertical space is very limited and the user often has to scroll vertically.

screen resolution and all the changes of the screen orientation is possible, but the additional code complicates and slows down the web survey application. Thus, it is more appropriate for less popular projects and it was not used in HelpMeVote which is used by thousands of voters.

A final reasonable explanation for the longer times among smartphone users is that they are probably completing the survey outdoors and they are more easily distracted than the computer users who complete the survey in a quiet room at home or in an office. However, since the dataset used for this paper does not include the parameter of the location where the respondents have completed the questionnaires, this hypothesis cannot be verified.

Many recent publications show a continuous increase of the percentage of respondents who use their mobile devices to respond to a web survey. If web survey designers want to avoid data quality differences between computer and smartphone users, they have to optimize the design of the online questionnaire for smartphones. A good web survey design should definitely eliminate the need for horizontal scrolling. But this feature alone is not enough. Survey designers caring for their smartphone users should also try to minimize the need for vertical scrolling by using short questions and short sets of response lists and by displaying only one question per page. Following these practices, they can expect very similar responses from all their respondents, no matter what device they use.

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