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Beyond traditional survey taking: adapting to a changing world

Usability of the ACS Internet Instrument on Mobile Devices[1]

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Abstract

The American Community Survey (ACS) added an Internet data collection mode as part of a sequential mode design in 2013. The ACS currently uses a single web application for all Internet respondents, regardless of whether they respond on a personal computer or on a mobile device. As market penetration of mobile devices increases, however, more survey respondents are using tablets and smartphones to take surveys that are designed for personal computers. Using mobile devices to complete these surveys may be more difficult for respondents and this difficulty may translate to reduced data quality if respondents become frustrated or cannot navigate around usability issues. This study uses several indicators to compare data quality across computers, tablets, and smartphones and also compares the demographic characteristics of respondents that use each type of device.

Keywords: Web surveys, Data quality, Mobile devices, Respondent burden

1. Introduction

Only a few years ago, optimizing websites and surveys for mobile instruments was not at the forefront of survey designers' minds. In May of 2011, only 35 percent of U.S. residents owned a smartphone and eight percent owned a tablet. Just two years later, 56 percent of residents owned a smartphone and 34 percent owned a tablet (Pew Research Internet Project, 2014). Originally, there were only a handful of options for mobile devices; the vast majority being Apple or Android. However, as consumer interest has increased, more devices are coming onto the market at more affordable rates, resulting in increased market penetration.

With more users browsing the Internet on mobile devices, Web designers have developed optimized versions of their webpages for viewing on mobile devices. This change is necessary because loading standard websites designed for personal computers (PCs) on a mobile device can be frustrating to users. Additionally, if there is not enough space on the screen to display all of the information legibly, users may have to scroll and zoom to be able to see all the information clearly. To optimize their sites for mobile use, web designers limit features to make the sites easier to view and quicker to load on mobile devices (Johansson, 2013). This includes condensing content so users do not have to scroll as much as well as limiting or removing graphics.

Survey designers have seen similar usability issues with using mobile devices to answer survey questions. Specifically, researchers have found longer response times (Mavletova 2013; McClain et al. 2012) and increased breakoffs (Callegaro 2013; Guidry 2012; Mavletova 2013; Wells et al. 2013) from mobile respondents. Given these results, they have taken steps to optimize surveys for mobile use. To measure the impact of this optimization, Baker-Prewitt (2013) randomly assigned respondents to complete a survey on a computer, tablet, smartphone, or optimized smartphone. She found less straightlining and fewer breakoffs on the smartphone using an optimized site as compared to the non-optimized. Similarly, Wells and his colleagues (2013) found fewer breakoffs and shorter response times when respondents used a mobile-optimized instrument.

While these studies provide some insight into the effects of not optimizing survey instruments for mobile devices, the current literature focuses on small, relatively short web surveys that use specific respondent populations, such as online panels or college students. No research, to date, has used a random national sample from a multi-mode household survey to assess the response and usability differences between devices. This limits our knowledge of

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which demographic groups use which devices to respond to surveys and whether those differences could be contributing to usability issues and overall data quality.

Therefore, this study uses the Census Bureau's American Community Survey (ACS) to assess the need to optimize for mobile devices in a large, national sample. The ACS is a monthly survey that takes approximately 40 minutes to complete and samples 3.54 million households annually. Prior to 2013, the ACS used three data collection modes: paper, telephone, and personal visit. In 2013, the ACS introduced Internet data collection as its fourth mode. The instrument is not currently optimized for mobile devices because when the instrument was originally designed, there was very low mobile device usage (2.2 percent of Internet respondents).

2. Methods

2.1 Data

The data used in this analysis come from Internet responses throughout the complete November 2013, December 2013, and January 2014 ACS production panels, which consists of data collected between October 2013 and March of 2014. In total, there were 227,151 Internet respondents. All estimates in this report use base weights that reflect each household's probability of selection into the sample.

We used the user-agent string to determine which devices respondents used to answer the survey. Once we had identified all of the devices used to complete the survey, we grouped them into four categories: computer, tablet, iPad, and phone. We separated tablets and iPads because both studies that specified which devices they used only included iPads (Guidry 2012; Wells et al. 2013). The iPad's operating system and software may influence respondent behavior and data quality compared to other tablets[3]. We counted hybrid laptops/tablets as computers because their external keyboards and trackpads make the responding experience more similar to using a computer.

2.2 Analysis

We first calculate the average size of households that used each device to complete the survey. If households that use a computer to respond to the survey are typically smaller than households that use mobile devices, then it follows that it would take them less time to complete the survey and they may answer fewer questions. Therefore, in order to compare results across devices, we need to ensure the households are similar. If household size does vary across devices, we will compare the total number of questions answered, on average, on each device.

We next calculate and compare the breakoff rate for the different devices. The numerator, breakoffs, includes any respondent that did not click the link to submit the survey, or reach the last applicable question in the survey, while the denominator includes anyone that accessed the Internet instrument and saw at least the first question. Some respondents started the survey on a mobile device and then switched to a computer to complete; these cases were not included in the breakoff analysis but we do analyze them separately.

To determine which respondents switched devices, we compare the user-agent strings at each login point. This analysis serves two purposes: the first, to identify the correct population for analyzing breakoffs, and second, to determine whether respondents could not or did not want to complete the survey on a mobile device and needed to switch to a computer, likely because it was easier. To calculate the percent of respondents that switched from each mobile device to a computer we compare the number of people that first logged in using each mobile device and subsequently logged in using a computer to the total number of respondents that logged in using each mobile device. This measure indicates whether respondents found any device particularly difficult to use to respond.

To this point, our measures have focused on people who either abandoned the survey entirely or abandoned their mobile device to complete the survey on a computer. However, completed cases can also tell us about respondent

[3] Although iPhones also use a different operating system and software than other smartphones, we were unable to separate them similarly because of the overall low incidence rate of smartphones.

burden and data quality. Therefore, we compared the average completion time across the four devices. We focus only on respondents who submitted the survey and answered all of the questions in one session. Inexplicable outliers (respondents that took longer than 70 hours to complete the survey) were removed from the analysis. These outliers likely arise because the paradata occasionally miss an event, such as logging out or logging back in. Due to the long response times, we assumed these respondents did not actually complete the survey in only one session.

The final two measures of burden and data quality focus more on individual responses than the overall survey. First, we look at rate of changed answers, which was calculated by comparing the total number of changed answers on each device to the total number of respondents that completed the survey on each device. Respondents can change their answers for a variety of reasons, but in the case of mobile devices, it is likely that more of these changes are a result of difficulty touching the smaller radio buttons or check boxes. This can lead to decreased data quality if mobile respondents do not realize they selected the wrong response option and it increases burden because they need to answer the question multiple times. To determine the rate of changed answers, we only include back to back changes[4]. This includes clicking one radio button and then another before proceeding to the next question or checking and unchecking check boxes. Next, we look at the error rate for each device, calculated by comparing the total number of errors rendered on each device to the total number of respondents that completed the survey on each device.

Finally, we look at the demographic characteristics of mobile respondents compared to computer respondents. Given Callegaro's (2013) recommendation that mobile cases be flagged or not included in analyses, we need to know whether mobile respondents are similar to other respondents. There is some concern that they are not, based on the Pew Research Internet Project findings that the majority of smartphone and tablet owners are younger and have a higher income than those who do not own such devices (2014). We compare respondent age, education, race, Hispanic origin, household income and whether the home is rented, across the four devices. To compare age and household income, we use the median as the basis of comparison, using a Wilcoxon score to test the difference between the income distributions of respondents using each device. For education, we look at the percent of respondents that have less than a high school education. Finally, to measure race, we look at the proportion of respondents who are Black; and for Hispanic origin, we look at the percent of respondents who are of Hispanic descent across all of the devices.

All comparisons in this report use Proc GLM in SAS to account for multiple comparisons and each household's probability of selection. The GLM procedure provides an F-statistic that measures whether there is any difference in the variable of interest across the different devices. Additionally, it provides t-tests that can be used to compare differences between two devices once it has been established that there is a difference between the devices overall.

3. Results

In the November 2013, December 2013, and January 2014 ACS data collection panels, 85.9 (0.08)[5] percent of Internet respondents used a computer, 7.6 (0.06) percent used an iPad, 3.9 (0.05) used another type of tablet, and 2.6 (0.04) percent used a mobile phone to access the survey[6]. This compares to a total of 2.2 percent of respondents using any mobile device to access the survey in the April 2011 ACS data collection panel (Horwitz et al. 2013a), 4.5 percent in the November 2011 ACS panel[7] (Horwitz, et al. 2013b), and 11.3 (0.04) percent in the January 2013 ACS panel (Horwitz 2014). Although we cannot statistically compare the mobile usage rates across this complete time period, there appears to be an upward trend in the percent of respondents using mobile devices to respond to the survey.

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[4] We eliminated respondents who have more than 40 consecutive changes because we found irregular patterns for these respondents that did not reflect true answer changes.
[5] The parentheses contain the standard error of the estimate.
[6] The device data do not account for respondents using multiple devices to complete the survey. For these estimates, we count the smallest device used by each respondent (phone, tablet, iPad, computer).
[7] The percent of responding using mobile devices for both the April and November tests are unweighted estimates due to a problem merging datasets.

Household size across the different devices ranges from 2.49 people for computer respondents and 2.79 for phone respondents. A multiple comparison shows that the average household size of respondents using the different devices varies significantly (F=177.19, p<0.001). The household size of iPad and tablet respondents, however, is not significantly different (t=5.9, p=0.311). The average household size for computer respondents is significantly smaller than the household size for all three mobile device respondents. This is likely because mobile device users tend to be younger (Pew Research Internet Project 2013; Rainie 2012) and younger individuals typically live in larger households (Nichols et al. 2014). Although these differences are significant, they are very small, especially given the large sample size.

Because household size varies across devices, we look at the number of questions answered across device. A multiple comparison of means shows that there are differences in the number of questions (F=18.92, p<0.001), with phone respondents answering 8.5 fewer questions, on average, than iPad respondents and 5.5 fewer than computer respondents, even though they have among the largest household sizes. We do not believe there will be an issue in comparing the different measures across all households and devices because the difference is small and the number of questions answered does not appear to be associated with household size.

Do mobile device respondents breakoff at a higher rate than computer respondents?

Traditionally, the average breakoff rate for the ACS is around 12 percent (Clark, 2014). If burden and data quality are consistent across different devices, we expect to see a similar breakoff rate for each device. Instead, we find that the breakoff rate for phone respondents (26.8 percent) was over 15 percentage points higher than that for computers (11.5 percent) (t=34.13, p<0.001). Additionally, phone respondents break off approximately 13 percentage points more than both tablet and iPad respondents (t=22.81, p<0.001 and t=25.95, p<0.001, respectively). The breakoff rate for tablet respondents is not significantly different from the rate for iPad respondents (t=0.72, p=0.465), but there is a small difference between iPad and tablet respondents and computer respondents. Increased breakoff rates are concerning for data quality because it leads to more missing data for items later in the survey.

Do respondents that start the survey on a mobile device switch to a computer?

Some respondents that have trouble completing the survey on a mobile device may not break off without returning, but rather switch to a computer. We find that 8.5 (0.41) percent of phone respondents switched to a computer, compared to only 3.9 (0.24) and 3.5 (0.16) percent of tablet and iPad respondents, respectively. Using a logistic regression model, we estimate that phone respondents are 2.3 times more likely to abandon their phone than tablet respondents are and 2.6 times more likely than iPad respondents are (p<0.001). It is concerning that mobile device users are switching to computers because not everyone has multiple devices on which they can answer questions. Therefore, some respondents are likely breaking off if they cannot switch.

Do mobile device respondents take longer to complete the ACS than computer respondents?

For the respondents that did complete the entire survey in one session, we can measure their burden by the time it took to complete the survey. The ACS advertises that respondents can expect the survey to take approximately 40 minutes to complete. The average completion time for tablets, iPads, and computers was close to the expected 40 minutes, ranging from 37 minutes (0.39) for computers to 40 minutes (0.28) for tablets, while phone respondents took 45 minutes (0.39). The average completion time for all the mobile devices is significantly greater than the time for computers (F=194.9, p<0.001). However, the difference that really stands out is for phone respondents. Phone respondents took more than eight minutes longer to complete the survey than computer respondents (t=20.5, p<0.001) did and almost six minutes longer than tablet respondents did (t=11.1, p<0.001). We expected to see this type of result because smaller phone screens require more scrolling in order to see the entire question and response options, and more zooming in order to touch the correct radio button or check box.

Do mobile device respondents change their answers more frequently than computer respondents?

If respondents are taking longer to respond because they need to zoom in to touch the radio buttons, they might accidentally select the wrong option, which would require them to change their answer to the correct option. Phone respondents changed their answer an average of 8.6 (0.06) times throughout the survey, compared to 4.6 (0.04) times for tablet respondents, 5.1 (0.03) times for iPad respondents, and 3.8 (0.01) times for computer respondents.

Both a multiple comparison test and t-test comparisons between all of the devices show the average number of answer changes between devices is significantly different, with p-values less than 0.001.

Not only did phone respondents change their answers more often than other respondents did, they also answered fewer questions, suggesting this is a common problem on such small devices. This problem is not isolated to phone respondents, however. Both tablet and iPad respondents changed their answers significantly more than computer respondents did. We suspect the increase in changed answers for these respondents is because the radio buttons are small compared to an adult's finger size, making it easy to accidentally select the response option above or below the one they intended. While answer changes increase burden, it is even more concerning if mobile respondents do not realize they selected the wrong answer or decide not to correct their error, which can lead to lower data quality.

Do mobile device respondents render more error messages than computer respondents?

Another data quality measure we examined was how often respondents rendered errors. The average number of errors rendered ranged from 1.1 (0.03) for phone respondents to 1.3 (0.02) for computer respondents. Individual t-tests comparing the average number of errors rendered show there was no difference in the number of messages rendered by iPad and computer respondents ($t=0.01$, $p=0.989$), while tablet respondents rendered significantly more errors than iPad respondents ($t=4.09$, $p<0.001$) and computer respondents ($t=4.93$, $p<0.001$), and phone respondents rendered fewer errors than iPad respondents ($t=3.16$, $p=0.002$), tablet respondents ($t=4.93$, $p<0.001$), and computer respondents ($t=3.57$, $p<0.001$). These findings are surprising as we expect computer respondents to have the fewest error messages because it is easier for them to read the questions and select answers. The number of questions answered may be contributing to this finding as phone respondents answered significantly fewer questions (145) than respondents of all the different devices (between 144 and 148 questions) ($F=41.21$, $p<0.001$).

Do the demographic characteristics of mobile device respondents differ from those of computer respondents?

In accordance with the research that finds mobile penetration is higher among younger people (Pew Research Internet Project, 2014; Zickuhr and Rainie, 2014), we saw similar usage pattern in the ACS. The average age of computer respondents was 50.3 (0.0) years compared to 48.6 (0.2) years for tablet respondents, 47.0 (0.1) years for iPad respondents, and 37.8 (0.2) years for phone respondents. A multiple comparison shows age is significantly different across device ($F=1438.65$, $p<0.001$).

While computer respondents are only a year or two older, on average, than tablet and iPad respondents, phone respondents are around 10 years younger. This may be related to income as phone respondents make significantly less money than respondents of the other devices do. Specifically, the median household income for phone respondents is \$46,132, while the median income for all of the other devices is greater than \$72,000 ($F=150.08$, $p<0.001$). It is possible this cohort cannot afford tablets or computers like the other respondents can, so they only have phones to use to complete the survey online.

We also find that twice as many phone respondents did not complete high school (3.4 (0.2)) as compared to iPad respondents (1.4 (0.1)) ($t=10.43$, $p<0.001$). A similar finding came from the Pew Research Center using data from January 2014, where 29 percent of tablet respondents had a high school education or less (Zickuhr and Rainie, 2014), while 44 percent of smartphone users had a high school education or less (Pew Research Center, 2014). These results are not surprising given phone respondents' lower income and age compared to the other respondents.

Again looking at the Pew Research Center's studies, they found that a higher proportion of smartphone users are African American or Hispanic (Pew Internet Research Project, 2014; Zickuhr and Rainie, 2014). It follows that if a higher proportion of these groups own smartphones, a higher proportion would use them to complete the survey. As expected, we found 10.3 (0.3) percent of phone respondents were Black, compared to 5.3 (0.1) percent of computer respondents, 5.6 (0.2) percent of iPad respondents, and 7.6 (0.2) percent of tablet respondents ($F=115.80$, $p<0.001$). Similarly, 13.7 (0.3) percent of phone respondents were Hispanic, compared to 6.5 (0.1) percent of computer respondents, 7.9 (0.2) percent of iPad respondents, and 8.5 (0.3) percent of tablet respondents ($F=173.94$, $p<0.001$).

Although there are significant differences in the demographic characteristics of respondents across devices, the phone respondents stand out in particular. Many of the differences between tablet, iPad, and computer respondents, while significant, are relatively small. However, phone respondents are much more likely to be younger, less educated, a minority, and have lower income compared to respondents of the other devices.

4. Discussion

The results from the analyses conducted for this paper suggest that responding to the ACS on a mobile device likely results in higher burden and lower data quality as compared to answering on a desktop or laptop computer. Mobile users typically broke off at a higher rate, took longer to complete the survey, and changed their answers more often than computer users. Many of the differences between computer users and iPad or tablet users, while significant, were minimal, especially considering the large sample size used in this analysis. The differences between phone respondents and other respondents, however, were far more drastic.

Although phone respondents appear to experience significantly more burden completing the survey and likely provide lower quality data as a result, they only make up 2.6 percent of all respondents. The demographic characteristics of these respondents, however, suggest that they are some of the hardest to interview in self-response modes (Joshipura 2008). Additionally, it is possible that they do not have an alternative device to use if they are struggling with the phone. This can result not only in breakoffs from the survey, but in the worst case, they may be frustrated enough that they refuse to complete the survey in other modes as well. While the percent of respondents that use a phone to respond to the survey is small, it is important to obtain responses from these people. Not only are they demographically different from other respondents, but they will cost considerably more in interviewer-administered phases of data collection. Therefore, we believe an optimized mobile version of the ACS would provide higher quality data at less burden to respondents. Future research will compare similar measures discussed in this paper between an optimized and non-optimized version of the ACS to determine whether we can make the survey easier for mobile respondents.

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