Response Quality and Demographic Characteristics of Respondents

Using a Mobile Device on a Web-based Survey

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As quickly as the Internet grew throughout the 1990s and 2000s, the growth of devices such as smartphones and tablets that allow one to access the Internet while mobile has been even more explosive. Given their increasing popularity and the conveniences they offer, it is no surprise that people are using these mobile devices to participate in Web-based surveys, even when those surveys have not been optimized for those devices. It is important that we understand the impact of mobile Internet access on Web surveys, particularly as we uncover who is using mobile devices to participate in Web surveys and the relative quality of their responses.

This study uses data from the 2011 administration of the National Survey of Student Engagement (NSSE), a survey of undergraduate college and university students in the U.S. and Canada. Server-side paradata were used to classify the 414,056 respondents in this study’s sample to (a) determine the demographic characteristics of respondents who exclusively used a smartphone or tablet and (b) compare the quality of their responses to those provided by other respondents using indicators such as survey abandonment, item non-response, and response differentiation. Results of the study were mixed, indicating that mobile device users do not necessarily provide responses of lower quality even when responding to a Web-based survey that is not optimized for the small screens of mobile devices. This study also provides evidence supporting the hypothesis that screen size is a factor that affects response quality on Web-based surveys.

**Literature Review**

In 2011, 78% of the adult population in the United States reported using the Internet (Pew Internet & American Life Project, 2012). This high level of penetration has allowed the growth
of Web-based surveys as a cheap, easy, and effective way to gather information from and about people in the U.S. However, as quickly as adults and teens in the U.S. were to take up regular use of the Internet, they have been even quicker to purchase and use smartphone, tablets, and e-readers that allow always-on mobile connections to the Internet. As of February 2012, nearly half (46%) of adults in the U.S. owned and used a smartphone; this is a 13% increase from just one year previous (Smith, 2012). Over the 2011 holiday season, both tablet and e-reader ownership in the U.S. nearly doubled from 10% to 19% of the U.S. adult population (Rainie, 2012).

Although the ownership and use of these devices have dramatically increased, little work has been done to ascertain how using these devices affect Web-based surveys (Link, 2011). Over two decades of usability studies suggest that mobile device users have different experiences and needs compared to non-mobile users (e.g. Johnson, 1998; Tamminen, Oulasvirta, Toiskallio, & Kankainen, 2004). Of particular relevance to this study is the focus that has been placed on the importance of screen size for usability, an issue of importance for mobile devices given their relatively small size (e.g. Brewster & Cryer, 1999; Chae, & Kim, 2004; Shrestha, 2007).

Facing similar issues, survey methodologists have come to many of the same conclusions as usability experts with respect to the challenges posed by the small screens of mobile devices and the inherent difficulties they pose for respondents trying to comprehend and respond to survey questions, two of the four stages of Tourangeau, Rips, and Rasinki’s (2000) framework for understanding how participants respond to survey questions. For example, conventional survey design wisdom suggests that we can or should “include extra instructions” for individual questions and “increase the size of the answer box” (p. 211, Bethlehem & Biffignandi, 2011).
These kinds of recommendations are important because respondents “use all available information to help them formulate an answer” (p. 211, Bethlehem & Biffignandi, 2011).

Research Questions

In the 2011 NSSE administration:

1. How many respondents to the Web instrument exclusively used smartphones or tablet computers?
   a. What are the demographic characteristics of those respondents?
   b. In terms of demographics, how do those respondents compare to the larger U.S. population of smartphone and tablet computer owners?

2. Do respondents who used smartphones or tablet computers provide responses of a lower quality than those who only used a desktop or laptop computer?
   a. Did they abandon the survey more frequently or earlier?
   b. Did they skip more questions?
   c. Did their responses match data previously collected by their college or university?
   d. Did they provide responses with lower non-differentiation?

I do not believe that every respondent who owned a smartphone or tablet used it to complete this survey but I do not know of any reason to suspect that any groups (gender, age, race and ethnicity) were more or less disposed to use those devices. Hence I hypothesize that the only difference between the demographics of smartphone and tablet owners and respondents who used those devices will be that the respondents will be a smaller proportion of the entire survey sample. On the other hand, I expect to find significant differences between the quality of the responses provided by respondents who used devices with smaller screens. Therefore I
hypothesize that smartphone users will have provided responses with significantly lower quality than tablet users who in turn provided responses with significantly lower quality than the remaining group of respondents.

Methodology

Data Sources and Sample

This study uses data from the spring 2011 NSSE administration, a survey of first-year and senior undergraduate students that focuses on “the nature and quality of their undergraduate experience” (NSSE, 2012, p. 1). Although there is a paper version of the NSSE instrument, this study naturally focuses on the Web instrument, the instrument used by 99% of the respondents. Further, this study only includes NSSE respondents at U.S. colleges and universities.

Server-side paradata identifying the Web browser and operating system were available for 414,056 respondents, nearly 98% of the U.S.-based respondents who used the Web instrument. Using that paradata, specifically the http user-agent header string, I classified respondents into one of three categories: Smartphone-only users, tablet-only users, and “other” users who used a computer or multiple devices. (As a practical matter, the only tablet users identified in this data set were those who used iPads; the market penetration and availability of non-iPad tablets may simply have been insufficient for them to be present in these data.)

Data from the Pew Internet & American Life Project were employed to provide points of comparison between the respondents to this survey and the broader U.S. population. Specifically, data from a 2011 report on smartphone ownership was used to give context to the number and percentage of respondents who exclusively used smartphones. The Pew data are particularly appropriate as they were collected in April and May of 2011, a time span directly overlapping with the administration period of NSSE of February through May (Smith, 2011).
Tablet ownership data was not compiled for this study; as explained later in Findings, the number of respondents who exclusively used tablets was too low to permit meaningful disaggregation.

**Response Quality Indicators**

As described in the research questions, four individual indicators of response quality and one aggregated indicator of response quality were examined in this study. These indicators are similar to those used by other researchers exploring response quality, particularly those who have explored satisficing such as McCarty and Shrum (2000), Chen (2011), and Barge and Gehlbach (2012). The first two individual indicators focus on survey abandonment, a straight-forward examination of (a) how many respondents abandoned the survey and (b) where in the survey those respondents abandoned it. The third individual indicator, item non-response, focuses on the number of questions skipped by respondents who completed (i.e. did not abandon) the survey. A significant body of research has demonstrated the relationship between item non-response and population estimates (e.g. Groves, Dillman, Eltinge, & Little, 2002; Bethlehem, Cobben, & Schouten, 2011). Survey abandonment and item non-response are examined separately in this study as they are caused by different factors (Peytchev, 2007).

The fourth individual indicator of response quality is a comparison between data provided by respondents and data provided by the college or university at which the respondents were enrolled. The most appropriate data to compare are student-provided and institution-provided gender. Both of these data are dichotomous variables in this study and it is trivial to count the number of respondents whose survey response did not match the institution-provided datum. Like the first two indicators, this data mismatch indicator merely provides a signal of a potential data quality problem; it is not an iron-clad assurance of low response quality.
The fifth indicator of response quality aggregates several response individual quality indicators and uses cutoff values to clearly identify respondents who may have provided a low quality response. This aggregate response quality indicator combines three different individual indicators: item non-response, gender mismatch, and a response differentiation index. This aggregate indicator was developed by Chen (2011); although a brief description is presented below, readers interested in the detailed description of the indicator and its development are directed to his 2011 *Research in Higher Education* article.

This aggregated response quality indicator is an index that flags respondents as having a low-quality response if it meets any of the following criteria: (a) a mismatch between the student- and institution-provided gender, (b) missing responses to one-third or more of the questions on the survey, and (c) a response differentiation index greater than .15. The first two criteria use indicators previously introduced and considered separately. The third criterion focuses on an index that measures variation in the responses provided by an individual respondent e.g. a response differentiation index. Originally created by McCarty and Shrum (2000) as a measure of satisficing, the index was adapted for NSSE by Chen in 2011. For each respondent the response differentiation index ranges from 0 to 1 with a lower number indicating less response differentiation and prior research suggesting that .15 is a good cutoff value for flagging low-quality responses. The aggregated response quality indicator has a value of 0 if the respondent does not meet any of the low-quality response criteria and a 1 otherwise so groups of respondents will have means between 1 and 0 for this aggregated response quality indicator.

**Findings**

Overall, few students exclusively used a smartphone or tablet to complete the Web instrument of NSSE in 2011. As shown in Table 1, these students collectively made up only
4.2% of the total number of respondents. The vast majority of these 17,226 respondents – 15,650 (91%) of them – used a smartphone.

<table>
<thead>
<tr>
<th>Device Type</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smartphone-only</td>
<td>15,650</td>
<td>3.8%</td>
</tr>
<tr>
<td>Tablet-only</td>
<td>1,576</td>
<td>0.4%</td>
</tr>
<tr>
<td>Other</td>
<td>393,830</td>
<td>95.8%</td>
</tr>
</tbody>
</table>

Table 1: Classification of respondents by device(s) used

So few respondents exclusively used a tablet that further analysis is not performed on that group of respondents. However, Tables 2-4 compare the percentage of respondents in different groups (gender, age, and racial/ethnic groups) that exclusively used a smartphone to the percentage of people in those groups in the U.S. who owned a smartphone as determined by the Pew Internet & American Life Project in April and May of 2011 (Smith, 2011).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Pew smartphone ownership</th>
<th>NSSE11 smartphone usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>39%</td>
<td>4%</td>
</tr>
<tr>
<td>Women</td>
<td>31%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Table 2: Comparison of smartphone owners and respondents by gender

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Pew smartphone ownership</th>
<th>NSSE11 smartphone usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-29 years old</td>
<td>52%</td>
<td>3%</td>
</tr>
<tr>
<td>30-49 years old</td>
<td>45%</td>
<td>2%</td>
</tr>
<tr>
<td>50-64 years old</td>
<td>24%</td>
<td>1%</td>
</tr>
<tr>
<td>65+ years old</td>
<td>11%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Table 3: Comparison of smartphone owners and respondents by age

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Pew smartphone ownership</th>
<th>NSSE11 smartphone usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>African American/Black</td>
<td>44%</td>
<td>4%</td>
</tr>
<tr>
<td>Caucasian/White</td>
<td>30%</td>
<td>4%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>44%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Table 4: Comparison of smartphone owners and respondents by race/ethnicity
In examining the response quality of respondents who exclusively used a smartphone or tablet, the first two individual indicators examined were related to item survey abandonment. 27% of the smartphone respondents abandoned the survey, a difference that if statistically significant at the $\alpha = .05$ level when compared to tablet respondents who abandoned the survey 12% of the time and “other” respondents who abandoned the survey 13% of the time. However, those respondents who abandoned the survey all abandoned it at about the same place in the survey when compared across these three categories.

The third individual indicator of response quality focused on item non-response. Excluding those respondents who abandoned the survey completely, most respondents completed the survey without skipping any questions. On average, smartphone respondents skipped .53 questions, tablet respondents skipped .60 questions, and “other” respondents skipped .80 questions. The .80 questions skipped by the “other” respondents was significantly higher ($\alpha = .05$) than number of questions skipped by the other two groups of respondents.

The fourth individual indicator of response quality identified respondents whose survey response indicating their gender differed from the data provided by their college or university. Less than 1% of respondents provided responses that differed from institution-provided data regarding their gender. Differences between the three groups of respondents were not significantly different.

The fifth indicator of response quality was an aggregate index combining item non-response, gender mismatch, and a measure of response differentiation. Respondents who exclusively used a tablet and respondents who used “other” devices had mean aggregate response quality indices of .090 and .094, respectively, indices that are not significantly different from one another. However, respondents who exclusively used a smartphone had a mean
aggregate response quality index of .191, a value that is significantly higher ($\alpha = .05$) than the other two groups of respondents.

**Discussion**

My first research question focused on the number and demographics of respondents who exclusively used smartphones or tablets to participate in this Web-based survey. First and foremost, very few respondents – 4.2% – exclusively used one of these devices with the majority of them using smartphones. In fact, the number of respondents who exclusively used tablets is so small that I did not disaggregate that group of respondents to further explore their demographic characteristics.

Although the percentage of respondents who exclusively used smartphones is low – 3.8% – it is even lower than I expected. The Pew Internet & American Life Project estimated that 35% of adults in the U.S. owned a smartphone at the time of the 2011 NSSE survey administration (Smith, 2011). The NSSE population is exclusively made of undergraduate college and university students, a population that is typically more affluent than the general population, so it is likely that more than 35% of the survey population owned a smartphone. Hence the 3.8% of respondents who exclusively used a smartphone possibly represent one-tenth of the respondents who could have done so. Even if I include all students who used a mobile device at any point in the survey administration, even if they also used other devices, that only accounts for 5.5% of the respondents. So no matter how I count them, students who used smartphones or tablets made up a very small fraction of the entire sample.

In terms of demographics, respondents who exclusively used smartphones compare favorably to the broader spectrum of adults in the U.S. who owned smartphones. Although the numbers of smartphone-using respondents are much smaller, the relative proportions of
respondents compared by gender, age, and (a broad indicator of) race and ethnicity reflects the larger trends in the smartphone-owning U.S. population: younger, (slightly) more male, and (slightly) more non-White.

Results are mixed with respect to the data quality indicators. Although respondents who exclusively used smartphones did not abandon the survey earlier, they abandoned the survey with greater frequency. Smartphone-using respondents also had a significantly higher mean on the aggregate data quality index, a result that is due to lower response differentiation among those respondents. But “other” respondents skipped the most questions and the remaining data quality indicator – gender mismatch – was inconclusive in distinguishing the three groups of respondents.

Strictly speaking, the data quality indicators suggest that respondents who exclusively used smartphones provided responses of a lower quality because 2 of the 5 data quality indicators identified them as providing significantly lower quality responses. However, one of the indicators indicted respondents who did not exclusively use smartphones or tablets as providing low-quality responses and the remaining two indicators were inconclusive. So this study provides weak evidence at best that respondents who exclusively used a smartphone to respond to a Web-based survey not optimized for mobile devices provided lower quality responses than their peers using tablets or a combination of different devices (smartphones, tablets, laptops, etc.).

This study also suggests that the original hypothesis – screen size affects data quality in Web-based surveys – may be valid. In particular, tablet and “other” users were statistically indistinguishable in 4 of the 5 data quality indicators used in this study. This suggests that there may be a point at which screen size becomes small enough to affect how respondents read and
process survey questions and responses, a point between the 10 inch screen of the iPad and the much smaller screens of smartphones.

**Limitations and future research.** Although this study included a large number of participants, it still focused on only one survey. Further, the survey was exclusively taken by undergraduate college and university students at 653 institutions in the United States so results may not be generalizable beyond that population. Only server-side paradata were included in this study, limiting the amount and kind of data used in analysis. Future research could increase the amount and kind of paradata collected, particularly making fine-grained time and date data available so completion (or abandonment) times for individual items and the entire survey could be compared among groups of respondents.

Further research still needs to be done to adequately define “low quality” in terms of survey responses. This study employed several indicators of response quality but they all remain crude indicators with no broadly accepted cutoffs or ranges defining “low” or “high” quality. This paper advances Chen’s (2011) work very slightly but like that study this one is focused on one particular survey. Broader, cross-survey work on these and other metrics of response quality would be very useful for the broader survey research community.

Finally, further research should be conducted to determine how people use tablets and smartphones to complete Web-based surveys. These studies should use qualitative methods, particularly field observations and ethnographic approaches, to understand the cultural and environmental factors that affect these respondents and their use of these mobile devices. This is particularly important as environmental factors such as distractions are a tenable alternative hypothesis to explain the findings of this study.

**Conclusion**
This study examined the respondents and responses to a Web-based survey that is not optimized for mobile devices. Despite being designed for devices with larger screens (e.g. laptop computers, desktop computers), 4.2% of the respondents used only a smartphone or tablet. Although very few respondents used a smartphone, these respondents reflect the broader demographic patterns reflected in the broader population of U.S. smartphone owners: younger, (slightly) more male, and (slightly) non-White.

Our collective understanding of how respondents understand and process survey instruments and individual questions led me to suspect that respondents who exclusively used smartphones or tablets provided lower-quality responses. Empirical evidence focusing on survey abandonment, item non-response, matching responses to an external data source, and an index of response differentiation shows that smartphone respondents did provide lower quality responses according to two of the five indicators. Moreover, in four of the five indicators respondents who exclusively used tablets and respondents who used other non-smartphone devices were indistinguishable, lending support to the theory that screen size may have been the distinguishing factor between respondents who used smartphone users and other respondents.
References


