Exploring Mode Effects between Smartphone and Personal Computer Mode of Administration of a National Household Study

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Abstract
Sixty-eight percent of U.S. adults now own smartphones (Pew Research Center, 2015), and smartphones are increasingly being used by respondents to respond to web surveys (Dillman, 2015). Mobile respondents may be completing the survey while experiencing greater distractions than personal computer (PC) respondents as they attempt to complete the survey "on the go," leading to more skipped items or less thorough responses than PC respondents. Likewise, even with surveys that have been optimized for smartphone use, visual presentation of some types of survey items on smartphones may differ from the presentation of the same items on a PC, which has the potential to lead to mode effects. In this analysis, we draw on two successive web implementations of the Residential Energy Consumption Survey (RECS) to investigate potential mode effects between PC and mobile modes of administration, focusing on item nonresponse and survey response distributions. We investigate the impact of strategies to reduce nonresponse and differences in response distribution between PC and mobile respondents.

Key Words: Mode Effects, Smartphone, Web Survey

1. Introduction

The prevalence of smartphones in the U.S. has increased rapidly from 35% adults in 2011 to 68% in 2015 (Pew Research Center, 2015), and smartphones are increasingly being used by respondents to respond to web surveys (Dillman, 2015) whether we intend for this or not (Link et al., 2014). This has potentially significant implications for survey research. Antoun (2015) outlines a set of factors that could differ between PC and mobile modes, with implications for measurement error. First, the context within which the survey is taken may differ for mobile and PC users, with mobile users potentially being subject to more distractions for their attention and possibly being influenced by the presence of others, which may have implications for the kind of information respondents are able and willing to accurately disclose. Environmental cues may also differ for respondents using mobile phones, who are less likely than PC users to take their survey at home (Mavletova and Couper 2013), than respondents using PCs. This potential difference in environmental cues and priming is of particular concern for studies (such as the present analysis) in which respondents are being asked questions about the characteristics of their home. In addition, technical features such as smaller screen size and keyboards on smartphones relative to PCs may make it difficult to read questions and input answers (Antoun 2015). Likewise, even with surveys that have been optimized for smartphone use, items may render

differently; for example respondents may have to scroll to see illustrative pictures or the full set of response options. Smartphones may also be subject to weaker or intermittent connectivity leading to increased break-offs (Antoun 2015).

Despite the potential, recent literature has shown only limited evidence of mode effects. Mavletova and Couper 2013 found evidence of more socially desirable responses to questions about alcohol consumption by mobile users but not for other sensitive questions, and in another experiment with a similar design no mode effects were found (Mavlitova 2013). More recently, Sommer et al (2016) validated responses against internal and external criterial and found mobile data was as consistent, reliable, and valid as PC responses. Buskirk and Andrus (2013) and Antoun (2015) found that nonresponse was equivalent between mobile and PC.

This analysis contributes to this growing literature with the investigation of three research questions:
1. Are there differences in survey completeness between PC and mobile respondents in two pilots of the Residential Energy Consumption Survey (RECS)?
2. In the first pilot, did we see differences in survey response in the questionnaire items that looked most dissimilar on PC and mobile?
3. Did we decrease differences in response between PC and mobile by increasing the visual similarity between PC and mobile for these items in the second pilot?

2. Methods

Data for this paper are based on two web/mail pilots of the Residential Energy Consumption Survey (RECS), a survey about energy use in homes sponsored by the U.S. Energy Information Administration and conducted by IMG Crown Energy Services and RTI International. The Cities Pilot, fielded in spring of 2015, included a sample of 5,355 housing units across the cities of Chicago, Illinois; Jacksonville, Florida; San Diego, California; Seattle, Washington; and Worcester, Massachusetts. A 38.4% response rate was achieved for the Cities Pilot. A second pilot study with a National Sample of 9,650 households across the United States was fielded in the fall of 2015. The National Pilot achieved a 40.2% response rate[1]. A comparison of the Cities and National Pilot design features and data collection outcomes are presented in Figure 1.

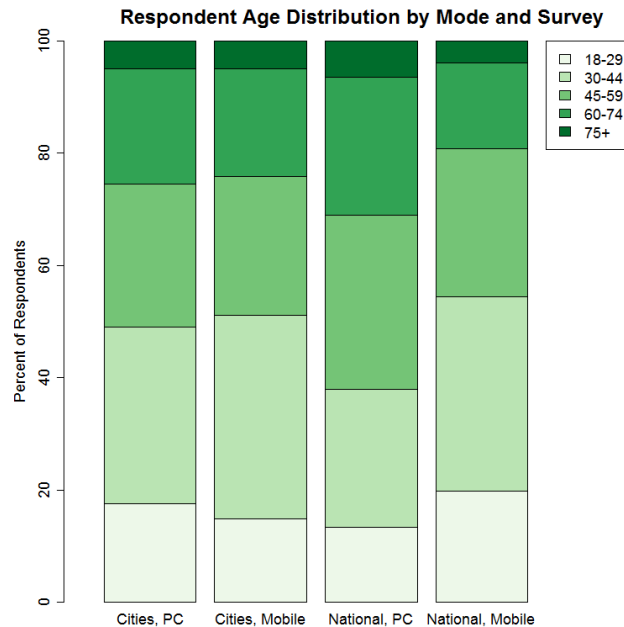|	**Cities Pilot**	**National Pilot**
Sample	5,355 housing units across 5 cities: Chicago, Jacksonville, San Diego, Seattle, Worcester	9,650 housing units across the U.S.
Field Period	Spring 2015	Fall 2015
Response Rate (AAPOR RR3)	38.4%	40.2%
Questionnaire Length	Random 50/50 assignment to short questionnaire (median 17 mins) or long questionnaire (median 25 mins)	All respondents received same questionnaire (median 31 mins)
PC Responses	794 (85% of web)	1,993 (86% of web)
Mobile Responses	143 (15% of web)	334 (14% of web)

Figure 1: Comparison of Design Elements and Data Collection Outcomes for the Cities and National Pilots

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[1] With the inclusion of the non-response follow-up mailing (not included in these analyses), the National Pilot Response rate was 54.92%.

The questionnaires used in the Cities Pilot and National Pilot were very similar. For the Cities Pilot respondents were randomly assigned to a short (17 minute) questionnaire or a longer (25 minute) questionnaire; all respondents in the National Pilot received the same questionnaire, which averaged 31 minutes in length. Limited questionnaire changes made between the Cities Pilot and National Pilot including adding, removing, and revising individual items and a few overall questionnaire changes such as changing the color palette. Some of the National Pilot wording revisions to individual items were intended to increase similarity in the PC and mobile presentations. Additional formatting changes were made between the Cities Pilot and National Pilot to increase similarity in layout between mail, PC, and mobile versions of the survey. Questionnaires were designed to be as similar as possible across these modes, but question length, format, and software constraints meant some items had more pronounced visual differences.

With the exception of one National Pilot web-only treatment group, all sampled households were given multiple opportunities to complete either a web or mail questionnaire. We experimented with various strategies to encourage respondents to complete the survey via web. (Some respondents were assigned to web-only conditions, web-first conditions, or were offered a bonus for participating via web versus mail.) However, use of PC or mobile devices for the web questionnaire was not specifically referenced in the contact materials. Overall, 47% of Cities Pilot respondents and 64% of National Pilot respondents responded via web. Of those who participated via web, 85% (n=794) of the Cities Pilot web participants and 86% (n=1,993) of the National Pilot web participants participated on a personal computer rather than on a mobile device, such as a smart phone or tablet.

On the Cities Pilot age of PC respondents was similar to mobile, but on the National Pilot mobile respondents were younger, on average (Figure 2).

Figure 2. Respondent Age Distribution by Mode and Survey

Both Cities and National Pilots mobile respondents had lower household income than PC respondents (Figure 3).
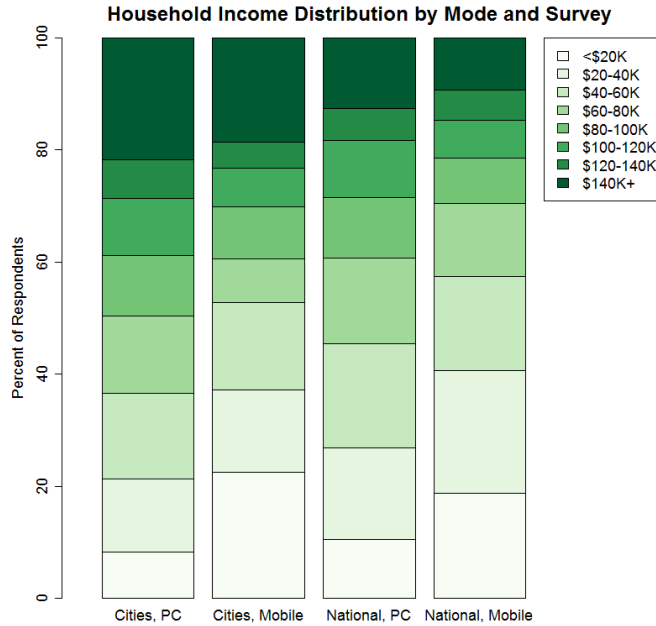
Figure 3. Respondent Household Income Distribution by Mode and Survey

3. Results

3.1 Item Nonresponse and Breakoffs

As shown in Figure 4, overall, there was less item nonresponse for PC respondents than mobile respondents for both the Cities (green) and National (blue) Pilots. In addition PC respondents were significantly less likely to break off without completing the full survey (Figure 5). There was significantly less item nonresponse in the National Pilot than in the Cities Pilot, and differences in item nonresponse between PC and mobile respondents was less pronounced for the National Pilot relative to the Cities Pilot (Figure 4). Although there were several enhancements to the National Pilot to encourage respondents to complete the full survey, including a progress bar and periodic motivational prompts (see Figure 6), breakoff rates for the National Pilot were not lower than the Cities Pilot, perhaps because half of the Cities Pilot respondents received a 20 minutes survey while all National Pilot respondents received a 30 minute survey (Figure 5). Ultimately, there are no statistically significant differences in break-off rates between the Cities and National Pilots.
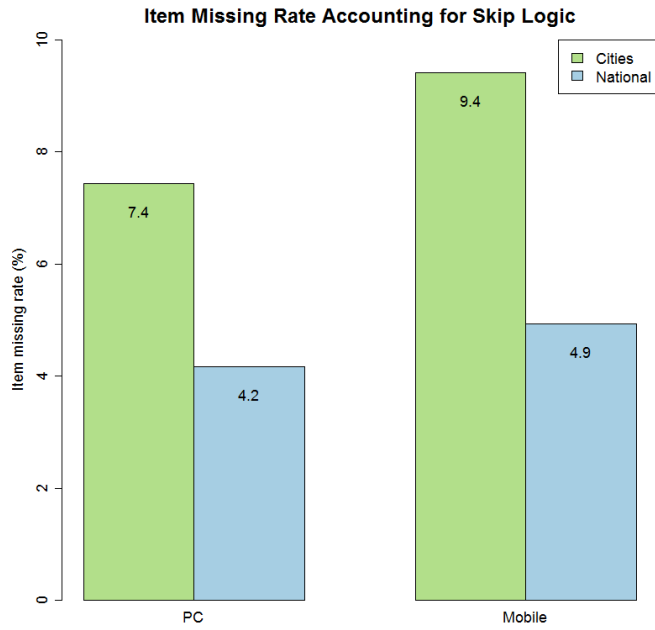
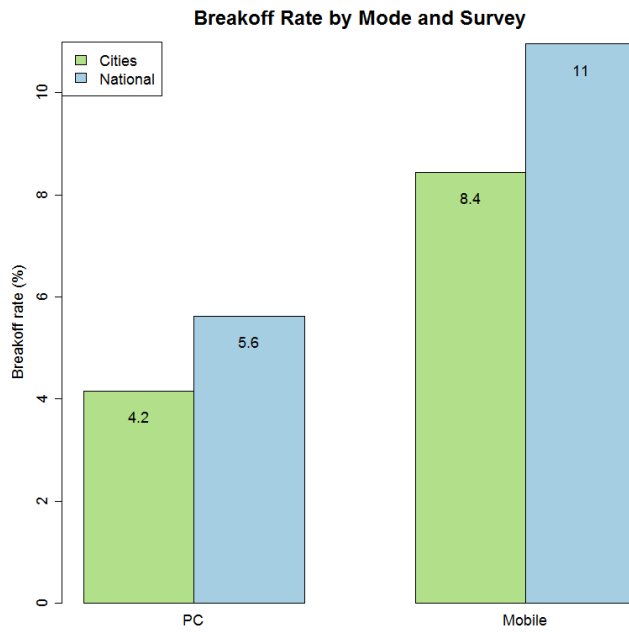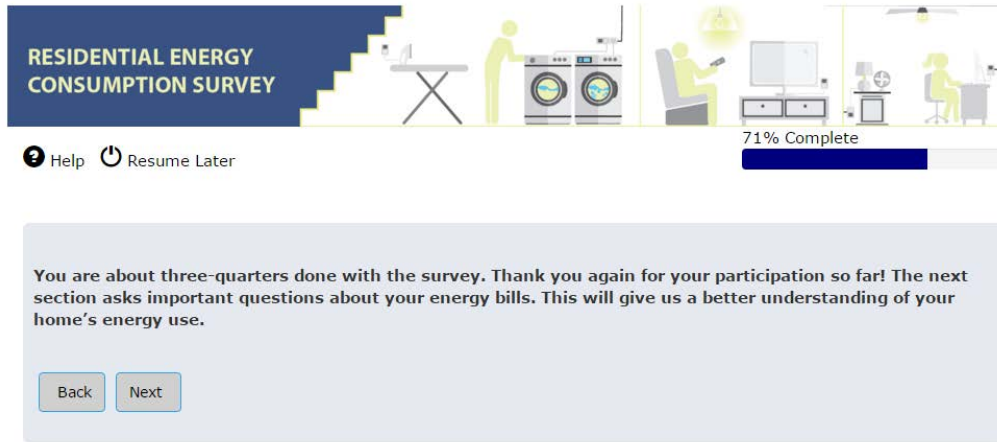**Figure 4.** Item Missing Rate Accounting for Skip Logic


Figure 5. Breakoff Rate by Mode and Survey

Figure 6. Screen shot of the National Pilot Survey Showing the Progress Bar and a Sample Motivational Prompt

3.2 Requests for Account Information

One of the last screens of the web survey (Figure 7) asks for energy supplier names and account numbers. For both the Cities (green) and National (blue) Pilots, these items had significantly higher amounts of nonresponse than other survey items, particularly for mobile respondents (Figure 8). While it was hypothesized that much of the item nonresponse on the Cities Pilot was due to respondent privacy concern or lack of access or knowledge of the requested information, it was also possible that the question format contributed. For this reason, we revised these screens for the National Pilot to render in a single column in both modes (Figure 7), and also used bolded headings and the principle of proximity to assist the respondent in visually processing this screen and understanding our request. Although not statistically significant, differences between PC and mobile item nonresponse appear slightly less pronounced for the National Pilot than for the Cities Pilot (Figure 8).
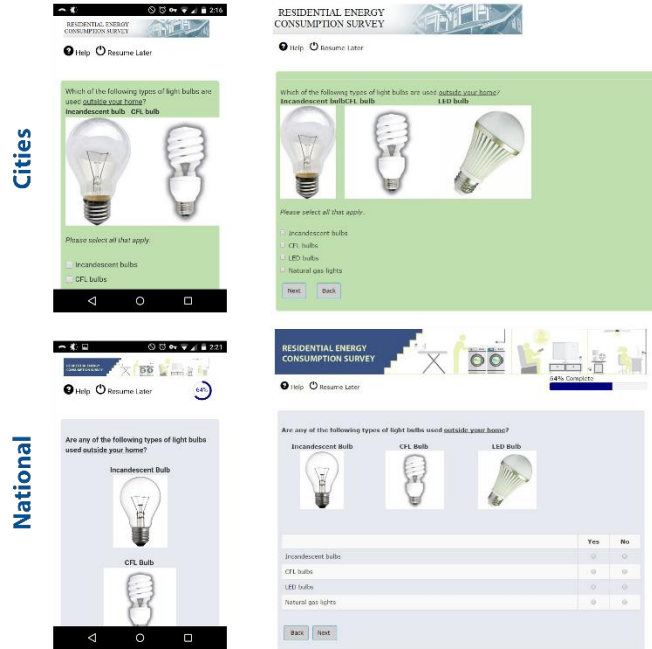
Figure 7. Mobile and PC Screen shots from Cities and National Pilots for a Survey Item Requesting Account Information
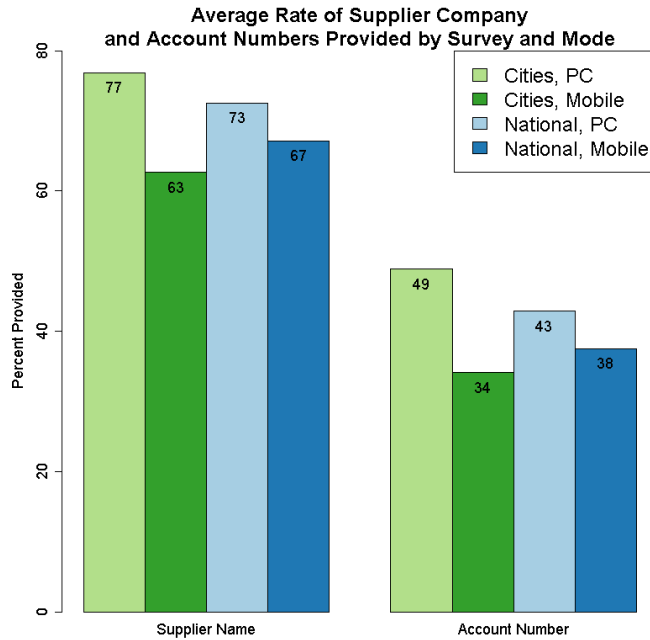

Figure 8. Average Rate of Supplier Company and Account Numbers Provided by Survey and Mode

3.3 Visibility of Pictures

A series of questions about light bulbs included pictures of three different bulb types. The Cities (green) mobile version required horizontal scrolling to see the third light bulb picture (LED bulb) and then vertical scrolling to get to the responses, but the National (blue) mobile version used vertical scrolling only, making it easier for respondents to view all three light bulb pictures before answering the questions (Figure 9). No statistically significant mode differences were detected for either survey (results not pictured). The chart below is suggestive of more consistency regarding LED bulbs in the National Pilot than in the Cities Pilot, but this finding is not statistically significant (Figure 10).

Figure 9. Mobile and PC Screen shots from Cities and National Pilots for a Survey Item That Included Pictures
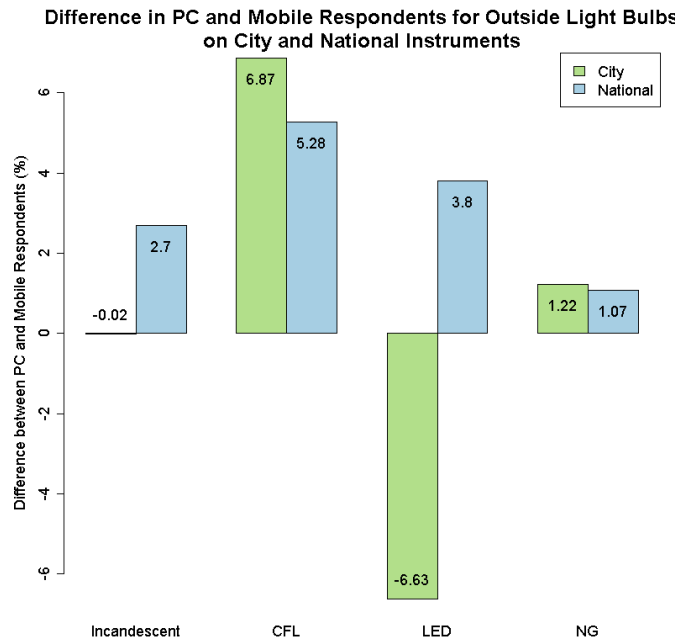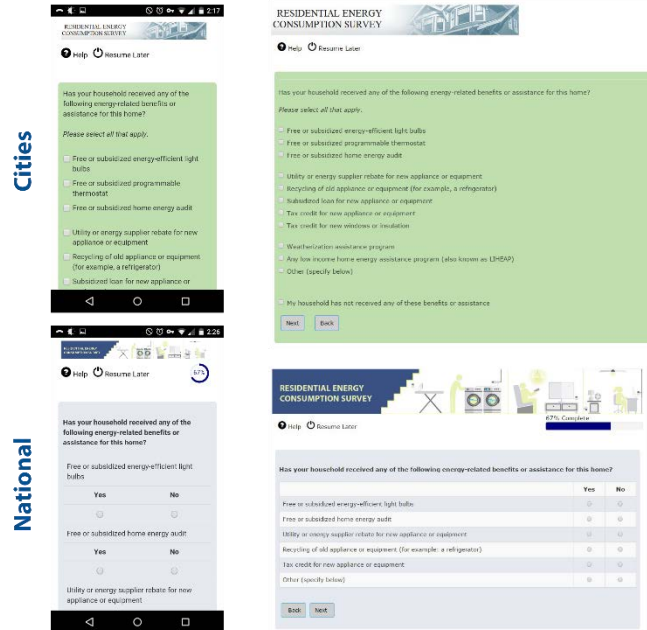

Figure 10. Difference in PC and Mobile Respondents for Outside Light Bulbs on City and National Instruments

## 3.4 Long Lists and the Use of "Mark All" versus Forced Response

The Cities Pilot included several questions with long lists of "mark all that apply" items. These questions were redesigned for the National Pilot to change from a "mark all" format to a "forced response" (yes/no) format and the set of response options was shortened to

minimize scrolling and respondent burden; both changes were made to reduce the potential for primacy effects that can sometimes be present with long "mark all" items. Figure 10 is one such example. For both Cities and National Pilots differences in responses between PC and mobile were present but not statistically significant (results not pictured). In the National Pilot, responses were generally more similar between PC and mobile than on the Cities Pilot, particularly for items at the end of the list that would not be initially visible without scrolling (Figure 11).

Figure 10. Mobile and PC Screen shots from Cities and National Pilots for a Survey Item with a Long List of Response Options
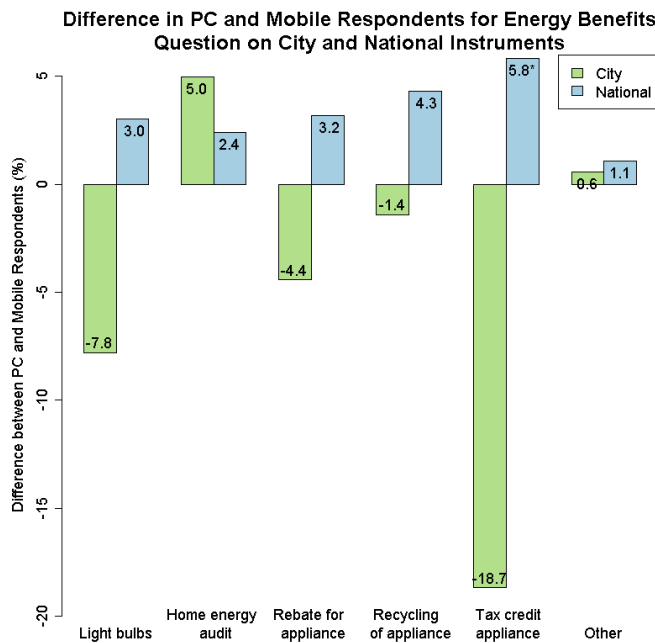
Figure 11. Difference in PC and Mobile Respondents for Energy Benefits Question on City and National Instruments

4. Summary and Conclusions

The RECS Cities Pilot and the RECS National Pilot questionnaires were composed mostly of fact-based questions that invite respondents to count various items in their residence; estimate the amount of use of various appliances, electronics, fuels, and energy-related services; and provide account information. To facilitate efficiency, the RECS Pilot studies have experimented with various methods to push respondents to web (rather than mail) participation, but has neither encouraged nor discouraged respondents specifically from completing the web survey on a mobile device. This analysis investigated whether this strategy resulted in mode differences between PC and mobile in terms of missing data and response distributions.

- Missing Data: Compared to mobile respondents, PC respondents had less item nonresponse and were less likely to break off. These differences were statistically significant for both the Cities and National Pilots. Although the National Pilot questionnaire was actually longer than both the short and long versions of the Cities Pilot, the use of periodic encouraging prompts and soft prompts in the National Pilot appears to have reduced missing data overall relative to the Cities Pilot, and may have been particularly salient for mobile respondents who are subject to more distractions than respondents sitting in front of a PC. Rates of breakoffs for PC and mobile were not affected by the National Pilot additions of a progress bar and motivational prompts.
- Survey Response Distribution: Although results suggest reducing horizontal scrolling and using a "forced response" format rather than "mark all" format contribute to greater similarity between PC and mobile responses, consistent with recent literature, differences detected in survey response distributions between PC and mobile modes were not statistically significant.

As smartphones have become increasingly mainstream, there have been advances in terms of resolution and screen size. At the same time users have become adept at using various websites and applications, some of which are still less optimized than others, and respondents may be picking up transferable skills that assist them in navigating surveys on smartphones. As we push RECS respondents toward web, our findings suggest that we need not specifically push respondents toward PC and away from mobile. Rather, we recommend continued attention and experimentation with strategies to encourage both PC and mobile respondents to complete the questionnaire with minimal item nonresponse.

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