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Willingness to use mobile technologies for data collection in a probability household panel

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We asked members of the Understanding Society Innovation Panel about their willingness to participate in various data collection tasks on their mobile devices. We find that stated willingness varies considerably depending on the type of activity involved: respondents are less willing to participate in tasks that involve downloading and installing an app, or where data are collected passively. Stated willingness also varies between smartphones and tablets, and between types of respondents: respondents who report higher concerns about the security of data collected with mobile technologies and those who use their devices less intensively are less willing to participate in mobile data collection tasks.

Keywords: smartphone; tablet; app; GPS; Bluetooth; accelerometer

1 Introduction

Mobile technologies, including smartphones and tablets, can be used in various ways for data collection. On the one hand, mobile devices allow administering survey questionnaires in innovative ways: respondents can be asked to answer questions sent via text messaging, or to complete questionnaires in a mobile web browser or in a survey app installed on a smartphone or tablet. These forms of survey administration allow near real-time data collection, for example as part of ecological momentary assessment in psychological studies (Moskowitz & Young, 2006), that make it possible to collect more detailed and more wide-ranging measures across multiple time points while reducing the need to recall information. On the other hand, mobile technologies enable researchers to collect new forms of data from survey respondents by relying on the additional measurement capabilities of mobile devices. GPS data can be collected from the respondent's mobile device to measure their location and travel patterns (e.g. Geurs, Veenstra, & Thomas, 2013), or to trigger surveys at pre-specified locations using geo-fencing (e.g. Ginnis, 2017). Accelerometer data can similarly be collected from the respondent's mobile device (e.g. Lathia, Sandstrom, Mascolo, & Rentfrow, 2017), as can data from external devices that are connected via Bluetooth, such as activity trackers (e.g. Scherpenzeel, 2017), smart scales (e.g. Kooreman & Scherpenzeel, 2014), or transdermal devices (e.g. Greenfield, Bond, & Kerr, 2014). Such data can be used to measure physical activity as well as other biological features, such as weight, body fat, and stress. Other possibilities of mobile data collection include asking respondents to take photos with the camera of their smartphone or tablet, for example to scan payslips or shopping receipts (e.g. Jäckle, Burton, Couper, & Lessof, 2017), or to track how respondents are using their mobile device (e.g. Revilla, Ochoa, & Loewe, 2017), for example which websites they are visiting. These new forms of data, some of which cannot feasibly be collected with survey questionnaires, can supplement or potentially even replace data collected using questionnaire-based methods.

Depending on the population of interest, however, not all subgroups will have access to mobile devices. In 2017, 76 percent of households in the United Kingdom reported owning a smartphone and 58 percent reported owning a tablet, but there are large differences by age and socio-economic status (Ofcom, 2017). Socio-demographic differences in coverage are similar in the United States and in other Western countries (Poushter, 2016). To reduce coverage bias in studies with mobile data collection, sample members without mobile device access or Internet access could be provided with a smartphone or tablet and a mobile Internet connection. This approach has already been implemented in two associated studies of the LISS Panel, a probability-based online panel

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in the Netherlands: the Smartphone Time Use Study and the Mobile Mobility Study (Scherpenzeel, 2017). Among those who have access to mobile devices, further potential barriers are whether individuals would actually be able and willing to participate in studies involving mobile data collection.

A few studies have started to examine the stated willingness of respondents to perform additional data collection tasks on their mobile device as part of a survey, and to explore which factors are associated with willingness. Results suggest that the level of willingness varies by data collection task: stated willingness is higher for tasks where respondents have control over the transmitted content than for tasks where data are collected automatically, even if those tasks require more effort from the respondent (Revilla, Couper, & Ochoa, 2018; Revilla, Toninelli, Ochoa, & Loewe, 2016). In addition, stated willingness varies with respondent characteristics. Respondents who use their device more intensively, measured by how often they download apps on their smartphone and the number of apps they regularly use, are more willing to participate in mobile data collection tasks (Keusch, Antoun, Couper, Kreuter, & Struminskaya, in Press; Pinter, 2015). In contrast, stated willingness is lower among people with higher privacy and security concerns and people with lower levels of trust that institutions will protect their data (Keusch et al., in Press; Revilla et al., 2018). Study characteristics also matter: stated willingness is higher for studies that are sponsored by a university rather than a government agency, studies that include incentives, and those that run over a shorter period of time overall (Keusch et al., in Press).

The literature examining stated willingness to participate in mobile data collection tasks has several limitations. First, all studies rely on data from opt-in online panels rather than probability samples of the general population. The sample members of these panels are self-selected and might be more cooperative than the general population. Second, existing research lacks a theoretical discussion of the underlying mechanisms of willingness. Third, while existing studies have examined the implications of respondent and study characteristics, no studies have examined the interactions of respondent and task characteristics in determining willingness.

In this paper, we examine the stated willingness of the general population with access to a smartphone or a tablet, to use mobile technologies for a range of data collection tasks, and what affects willingness. Studying hypothetical rather than actual willingness allows us to understand the determinants of willingness across a range of tasks among a general population sample. Although hypothetical measures of willingness might be influenced by context effects, as other subjective measures in surveys (Sudman, Bradburn, & Schwarz, 1996), these measures have been shown to reflect actual behaviour. Jäckle, Burton, et al. (2017) find that hypothetical willingness is predictive of participation in a mobile app study: respondents who indicated that they would be very or somewhat willing to download and install a survey app on their mobile device have a 4.4 percentage point higher predicted probability of using an app to provide data about their expenditure compared to respondents who reported that they are a little or not at all willing.

We propose a framework of how characteristics of the data collection task (that might constitute potential barriers to participation), respondent characteristics, and interactions between the two, can affect willingness to participate in mobile data collection. We use data on 1,660 survey respondents of the Understanding Society Innovation Panel (University of Essex. Institute for Social and Economic Research., 2017), a nationally representative household panel study in Great Britain, who reported using a smartphone or tablet, to examine the following research questions:

1. How does stated willingness to use mobile technologies vary across different data collection tasks?
2. How does stated willingness to do different tasks vary between smartphone and tablet?
3. Which respondent characteristics predict stated willingness to do different tasks?
4. Which task characteristics predict stated willingness, and does the effect depend on respondent characteristics?

2 Task characteristics and respondent characteristics associated with willingness to participate in mobile data collection

Mobile data collection tasks have various characteristics that constitute potential barriers to participation and which might affect the respondent's willingness to take part. In Table 1, we outline five key characteristics for a range of data collection tasks.

A first characteristic is that most data collection tasks require respondents to download and install an app on their smartphone or tablet to be able to take part in the data collection process. Even if the required sensors or features (such as camera, accelerometer, GPS, or Bluetooth) are already implemented and installed on the device, an app needs to be downloaded to access the data collected from the sensors, process and store them on the device, and transmit them to the researcher. For some tasks, respondents also need to activate features on their device (for example turning on Bluetooth) or give data capture permissions (for example allowing the app to capture GPS coordinates of the mobile device). Only a few tasks, including administering a web questionnaire in the mobile browser or administering a questionnaire by text messages, can solely rely on apps that are already installed on the respondent's device and that do not need any additional permissions by the respondent.

Second, the data collection activities differ in how actively they involve the respondent in the data collection process, which affects how much control respondents have over the content measured, and how much of their time the task

Table 1
Characteristics of mobile data collection tasks

Mobile data collection task	(1) Requires downloading and installing an app	(2) Role of respondent in data collection process	(3) Requires uploading mobile data	(4) Technical demands	(5) Potential privacy threat
Questionnaire	No	Active	Yes	Low	Content-dependent
Survey app	Yes	Active	Yes	Low	Content-dependent
Device usage tracking app	Yes	Passive	Yes	High	Yes
Text messages	No	Active	No	Low	Content-dependent
Camera	Yes	Active	Yes	High	Content-dependent
Accelerometer	Yes	Passive	Yes	High	Content-dependent
GPS	Yes	Passive	Yes	High	Yes
Bluetooth linkage to external device	Yes	Passive	Yes	High	Content-dependent

takes. Some activities require respondents to actively complete measurements, such as answering questions in a survey app or taking photos. These activities give respondents full control over what information they provide to the researcher. Other activities, such as GPS location tracking, rely on passive measurement and do not involve respondents in the data collection process. Although respondents have a passive role in the data collection process itself, they may still have an active role in setting up the data collection activity: they may need to download and install an app, give consent to data collection, and activate features on their device. For these activities, the only control respondents have over what is measured is that they can switch off the data collection process. Passive data collection activities allow the collection of continuous data: the GPS location of a mobile device, for example, can be tracked continuously over a certain period.

Third, all data collection tasks, except those that rely on text messaging for data transmission, require that data are uploaded as part of the data collection process, which might affect mobile data usage limits and associated costs. The amount of data to be uploaded varies between activities and also depends on how the activity is implemented. Uploading photos, for example, is likely to require more data than uploading responses from a mobile questionnaire; uploading GPS coordinates that are collected continuously is likely to require more data than uploading coordinates that are collected at certain intervals.

Fourth, mobile data collection tasks have different technical demands, including how much battery power and storage capacity they require. Tasks that collect data via sensors, such as GPS or accelerometer, as well as tasks that rely on apps that are continuously running in the background, such as an app that tracks how respondents use their mobile device, are likely to reduce battery life more than tasks that rely on apps that are only used intermittently, such as answering questions sent via text messaging. The required storage capacity also varies between tasks, for example taking photos for data collection requires more storage capacity, as photos need to be stored on the mobile device before they are sent to the researcher, whereas other tasks require no additional storage capacity, for example tasks that use the mobile browser that is already installed on the respondent's mobile device. In Table 1, we classify the technical demands of tasks in relative terms; we code tasks as highly demanding if they consume a lot of battery power, require a lot of storage capacity, or both. How each task is implemented, for example how frequently GPS coordinates are captured, can affect the technical demands.

Finally, the data collection activities differ in the extent to which they potentially intrude on the respondent's privacy. GPS data are of a more private nature as they could possibly be used to identify an individual. Similarly, data from an app that tracks the respondent's usage of their phone are of a more private nature. For other tasks, privacy concerns are likely to depend on the content of the data collected. For example, accelerometer data might be perceived as private by some people, in a similar way as self-reports on physical activity might be sensitive for some people.

As data collection tasks differ in what they require from respondents, willingness to use them is likely to vary be-

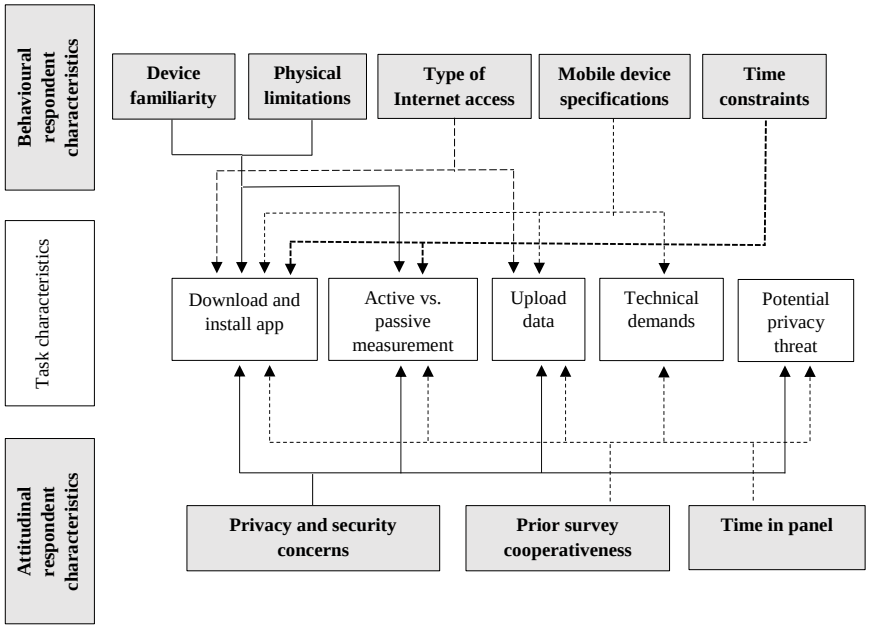

Figure 1. Task characteristics and respondent characteristics that can affect the willingness to participate in mobile data collection tasks

tween tasks, but also between types of respondents: some requirements might constitute barriers to participation for some people but not for others. We developed the framework in Figure 1 to identify the factors that may influence willingness. It is informed by related work in this area, including the technology acceptance model (TAM) (Davis, 1986, 1989; Venkatesh & Davis, 2000; Venkatesh, Morris, Davis, & Davis, 2003), especially as applied to mobile survey participation by Bosnjak, Metzger, and Gräf (2010). Figure 1 represents the conceptual determinants of willingness: task characteristics, respondent characteristics, and interactions between the two. The relevant respondent characteristics include both behavioural and attitudinal characteristics.

Device familiarity Respondents who feel more comfortable and confident with using their mobile device, who use their device more frequently, or who already use similar device features for their own purposes might be more willing to participate in mobile data collection tasks. Device familiarity might especially affect tasks that require respondents to download and install an app, and those that actively involve respondents in the data collection process. Previous research has shown that device familiarity is associated with increased smartphone use to complete web questionnaires (Couper, Antoun, & Mavletova, 2017), and a similar association can be expected between device familiarity and the willingness to use mobile technologies.

Physical limitations Respondents with physical limitations, in particular visual impairment and limited manual dexterity, may find it harder to use mobile devices (McGaughey, Zeltmann, & McMurtrey, 2013) and may therefore be less willing to participate in mobile data collection tasks. Physical limitations are also more likely to affect technologies that require respondents to download and install an app, and to be actively involved in the data collection process.

Type of Internet access The way that respondents connect their mobile device to the Internet may be another determinant of how willing they are to participate in mobile data collection. Respondents who only use mobile Internet and have limited mobile data allowances or a pay-as-you-go plan may be less willing to participate in mobile data collection than those with unlimited data plans or WiFi access at home. The type of Internet access is particularly relevant for data collection tasks that require downloading an app and uploading a large amount of mobile data.

Mobile device specifications The technical specifications

of the mobile device that respondents use may also affect their willingness to participate in mobile data collection. Respondents may not have sufficient storage capacity on their device to download and install apps or to store data, they may use older mobile devices with shorter battery life and slower processing speed, they may not have an app store account, or they may use an operating system for which the data collection app has not been developed. Depending on the specification of their device, respondents may hence be less able and willing to participate in mobile data collection, in particular to complete tasks that require downloading an app, or that use a large amount of storage capacity and battery power.

Time constraints Busy people, including respondents with long working and commuting hours, and those with young children and caring responsibilities, may be less willing to participate in data collection requests using mobile technologies. They may be particularly reluctant to complete tasks that require active involvement in the data collection process and repeated participation. People with time constraints were shown to have lower response propensities in surveys (Abraham, Maitland, & Bianchi, 2006; Groves & Couper, 1998), which suggests that a similar association can be expected between time constraints and willingness to participate in additional data collection requests that are beyond survey interviews.

Privacy and security concerns Mobile technologies have the potential to collect personally identifying information automatically on a large scale, including photos, GPS coordinates and device use profiles. Respondents might consider these data collection activities intrusive to their privacy, and might be concerned about data security when providing sensitive information to researchers via mobile technologies (Chin, Felt, Sekar, & Wagner, 2012). Respondents who have greater concerns about privacy and data security might be less willing to participate in mobile data collection tasks, in particular to complete tasks that involve downloading an app, that are potentially intruding to privacy and tasks where respondents have little control over the transmitted content.

Prior survey cooperativeness Sample members may vary to what extent they are generally open or resistant towards requests for data collection. When being recruited to a survey, they may be reluctant to participate for various reasons, including anticipated burden, lack of interest, or lack of trust in the survey agency (Groves & Couper, 1998). Those, however, who have shown a general openness towards data collection and have been cooperative in previous survey requests may also be more willing to comply with additional data collection requests that use mobile technologies. Previous research on the willingness to comply with in-survey requests has, for example, found that respondents who were cooperative in previous survey interviews were also more likely to give consent to administrative data linkage (Sakshaug, Couper, Ofstedal, & Weir, 2012).

Time in panel In longitudinal studies where sample members are repeatedly invited to survey interviews, time in panel may be another determinant of how willing they are to comply with additional data collection requests. In the course of their panel participation, respondents may develop a sense of loyalty and commitment to the study and may gain more trust in the survey agency. When confronted with an additional data collection request, respondents who have been part of the panel for a longer time may therefore be more willing to participate in the data collection task compared to respondents who joined the panel more recently.

3 Data and Methods

3.1 Survey

We use data from wave 9 of the Understanding Society Innovation Panel, a nationally representative household panel study in Great Britain funded by the UK Economic and Social Research Council and led by the Institute for Social and Economic Research at the University of Essex (University of Essex. Institute for Social and Economic Research., 2017). The Innovation Panel is based on a stratified, clustered sample of households in England, Scotland, and Wales (Lynn, 2009). In addition to the original sample from wave 1, refreshment samples were drawn at waves 4 and 7. The interview is conducted annually among all household members aged 16 and older. Households where no household member participates in two consecutive years are no longer issued to the field. At wave 9, a random two-thirds of sample households were allocated to a sequential mixed-mode design, where non-respondents to the web survey were followed up by face-to-face interviewers. The other third of households were first approached by face-to-face interviewers. In the final phase of fieldwork non-respondents were given the option of completing the survey online or by telephone. Of 1,399 households issued at wave 9, 84.7 percent responded. In responding households, 85.4 percent of individuals completed a full interview (see Jäckle, Gaia, Al Baghal, Burton, & Lynn, 2017). Data for wave 9 were collected between May and September 2016. For details on the survey design and fieldwork see the online documentation.[1].

[1] https://www.understandingsociety.ac.uk/documentation/innovation-panel

The data are available from the UK Data Service.[2]

3.2 Measures of willingness to use mobile technologies

Respondents who indicated that they use the Internet for personal purposes were asked: "Which of the following devices do you use to connect to the Internet?" (yes, no)

1. Desktop computer
2. Laptop
3. Smartphone
4. Tablet
5. Feature phone / non-touchscreen mobile phone
6. E-book reader (e.g., Kindle)
7. Smartwatch
8. Other

Following the question about device use, we asked respondents who use a smartphone: "How willing would you be to carry out the following tasks on your smartphone for a survey?" (very willing, somewhat willing, a little willing, not at all willing)

1. Complete an online questionnaire on your mobile phone
2. Download a survey app to complete an online questionnaire
3. Download an app which collects anonymous data about how you use your smartphone
4. Answer a couple of questions sent via text messaging
5. Use the camera of your smartphone to take photos or scan barcodes
6. Allow built-in features of your smartphone to measure the frequency and speed at which you walk, run or cycle
7. Share the GPS position of your smartphone
8. Connect your smartphone via Bluetooth to other electronic devices (e.g., wearables such as Fitbit).

Similarly, respondents who reported using a tablet were asked about the subset of tasks for which tablets are typically used: "How willing would you be to carry out the following tasks on your tablet for a survey?" (very willing, somewhat willing, a little willing, not at all willing)

1. Complete an online questionnaire on your tablet
2. Download a survey app to complete an online questionnaire
3. Download an app which collects anonymous data about how you use your tablet
4. Use the camera of your tablet to take photos or scan barcodes
5. Connect your tablet via Bluetooth to other electronic devices (e.g., wearables such as Fitbit).

If respondents reported using both devices, they were asked both sets of questions – first about their willingness to complete tasks on their smartphone, then about their tablet. As the questions were only asked of respondents who said that they have access to a smartphone, to a tablet, or both, our analyses of willingness are conditional on reported mobile device access.

In the face-to-face interview, the questions were implemented in the computer-assisted self-interviewing (CASI) section to reduce potential mode effects due to the mixed-mode design of the Innovation Panel. In this section, the interviewer passed the laptop to the respondents and asked them to complete the questions on their own.

Of the 2,174 respondents who gave a full interview, 48 respondents were excluded because they participated in the CAPI interview but refused or were not able to do the self-completion section; 31 respondents were excluded because they gave a CATI interview in the final non-response conversion stage and were not asked the self-completion section; a further 190 respondents were excluded because they do not use or have access to the Internet. This leaves 1,905 Innovation Panel respondents who were asked about mobile device access. Among those respondents, 87.1 percent reported having access to either a smartphone or a tablet and were hence asked about willingness ($N = 1,660$). The remaining 12.9 percent have no access to either mobile device or provided missing values to both questions on mobile device access and were excluded from the analytic sample ($N = 245$). The majority of respondents with mobile device access use both devices (59.0 percent) whereas 23.7 percent only use a smartphone and 16.5 percent only a tablet.

The data were weighted for all analyses to account for unequal selection probabilities and differential nonresponse. Standard errors were adjusted to account for the stratified, clustered sample design of the Understanding Society Innovation Panel. All analyses were conducted using the svy procedures in Stata.

3.3 Respondent-level predictors of willingness

This section describes how we operationalised the respondent-level predictors of our framework. Descriptive statistics for the predictors are shown in Tables 2 and 3. The full wording of questions is documented in Appendix D; numbers in parentheses index the corresponding questions in the Appendix.

Device familiarity. We use three measures of device familiarity which were asked separately for smartphone and tablet: frequency of use, intensity of use, and self-rated skill. We coded frequency of device use (Q4) as 1 if the device is used daily, and 0 otherwise. The categories were collapsed rather than included as an ordinal or continuous measure because the distribution is highly skewed. To measure intensity of use (Q5), we asked respondents which activities they carry out on their device. We include the number of activities car-

[2] https://discover.ukdataservice.ac.uk/catalogue/?sn=6849.

Table 2
Descriptive statistics of continuous respondent characteristics

	Smartphone users					Tablet users				
	Mean	Std. Dev.	Min	Max	*N*	Mean	Std. Dev.	Min	Max	*N*
Number of activities	8.5	3.2	0	12	1379	6.7	3.4	0	12	1259
Self-reported skill	3.8	1.1	1	5	1379	3.7	1.1	1	5	1261
Security concerns	2.5	1.0	1	5	1371	2.6	1.1	1	5	1255
Prior panel response rate	0.9	0.2	0.1	1	1379	0.9	0.1	0.1	1	1261
Age	41	16	16	87	1379	46	17	16	91	1261
Indiv. monthly gross inc. in £	1984	1974	0	15000	1379	2010	1844	0	15000	1261

Table 3
Descriptive statistics of categorical respondent characteristics

	Smartphone users	Tablet users
Frequency of use		
Every day	83%	51%
Less than every day	17%	49%
N	1,378	1,260
Physical limitations		
Yes	5%	5%
No	96%	95%
N	1,376	1,259
WiFi access at home		
Yes	97%	98%
No	3%	2%
N	1,379	1,261
Type of smartphone contract		
Pay-as-you-go plan	12%	-
Fixed data plan or WiFi only	89	-
N	1,377	-
Time constraints		
Yes	29%	26%
No	71%	74%
N	1,379	1,261
Item-nonresponse		
≥ 1 items missing	61%	61%
No items missing	39%	39%
N	1,379	1,261
Consent to data linkage		
Yes	61%	60%
No	39%	40%
N	1,347	1,232
Mode of interview		
Face-to-face	41%	42%
Web	59%	58%
N	1,379	1,261
Number of eligible waves		
1-3	40%	36%
4-6	27%	26%
7-9	33%	38%
N	1,379	1,261
Gender		
Female	50%	53%
Male	50%	47%
N	1,379	1,261
Education		
Higher degree	42%	44%
A-level	27%	24%
GCSE	24%	24%
No qualification	7%	9%
N	1,368	1,254
Labour force status		
In work	66%	62%
Not in work	34%	38%
N	1,378	1,259
Housing tenure		
Has own house	68%	75%
Not own house	32%	25%
N	1,378	1,260

ried out as a count variable, ranging from 0 to 12. Finally, we asked respondents to rate their skills using a mobile device (Q6). We include self-rated skill as a continuous variable, ranging from 1 = Beginner to 5 = Advanced.

Physical limitations. We include an indicator of whether the respondent has any physical limitations: coded as 1 if the respondent has any visual impairment apart from wearing standard glasses or has limited manual dexterity, and coded as 0 otherwise. Note from Table 3 that this variable is highly skewed: among the sample of mobile device users, most respondents do not have any physical limitations.

Type of Internet access. To measure how respondents access the Internet (Q2), we use an indicator coded as 1 if the respondent has WiFi at home, and 0 if not. Again, note from Table 3 that most people have WiFi access from home. We also asked smartphone users about the type of data plan (Q3) they have. The variable is coded as 1 if the respondent has a pay-as-you-go plan, and 0 if the respondent has a fixed data plan with a monthly data allowance or uses WiFi only.

Time constraints. We derived an indicator for the respondent's time constraints: coded as 1 if the respondent is employed or self-employed and works for more than 40 hours per week, or commutes to work for more than one hour one-way, or has young children under the age of five in the household or other caring responsibilities, and coded as 0 otherwise.

Security concerns. We asked respondents to rate their security concerns (Q8) when providing information using various mobile technologies: whether they are not at all concerned, a little concerned, somewhat concerned, very concerned, or extremely concerned. They were asked about the same set of technologies as in the willingness questions: smartphone users were asked about eight different technologies, tablet users about five technologies. Respondents with access to both smartphone and tablet were asked this question only once, about security concerns on smartphone and tablet at the same time. To measure the average level of security concerns across technologies, we use the mean of the individual security concern items, ranging from 1 (if the respondent is not at all concerned about any technologies) to 5 (if the respondent is extremely concerned about all technologies).

Prior survey cooperativeness. We include three measures of prior survey cooperativeness. The first indicator is whether the respondent has any item-nonresponse in the survey, coded as 1 if the respondent has at least one missing item among the questions prior to the questionnaire module on willingness, and 0 otherwise. The second indicator is whether the respondent gave consent to link their survey data with credit rating data held by the Financial Conduct Authority (FCA), coded as 1 if the respondent gives consent, and 0 if not. As the consent rate to data linkage is considerably lower in web than in face-to-face (Burton, 2016), we also control for the mode of data collection, coded as 1 if web and 0 if face-to-face. The third indicator is the respondent's prior panel response rate which is the proportion of waves in which the respondent was eligible and gave a full interview, ranging from 0.11 to 1.

Time in panel. We measure time in panel as the number of waves for which the respondent has been eligible: whether the respondent has been a member of the Understanding Society Innovation Panel for 7-9 waves (original sample member or joined the panel in wave 2 or 3), for 4–6 waves (member of the wave 4 refreshment sample or joined the panel in wave 5 or 6), or for 1–3 waves (member of the wave 7 refreshment sample or joined the panel in wave 8 or 9).

Socio-demographics. Finally, we control for a set of socio-demographic characteristics, including gender, age, education, labour force status, income, and housing tenure, to help identify the genuine effects of respondent characteristics and attitudes. Gender was coded as 1 if female and 0 if male. We include a variable for age and one for age-squared as age was found to have a curvilinear relationship with willingness. Education was coded in four categories: whether the respondent has a professional or a university degree, has A-levels (equivalent to 13 years of schooling in the UK), has GCSE (equivalent to 11 years of schooling in the UK), or has no qualifications. Labour force status was coded as 1 if the respondent is in work (employed or self-employed), and 0 if not in work. To measure income, we use a derived indicator of the respondent's monthly gross income that is provided with the data set, including earnings from employment and self-employment as well as unearned income from benefits, pensions and other sources. Income was top-coded to a maximum value of £15,000. In the model, we take the natural logarithm as the distribution of income is highly skewed. Housing tenure, used as a measure of wealth, was coded as 1 if the respondent lives in their own house (with a mortgage or owned outright), and 0 otherwise.

3.4 Task-level predictors of willingness

To examine the association between task characteristics and the willingness to participate in mobile data collection, we coded the characteristics of each of the eight types of mobile data collection tasks according to Table 1: whether the data collection task requires respondents to download and install an app (coded as 1 if yes and 0 if no); whether respondents have an active role in the data collection process (coded as 1 if respondents are actively and 0 if they are passively involved); whether the task has relatively high technical demands (coded as 1 for high technical demands and 0 for low demands); and to what extent the data collection intrudes on the respondent's privacy (coded as 1 if the activity represents a privacy threat and 0 if the privacy threat is content-dependent). We do not include an indicator of whether the data collection task involves uploading mobile data because

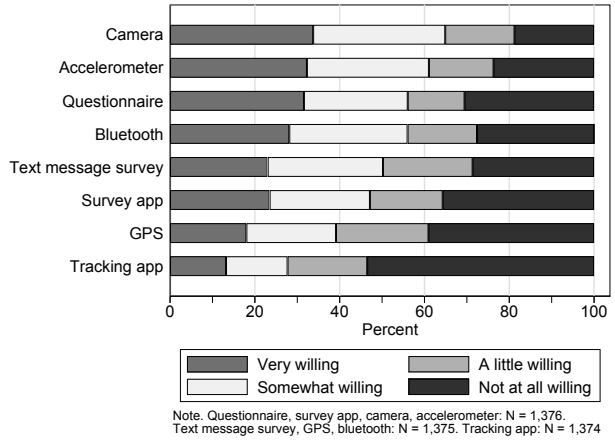

Figure 2. Stated willingness to complete data collection tasks on a smartphone

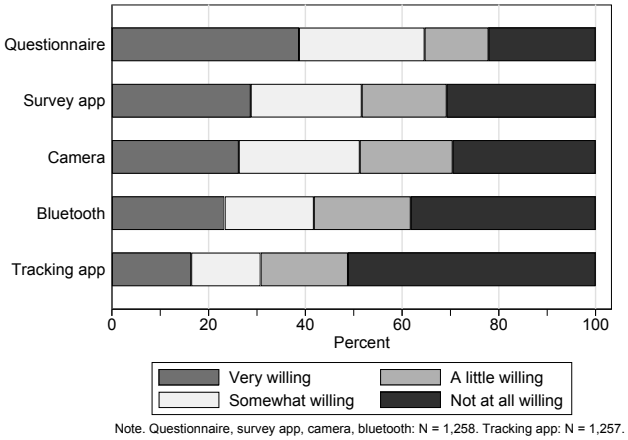

Figure 3. Stated willingness to complete data collection tasks on a tablet

it would only represent one activity: completing a survey by text messages.

4 Results

4.1 How does stated willingness to use mobile technologies vary across different data collection tasks?

Stated willingness to use mobile technologies on a smartphone for data collection varies considerably by data collection task (Figure 2, Table A1 in the Appendix). On the one hand, the majority of smartphone users would be (very or somewhat) willing to use the camera of their smartphone to take photos or to scan barcodes for a survey (65 percent). A similar proportion of respondents would be willing to allow the accelerometer built into their smartphone to measure their physical movement (61 percent). On the other hand, a much smaller proportion of smartphone users would be willing to share the GPS position of their phone (39 percent) and only 28 percent would be willing to download and use a tracking app that collects anonymous data about how they use their phone. More than half of respondents would be not at all willing to do this task.

These findings suggest that not all smartphone users would be willing to use all kinds of technologies on their phone for data collection, and that they make a clear distinction between different tasks, depending on what type of technology the tasks involve.

When asking tablet users about their stated willingness to participate in mobile data collection, we find that willingness varies across data collection tasks in a similar way, but there are some notable differences compared to smartphone users (Figure 3, Table A2 in the Appendix). A smaller percentage of tablet users would be willing to use the camera of their tablet to take photos or scan barcodes for a survey (51 percent), presumably as they are less used to taking photos on their tablet. A larger percentage, however, would be willing to complete an online questionnaire on their tablet (64 percent), presumably because it is easier to complete surveys on devices with a larger screen size. The difference in stated willingness to complete an online questionnaire is also reflected in the numbers for actual device use in the Innovation Panel web survey: of the 1,123 web respondents who gave a full interview in wave 9, 26.9 percent used a tablet for survey completion whereas only 7.4 percent used a smartphone.

Comparing the stated willingness of smartphone users and tablet users gives a first indication that respondents also make a distinction between devices: they are more willing to complete certain tasks on a smartphone than on a tablet or vice versa. This first set of analyses, however, is based on two different albeit overlapping populations: those who use a smartphone compared to those who use a tablet. In the next section, we examine the stated preferences of the 980 respondents who have access to both devices to better understand how willingness differs between smartphones and tablets.

4.2 How does stated willingness to do different tasks vary between smartphone and tablet?

To simplify the analysis, we dichotomised the four-point willingness scale: we coded very willing and somewhat willing as willing, and a little willing and not at all willing as not willing. We then compared if respondents are willing to complete data collection tasks on both devices, only on one device, or on neither device. As shown in Figure 4 (and in Table B1 in the Appendix), we find that a large majority of respondents have consistent levels of willingness: they are equally willing or equally unwilling to complete data collection tasks on a smartphone or on a tablet. The level of consistency varies slightly by data collection task. Respondents are most consistent in their willingness to use a tracking app

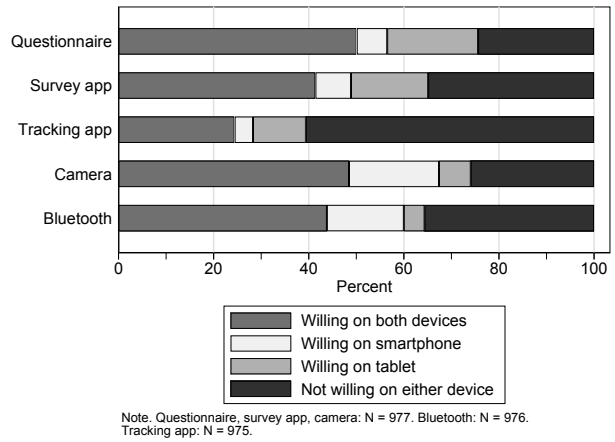

Figure 4. Consistency of stated willingness among respondents with access to smartphone and tablet

that collects anonymous data about how they use their mobile device (85 percent are equally willing or equally unwilling), and least consistent in their willingness to complete a questionnaire in the mobile browser (still 75 percent are equally willing or equally unwilling).

To test the relationship between willingness to complete a given task on a smartphone and willingness to complete the task on a tablet, we computed Kendall's tau-b correlation coefficients that measure the association between two ordinal variables. We find a moderate to strong positive correlation for all tasks, ranging from $\tau_b = 0.49$ for completing an online questionnaire to $\tau_b = 0.65$ for connecting to other devices via Bluetooth, which confirms the interpretation of Figure 4, that willingness is moderately consistent between devices.

Among respondents who expressed different levels of willingness across devices, the preference is task-related: the majority would be more willing to use their tablet to complete an online questionnaire, to use a survey app, or to use a tracking app that collects anonymous data about how they use their device, but would be more willing to use their smartphone to take photos or to connect to other devices via Bluetooth. These differences in preference may reflect how respondents use the devices. Respondents may use the camera of their smartphone more often than the camera of their tablet. For survey-related tasks including completing an online questionnaire and using a survey app, respondents seem to prefer devices with a larger screen size.

These findings suggest that stated willingness is consistent for the majority of respondents, but some respondents make a distinction between different devices. We therefore cannot assume that all respondents who have multiple devices would be equally willing to do the same type of task on all devices.

4.3 Which respondent characteristics predict stated willingness to do different tasks?

Table C1 in the Appendix shows the bivariate relationship of respondent characteristics and stated willingness to complete different data collection tasks on a smartphone. To facilitate later analyses, the willingness scale was dichotomised into willing (combining very willing and somewhat willing) and not willing (combining a little willing and not at all willing). We find a significant association in the expected direction for most characteristics, including device familiarity, physical limitations, and security concerns. Time in panel and one of the indicators of prior survey cooperativeness, however, suggest a significant relationship with willingness that is opposite to what we expected: respondents who were sampled longer ago and are still in the panel appear to be less willing to participate in mobile data collection than panel members who were sampled more recently, although the effect is statistically significant for only three of the tasks. Contrary to our expectation, respondents who completed all previous interviews in which they were eligible seem to be less willing to participate in mobile data collection than those who did not complete all previous interviews, but the effect is statistically significant for only two of the tasks. Type of Internet access as well as time constraints do not have a significant bivariate relationship with willingness for any of the data collection tasks.

To further understand which respondent characteristics are associated with stated willingness to complete different data collection tasks, we ran regression models for each of the individual tasks, using different specifications. First, we fitted a series of ordered logistic regression models using the ordinal willingness scale as dependent variable, separately for smartphone and tablet. Second, we fitted a series of binary logistic regression models using the dichotomised willingness scale as dependent variable. Table 4 shows the results of the binary logistic regression models for willingness to complete data collection tasks on a smartphone. The binary logistic regression models for tablet and the ordered logistic regression models for smartphone and those for tablet all yield very similar results, so we do not present them in this paper.

We show the average marginal effects that denote the increase in the predicted probability of being willing for a one-unit change in the explanatory variable. The average marginal effect of frequency of smartphone use in the first model, for example, shows that respondents who use their smartphone every day have a 7 percentage point higher predicted probability to be willing to take photos on their smartphone for a survey compared to those who use their device less frequently, although the effect is not statistically significant. To recall the different levels of willingness across data collection tasks, we also show the proportion of smartphone users who reported that they are very or somewhat willing

to complete the individual tasks in the first row of the table ("Proportion willing"). As we replicate the models for the eight different smartphone data collection tasks, we adjusted the p-values of the average marginal effects estimated from the logistic regressions using the Holm-Bonferroni method to account for multiple testing (Holm, 1979).

Intensity of smartphone use, one of our indicators of device familiarity, is predictive of willingness for six of the data collection tasks. Respondents who use their smartphone more intensively, measured by the number of activities they carry out on their phone, are significantly more willing to allow the accelerometer to measure their physical activity, to complete a web survey in a mobile browser or in a survey app, to connect their smartphone to other devices via Bluetooth, to share the GPS position of their smartphone, and to use an app that tracks how they use their device. The effect has a similar magnitude across tasks: for every additional activity that respondents do on their smartphone, they have a 2 to 4 percentage point higher predicted probability of being willing to engage in mobile data collection. The other two indicators of device familiarity, frequency of smartphone use and self-rated skill using a smartphone, however, do not have a significant effect on willingness in the multivariate models, despite having a significant bivariate relationship with willingness. When controlling for other characteristics, respondents who use their smartphone every day and who consider themselves proficient smartphone users are no more willing to participate in mobile data collection than those who use their smartphone less frequently and have lower self-rated skills.

The level of security concerns about mobile technologies is a second factor which is predictive of willingness to participate in mobile data collection. The more concerned respondents are about the security of providing information via mobile technologies, the less willing they are to complete each of the possible data collection tasks. The magnitude of the effect varies depending on the type of technology involved: it is larger for activities that are potentially threatening to the respondent's privacy. Respondents with greater security concerns have a 20 percentage point lower predicted probability to be willing to share the GPS location of their phone, but only an 11 percentage point lower predicted probability to be willing to complete an online questionnaire in a mobile browser.

In the multivariate models, we do not find a significant effect of physical limitations on willingness for any of the data collection tasks, presumably because we control for age. Respondents with physical limitations do not report lower levels of willingness compared to those without these limitations. We also do not find a significant effect of type of Internet access on willingness for any of the data collection tasks, similarly to the bivariate analysis: respondents without WiFi access at home and those with a pay-as-you-go plan are as willing to participate in mobile data collection as respondents with WiFi access or a fixed data plan. Time constraints are also not associated with willingness for any of the data collection tasks: respondents who have long working or commuting hours, children under the age of five or other caring responsibilities are not less willing to participate in mobile data collection compared to those without these time constraints.

Our indicators of prior survey cooperativeness are also not predictive of willingness in the multivariate model. Respondents with item-nonresponse in the Innovation Panel questionnaire and those who gave consent to data linkage have similar levels of willingness to participate in mobile data collection as respondents without item-nonresponse and those who did not give consent. We also do not find a significant association in the multivariate model between willingness and prior panel response rate: panel members who have been cooperative in past waves are equally willing to complete additional data collection requests as members who have been less cooperative.

Similarly, time in panel, measured by the number of eligible waves, is not predictive of willingness for any of the tasks. Respondents who have been in the panel longer are as willing to participate in mobile data collection as panel members who joined the panel more recently, when controlling for other respondent characteristics. We also tested the interaction between number of eligible waves and prior panel response rate: respondents who completed all interviews and were eligible for a larger number of waves might have more experience with the survey compared to respondents who completed all interviews but were eligible for fewer waves. The interaction effect, however, is not significant (analysis not shown).

4.4 Which task characteristics predict stated willingness, and does the effect depend on respondent characteristics?

To examine the effect of both task characteristics and respondent characteristics on stated willingness and to test for task-respondent interactions, we fitted multilevel logistic regression models predicting willingness to use mobile technologies on a smartphone. The model has two levels: the task level, nested within respondents. We used the dichotomised willingness as dependent variable to match the analysis for Research Question 3 and included random intercepts for each respondent. Given the small number of data collection tasks that we examined, we have limited variation in characteristics across tasks. We also ran models using the individual tasks as predictors of willingness. As will be shown in this section, however, the analysis of task characteristics reveals determinants of willingness that cannot be identified just by comparing the tasks.

Table 5 shows three multilevel logistic regression models:

Table 4
Logistic regression models predicting willingness to complete data collection tasks on a smartphone. Average marginal effects.

	Camera	Accelero-meter	Question-naire	Blue-tooth	Text messages	Survey app	GPS	Tracking app
Proportion willing ($N = 1,379$)	0.65	0.61	0.56	0.56	0.50	0.47	0.39	0.28
Frequency of use: Every day	0.07	−0.04	0.09	−0.04	0.08	0.04	−0.03	0.01
	(0.04)	(0.03)	(0.05)	(0.04)	(0.06)	(0.05)	(0.05)	(0.06)
Number of activities	0.02	0.04***	0.04***	0.03**	0.02	0.04***	0.03***	0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Self-reported skill	0.04	0.03	0.04	0.05	0.01	0.05	0.03	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Physical limitations: Yes	−0.05	−0.12	−0.02	0.06	−0.08	−0.05	0.08	−0.00
	(0.06)	(0.06)	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)	(0.07)
WiFi access: Yes	−0.14	−0.05	−0.16	−0.08	−0.17	−0.14	−0.17	−0.10
	(0.09)	(0.08)	(0.10)	(0.09)	(0.12)	(0.10)	(0.10)	(0.09)
Pay-as-you-go plan: Yes	0.06	0.04	0.02	−0.00	0.03	−0.03	0.05	0.06
	(0.04)	(0.05)	(0.05)	(0.05)	(0.04)	(0.06)	(0.05)	(0.05)
Time constraints: Yes	−0.06	−0.02	−0.01	−0.05	0.03	0.00	−0.05	0.02
	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	(0.03)
Security concerns	−0.14***	−0.14***	−0.11***	−0.16***	−0.17***	−0.12***	−0.20***	−0.17***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Item-nonresp.: ≥ 1 items missing	−0.04	−0.04	0.02	−0.06	−0.04	−0.02	−0.03	0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Consent to data linkage: Yes	0.05	0.07	0.03	0.02	0.02	0.05	−0.01	0.06
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)
Mode of interview: Web	0.06	0.07	0.04	−0.02	−0.00	0.06	−0.01	0.02
	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Prior panel response rate	−0.01	−0.12	−0.05	−0.08	−0.00	0.04	−0.33	−0.22
	(0.09)	(0.10)	(0.09)	(0.10)	(0.10)	(0.11)	(0.09)	(0.08)
Number of eligible waves (Ref.: 7–9)								
1–3	0.03	0.06	0.08	0.01	0.03	0.07	0.03	0.03
	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
4–6	0.06	0.04	0.03	0.01	−0.01	0.02	0.06	0.04
	(0.04)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)
Female	0.03	0.03	0.07	−0.06	0.06	0.03	−0.04	0.02
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Age	0.01	0.01	0.00	0.00	0.02	0.01	0.01	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Age-squared	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education (Ref.: No qualification)								
Higher degree	0.07	0.08	0.08	0.08	0.10	0.04	0.06	0.14
	(0.05)	(0.06)	(0.07)	(0.06)	(0.07)	(0.06)	(0.07)	(0.04)
A-level	0.10	0.09	0.15	0.06	0.13	0.09	0.02	0.20**
	(0.06)	(0.05)	(0.06)	(0.06)	(0.07)	(0.06)	(0.07)	(0.04)
GCSE	0.07	0.06	0.09	0.05	0.11	0.06	0.02	0.17
	(0.06)	(0.05)	(0.07)	(0.06)	(0.08)	(0.07)	(0.07)	(0.05)
Labour force status: In work	−0.03	−0.01	−0.03	−0.05	−0.11	−0.07	−0.07	−0.13
	(0.05)	(0.04)	(0.05)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)
Income (ln)	0.00	−0.00	0.01	0.01	−0.01	−0.01	−0.01	−0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Housing tenure: Own house	0.02	0.02	−0.01	0.01	0.02	−0.00	−0.05	−0.10
	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.05)	(0.04)	(0.04)
Nagelkerke R-squared	0.27	0.36	0.42	0.36	0.26	0.38	0.31	0.42
N	1,317	1,317	1,317	1,316	1,316	1,317	1,316	1,315

P-values were adjusted using the Holm-Bonferroni method. Standard errors in parentheses. N = 58 respondents had missing values in at least one of the predictor variables and were dropped from the analysis using listwise deletion.
$*\ p < 0.05$ $**\ p < 0.01$ $***\ p < 0.001$

first, we estimate a null model with random intercepts only to compute variance components and the intra-class correlation (ICC); in the second model, we include fixed effects for task characteristics and in the third, full model, we include fixed effects for both task characteristics and respondent characteristics. Whereas in Table 4 we estimated the effect of respondent characteristics on willingness separately for each of the eight data collection tasks, the multilevel model in Table 5 shows the pooled effect of the different respondent characteristics across tasks. On average across all data collection tasks, we find that 51.0 percent of respondents would be willing to participate in mobile data collection on their smartphone ($n = 10,531$).

We use the Akaike information criterion (AIC) and likelihood ratio tests to assess model fit (Hox, 2010). The decreasing AIC values suggest an improvement in model fit across the three models. Similarly, the likelihood ratio tests show that each subsequent model significantly improves model fit compared to the previous model.

In the model which only includes task characteristics, we find that all four task characteristics are significant predictors of willingness to participate in mobile data collection. Respondents have a 7.1 percentage point lower predicted probability of willingness to participate in tasks that require downloading and installing an app on their smartphone compared to tasks without this requirement. This result supports our expectation that downloading and installing an app is a potential barrier to participation. Data collection tasks that actively involve respondents in the data collection process have higher levels of willingness than passive tasks: respondents have a 7.5 percentage point higher predicted probability to report that they are willing to participate in active tasks compared to passive tasks, presumably because they have more control over the content of the data if they are actively involved in the data collection process. Surprisingly, respondents are more willing to complete tasks that have relatively high technical demands, such as those requiring a lot of battery power or storage capacity, compared to tasks with relatively low technical demands: they have a 21.1 percentage point higher predicted probability of willingness to complete more technically demanding tasks than those with relatively low demands. This effect might be driven by other aspects of the tasks: albeit technically demanding, the tasks might be frequently used by respondents (e.g., the smartphone camera), and might have higher levels of willingness than tasks that have low technical demands but are rarely used by respondents. Finally, we find that tasks that are potentially threatening to the respondent's privacy have lower levels of willingness, which confirms our expectation that a potential privacy threat might represent a possible barrier to participation. Respondents have a 31.4 percentage point lower predicted probability of willingness to complete tasks that potentially threaten their privacy compared to tasks where the potential privacy threat is content-dependent. When we control for respondent characteristics in the third model, we find that the effect of each of the task characteristics remains significant, although the magnitude of the predicted probabilities decreases slightly.

Regarding respondent characteristics, the multilevel model confirms some findings of the task-specific models shown in Table 4: characteristics that have a significant effect on willingness in the task-specific models, including intensity of smartphone use and security concerns, also have a significant effect in the multilevel model. There are, however, some differences. The multilevel model suggests that respondents with high self-rated skill using a smartphone are significantly more willing to participate in mobile data collection and those with WiFi access at home are significantly less willing to participate; neither of these variables significantly affects willingness in the task-specific models. Two of the prior survey cooperativeness indicators, consent to data linkage and prior panel response rate, as well as time in panel also have a significant effect on willingness in the multilevel model, although not being predictive of willingness in the task-specific models.

In addition to examining the main effect of task characteristics on willingness, we empirically tested the interactions of task characteristics and respondent characteristics that we proposed in our framework. Among all interaction effects that we specified in Figure 1, we only find significant interaction effects between frequency of smartphone use and task characteristics as well as between prior survey cooperativeness and task characteristics (analysis not shown).

For respondents who do not use their smartphone every day, the requirement to download and install an app does not significantly affect their willingness to participate in mobile data collection (main effect: $AME = +0.1$ percentage points, $p = 0.980$). Respondents who use their smartphone every day, however, are significantly less willing to participate in mobile data collection compared to less frequent smartphone users if the task requires downloading and installing an app (interaction effect: $AME = -6.9$ percentage points, $p = 0.002$). Infrequent smartphone users have similar levels of willingness for both active and passive tasks (main effect: $AME = +0.5$ percentage points, $p = 0.808$), whereas respondents who use their smartphone every day are more willing to participate in mobile data collection than infrequent users if the task actively involves them in data collection (interaction effect: $AME = +7.1$ percentage points, $p<0.001$).

We also find significant interaction effects between prior panel response rate and three of the task characteristics. First, respondents who have been relatively uncooperative in previous survey waves, measured by a low prior panel response rate, are less willing to participate in active than in passive tasks (main effect: $AME = -13.4$ percentage points, $p = 0.002$). Those who have previously been more coopera-

Table 5
Multilevel logistic regression model predicting willingness to complete data collection tasks on a smartphone. Average marginal effects.

	Null model		Task characteristics		Task and respondent characteristics	
	AME	SE	AME	SE	AME	SE
App download required	-	-	−0.071***	0.014	−0.058***	0.012
Active role of respondent	-	-	0.075***	0.014	0.063***	0.012
High technical demands	-	-	0.211***	0.016	0.175***	0.014
Potential privacy threat	-	-	−0.314***	0.011	−0.258***	0.010
Frequency of use: Every day	-	-	-	-	0.014	0.020
Number of activities	-	-	-	-	0.030***	0.003
Self-reported skill	-	-	-	-	0.036***	0.008
Physical limitations: Yes	-	-	-	-	−0.034	0.032
WiFi access: Yes	-	-	-	-	−0.156***	0.043
Pay-as-you-go plan: Yes	-	-	-	-	0.025	0.021
Time constraints: Yes	-	-	-	-	−0.013	0.015
Security concerns	-	-	-	-	−0.163***	0.006
Item-nonresponse: ≥ 1 items missing	-	-	-	-	−0.024	0.013
Consent to data linkage: Yes	-	-	-	-	0.028*	0.013
Mode of data collection: Web	-	-	-	-	0.026	0.013
Prior panel response rate	-	-	-	-	−0.101*	0.040
Number of eligible waves (Ref.: 7–9)						
1–3	-	-	-	-	0.036*	0.015
4–6	-	-	-	-	0.029	0.016
Female	-	-	-	-	0.024	0.013
Age	-	-	-	-	0.010***	0.003
Age-squared	-	-	-	-	−0.000***	0.000
Education (Ref.: No qualification)						
Higher degree	-	-	-	-	0.086**	0.027
A-level	-	-	-	-	0.117***	0.028
GCSE	-	-	-	-	0.092***	0.028
Labour force status: In work	-	-	-	-	−0.064***	0.018
Income (ln)	-	-	-	-	−0.002	0.004
Housing tenure: Own house	-	-	-	-	−0.013	0.016
Respondent variance	1.893	-	2.149	-	1.652	-
ICC	0.365	-	0.395	-	0.334	-
AIC	11960	-	11161	-	10293	-
X^2 of LR-test against previous model	-	-	807***	-	914***	-

Responses = 10,531 and respondents = 1,317. ICC = intra-class correlation. N = 58 respondents had missing values in at least one of the predictor variables and were dropped from the analysis using listwise deletion.
$*\ p < 0.05$ $**\ p < 0.01$ $***\ p < 0.001$

tive, however, are more willing to complete tasks where they are actively involved in data collection than less cooperative respondents (interaction effect: AME = +21.0 percentage points, p<0.001). Second, we find that relatively uncooperative panel members are more willing to complete tasks with relatively high technical demands compared to tasks with lower demands (main effect: AME = +32.7 percentage points, p<0.001). Those who have been cooperative, however, have lower levels of willingness for tasks that are technically demanding compared to uncooperative respondents (interaction effect: AME = −16.3 percentage points, p<0.001). Third, the results suggest that relatively uncooperative panel members are willing to participate in mobile data collection independent of whether the task is intruding on their privacy (main effect: AME = −2.4 percentage points, p = 0.619). Cooperative respondents, however, are

less willing to complete data collection tasks that are potentially threatening to their privacy compared to uncooperative respondents (interaction effect: $AME = -25.1$ percentage points, $p<0.001$).

5 Discussion

In this paper, we examine the stated willingness of the general population with access to a smartphone or a tablet to participate in mobile data collection tasks, using data from a nationally representative household panel study in Great Britain. We provide novel evidence on how stated willingness varies between eight different mobile data collection tasks and between different mobile devices (smartphones and tablets). We also provide novel evidence on the relative importance of respondent characteristics, task characteristics, and their interactions, by proposing and testing a theoretical framework of the determinants of willingness to participate in different mobile data collection tasks.

We find that the level of stated willingness varies by data collection task and, to a lesser extent, by device. Respondents seem to make a clear distinction between different tasks: fewer people would be willing to share the GPS position of their mobile device than to take a photo for a survey or to complete a questionnaire in a mobile browser. More than half of respondents would not be at all willing to download an app which collects anonymous data about how they use their mobile device. These findings are consistent with previous results based on online access (volunteer) panels in other countries (Revilla et al., 2018; Revilla et al., 2016). The majority of people who use both a smartphone and a tablet have consistent preferences: they are equally willing or equally unwilling to use either of their devices for data collection. For some respondents, the device type, however, makes a difference: a tablet would be the preferred device for completing an online questionnaire in a mobile browser or survey app, whereas a smartphone would be the preferred device for taking photos or for connecting to other devices via Bluetooth.

We also find that stated willingness varies with respondent characteristics: those who use their mobile device more intensively and have lower levels of security concerns are more willing to use mobile technologies for data collection. These findings are consistent with previous findings from access panels (Keusch et al., in Press; Pinter, 2015; Revilla et al., 2018). Other respondent characteristics that we examined do not significantly affect willingness.

The difference in stated willingness between different data collection tasks is related to the characteristics of the tasks: respondents are more willing to participate in tasks where they actively complete the measurements than in tasks where data are collected passively. This finding is consistent with previous results from an access panel in Spain, Portugal and Latin America (Revilla et al., 2018; Revilla et al., 2016). In addition, we find that respondents are less willing to participate in tasks that require downloading an app and in tasks that measure highly private information. Somewhat surprisingly, respondents are more willing to participate in tasks that place higher technical demands (such as battery usage) on their devices; however, this may be an effect of the specific tasks we studied.

Finally, we find some evidence that the effect of task characteristics on stated willingness depends on respondent characteristics: for respondents who use their device every day, the requirement to download an app reduces willingness, while the requirement to actively complete the measurement increases willingness. For respondents who use their devices less frequently neither task characteristic affects stated willingness. This could be because frequent users are likely to have a larger number of apps and files stored on their device, and therefore less available storage space than infrequent users. Conversely, they are likely to be more confident in actively completing tasks using their device, and might find active completion less burdensome than infrequent users.

These findings suggest that willingness to participate in mobile data collection depends on the type of data that researchers want to collect as well as on characteristics of the population of interest that they want to study. Researchers who aim to implement mobile data collection in surveys might adjust the data collection request to the potential barriers of participation that the specific tasks entail. When asking respondents, for example, to complete data collection tasks that require downloading and installing an app on their mobile device, researchers might provide additional instructions or screenshots to respondents on how to access the app store and to download and install apps on their device. For data collection activities that are potentially intruding on the respondent's privacy, including sharing GPS coordinates, researchers might leverage data confidentiality and other data security aspects of the study as part of the data collection request.

In order to maximise participation rates in studies with mobile data collection, researchers might also consider tailoring data collection requests to respondents based on information available from a screening questionnaire. Respondents who have access to a mobile device but are not sufficiently familiar with using the device or use the device less intensively could be offered one-time support by an interviewer who helps them to install and use a data collection app, or could be provided with assistance during data collection, for example by setting up a support hotline. Respondents who report high levels of security concerns could receive invitation letters that contain more information about procedures to ensure data confidentiality. Those who have previously been uncooperative with the study could receive motivational statements in the invitation letter which state the importance of the respondent's participation for the study or

could be provided with higher levels of incentives, particularly in studies that ask respondents to share data from their accelerometer, to connect their mobile device to other devices via Bluetooth, or to use an app that tracks how they use their mobile device.

A limitation of our study is that we focused on a relatively small set of feasible mobile data collection tasks. While we classified the characteristics of these tasks a priori, we did not investigate the full set of potential tasks: we would need 32 ($= 2^5$) tasks to fully test our theoretical model with five task characteristics. We would be hard pressed to find realistic mobile data collection tasks to fit each of these cells. The aim of this paper, however, is to give researchers an idea which task characteristics to consider when examining willingness on a particular data collection task.

While this paper focuses on willingness to participate in mobile data collection generally, a potential avenue for further research is to examine compliance over time in repeated data collection tasks, and the factors that are associated with compliance. Respondents might be willing to engage in mobile data collection for one-off tasks but might drop out of tasks that are continuous or require repeated participation. In studies that track the GPS location of a smartphone, for example, respondents might decide to turn off the GPS function of their mobile device once they realise that GPS consumes a considerable amount of battery power. To shed more light on the effect of respondent characteristics on willingness, future studies might consider including more elaborate typologies of mobile device users in their models. For example, respondents might vary in their attitudes of how important mobile devices are in their daily life, whether they are considered as an integral part or more of a necessity. The role that mobile devices already play in the respondent's life might affect how disruptive they perceive mobile data collection requests and subsequently how willing they are to take part. Mobile device users might also differ in how they perceive themselves with regards to the technology life cycle, whether they see themselves as early or late adopters of mobile technologies (Bosnjak et al., 2010; Davis, 1986, 1989; Venkatesh & Davis, 2000; Venkatesh et al., 2003). This difference in perception might affect their openness towards mobile technologies in general and their willingness to use new technologies for data collection in particular. More research is also needed to further understand some of the findings of this paper. Further research could explore, for example, why frequent smartphone users appear less willing to participate in mobile data collection if the task requires downloading and installing an app, or why cooperative panel members appear less willing to complete some of the data collection tasks.

As survey researchers and others continue to find ways of exploiting the powerful mobile devices that many people carry around with them all day, we need to be mindful of what tasks people might be willing to do, and who might be willing to do what tasks. This paper begins to lay out the issues and provides initial empirical evidence on these important sources of variation in willingness to perform additional data collection tasks using these devices.

References

Abraham, K. G., Maitland, A., & Bianchi, S. M. (2006). Nonresponse in the american time use survey: Who is missing from the data and how much does it matter? *Public Opinion Quarterly*, *70*(5), 676–703.

Bosnjak, M., Metzger, G., & Gräf, L. (2010). Understanding the willingness to participate in mobile surveys: Exploring the role of utilitarian, affective, hedonic, social, self-expressive, and trust-related factors. *Social Science Computer Review*, *28*(3), 350–370.

Burton, J. (2016). *Results for web/face-to-face linkage consent questions in the Innovation Panel.* Paper presented at the CLOSER Mixing Modes and Measurement Methods in Longitudinal Studies Workshop, London, UK.

Chin, E., Felt, A. P., Sekar, V., & Wagner, D. (2012). *Measuring user confidence in smartphone security and privacy.* Proceedings of the Eighth Symposium on Usable Privacy and Security, Washington, DC.

Couper, M. P., Antoun, C., & Mavletova, A. (2017). Mobile web surveys: A total survey error perspective. In P. Biemer, S. Eckman, B. Edwards, E. de Leeuw, F. Kreuter, L. Lyberg, . . . B. West (Eds.), *Total survey error in practice* (pp. 133–154). New York: Wiley.

Davis, F. D. (1986). *A technology acceptance model for empirically testing new end-user information systems: Theory and results.* Doctoral Dissertation. Cambridge: MIT Sloan School of Management.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319–340.

Geurs, K., Veenstra, S., & Thomas, T. (2013). *The setup of a mobile mobility panel for the netherlands.* Proceedings of the 13th World Conference on Transportation Research, Rio de Janeiro, Brazil.

Ginnis, S. (2017). *Mobile-based geo-triggered surveys: Experiences from the field.* Paper presented at the CLOSER "New Technologies to Measure Non-Health Topics in Longitudinal Studies" workshop, London, UK.

Greenfield, T. K., Bond, J., & Kerr, W. C. (2014). Biomonitoring for improving alcohol consumption surveys: The new gold standard? *Alcohol Research: Current Reviews*, *36*(1), 39–45.

Groves, R. M. & Couper, M. P. (1998). *Nonresponse in household interview surveys.* New York: Wiley.

Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics*, *6*(2), 65–70.

Hox, J. (2010). *Multilevel analysis: Techniques and applications.* New York: Routledge.

Jäckle, A., Burton, J., Couper, M. P., & Lessof, C. (2017). *Participation in a mobile app survey to collect expenditure data as part of a large-scale probability household panel: Response rates and response biases.*

Jäckle, A., Gaia, A., Al Baghal, T., Burton, J., & Lynn, P. (2017). *Understanding Society. The UK Household Longitudinal Study Innovation Panel. Waves 1-9, user manual.* https://www.understandingsociety.ac.uk/documentation/innovation-panel. Colchester: University of Essex.

Keusch, F., Antoun, C., Couper, M. P., Kreuter, F., & Struminskaya, B. (in Press). *Willingness to participate in passive mobile data collection.*

Kooreman, P. & Scherpenzeel, A. (2014). High frequency body mass measurement, feedback, and health behaviors. *Economics and Human Biology*, *14*(1), 141–153.

Lathia, N., Sandstrom, G. M., Mascolo, C., & Rentfrow, P. J. (2017). Happier people live more active lives: Using smartphones to link happiness and physical activity. *PLoS ONE*, *12*(1), 1–13.

Lynn, P. (2009). *Sample design for Understanding Society.* Understanding Society Working Paper, 2009–1.

McGaughey, R. E., Zeltmann, S. M., & McMurtrey, M. E. (2013). Motivations and obstacles to smartphone use by the elderly: Developing a research framework. *International Journal of Electronic Finance*, *7*(3/4), 177–195.

Moskowitz, D. S. & Young, S. N. (2006). Ecological momentary assessment: What it is and why it is a method of the future in clinical psychopharmacology. *Journal of Psychiatry & Neuroscience*, *31*(1), 13–20.

Ofcom. (2017). The communications market report. Retrieved from https://www.ofcom.org.uk/__data/assets/pdf_file/0017/105074/cmr-2017-uk.pdf

Pinter, R. (2015). Willingness of online access panel members to participate in smartphone application-based research. In D. Toninelli, R. Pinter, & P. de Pedraza (Eds.), *Mobile research methods: Opportunities and challenges of mobile research methodologies* (pp. 141–156). London: Ubiquity Press.

Poushter, J. (2016). Smartphone ownership and internet usage continues to climb in emerging economies. Retrieved from http://www.pewglobal.org/2016/02/22/smartphone-ownership-and-internet-usage-continues-to-climb-in-emerging-economies/

Revilla, M., Couper, M. P., & Ochoa, C. (2018). Willingness of online panelists to perform additional tasks. *Methods, Data, Analyses*, 1–29.

Revilla, M., Ochoa, C., & Loewe, G. (2017). Using passive data from a meter to complement survey data in order to study online behavior. *Social Science Computer Review*, *35*(4), 521–536.

Revilla, M., Toninelli, D., Ochoa, C., & Loewe, G. (2016). Do online access panels need to allow and adapt surveys to mobile devices? *Internet Research*, *26*(5), 1209–1227.

Sakshaug, J. W., Couper, M. P., Ofstedal, M. B., & Weir, D. R. (2012). Linking survey and administrative records: Mechanisms of consent. *Sociological Methods & Research*, *41*(4), 535–569.

Scherpenzeel, A. (2017). Mixing online panel data collection with innovative methods. In S. Eifler & F. Faulbaum (Eds.), *Methodische Probleme von Mixed-Mode-Ansätzen in der Umfrageforschung* (pp. 27–49). Wiesbaden: Springer.

Sudman, S., Bradburn, N. M., & Schwarz, N. (1996). *Thinking about answers.* San Francisco: Jossey-Bass.

University of Essex. Institute for Social and Economic Research. (2017). Understanding Society: Innovation Panel. Waves 1-9, 2008-2016 [data collection]. 8th edition. UK Data Service. doi:10.5255/UKDA-SN-6849-9

Venkatesh, V. & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186–204.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425–478.

Appendix A

RQ1. How does stated willingness to use mobile technologies vary across different data collection tasks?

Table A1
Stated willingness to complete data collection tasks on a smartphone (in percent)

	Very willing	Somewhat willing	A little willing	Not at all willing	Missing	Total
Camera	33.7	31.1	16.3	18.7	0.2	100.0
Accelerometer	32.2	28.7	15.2	23.7	0.2	100.0
Questionnaire	31.5	24.4	13.4	30.5	0.2	100.0
Bluetooth	28.0	27.8	16.3	27.5	0.3	100.0
Text message survey	23.0	27.1	21.1	28.6	0.2	100.0
Survey app	23.4	23.6	17.1	35.6	0.2	100.0
GPS	18.0	21.1	21.8	39.0	0.2	100.0
Tracking app	13.2	14.5	18.7	53.3	0.3	100.0

$N = 1,379$.

Table A2
Stated willingness to complete data collection tasks on a tablet (in percent)

	Very willing	Somewhat willing	A little willing	Not at all willing	Missing	Total
Questionnaire	38.5	25.9	13.2	22.0	0.5	100.0
Survey app	28.6	22.8	17.5	30.6	0.5	100.0
Camera	26.1	24.9	19.1	29.4	0.5	100.0
Bluetooth	23.2	18.3	19.9	38.0	0.5	100.0
Tracking app	16.3	14.3	18.0	50.9	0.5	100.0

$N = 1,261$.

Appendix B

RQ2. How does stated willingness to do different tasks vary between smartphone and tablet?

Table B1
Consistency of stated willingness among respondents with access to smartphone and tablet (in percent)

	Willing on both devices	Willing on smartphone	Willing on tablet	Not willing on either device	Missing	Total
Questionnaire	49.9	6.4	19.1	24.3	0.3	100.0
Survey app	41.3	7.5	16.2	34.8	0.3	100.0
Tracking app	24.3	3.9	11.1	60.3	0.4	100.0
Camera	48.3	18.9	6.7	25.9	0.3	100.0
Bluetooth	43.6	16.1	4.3	35.5	0.4	100.0

$N = 980$.

Appendix C

RQ3. Which respondent characteristics predict stated willingness to do different tasks?

Table C1

Percent willing to participate in mobile data collection on a smartphone by respondent characteristics

	Camera	Accelero-meter	Question-naire	Blue-tooth	Text messages	Survey app	GPS	Tracking app
Use smartphone every day								
No	48.3	42.0	25.3	37.9	33.5	22.1	28.3	12.4
Yes	68.4	65.0	62.4	59.8	53.7	52.3	41.4	30.8
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000
Number of activities on smartphone								
0-2	31.1	18.6	4.6	5.7	21.5	1.0	9.7	1.2
3-4	51.5	34.4	16.1	32.9	35.3	15.3	28.7	7.0
5-6	52.1	40.6	31.7	32.2	39.2	24.7	26.7	10.6
7-8	64.6	53.5	54.1	60.3	48.6	42.9	36.0	20.6
9-10	70.8	70.3	68.0	58.1	53.6	56.7	39.5	34.8
11-12	74.2	78.8	76.0	74.5	60.7	65.9	51.6	41.7
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Self-reported skill								
1 Beginner	17.0	13.3	7.6	6.4	6.0	8.4	8.2	0.0
2	48.6	32.9	18.3	27.7	40.0	16.9	21.1	6.8
3	62.2	53.0	42.9	46.9	50.3	31.5	36.1	20.0
4	67.9	64.0	60.6	58.0	50.1	50.3	39.2	28.0
5 Advanced	72.4	75.1	74.4	72.1	57.1	65.9	48.5	40.5
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Physical limitations								
No	65.8	62.7	57.2	56.7	51.1	48.4	39.5	28.3
Yes	44.5	26.5	31.5	40.7	31.6	20.6	32.3	13.4
Prob>F	0.021	0.000	0.006	0.091	0.019	0.000	0.355	0.030
WiFi access								
No	71.0	59.4	62.4	58.0	64.3	54.0	56.6	42.8
Yes	64.7	61.1	55.8	55.9	49.8	46.9	38.6	27.2
Prob>F	0.570	0.868	0.595	0.849	0.244	0.550	0.098	0.117
Pay-as-you-go plan								
No	65.2	61.9	57.0	56.9	50.7	48.4	38.8	27.3
Yes	61.8	55.0	49.2	49.2	46.3	37.9	42.1	31.2
Prob>F	0.428	0.213	0.150	0.151	0.281	0.091	0.545	0.400
Time constraints								
No	65.3	59.8	54.2	55.2	48.9	45.1	39.1	26.2
Yes	63.8	64.0	60.6	58.0	53.5	52.1	39.2	31.3
Prob>F	0.701	0.326	0.122	0.445	0.226	0.085	0.986	0.217
Security concerns								
Not at all concerned	86.0	85.3	78.5	84.1	75.9	72.9	71.8	64.8
A little ...	78.6	75.5	70.7	70.0	63.4	58.7	51.5	35.3
Somewhat ...	55.2	51.2	46.0	45.6	40.9	38.8	23.8	14.1
Very ...	37.2	32.3	30.5	28.2	22.7	20.6	16.2	5.4
Extremely ...	31.4	18.7	11.7	9.1	7.9	7.4	4.3	2.2
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

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	Camera	Accelero-meter	Question-naire	Blue-tooth	Text messages	Survey app	GPS	Tracking app
Item-nonresponse								
No	70.2	66.7	57.5	62.9	55.7	51.1	44.2	30.7
Yes	61.5	57.4	55.1	51.6	46.7	44.6	35.9	25.8
Prob>F	0.013	0.009	0.555	0.001	0.006	0.073	0.009	0.164
Consent to data linkage								
No	61.1	54.4	52.0	49.8	47.2	42.4	36.5	22.8
Yes	67.8	65.5	58.8	59.9	52.7	50.6	40.9	31.1
Prob>F	0.031	0.003	0.056	0.002	0.151	0.026	0.170	0.010
Prior panel respone rate								
Less than 1	64.9	66.0	60.3	60.6	48.1	47.6	51.0	34.0
1	64.9	59.5	54.7	54.6	50.9	47.0	35.5	25.8
Prob>F	0.992	0.079	0.149	0.106	0.492	0.887	0.000	0.034
Number of eligible waves								
1-3	65.0	65.2	63.2	59.0	52.7	53.3	40.2	30.0
4-6	70.4	62.3	56.4	56.9	50.5	47.7	41.8	31.1
7-9	60.2	55.0	47.0	51.6	47.0	39.2	35.6	22.1
Prob>F	0.110	0.044	0.004	0.234	0.406	0.018	0.415	0.118

Appendix D
Questionnaire

Q1 – Access to mobile technologies

Which of the following devices do you use to connect to the Internet?
(a) Desktop computer (b) Laptop (c) Smartphone (d) Tablet (e) Feature phone/non-touchscreen mobile phone (f) E-book reader (e.g., Kindle) (g) Smartwatch (h) Other

Q2 – WiFi access

Do you have WiFi access at home? (a) Yes (b) No

Q3 – Type of smartphone contract

Do you have a fixed data plan or a pay-as-you-go contract to get mobile Internet on your smartphone?
(a) Fixed data plan (b) Pay-as-you-go contract (c) No fixed data plan or pay-as-you-go contract (use WiFi only)

Q4 – Frequency of mobile device use

- How often do you use a smartphone for activities other than phone calls or text messaging?

  (a) Every day (b) Several times a week (c) Several times a month (d) Once a month or less

- How often do you use a tablet?

  (a) Every day (b) Several times a week (c) Several times a month (d) Once a month or less

Q5 – Activities carried out on mobile devices

- Do you use your smartphone for the following activities?

  (a) Yes (b) No

  – Browsing websites
  – Email
  – Taking photos
  – Looking at content on social media websites/apps (e.g., looking at text, images, videos on Facebook, Twitter, Instagram)
  – Posting content to social media websites/apps (e.g., posting text, images, videos on Facebook, Twitter, Instagram)
  – Making purchases (e.g., booking train tickets, buying clothes, ordering food)
  – Online banking (e.g., checking account balance, transferring money)
  – Installing new apps (e.g., from iTunes, Google Play Store)
  – Using GPS/location-aware apps (e.g., Google Maps, Foursquare, Yelp)
  – Connecting to other electronic devices via Bluetooth (e.g., smartwatches, bathroom scales)
  – Playing games
  – Streaming videos or music
  – Other

- Do you use your tablet for the following activities?

  (a) Yes (b) No

  – Browsing websites
  – Email
  – Taking photos
  – Looking at content on social media websites/apps (e.g., looking at text, images, videos on Facebook, Twitter, Instagram)
  – Posting content to social media websites/apps (e.g., posting text, images, videos on Facebook, Twitter, Instagram)
  – Making purchases (e.g., booking train tickets, buying clothes, ordering food)
  – Online banking (e.g., checking account balance, transferring money)
  – Installing new apps (e.g., from iTunes, Google Play Store)
  – Using GPS/location-aware apps (e.g., Google Maps, Foursquare, Yelp)
  – Connecting to other electronic devices via Bluetooth (e.g., smartwatches, bathroom scales)
  – Playing games
  – Streaming videos or music
  – Other

Q6 – Self-reported level of skill

- Generally, how would you rate your skills of using a smartphone on a scale from 1 = Beginner to 5 = Advanced?

  (a) 1 Beginner (b) 2 (c) 3 (d) 4 (e) 5 Advanced

- Generally, how would you rate your skills of using a tablet on a scale from 1 = Beginner to 5 = Advanced?

  (a) 1 Beginner (b) 2 (c) 3 (d) 4 (e) 5 Advanced

Q7 – Willingness to participate in mobile data collection

- How willing would you be to carry out the following tasks on your smartphone for a survey?

  (a) Very willing (b) Somewhat willing (c) A little willing (d) Not at all willing

  – Complete an online questionnaire on your mobile phone.
  – Download a survey app to complete an online questionnaire.
  – Download an app which collects anonymous data about how you use your smartphone.
  – Answer a couple of questions sent via text messaging.
  – Use the camera of your smartphone to take photos or scan barcodes.
  – Allow built-in features of your smartphone to measure the frequency and speed at which you walk, run or cycle.
  – Share the GPS position of your smartphone.
  – Connect your smartphone via Bluetooth to other electronic devices (e.g., wearables such as Fitbit).

- How willing would you be to carry out the following tasks on your tablet for a survey?

  (a) Very willing (b) Somewhat willing (c) A little willing (d) Not at all willing

  – Complete an online questionnaire on your tablet.
  – Download a survey app to complete an online questionnaire.
  – Download an app which collects anonymous data about how you use your tablet.
  – Use the camera of your tablet to take photos or scan barcodes.
  – Connect your tablet via Bluetooth to other electronic devices (e.g., wearables such as Fitbit).

Q8 – Security concerns

In general, how concerned would you be about the security of providing information in the following ways?
(a) Not at all concerned (b) A little concerned (c) Somewhat concerned (d) Very concerned (e) Extremely concerned

- Complete an online questionnaire in your mobile browser.
- Download a survey app to complete an online questionnaire.
- Download an app which collects anonymous data about how you use your [smartphone/tablet/smartphone or tablet].
- Answer a couple of questions sent via text messaging.
- Use the camera of your [smartphone/tablet/smartphone or tablet] to take photos or scan barcodes.
- Allow built-in features of your smartphone to measure the frequency and speed at which you walk, run or cycle.
- Share the GPS position of your smartphone.
- Connect your [smartphone/tablet/smartphone or tablet] via Bluetooth to other electronic devices (e.g., wearables such as Fitbit).