Bring Your Own Device and the 2020 Census Research & Testing

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Abstract
The U.S. Census Bureau is exploring the "bring your own device" (BYOD) concept for the 2020 Census. The Census Bureau is developing applications that run on commercial devices for potential use in the 2020 Census. To date, an address listing and mapping application and an interviewer-administered survey application have been developed to run on Apple iOS, Google and Microsoft mobile Windows operating systems. This software was also developed to run on multiple form factors, including tablets and smartphones. At the same time that the technological components of this program are being worked out, policy and public relations aspects are also being explored. This paper will discuss preliminary results of the general public's willingness to use their own device in a work setting, such as a Census.

Key Words: BYOD, Commercial Devices, Survey Results

Background[1]

As it does every decade, the Census Bureau will conduct a census in 2020 to enumerate the population and housing in the United States and to disseminate data to the President, the States, and the American People. The Census Bureau is committed to designing and conducting a 2020 Census that costs less per housing unit than the 2010 Census (adjusted for inflation) while maintaining quality results. To achieve its cost and quality targets and meet its strategic goals, the Census Bureau must make fundamental changes to the design, implementation, and management of the decennial census. Substantial innovation and improvements are necessary to meet these goals. As a result, the 2020 research program focuses on key cost drivers, including reengineering the field operational infrastructure to take advantage of efficiencies gained through using electronic data collection methods (U.S. Census Bureau, 2012a).

The workload for nonresponse followup drives the number of employees hired and the materials needed to conduct the enumeration. In 2010, the nonresponse followup workload was almost 50 million housing units and the Census Bureau had estimated that approximately 400,000 devices would be needed to conduct an automated followup operation.

Options to enumerate the nonresponse workload in 2020 are focused on hardware related to automated operations. The continuum of options range from government furnished equipment and services to employee provided equipment and service (i.e., Bring Your Own Device or BYOD). The Digital Services Advisory Group and Federal CIO Council suggest that "BYOD is about offering choices to customers… the government can address the personal preferences of its employees, offering them increased mobility and better integration of their personal and work lives…in a way that optimizes their productivity" (Digital Services Advisory Group and Federal Chief Information Officers Council, 2012). Thus the Census Bureau plans to investigate and test the feasibility of implementing a BYOD framework as we prepare for the 2020 Census.

A more extensive literature review was attempted, but given that this appears to be a new realm of research, we met limited success in finding further sources.

[1] This report is released to inform interested parties of ongoing research and to encourage discussion of work in progress. Any views expressed on statistical, methodological, technical, or operational issues are those of the authors and not necessarily those of the U.S. Census Bureau.

Methods and Results

The goals of this paper are to:

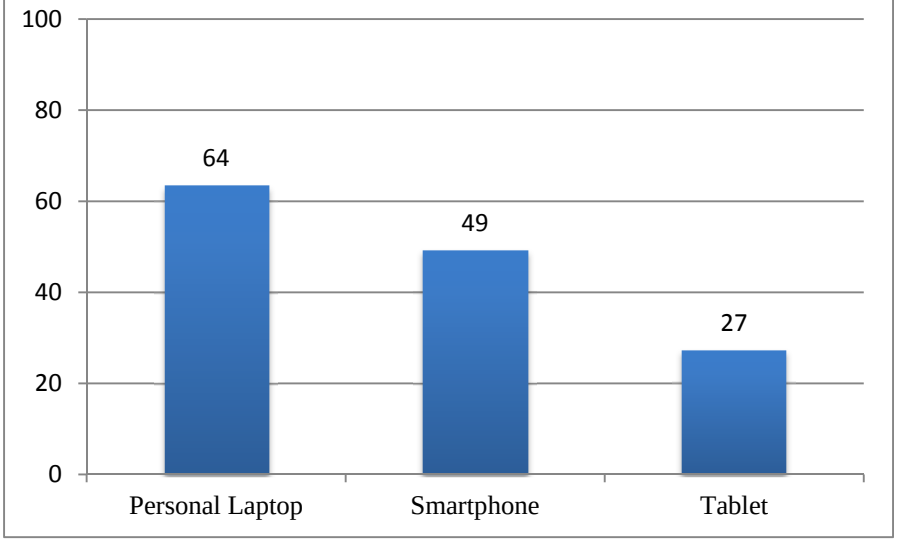
- Present results of an internal Census Bureau field interviewer study to identify the type of devices and internet access interviewers currently have.
- Present results about the general public's willingness to use their own device for work purposes.

Census Interviewer Survey Results

In order to identify the type of devices and the type of internet access Census Bureau field interviewing staff currently have, the Census Bureau conducted a survey from July 25, 2013 to August 23, 2013 with all field staff with Computer Assisted Personal Interview (CAPI) laptops (U.S. Census Bureau, 2012b). A total of 8,725[2] field staff received the survey on their CAPI laptops, with 4,265 of them completing the survey resulting in a response rate of 48.9% (AAPOR, RR1).

Figure 1 below shows the percent of field staff who report owning each type of device.

Figure1. Percent of Census Bureau Interviewers Owning Each Type of Device (Unweighted)



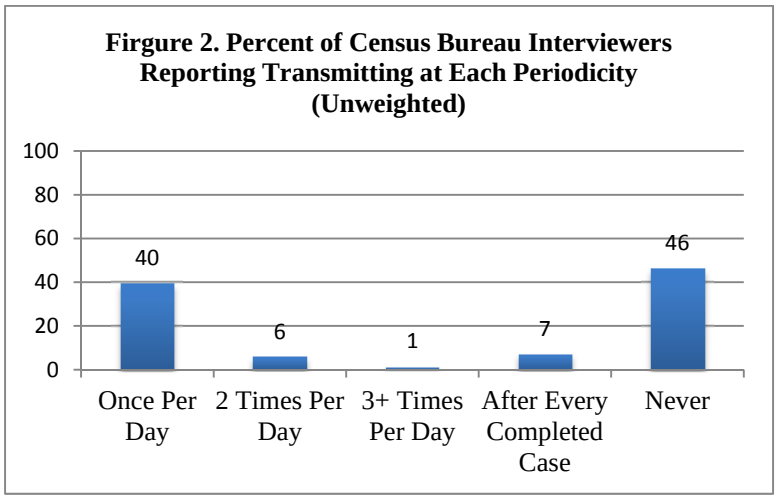
Note: Does not sum to 100 percent because an interviewer can own multiple devices.

We see that about 64 percent of field staff report currently owning or having access to a personal laptop. Laptops are currently the type of device that is provided to field staff for CAPI survey work. Almost half of field staff report owning a smartphone. Of those that own a smartphone, it is almost evenly split among iPhone and Android users – 43 percent report owning an iPhone and 48 percent report owning an Android. Just over a quarter of field staff report owning a tablet of some kind. Overall, about 45% of field staff report owning at least two of these devices (not shown in Figure 1). Of note to the current effort, at least half of the current Census Bureau field staff currently personally own the equipment needed to implement a BYOD infrastructure.

[2] This included temporary staff who were hired for the American Housing Survey expansion.

For field staff with smartphones, we asked about the type of data and voice plans they had with the device. About 40 percent of field staff reported having an unlimited data plan and 39 percent of field staff reported having an unlimited voice plan, with about 24 percent indicating they have both. The prevalence of unlimited plans in the future could play a key role in determining whether the Census Bureau would need to reimburse employees for extensive use of their personal data and voice plans.

About 91 percent of field staff reported having personal internet access at home, with about 89 percent of those with personal internet access reporting they have Wi-Fi. Currently the Census Bureau provides a cellular data modem on the CAPI laptops so that field staff may transmit results while in the field. Figure 2 presents how often interviewers reported transmitting data while in the field.



We see that the many field staff report never transmitting while in the field (46 percent), followed by field staff who only transmit once per day (40 percent). Given that many of the field staff report never transmitting in the field and having internet access at home, it seems quite plausible that these transmissions could be made from home without the need of the Census Bureau providing a wireless hotspot.

Gallup Daily Tracking Survey Results

As a part of a different research agenda, Gallup has been conducting a nightly survey for the Census Bureau that asks 19 questions measuring knowledge about and attitudes towards the Federal Statistical System. As the survey sponsor, we elected to add an additional five questions on topics of choice. From August 5, 2013 to September 2, 2013, we asked five questions to gauge respondents' (i.e. the general public) willingness to use their own device for work purposes. In total 6,013 respondents[3] completed the survey during this time period, however only respondents who were employed or looking for work were eligible for these questions, so only 3,723 (62 percent) respondents received them. Because the workforce for a census is one that is hired temporarily, with very little required expertise or experience, the general workforce population is a suitable proxy for the mass-hired census workforce. In 2010, for example, over a half of a million U.S. residents were hired temporarily to work for the census enumeration.

[3] The response rate was about 8.0 percent (AAPOR, RR3). All data has been weighted to produce a nationally representative sample. The weights account for unequal selection probabilities and adjust for non-response and coverage effects. Although the Gallup Daily Tracking Survey is portrayed as being nationally representative, it does not meet Census Bureau quality standards for dissemination and is not intended for use as precise national estimates or distribution as a Census Bureau data product. We consider the quantitative estimates informative in a relative sense, not as statistically precise estimates of a target population. All variances were estimated using the Jacknife method with two strata and four PSU's.

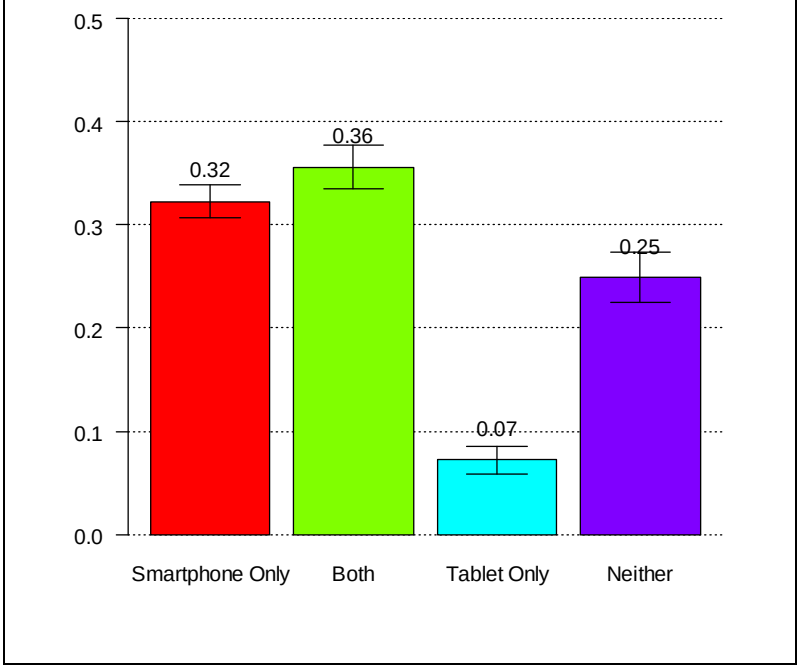
Our goals were to understand the following generally, with respect to demographic differences, and to establish a baseline that we can monitor for the next few years leading up to the 2020 Census:

1. Of the workforce who owns a smartphone, tablet (or both), what proportion would be willing to use their own device for:
    a. Work calls?
    b. Work emails?
    c. Download apps for work purposes?
2. If unsure or unwilling to use their own device for at least one work purpose, is their main concern cost, privacy or something else?
3. What role does compensation play in the willingness to use their own device?
4. Determine if there are any demographic differences.

Please see Appendix A for actual question wording.

Figure 3 below shows the distribution of respondents in the workforce who own a smartphone and/or tablet.

Figure 3. Distribution of Respondents In The Workforce Who Own A Smartphone or Tablet

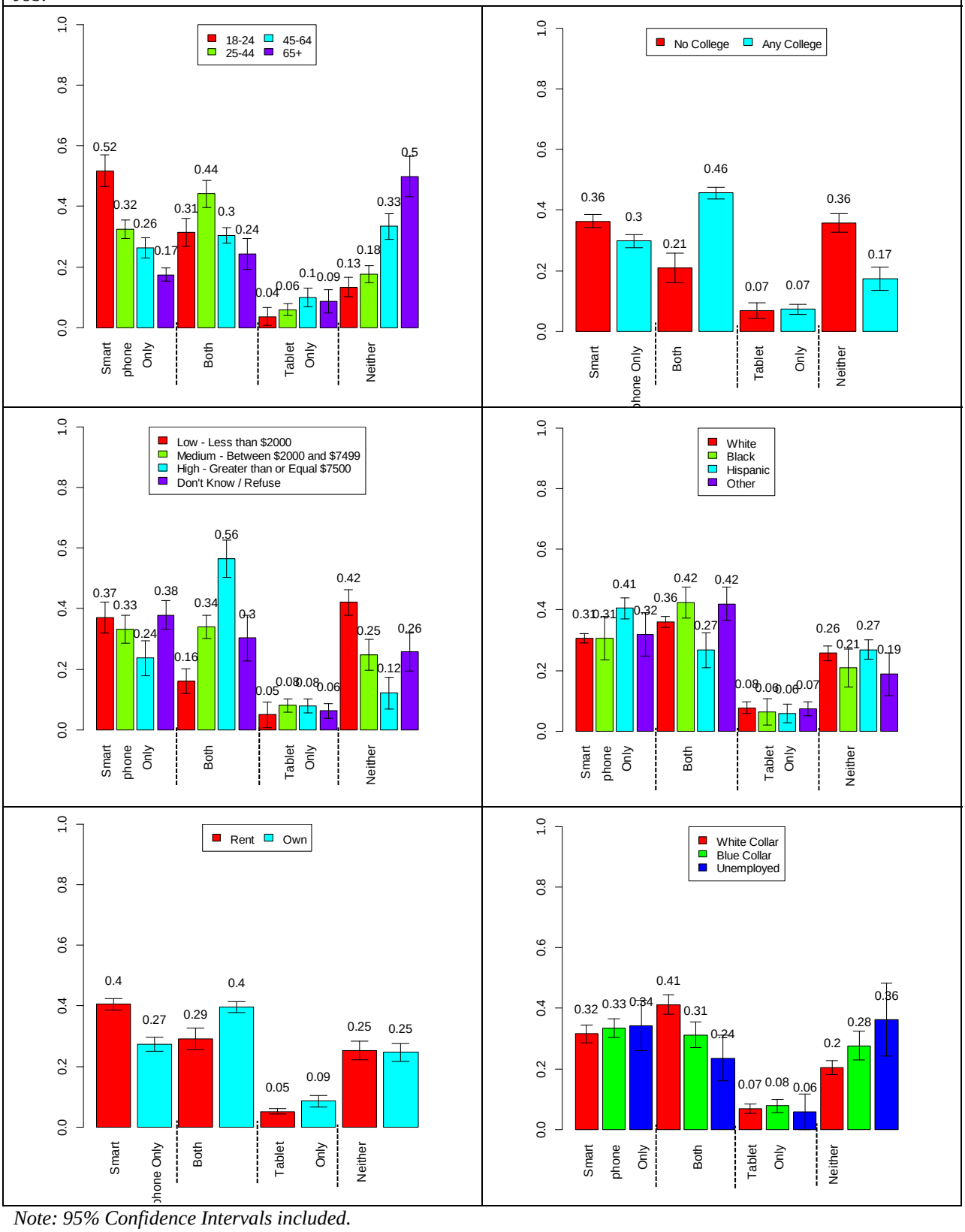


Note: 95% Confidence Intervals included.

Figure 3 shows about 68 percent ("smartphone only" and "both" – a smartphone and tablet) report owning a smartphone and about 43 percent (tablet only and both) report owning a tablet. About 25 percent of respondents report not owning either a smartphone or a tablet[4]. This 25 percent of respondents were not asked the remaining questions, which brings our sample down to 2,765 respondents (or about 46 percent of all respondents). Figure 4 below shows the same distribution as Figure 3, by age, education, income, race/ethnicity, tenure and type of job.

[4] Included in the neither category are one respondent who reported "don't know" and one respondent who reported "refused" to the questions about owning a smartphone or tablet. They are included with the "Neither" category since they would not be asked subsequent questions as we could not identify which type of device they owned.

Figure 4. Distribution of Type of Device Owned by Age, Education, Income, Race/Ethnicity, Tenure and Type of Job.

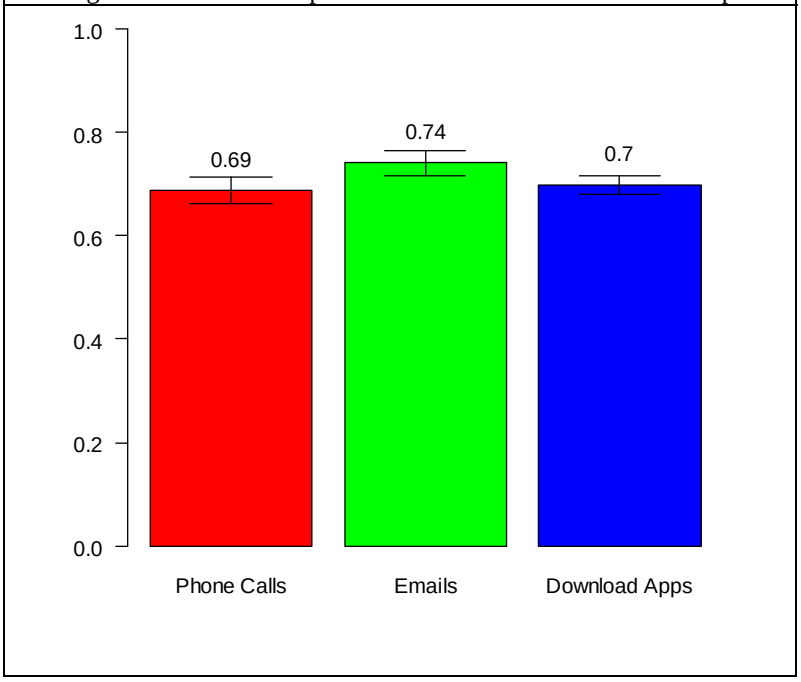


Note: 95% Confidence Intervals included.

Figure 4 shows that the youngest adults (18-24) are more likely to own only a smartphone (52 percent), younger adults (25-44) are more likely to own both a smartphone and tablet (44 percent), and the elderly are most likely to own neither (50 percent). We also see that persons with higher education and income are more likely to own both, while those with less are more likely to own only a smartphone or neither.[5] We see that renters are more likely than owners to own a smartphone only; while owners are more likely to own both a smartphone and a tablet. Lastly, we see that respondents with white collar jobs are more likely to own both a smartphone and tablet than those who are unemployed; while those who are unemployed are more likely to own neither.

Figure 5 shows the distribution of respondents who reported they would use their smartphone or tablet for work related purposes.

Figure 5. Distribution Of Respondents Who Reported They Would Be Willing to Use Their Smartphone or Tablet For Work Related Purposes



Note: 95% Confidence Intervals included.

Figure 5 shows that nearly 70 percent of respondents reported being willing to use their device for each of the work related purposes. Sixty-one percent of respondents said yes to all purposes, 19 percent said no to at least one purpose, and 20 percent said no to all purposes (not shown in Figure 5). To understand the characteristics of respondents who are willing to use their device for work related purposes, we fit three logistic regression models where the dependent variable in each model was the work purpose. The following variables were included in the model as independent variables:

- Type of Device Owned – Smartphone (reference), Both, Tablet.
- Race/Ethnicity – White (reference), Black, Hispanic, Other (includes Asian, American Indian/Alaska Native, Native Hawaiian or Pacific Islander, and multiple races reported)

[5] Respondent who Don't Know or Refuse their income are included as their own category because they make up about 13 percent of our sample. Past research has shown that respondents in this category have different views or attitudes than respondents who report their income, such as an increased concern for privacy (Fulton, 2012; King, Childs, Wroblewski, Miller, 2013).

- Age – 18-24 years of age, 25-44 years of age, 45-64 years of age, 65+ (reference)
- Education – No College Education, Any College Education (reference)
- Gender – Male (reference), Female
- Household Monthly Income – Low (Less than $2000/month), Medium (Between $2000 and $7499/month), High (Greater than or equal to $7500/month, reference), Don't know/Refuse
- Tenure – Own (reference), Rent
- Type of Job – White Collar (reference), Blue Collar, Unemployed

Table 1 shows the logistic results and Table 2 below shows contrast results where necessary.

Table 1 Results of Logistic Regression to Identify Characteristics Associated With Willingness To Use Own Device for Work Purposes

	Phone Calls		Emails		Download Apps	
Variable	Parameter Estimate (SE)		Parameter Estimate (SE)		Parameter Estimate (SE)	
Intercept	0.60 (0.21)	***	0.41 (0.27)		0.42 (0.26)	***
Type of Device – Both Smartphone and Tablet	0.01 (0.18)		0.20 (0.15)		0.15 (0.13)	
Type of Device –Tablet Only	-0.80 (0.18)	***	-0.23 (0.16)		-0.59 (0.10)	***
Race/Ethnicity - Black	-0.19 (0.15)		-0.20 (0.21)		-0.13 (0.14)	
Race/Ethnicity - Hispanic	-0.09 (0.17)		-0.13 (0.18)		-0.12 (0.22)	
Race/Ethnicity - Other	-0.32 (0.29)		-0.30 (0.29)		-0.19 (0.23)	
Age – 18 to 24	1.13 (0.26)	***	1.90 (0.18)	***	1.83 (0.28)	***
Age – 25 to 44	0.57 (0.16)	***	0.83 (0.06)	***	0.60 (0.14)	***
Age – 45 to 64	0.16 (0.17)		0.23 (0.13)	*	0.28 (0.19)	
Any College Education	0.28 (0.12)	**	0.28 (0.15)	*	0.30 (0.08)	**
Female	-0.28 (0.08)	***	-0.23 (0.10)	**	-0.41 (0.09)	***
Low Income	0.30 (0.24)		0.28 (0.18)		0.53 (0.14)	
Medium Income	-0.28 (0.14)	**	-0.20 (0.13)		-0.20 (0.18)	**
DK/REF Income	-0.48 (0.10)	***	-0.61 (0.07)	***	-0.37 (0.16)	***
Tenure – Rent	-0.03 (0.08)		0.09 (0.14)		0.01 (0.13)	
Blue Collar Job	-0.07 (0.12)		0.02 (0.14)		-0.16 (0.14)	
Unemployed	0.13 (0.21)		0.01 (0.27)		-0.13 (0.24)	

*** p<=0.01, ** p<=0.05, * p<=0.10

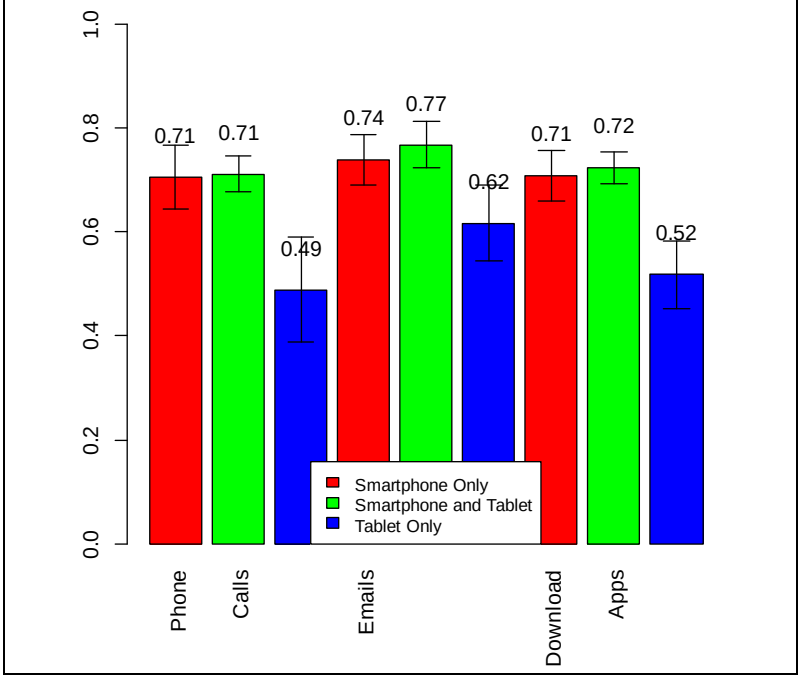
Table 2. Contrast Results of Logistic Regression to Identify Characteristics Associated With Willingness To Use Own Device for Work Purposes

Contrast	Phone Calls	Emails	Download Apps
Both Smartphone and Table compared to Tablet Only	***	*	***
Black compared to Hispanic			
Black compared to Other			
Hispanic compared to Other			
Ages 18-24 compared to Ages 25-44	**	***	***
Ages 18-24 compared to Ages 45-64	***	***	***
Ages 25-44 compared to Ages 45-64	***	***	**
Low Income compared to Medium Income	***	**	***
DK/REF Income compared to Low Income	***	***	***
DK/REF Income compared to Medium Income		**	
Blue Collar Job compared to Unemployed			

*** p<=0.01, ** p<=0.05, * p<=0.10

In Table 1, a positive and significant parameter estimate indicates that a respondent with that characteristic is more likely to be willing to use their own device for work purposes compared to the reference group. A negative and significant parameter estimate indicates that a respondent with that characteristic is less likely to be willing to use their own device for work purposes compared to the reference group. In Table 2, a comparison that is statistically significant indicates that there is a difference in the parameter estimates for the non-reference groups. The logistic regression results show that generally the type of device a respondent has, age, and income of a respondent have the largest most significant impacts, when looking at the size of the effects. While both gender and education were significant, the size of the effects were not as large. The following three charts provide the marginal impact of type of device, age and income.

Figure 6. Distribution Of Respondent Who Report Being Willing To Use Their Own Device For Work Related Purposes By Type of Device Owned

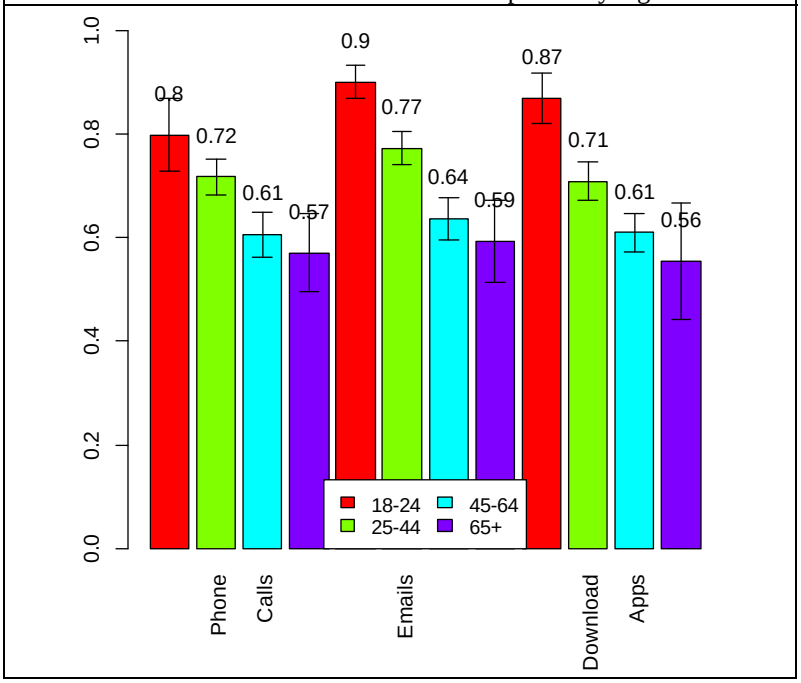


Note: 95% Confidence Intervals included.

Figure 6 shows that persons who own only a smartphone or both a smartphone and a tablet are more likely to report that they are willing to use their device (or one of their devices) than those who only own a tablet.

Figure 7 below shows the distribution of respondents who report being willing to use their own device for work purposes by age.

Figure 7. Distribution Of Respondent Who Report Being Willing To Use Their Own Device For Work Related Purposes By Age

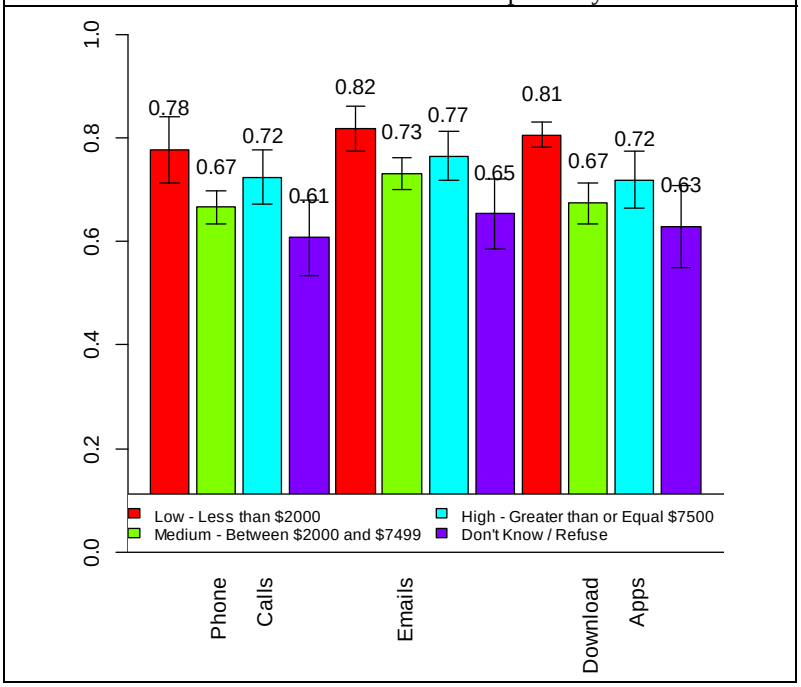


Note: 95% Confidence Intervals included.

Figure 7 shows a declining linear trend with age. As age increases, respondents are less willing to use their own device for work purposes. As we get closer to the 2020 Census, and as the population continues to age, it will be important to watch this trend over time.

Figure 8 In shows the distribution of respondents who report being willing to use their own device for work purposes by reported income.

Figure 8. . Distribution Of Respondent Who Report Being Willing To Use Their Own Device For Work Related Purposes By Income



Note: 95% Confidence Intervals included.

Figure 8 does not show a clear linear trend, but we see that persons with lower or higher incomes are generally more willing to use their own devices for work purposes than respondents in a middle income category and those who do not report their income (a trait correlated with increased concerns of privacy). For those with lower incomes, this may be because they are willing to do what the job asks to ensure that they have a job, while those with the highest incomes may already have jobs where this is expected.

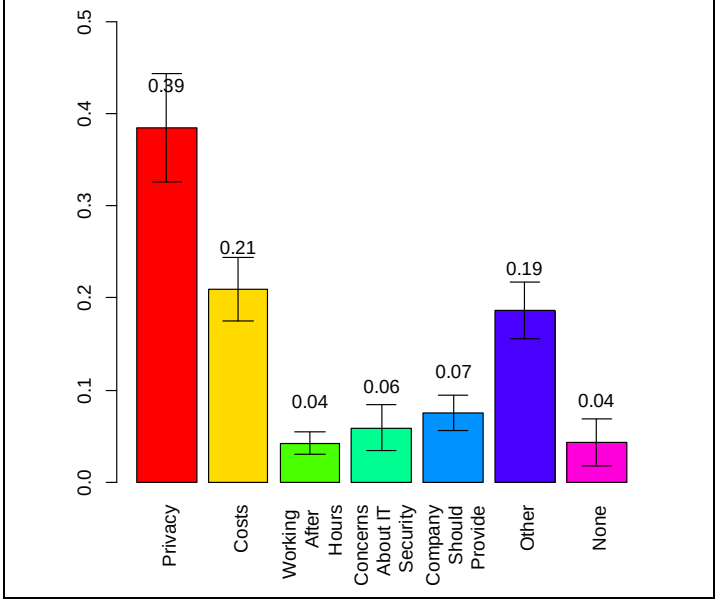
If a respondent indicated that they were not willing to use their device for at least one work purpose we asked them what concerns them the most about using their own device. These were open-ended responses that interviewers coded into one of the following categories:

- Privacy
- Cost
- Device being lost or stolen
- Working after hours
- Concerns about IT security
- Company should pay for it / provide it for employees if it is expected
- Getting viruses
- Device being broken
- Other
- None
- Don't Know
- Refused

Figure 9 shows the distribution of these concerns, collapsing the lesser used categories into "Other."[6]

[6] Categories that were collapsed with Other generally had a low number of responses. These included (1) Don't know, 2 percent, (2) Refused, 0.4 percent, (3) Device being lost or stolen, 0.9 percent, (4) Getting viruses, 0.6 percent, (5) Device being broken, 0.3 percent.

Figure 9. Proportion of respondents who declined at least one purpose citing their concern in each category.



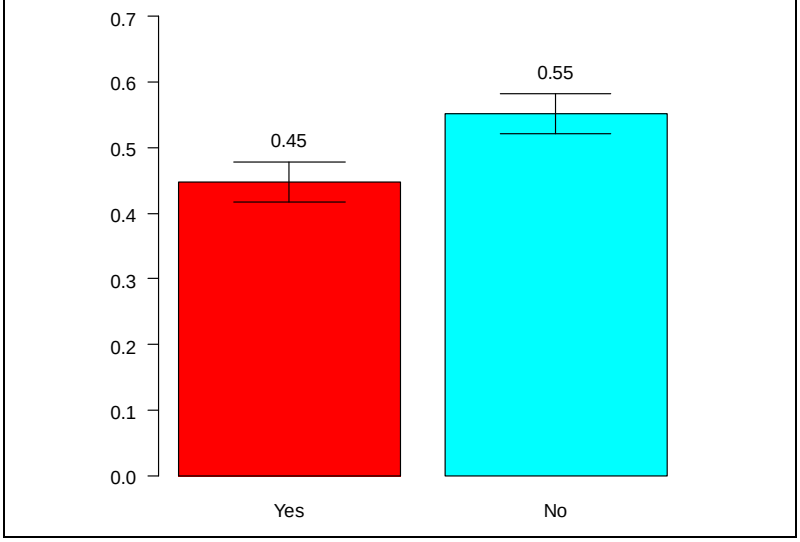
Note: 95% Confidence Intervals included.

Figure 9 shows that respondents reported being most concerned with privacy (31 percent) followed by costs (21 percent). Due to small sample sizes in a number of demographic variables we could not draw strong conclusions about any differences by demographics. However, we saw that persons who said no to all work purposes were more likely to cite privacy concerns (44 percent) than those who said yes to at least one (32 percent).[7]

Lastly, if a respondent said yes to using their device for at least one work purpose, we asked the respondents if they would be willing to use their own device even if they were not compensated for using their own data or minutes. Figure 10 shows the percent of respondents who reported that they would be willing to use their own device for work purposes if they were not compensated.

[7] Chi-square=49.9, DF=6, p<0.01

Figure 10. Percent of Respondents Who Report Willing To Use Their Own Device For Work Purposes if not Compensated



Note: 95% Confidence Intervals included.

Figure 10 shows that the majority of respondents, about 55 percent, reported not being willing to use their own device if not compensated (when directly asked). While a logistic regression shows some small differences in a handful of demographics (age, income and gender) the biggest difference is seen in a respondent's willingness to use their own device.[8] Respondents who report being willing to use their own device for all work purposes indicate that they would be willing to use their own device without compensation about 52 percent of the time. In contrast those who say they would not be willing to use their own device for at least one work purpose report that they would be willing to use their own device for work purpose without compensation only about 23 percent of the time.

Conclusions

In conclusion, the Gallup results have shown us that most respondents report being willing to use their device for work purposes. We see that smartphone users, younger persons, and those with lower incomes are generally more willing to use their own device.

When respondents express an unwillingness to use their own device, the majority of respondents report privacy being their main concern. However, when prompted specifically about compensation, a majority indicate that they would only use their device if compensated.

Moving forward the Census Bureau will continue to monitor the public receptiveness of using one's own device for work. In addition, the Census Bureau will explore the public's willingness to be enumerated given a BYOD concept in which interviewers are using their personally owned devices. This is the beginning of a larger research agenda that will have many technical, legal and policy components.

Acknowledgements

Thank you to Monica Wroblewski, Julia Coombs, and Dawn Nelson for their reviews of this paper.

[8] See Appendix B for logistic results.

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APPENDIX A – Question Wording

1. Some cell phones are called smartphones because of certain features they have. Do you have a smartphone, such as an iPhone, Android, Blackberry, or Windows phone, or are you not sure?

2. Do you have a tablet computer like an iPad, Samsung Galaxy, Motorola Xoom, or Kindle Fire?

3. Would you be willing to use your own smartphone/tablet/smartphone or tablet…

    - To make and receive phone calls for work purposes?
    - For work email?
    - To download and use apps for your job?

4. What are you most concerned about? *Responses coded not read.*

    - Privacy
    - Cost
    - Device being lost or stolen
    - Working after hours
    - Concerns about IT security
    - Company should pay for it / provide it for employees if it is expected
    - Getting viruses
    - Device being broken
    - Other
    - None
    - Don't Know
    - Refuse

5. Would you still be willing to use your own device for work if your job did not pay you back for using your data or minutes?

APPENDIX B – Results of Logistic Regression to Identify Characteristics Associated With Willingness To Use Own Device for Work Purposes If Not Compensated

Table 1. Results of Logistic Regression to Identify Characteristics Associated With Willingness To Use Own Device for Work Purposes If Not Compensated

Variable	Parameter Estimate (SE)	
Intercept	-1.28 (0. 29)	***
Type of Device – Both Smartphone and Tablet	0.15 (0.11)	
Type of Device –Tablet Only	0.09 (0.28)	
Will Use Device For All Work Purposes	1.26 (0.12)	***
Race/Ethnicity - Black	-0.17 (0.18)	
Race/Ethnicity - Hispanic	-0.05 (0.15)	
Race/Ethnicity - Other	0.24 (0.20)	
Age – 18 to 24	-0.01 (0.13)	
Age – 25 to 44	0.25 (0.09)	***
Age – 45 to 64	0.32 (0.09)	***
Any College Education	-0.01 (0.19)	
Female	-0.23 (0.08)	***
Low Income	-0.28 (0.21)	
Medium Income	-0.28 (0.08)	***
DK/REF Income	-0.18 (0.18)	
Tenure – Rent	0.15 (0.10)	
Blue Collar Job	0.20 (0.13)	
Unemployed	-0.08 (0.27)	

*** p<=0.01, ** p<=0.05, * p<=0.10

A positive and significant result indicates that a respondent with that characteristic is more likely to be willing to use their own device if not compensated. A positive and significant result indicates that a respondent with that characteristic is less likely to be willing to use their own device if not compensated.

Table 2. Contrast Results of Logistic Regression to Identify Characteristics Associated With Willingness To Use Own Device for Work Purposes If Not Compensated

Contrast	Signficance
Both Smartphone and Table compared to Tablet Only	
Black compared to Hispanic	
Black compared to Other	
Hispanic compared to Other	
Ages 18-24 compared to Ages 25-44	***
Ages 18-24 compared to Ages 45-64	***
Ages 25-44 compared to Ages 45-64	
Low Income compared to Medium Income	
DK/REF Income compared to Low Income	
DK/REF Income compared to Medium Income	
Blue Collar Job compared to Unemployed	

*** p<=0.01, ** p<=0.05, * p<=0.10

A comparison that is statistically significant indicates that there is a difference in the parameter estimates for the non-reference groups.