



THE JOURNAL ON
TECHNOLOGY AND
PERSONS WITH
DISABILITIES

Smartphone Use and Activities by People with Disabilities: User Survey 2016

John T. Morris, PhD, W. Mark Sweatman, PhD, Michael L. Jones, PhD

Rehabilitation Engineering Research Center for Wireless Technologies

Shepherd Center

john_morris@shepherd.org, mark_sweatman@shepherd.org,

mike_jones@shepherd.org

Abstract

Access and use of mainstream wireless technology is essential to social and economic participation, which can be especially challenging to people with disabilities. Technology ownership rates are indicative of general access to these critical technologies. However, analysis of the activities of technology users can provide more detailed assessment of the nature and degree of technology access. This article presents findings from the Survey of User Needs (SUN) for Wireless Technologies, a large, multi-year survey on use of consumer wireless technology by people with disabilities, conducted by the Rehabilitation Engineering Research Center for Wireless Technologies. Because of their versatility (connectivity, size, and portability) smartphones have come to occupy the center of many people's digital experience. Data are presented on the ways people with disabilities use their smartphones, including voice calling, text messaging, emailing, using mobile apps, social networking, etc. Analysis of smartphone activities is provided on three areas: 1) adults with physical, cognitive, and sensory disabilities analyzed as a group; 2) the impact of key demographic variables – age, race/ethnicity, household income; 3) activities by disability type (blindness, deafness, difficulty speaking, etc.).

Keywords

Information & Communication Technology (ICT), Research and Development, Accessibility

Introduction

Access and use of mainstream wireless technology has become essential to social and economic participation. Digital exclusion means less independence and greater social exclusion. If you don't have access to mainstream consumer information and communication technology, you're not part of the conversation, both literally and figuratively. Ownership rates are generally indicative of access to these critical technologies. However, analysis of the activities of technology users can provide more detailed assessment of the nature and degree of technology access. This article presents findings from the Survey of User Needs (SUN) for Wireless Technologies, a large, multi-year survey on use and usability of mainstream wireless technology by people with disabilities, conducted by the Rehabilitation Engineering Research Center for Wireless Technologies (Wireless RERC). Data are presented on the ways people with disabilities use their smartphones, including voice calling, text messaging, using mobile apps, social networking, accessing the Internet, etc.

Because of their versatility (connectivity, size, and portability) smartphones have come to occupy the center of many people's personal communications infrastructure and digital life. Data from the CTIA-The Wireless Association show over 378 million wireless service subscriber connections in the United States (CTIA 2015), substantially exceeding the total national population. The Pew Research Center reports steadily rising rates of cellphone ownership (including smartphones), from 73% of American adults in 2006 to 92% in 2015 (Pew 2015). Smartphone ownership has risen from 35% of American adults in 2011, to 56% in 2013, and 68% in 2015; the tablet ownership rate rose from 10% to 34% and 45% (Table 1).

People with disabilities have access to mainstream mobile wireless technology at generally the same rates as the general population. Survey research data collected by the

Rehabilitation Engineering Research Center for Wireless Technologies (Wireless RERC)

indicate that 84% of people with disabilities own or use a cellphone or smartphone. Including tablets raises the wireless device ownership rate for people with disabilities to 91%. Table 1 shows that the smartphone ownership rate among people with disabilities has risen from 57% to 72% in the three years from 2012-2013 to 2015-2016. Tablet ownership rose from 35% to 50%.

Table 1. Device Ownership by Adults with Disabilities (SUN) and in the General Population (Pew Research Center), 2012-2015.

Device Type	SUN 2012-2013	SUN 2015-2016	Pew 2013	Pew 2015
Basic Phone (e.g. Motorola Razr, Pantech Breeze, Nokia 6350)	27%	13%	35%	24%
Smartphone (e.g. iPhone, Android phone, Windows phone)	57%	72%	56%	68%
Tablet (e.g. iPad, Kindle Fire, Galaxy Tab, Microsoft Surface)	35%	50%	34%	45%

Overall ownership rates of mobile wireless devices, particularly smartphones, provide a key indicator of access to wireless technology (Morris et al. 2016; 2014). However, understanding what people with disabilities *do* with their devices will shed light on how and whether they are realizing the rapidly expanding potential of their technology. This article provides analysis of the smartphone activities and behaviors on three levels /dimensions:

1. Analysis of adults with disabilities analyzed as a group; includes comparison with the data from the Pew Research Center for the general population of adults.
2. Analysis of the impact of key demographic variables – household income and age – on smartphone activities.

3. Analysis of smartphone activities and behaviors by disability type (blindness, deafness, difficulty speaking, etc.) will provide additional insight into the specific behaviors of each group, and perhaps identify opportunities for serving them better.

Discussion

Originally launched in 2002 and now in its 5th version, the SUN has been updated over the years to keep current with the rapid pace of technological change. This unique, nationwide survey on wireless technology use by people across disabilities has come to be an important reference for the wireless industry, government regulators, people with disabilities, disability advocates, and other researchers. Over 7,500 people with all types of disabilities have completed at least one of the previous versions of the SUN since 2002. Sample size for the current version of the SUN is 1,168 respondents across the disability categories listed in Table 2. Participants were recruited using convenience sampling via email, the web, personal outreach, telephone, and in-person interviews. The mean age of all respondents who reported a disability was 59.29 years and 52.23 for the 2012-2013 and 2015-2016 surveys, respectively. Whites accounted for 81 percent and 84 percent of the earlier and later samples, respectively. Females represented 58% of respondents in both surveys. Regarding income, 61 and 56 percent of the earlier and later samples reported annual household income below \$50,000.

Table 2. Wireless RERC Survey of User Needs: Sample by Disability Type (% of respondents).*

Disability Type	2012-2013 Respondents (%) (n = 1068)	2015-2016 Respondents (%) (n = 970)
Difficulty walking, standing or climbing stairs	39%	42%
Hard of hearing	24%	31%
Deaf	12%	12%
Low vision	16%	13%
Blind	8%	6%
Difficulty using hands or fingers	25%	25%
Difficulty concentrating, remembering, deciding	25%	21%
Frequent worry, nervousness, or anxiety	23%	23%
Difficulty using arms	17%	20%
Difficulty speaking so people can understand me	15%	17%

* Figures add to more than 100% because many respondents reported more than one disability.

Four of the top-level disability categories (difficulty walking/standing, hearing, seeing, and thinking) are used by the U.S. Census Bureau's American Community Survey (Ruggles et al 2015). The other four top-level categories are adapted from the semi-annual National Health Interview Survey (NHIS) conducted by the Centers for Disease Control and Prevention (CDC 2015). The SUN 5 questionnaire permits segmentation by disability sub-types (e.g., low vision/blind as a subtypes of difficulty seeing; and deaf/hard of hearing as subtypes of difficulty hearing). Basing the disability categories on existing national databases permits comparison with the SUN sample in order to identify possible validity threats due to convenience sampling.

Key smartphone activities examined include texting, mobile Internet, emailing, using apps, social media, maps/GPS, voice calling and video calling/chats. Analysis focuses on demographics (household income and age) and disability type. Data from the Pew Research

Center's survey on smartphone activities and the 2012-2013 SUN are used for comparison. Key questions addressed include:

- Do people with disabilities use functions and services such as email, text messaging, mobile Internet and social media at the same rate as the general population (disability divide – Horrigan 2010; Kessler Foundation and NOD 2010)?
- Do younger adults with disabilities use wireless technology more broadly and more intensively (use of more of these functions with greater frequency and duration) than older users (age divide – Wireless RERC 2013)?
- Among people with disabilities, does income affect use of these wireless functions and services (economic access – Morris et al 2014)?
- Do people with certain disabilities use these functions and services more or less than people with other disabilities (Morris et al 2014)?

People with disabilities engaged in core cellphone activities at similar rates as the general population in 2012-2013 (Table 3) and in 2015-2016 (Table 4), although with some variation for specific activities. Table 3 shows activities for owners of *all types of mobile phones* (basic cellphones and smartphones), while Table 4 shows activities for *smartphones only*. This difference in reporting between the two periods was made necessary by the way the Pew Research Center reported data, likely a reflection of the expanded adoption of smartphones since 2013. It might have seemed important to Pew researchers to include all mobile phone users in 2013 when a substantial portion of the population used regular cellphones, but not so much by 2015. The fact that many of the features and functions listed in Tables 3 and 4 are much more easily, or even exclusively, accessible via smartphones may have informed decisions regarding

data collection and reporting. Because of these differences the Pew data for the two time periods cannot be compared, nor can the SUN data for these two tables.

Table 3. Wireless Activities for *Cellphone* Users with Disabilities (SUN 2012-2013) and the General Population (Pew Research Center, April-May 2013).

Wireless Activities	SUN 2012-2013*	Pew 2013**
Texting	71%	81%
Internet	60%	60%
Email	61%	52%
Mobile apps	48%	50%
Social media	48%	N/A
Maps/GPS	45%	49%
Voice calling	64%	N/A
Video calling	25%	21%

Table 4. Wireless Activities for *Smartphone* Users with Disabilities (SUN 2015-2016) and the General Population (Pew Research Center, 2015).

Wireless Activities	SUN 2015-2016*	Pew 2015**
Texting	88%	97%
Internet	81%	89%
Email	85%	88%
Mobile apps	70%	N/A
Social media	66%	75%
Maps/GPS	74%	41%
Voice calling	67%	N/A
Video calling	39%	N/A

These core activities for both groups include: text messaging, accessing the Internet, sending and receiving email, using mobile apps, social networking, getting directions/navigation,

and listening to music. Notably, three functions have become almost universally used by smartphone users in the general population – and widely used by the smartphone users with disabilities – in recent years: text messaging, accessing the Internet and emailing. The 2013 Pew data also include video calling/chats, as do the SUN data for both 2012-2013 and 2015-2016. In 2013, both the Pew and SUN samples reported similar rates of video calling/chats (21% and 25%, respectively). SUN respondents in 2015-2016 reported substantially higher rates of video calling/chats than their peers in the earlier survey, a trend that probably holds for the general population. This trend is likely the result of the proliferation of smartphones with bigger and higher-resolution screens, expanded access to high-speed, low-latency 4G networks in the U.S., and the proliferation of video-calling applications and services (Facetime, WhatsApp, etc.). It should be noted that video calling can be a key assistive technology for people with speech, hearing, and cognitive limitations, which might cause its use to be more common in the population of people with disabilities.

Two demographic variables – income and age – often affect adoption of technology, particularly for new technologies which tend to be expensive and relatively unknown to the general population. However, as technologies mature, prices go down and social acceptance expands. More than 8 years have passed since the iPhone was launched and more than 15 years since the first Blackberry devices with two-way messaging appeared. Additionally, the relative costs and benefits of competing technologies (landline phone service and personal computers) can drive adoption of new technologies (smartphones and mobile services) by people with fewer financial resources – the phenomenon known as “wireless substitution” (Blumberg and Luke 2016). These income and age variables for technology adoption are expected to influence the smartphone activities by people with disabilities as well as the general population. However the

fact that smartphones can offer highly economical and robust assistive solutions can alter the impact of income and age on smartphone use. Smartphone features and functions like screen navigation by touch (e.g., VoiceOver on iOS and TalkBack on Android), speech generating apps, mobile memory aids for people with cognitive needs, and video-calling for people with speech-hearing needs represent critical assistive technology solutions to some users. Consequently, several expectations about smartphone activities of people with disabilities can be identified:

- Smartphone users with higher incomes are more likely to use smartphone features and functions than their peers with lower incomes.
- Older smartphone users with disabilities are less likely to use smartphone features and functions than their younger peers.
- Age and income divides related to smartphone activities have diminished in recent years.
- People with specific disabilities (e.g., speech-hearing difficulties) use some smartphone features and functions more than people with different disabilities.

SUN data show that annual household income does have an effect on smartphone activities in the expected direction – respondents with higher income are more likely to use a range of smartphone features (Tables 5 and 6). However, income effects are primarily evident in the more recent period (2015-2016) than the earlier period (2012-2013). Only email shows a clear positive relationship with household income, and this relationship is relatively weak. For the more recent survey most of the activities listed in Table 6 show moderate or strong positive relationships with household income, especially use of mobile apps and social media. Email, video calling, and mobile Internet show moderate positive relationships with household income. These results run contrary to expectations, as the diffusion of technology over time should soften

income effects. One possible explanation is that early adopters (smartphone users represented a much smaller percentage of the earlier SUN sample) tend to be intensive users regardless of income or other demographic characteristics. By this logic the smartphone activity of later adopters would be more likely to show demographic effects.

Table 5. Which Features and Functions Do You Use on Your Smartphone? (Wireless RERC 2012-2013, by gross Annual Household Income).

Features/Functions	Less than \$35,000 (n = 216)	\$35,000 - \$49,999 (n = 80)	\$50,000 - \$74,999 (n = 103)	\$75,000 or more (n = 169)
Texting	90%	98%	92%	89%
Internet	85%	88%	84%	88%
Email	86%	86%	86%	91%
Mobile apps	70%	65%	67%	73%
Social media	68%	74%	67%	73%
Maps/GPS	71%	58%	64%	67%
Voice calling	62%	63%	71%	63%
Video calling	34%	26%	36%	33%

Table 6. Which Features and Functions Do You Use on Your Smartphone? (Wireless RERC 2015-2016, by Gross Annual Household Income).

Features/Functions	Less than \$35,000 (n = 246)	\$35,000 - \$49,999 (n = 80)	\$50,000 - \$74,999 (n = 137)	\$75,000 or more (n = 195)
Texting	86%	88%	91%	90%
Internet	78%	83%	85%	86%
Email	81%	85%	88%	90%
Mobile apps	63%	68%	72%	79%
Social media	66%	78%	76%	83%
Maps/GPS	66%	71%	66%	69%
Voice calling	70%	70%	59%	70%
Video calling	36%	41%	39%	45%

SUN data show much broader effects of age on smartphone activities (Tables 7 and 8), especially for the earlier time period. The data support expectations that age has an inverse relationship to use of smartphone features and functions – younger smartphone owners are more likely to report higher rates of use than their older peers – and that age effects diminish over time (despite the findings for income reported above). In the earlier period there is at least a moderate inverse linear relationship between age and all eight smartphone activities/functions listed (Table 7). For five of these activities – using Internet, mobile apps, maps, voice calling, and video calling – the gap between the percentage of 18-29 year olds and people 65 years or older who use these functions is over 20 percentage points. For use of maps/GPS the difference is very large: 62 percent. In the more recent period use of Internet, mobile apps, and video calling still showed substantial differences between the youngest and oldest age cohorts of smartphone owners (Table 8). The gap in use of social media between youngest and oldest smartphone users actually increased substantially (from 9 to 35 percent) compared to the earlier period. For other activities, internet, email, and maps, the differences diminished compared to the earlier period.

Table 7. Which Features and Functions Do You Use on Your Smartphone? (Wireless RERC. 2012-2013, by Age).

Features/Functions	18-29 (n = 58)	30-49 (n = 244)	50-64 (n = 225)	65+ (n = 65)
Texting	95%	91%	93%	83%
Internet	91%	89%	87%	66%
Email	90%	88%	86%	80%
Mobile apps	81%	73%	69%	46%
Social media	74%	72%	68%	65%
Maps/GPS	88%	77%	60%	26%
Voice calling	71%	66%	65%	48%
Video calling	52%	36%	26%	22%

Table 8. Which Features and Functions Do You Use on Your Smartphone? (Wireless RERC 2015-2016, by Age).

Features/Functions	18-29 (n = 65)	30-49 (n = 216)	50-64 (n = 253)	65+ (n = 152)
Texting	88%	91%	89%	84%
Internet	86%	88%	82%	68%
Email	86%	90%	85%	80%
Mobile apps	75%	78%	67%	63%
Social media	83%	79%	63%	48%
Maps/GPS	72%	81%	75%	62%
Voice calling	72%	74%	63%	65%
Video calling	51%	51%	34%	24%

Crosscutting income and age divides, are some notable differences in wireless activities between disability types (Tables 9 and 10). Perhaps least surprising is that people with hearing and speaking difficulties use voice calling the least by a substantial margin in both the earlier and later periods. Perhaps more surprising is that people with seeing and hearing limitations use social media the least among the eight disability groups represented in Tables 9 and 10. One explanation is that these two disability types include low vision and hearing which commonly result from aging related decline in function. These results might be driven as much or more by age than disability. Areas of similarity in smartphone activities across disability type include core functions of text messaging, Internet access, and email. People with all disability types in both periods of time utilized these services at high rates in both the earlier and later time periods. Furthermore, there was relatively little variation in use across disability types.

Table 9. Which Features and Functions Do You Use on Your Smartphone? (Wireless RERC
2012-2013, by Disability or Impairment)

Features/ Functions	Thinking (n = 143)	Anxiety (n = 132)	Seeing (n = 158)	Hearing (n = 228)	Speaking (n = 86)	Using arms (n = 87)	Using hands, fingers (n = 133)	Walking, climbing stairs (n = 199)
Texting	87%	86%	89%	93%	87%	87%	89%	88%
Internet	83%	83%	84%	86%	83%	85%	86%	83%
Email	85%	81%	81%	89%	90%	84%	87%	86%
Mobile apps	64%	69%	73%	67%	65%	67%	71%	68%
Social media	71%	67%	60%	61%	69%	71%	68%	67%
Maps/GPS	64%	67%	67%	73%	70%	64%	65%	69%
Voice calling	71%	67%	77%	48%	44%	75%	73%	74%
Video calling	28%	27%	30%	35%	44%	31%	29%	26%

Table 10. Which Features and Functions Do You Use on Your Smartphone? (Wireless RERC
2015-2016, by Disability or Impairment)

Features/ Functions	Thinking (n = 144)	Anxiety (n = 15)	Seeing (n = 159)	Hearing (n = 341)	Speaking (n = 99)	Using arms (n = 118)	Using hands, fingers (n = 150)	Walking, climbing stairs (n = 264)
Texting	87%	91%	88%	90%	88%	84%	87%	86%
Internet	85%	85%	79%	82%	80%	77%	80%	80%
Email	85%	88%	81%	88%	86%	81%	85%	83%
Mobile apps	71%	76%	74%	69%	68%	70%	69%	70%
Social media	71%	73%	55%	64%	71%	71%	71%	66%
Maps/GPS	74%	78%	75%	75%	74%	64%	67%	71%
Voice calling	77%	76%	77%	58%	50%	72%	75%	73%
Video calling	42%	42%	39%	33%	53%	37%	41%	36%

Additionally, there have been some notable changes in wireless activity for specific disability types over the past few years. Use of voice-calling has increased substantially for people with cognitive, emotional, hearing and speaking limitations over time. This likely reflects in part the “wireless substitution” (Blumberg and Luke 2016) trend by which increasing percentages of the population “cut the cord” of landline telephone subscription in favor of mobile wireless telephony. Notably, use of voice-calling has been relatively stable for people with vision, upper extremity and mobility difficulties. It is well known that blind individuals enthusiastically embraced the iPhone after Apple introduced the VoiceOver touchscreen navigation feature for the iPhone in mid-2009. Anecdotal evidence also indicates that people with vision or mobility limitations have regarded mobile voice-calling as a key personal security feature for going outside the home.

Conclusions

The maturing of mobile information and communication technologies (ICT) – including smart mobile devices and the networks over which they operate – over the past several years has made available unprecedented technological capabilities to the mass public. Now, substantial majorities of the general population and the population of people with disabilities own and regularly use these sophisticated technologies. For both populations the smartphone has come to occupy the center of their information and communications infrastructure – critical tool supporting independence, community participation, employment, education, and more. There has been little difference in smartphone (and tablet) ownership rates between the two groups since 2012, most likely a reflect of the critical nature of the tools and generally high levels of accessibility of these devices for people with disabilities. Also, both groups showed substantial increases since 2012 in use of core and extended functionality of their smartphones, including

text messaging, email, using the Internet and social media, and using mobile apps. However, the expansion in use of these functions was generally greater for the general population. For smartphone users who reported a disability, income, age and disability type had variable effects on smartphone activities. In most cases, the trends supported expectations of diminishing differences as smart mobile technology matured. These results do not suggest that barriers to accessibility and use of mobile smart technology have been largely overcome. Instead, they suggest that these technologies constitute critical tools for all individuals, perhaps especially for people with disabilities. Also, barriers to access persist. The analysis provided here can help researchers, engineers, regulators, advocates, and people with disabilities understand the topography of mobile wireless access and use.

Acknowledgement

The Rehabilitation Engineering Research Center for Wireless Technologies is funded by the National Institute on Disability, Independent Living and Rehabilitation Research of the U.S. Department of Health and Human Services, grant # 90RE5007-01-00. The opinions contained in this document are those of the grantee and do not necessarily reflect those of the U.S. Department of Health and Human Services.

Works Cited

Blumberg, Stephen J., and Julian V. Luke. "Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, January–June 2016." Centers for Disease Control and Prevention, 2016. Web. 30 November 2016.

CDC/National Center on Health Statistics, National Health Interview Survey, 2015. Web. 29 November 2016.

CTIA-The Wireless Association. "Wireless Industry Summary Report, Year-End 2014." CTIA, 2015. Web. 28 August 2016.

Duggan, Maeve and Aaron Smith. "Cell Internet Use 2013", Pew Research Center, September 16, 2013. Web. 25 November 2016, <http://pewinternet.org/Reports/2013/Cell-Internet.aspx>.

Horrigan, John B. "Broadband Adoption and Use in America." U.S. Federal Communications Commission, 2010. Web. 28 November 2016.

Kessler Foundation and National Organization on Disability. "The ADA, 20 Years Later." 2010. Web. 22 November 2016.

Morris, John T., Michael L. Jones, and W. Mark Sweatman. "Wireless Technology Use by People with Disabilities: A National Survey." *Journal on Technology and Persons with Disabilities*, 2016. Volume 4: 101-113. Web. 29 November 2016.

Morris, John T., James L. Mueller, and Michael L. Jones. "Wireless Technology Uses and Activities by People with Disabilities." *Journal on Technology and Persons with Disabilities*, 2014. Volume 2: 29-45. Web. 29 November 2016.

Morris, John T. and James L. Mueller. "Blind and Deaf Consumer Preferences for Android and iOS Smartphones." *Inclusive Designing: Joining Usability, Accessibility, and Inclusion*. Ed. Pat Langdon, et al. London: Springer, 2014. 69-79. Print.

Pew Research Center. "U.S. Smartphone Use in 2015." Web. November 18, 2016.

<http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/>

Pew Research Center. "Device Ownership over Time", 2015. Web. August 28, 2016.

<http://www.pewinternet.org/data-trend/mobile/device-ownership>

Pew Research Center. "Cell Phone Activities 2013" Web. November 22, 2016

www.pewinternet.org/files/old-media/Files/Reports/2013/PIP_Cell%20Phone%20Activities%20May%202013.pdf

Steven Ruggles, Katie Genadek, Ronald Goeken, Josiah Grover, and Matthew Sobek.

"Integrated Public Use Microdata Series: Version 6.0 [Machine-readable database]."

Minneapolis: University of Minnesota, 2015. Web. 30 November 2016.

Wireless RERC. SUNspot: Adults with Disabilities, Age and Use of Wireless Devices, July 2013. Web. 27 September 2016.

Journal on Technology and Persons with Disabilities

ISSN 2330-4219

LIBRARY OF CONGRESS * U.S. ISSN CENTER
ISSN Publisher Liaison Section
Library of Congress
101 Independence Avenue SE
Washington, DC 20540-4284
(202) 707-6452 (voice); (202) 707-6333 (fax)
issn@loc.gov (email); www.loc.gov/issn (web page)

© 2017 The authors and California State University, Northridge



This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. To view a copy of this license, visit <https://creativecommons.org/licenses/by-nc-nd/4.0/>

All rights reserved.