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Wireless Device Use by Individuals with Disabilities: Findings from a National Survey

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Abstract

We present findings from the Rehabilitation Engineering Research Center for Wireless Inclusive Technologies (Wireless RERC) Survey of User Needs (SUN) for 2017-2018. The Wireless RERC has surveyed wireless technology adoption and use among individuals with disabilities since 2002, and this article presents findings from the sixth iteration of the SUN. Broadly, it continues to find growing rates of adoption of smartphone technologies among people with disabilities relative to the general population. With an increase of smartphone use among individuals with disabilities from 54% in 2012-2013 and 71% in 2015-2016, to 88% in 2017-2018, our findings suggest further narrowing of the digital “disability divide.” SUN respondents generally indicated that their devices were easy to use. Regarding device satisfaction, over three-fourths of smartphone users indicated that they were satisfied or very satisfied with their smartphones. Relatively less established, newer features such as real-time-text and intelligent personal assistants have yet to be widely adopted. However, the higher-than-average use of real-time-text among individuals who reported deafness or difficulty hearing suggests this features’ potential for increasing usability and accessibility of these devices, specifically, and communications, in general. For this version, we added new questions on the adoption and use of next-generation wireless devices, as part of a growing trend toward Internet of Things (IoT)-based “smart homes.”

Keywords

Smartphones, wireless devices, intelligent personal assistants, emerging assistive

Introduction

Smartphones have transformed mobile phones from being telecommunications devices to computing devices. They serve as a news and information source, enable communications for people with hearing disabilities without an intermediary, are of assistance during and in the wake of emergencies, facilitate telehealth, and can be a key route to employment through job searches and the online application process. We present findings from the Rehabilitation Engineering Research Center for Wireless Inclusive Technologies (Wireless RERC) Survey of User Needs (SUN) for 2017-2018. Wireless RERC's ongoing SUN data collection and analysis identifies trends in access to wireless technologies by people with disabilities. Now in its fourth cycle of funding by the National Institute on Disability, Independent Living and Rehabilitation Research (NIDILRR), the Wireless RERC has surveyed wireless technology adoption and use among individuals with disabilities since 2002.

This survey, now in its sixth iteration, builds on prior versions of the survey (Morris, Jones, and Sweatman; Morris et al.) through inclusion of next-generation wireless technologies, such as wearables and the Internet of Things (IoT), and their prospective applications for monitoring, sensing, assistance, guidance, and navigation. Our final validated sample size was $N = 426$, with a mean age of 51 years. Of this sample, 87.8% ($N = 374$) reported use or ownership of a wireless device, while 2.8% respondents ($N = 12$) reported that they did not use or own a wireless device. For the remaining 9.4% of respondents, no answer was provided. Below, we provide data based on the sample ($N = 374$), of users who indicated owning or using a wireless device such as a traditional cell phone, smartphone, tablet, or wearable device. This article comprises three main areas of analysis: 1) overall adoption and use of wireless devices among users with disabilities, with comparison to prior iterations of the SUN and against the general

population as surveyed by the Pew Research Center, 2) use of specific wireless device features generally associated with greater accessibility or usability for specific disability categories, and 3) activity-based use of wireless devices by individuals with disabilities, which is new to this version of the SUN.

Methods

Originally launched in 2002, the SUN is updated periodically to be responsive to the rapid pace of technological change. For this version, we added new questions based on Wireless RERC focus group research on the adoption and use of next-generation wireless devices, including “smart speakers” such as Amazon Echo with Alexa or Google Home with Google Assistant (Wireless RERC). As part of a growing trend toward Internet of Things (IoT)-based “smart homes,” these technologies represent, in essence, the next generation of home automation and accessibility solutions (Atzori, Iera, and Moribito; Domingo; Moon, Baker, and Goughnour). It is worth noting that devices such as smart lights and thermostats can be controlled through smartphone apps, further reflecting the continued integration of wireless technologies.

The SUN is a national survey administered online, as well as by telephone. Recruitment relied upon convenience sampling, drawing upon the Wireless RERC’s Consumer Advisory Network (CAN), which totals about 2,100 individuals with disabilities, as well as web-based recruitment through partnering universities and organizations. Disability demographics are based upon categories used by the American Community Survey (ACS), augmented with categories adapted from the National Health Interview Survey (NHIS) for a more robust listing of functional limitations (Lauer and Houtenville; McGuire et al.). However, the categories allowed for finer segmentation of respondents by disability sub-type, such as distinctions between individuals who are blind and who have low vision.

Discussion

Device Ownership and Use

A total of 13.4% (N = 50) of wireless device users indicated ownership of a *basic cell phone*. The proportion of respondents with a disability reporting use of a basic cell phone in 2017-2018 is unchanged from the 2015-2016 SUN, which reported the same rate of use. Following a decline from 31% in 2012-2013, this flatness may be attributed to increasing ownership of smartphones among users with disabilities, owing in part to greater affordability, accessibility, and user preference. These rates are comparable to the general population, with the latest Pew survey reporting 15% of U.S. adults who own cellphones but not smartphones (Pew Research Center).

Regarding users of basic cell phones in the current survey, a majority of these users are over 50 years of age, male, Caucasian, and have an income of less than \$25,000 per year. Over half of basic cell phone owners (52%) reported owning their devices for more than four years, while 21% reported owning their devices for more than three years. Interestingly, some basic cell phone users also reported ownership of a smartphone (32%), a tablet (36%), or a wearable device (20%) such as an activity tracker. To maintain consistency with previous surveys, respondents were asked to self-identify and select all categories of disability that applied to them. In doing so, some respondents indicated more than one disability. The average number of functional difficulties reported by users of basic cell phones is 2.4 ± 1.6 difficulties. In rank order, these difficulties include mobility (40%), anxiety (40%), use of hands or fingers (30%), cognition (30%), and vision (22%).

Among individuals who indicated the use of a wireless device, 87.7% (valid N = 328) reported owning a smartphone. The proportion of respondents with a disability who indicated use

of a smartphone in the 2017-2018 SUN (88%) continues to increase, as compared to 54% in 2012-2013 and 71% in 2015-2016. Interestingly, 2017-2018 SUN respondents reported higher smartphone adoption rates than the Pew national sample of the general population (81%) in its most recent survey (Pew Research Center). This continues a trend also seen in the early versions of the SUN, in which people with disabilities similarly reported slightly higher smartphone use.

Regarding current SUN users of smartphones, a majority are under 60 years of age, female, Caucasian, and have an income of over \$25,000 per year. Some smartphone users indicated more than one disability. The average number of functional difficulties reported by users of smartphones is 2.1 ± 1.5 difficulties. In rank order, these difficulties include mobility (40%), anxiety (27%), use of hands or fingers (26%), cognition (26%), and hearing (23%).

Regarding smartphone type, slightly more iPhones (54%) were reported than Android-powered smartphones (46%), such as the Samsung Galaxy and Motorola Droid. Regarding the duration of ownership, 43% of smartphone owners have owned their devices for more than four years, while an additional 8% reported owning their phones for 3-4 years, and 16% reported owning their devices for 2- 3 years. Of the remaining users, 17% have owned their devices for at least one year, while only 15% have owned their devices for less than one year. The following chart shows the duration of device ownership for basic cell phones, with comparisons to other wireless devices queried by the SUN.

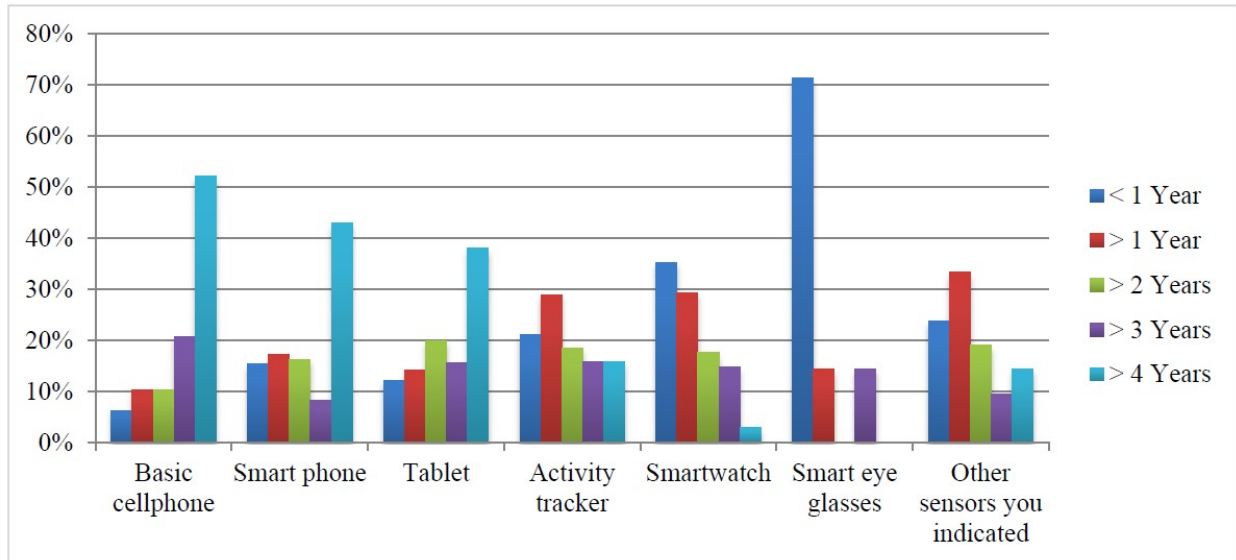


Fig. 1. How Long Have You Had Your Device?

Ease of Use and Device Satisfaction

Regarding overall ease of use for wireless devices, a majority of users of both basic cell phones and smartphones indicated that their devices were easy to use. Regarding basic cell phones, 29% indicated that they were very easy to use, and 33% indicated they were easy to use. Of remaining basic cell phone users, 25% indicated they were somewhat hard to use, 4% indicated they were hard to use, and 8% indicated they could not use them without help. Regarding smartphones, 37% indicated them as very easy to use, and 39% indicated them as easy to use. Of remaining users, 20% indicated they were somewhat hard to use, 3% indicated they were hard to use, and only one user (0.3%) indicated not being able to use it without help. Regarding device satisfaction, over three-fourths of smartphone users indicated that they were satisfied or very satisfied with their smartphones. Regarding the selection and purchase of devices, personal recommendations were the most important source of information with 57% of respondents indicating very important and important, followed by package labels (53%), online consumer sources (51%), and consumer reviews (49%), comprising either important or very

important sources of information. Figure 2 provides a full breakdown regarding the importance of sources of information on device selection among consumers with disabilities

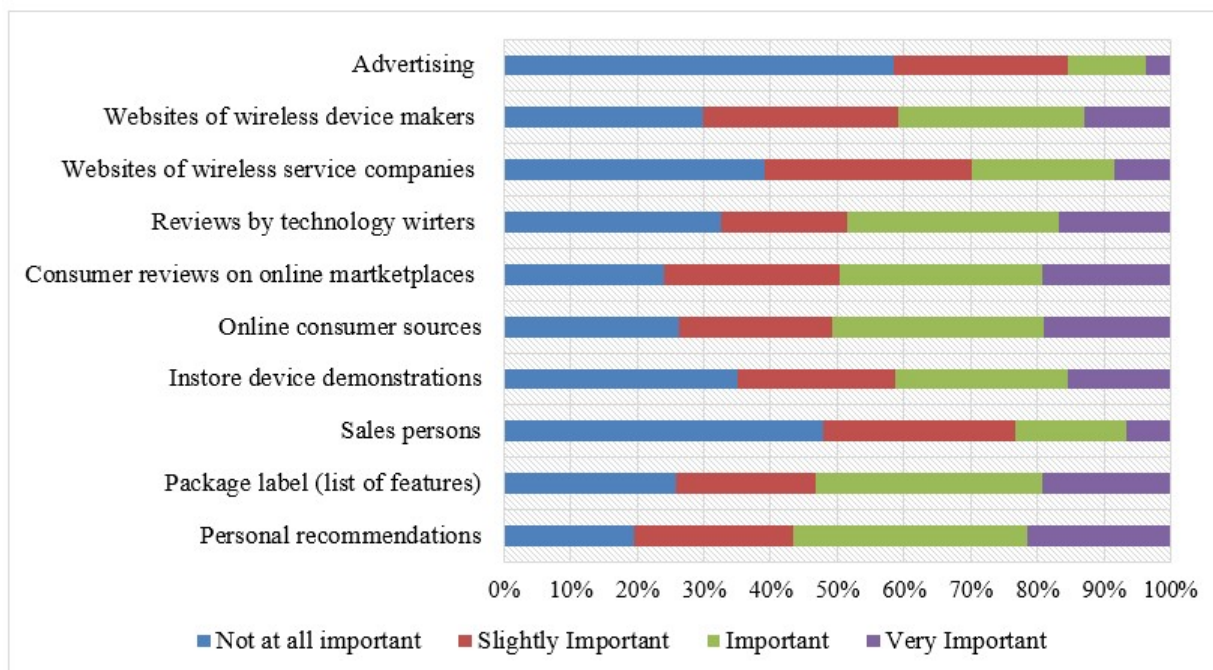


Fig. 2. Influence of Informational Sources on Device Selection

Visual and Audio Display Technologies: Screen Reader and Screen Magnifier Technologies

The SUN probed on the use of technologies to present textual or graphical content in alternate formats to make this content accessible for users, including individuals who are blind, individuals with low vision, or for individuals with other vision-related disabilities. Of our total valid sample (N = 426), a total of 81 respondents, or 19%, indicated their use of screen-reader technology. Of this group, 49 individuals, or 61%, reported blindness. *Because the questionnaire does not specify the nature of blindness in diagnostic terms, it is possible that respondents that indicated as “blind” may have some usable vision.* However, over 20% of screen-reader users report difficulties with cognition, anxiety, hands and fingers, or mobility. Screen-reader technology users reported 2.3 difficulties on average. Of this group, 51% of the sample reported only one difficulty, 49% reported two or more difficulties, and 25% reported four or more.

Fifty-seven percent (57%) of screen-reader users in the SUN sample were female; 68% identify as white or Caucasian; 70% had a bachelor's degree or higher; and 57% are currently employed either full or part-time. The average age of screen reader users was 49 years of age.

A total of 52 respondents, or 12% of the SUN sample, reported the use of screen magnifier technologies for their wireless devices. Of this group, 46 individuals, or 89% of these users, reported a vision difficulty. Considering the application of this technology and its reliance on vision, these findings may be as expected. *Because the questionnaire does not specify the nature of blindness in diagnostic terms, it is possible that respondents that indicated as "blind" may have some usable vision.* Screen magnifier technology users, on average, reported 3.2 ± 2 difficulties. The median number of difficulties was 2.5. Seventy-three percent (73%) of screen magnifier technology users in the SUN sample were female; 58% identified as white or Caucasian; 60% had a bachelor's degree or higher; and 50% were employed full or part-time. The average age of these users was 49 years old, with 52% of users being 50 years of age or older. While these findings strongly suggest a relationship between vision difficulty and the use of this technology, it also implies a possible relationship between age and screen magnifier use, as well.

Wireless Device Features: Real-time Text and Intelligent Personal Assistants

The SUN also probed on features and applications generally not considered as assistive technologies, but which may support accessibility and usability within specific contexts. Two of these features, real-time-text (RTT) and intelligent personal assistants are presented here. A total of 32 respondents indicated the use of RTT, which may be defined simply as text messaging that is transmitted instantly as it is typed or created. Of these users, the overwhelming majority - 26 individuals, or 81% - reported difficulty with hearing. An additional 28% of respondents

reported functional deafness. Also, 22% of RTT users reported difficulties with cognition, mobility, and vision. None of these users reported blindness, which is an expected finding given that text-messaging generally relies on some form of vision. The total number of difficulties reported by RTT users ranged from 0-6, with 2.3 difficulties reported on average. Thirty-eight percent (38%) of the sample reported only one difficulty; 32% reported 3 or more difficulties; and 20% reported four or more. Seventy-five (75%) percent of RTT users in the SUN sample were female; 81% identified as Caucasian; 63% reported earning a bachelor's degree or higher; and 55% reported annual incomes of \$50,000 or greater. Thirty-four percent (34%) were currently working either full or part-time. The average age of RTT users was 67, and 69% of users were over age 60.

The SUN also queried on the use of intelligent personal assistants for wireless devices, such as Apple Siri, Google Assistant, Microsoft Cortana, and Amazon Alexa. A total of 90 respondents, or 21% of the SUN sample, indicated their use of intelligent personal assistants. Users indicated a diverse range of functional abilities, with cognition difficulty and mobility difficulty tied as the top two difficulties (N = 28, or 31% of users), followed by vision difficulties and hearing difficulties, tied for second place (N = 23, or 26% of users). Thirty-eight percent (38%) of the sample reported only one difficulty; 30% reported three or more difficulties; and 18% reported four or more. Sixty-three percent (63%) of intelligent personal assistant users in the SUN sample were female, and 69% identified as Caucasian. Sixty-eight percent (68%) reported obtaining a bachelor's degree or higher, and 49% reported annual incomes of over \$50,000. Forty-eight percent (48%) were currently working full or part-time; the majority (52%) were retired or not employed. The average age of users of intelligent personal agents was 52

years of age, with a standard deviation of 16 years. Fifty-eight percent (58%) of this group were over age 50.

Wireless Device Activities

The SUN also queried respondents with disabilities regarding the activities for which they used their wireless devices beyond “core” communication functions. We present the findings for three categories, based upon the key functions associated with many frequently used applications for smartphones, tablets, and other wireless devices. Rather than consider specific apps, this version of the SUN took a functional approach.

Community Mobility Activities

Next, the SUN queried on the use of wireless devices for assisting individuals with navigation and wayfinding, which are commonly associated with apps such as Google Maps or Apple Maps. A sizable majority of respondents used their devices for two uses, in particular, navigating and wayfinding through GPS and map-based apps (65%) and locating places of interests such as restaurants and stores (63%). In particular, respondents who identified as functionally deaf used their devices for community mobility far more than any other group, at 93%. Individuals who indicated vision difficulties were second among this group, at 84%. However, at least 70% of all SUN participants indicated the use of their devices for community mobility, regardless of disability or functional limitation.

Money Management and Personal Finances

SUN participants were asked about the use of their wireless devices for managing money and finances. None of the activities presented were indicated by a majority of respondents. However, the most commonly indicated uses included shopping online either to compare prices or make purchases (49%), banking online (44%), or paying bills (35%). Only 19% of

respondents indicated their use of instant payment applications such as Apple Pay or Google Pay. Users who identified as people who are deaf (83%), having a vision difficulty (72%), blind (71%), or having a speech difficulty (70%) were the most frequent users of devices for managing money or finances.

Health, Wellness, and Home Environment

SUN participants were asked about the use of their wireless devices separately for health and wellness, as well as control of the home environment. In no instance did any activity receive a response of greater than 25%. Use of wireless devices for these activities included tracking of personal fitness such as steps taken, calories burned, or nutrition (25%), monitoring personal health such as weight, blood sugar, blood pressure, or heart rate (19%), using wireless devices for home automation such as control of lights, thermostats, or other environmental devices (12%), using wireless devices to control home security systems (9%). Only five percent (5%) of SUN participants indicated using their devices either for personal medical alerts such as Alert1 or LifeAlert.

Conclusions

Consumers with disabilities generally report high usability and satisfaction with their mobile phones. Demographics suggest that basic cell phones tend to be owned more frequently by individuals who are older or who report lower incomes, while higher incomes tend to characterize users of smartphones, which aligns with prior SUN analyses, as well as other national surveys of mobile phone usage among individuals with disabilities. No single indicated functional difficulty seems to explain ownership preferences between basic cell phones and smartphones. In either case, however, owners of these devices tend to use them for a relatively

long duration. In all cases, owners of these devices report high levels of ease of use and satisfaction, which suggests increasing levels of usability.

Drawing upon the SUN's sample of users with disabilities, it remains clear that certain wireless technology features for accessibility continue to experience high levels of use based on their utility to certain groups. The use of screen readers and screen magnifiers at high levels by individuals who reported blindness or vision difficulties provide but one example of how built-in accessibility features remain vital to technology access. By contrast, relatively less established, newer features such as real-time-text and intelligent personal assistants have yet to be widely adopted. However, the higher-than-average use of real-time-text among individuals who reported deafness or difficulty hearing suggests this features' potential for increasing usability and accessibility of these devices, specifically, and communications, in general. Meanwhile, the use of intelligent personal assistants, while rather low use overall, has a more diffuse group of users, which may suggest these features' usefulness across multiple disability categories. The voice control associated with intelligent personal assistants may benefit people with vision-related disabilities and individuals who have difficulty using their hands or fingers in equal measures.

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Works Cited

- Atzori, Luigi, Antonio Iera, and Giacomo Morabito. "The internet of things: A survey." *Computer Networks*, vol. 54, no. 15, 2010, pp. 2787-2805.
- Domingo, Mari Carmen. "An overview of the Internet of Things for people with disabilities." *Journal of Network and Computer Applications*, vol. 35, no. 2, 2012, pp. 584-596.
- Lauer, Eric Andrew, and Andrew J. Houtenville. "Estimates of prevalence, demographic characteristics and social factors among people with disabilities in the USA: a cross-survey comparison." *BMJ open*, vol. 8, no. 2, 2018, e017828.
- McGuire, D. O., Tian, L. H., Yeargin-Allsopp, M., Dowling, N. F., & Christensen, D. L. "Prevalence of cerebral palsy, intellectual disability, hearing loss, and blindness, National Health Interview Survey, 2009–2016." *Disability and health journal*, vol. 12, no. 3, pp. 443-451.
- Moon, N. W., Baker, P. M., & Goughnour, K. Designing wearable technologies for users with disabilities: Accessibility, usability, and connectivity factors. *Journal of Rehabilitation and Assistive Technologies Engineering*, vol. 6, 2055668319862137.
- 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*, vol. 4, no. 1, 2016, pp. 101-113. Retrieved from <http://scholarworks.csun.edu/bitstream/handle/10211.3/180118/ID-22-Morris-JTPD-2016.pdf?sequence=1>.
- Morris, John, et al. "Wireless technology use and disability: Results from a national survey." *Journal on Technology and Persons with Disabilities*, vol. 1, no. 1, 2014, pp. 70-80. Retrieved from

<http://scholarworks.csun.edu/bitstream/handle/10211.3/121967/JTPD201406-p70-80.pdf?sequence=1>

Pew Research Center. Mobile fact sheet: Mobile phone ownership over time, 2019. n.d.

Retrieved from <https://www.pewresearch.org/internet/fact-sheet/mobile/>.

Rehabilitation Engineering Research Center on Wireless Technologies (Wireless RERC).

(Nathan W. Moon., Paul M.A. Baker, and Kenneth Goughnour, under center authorship).

Accessibility, Usability, and Social and Cultural Acceptance of Next-Generation

Wirelessly Connected Devices (Brief #18-01), 2019. Retrieved from

<http://www.wirelessrerc.gatech.edu/sites/default/files/publications/wireless-rerc-research-brief-18-01-1.pdf>.