Use of Mainstream Wireless Technology by Adults who Use Augmentative and Alternative Communications

John T. Morris, PhD, Diane N. Bryen, Ph.D.

Rehabilitation Engineering Research Center for Wireless Technologies,

Shepherd Center and Temple University

john_morris@shepherd.org, dianeb@temple.edu

Abstract

Cellphones, smartphones and tablets offer considerable potential to enhance the independence and social and economic participation of people with disabilities. The rapid proliferation of smartphones and tablets has offered new low-cost speech generating options on mainstream platforms for users of augmentative and alternative communication (AAC) devices. Data are presented from the Survey of User Needs (SUN), a national survey on use of mobile wireless technology by people across several disability types. The wireless experiences and needs of AAC users are compared with those of other respondents with disabilities. A total of 38 adult AAC users and 998 adults with disabilities who do not use AAC completed the questionnaire. Only 70% of respondents who use AAC reported owning or using a wireless device (basic cellphone, smartphone, or tablet), compared to 92% of other respondents with disabilities. More than half (55%) of AAC respondents who do not have a wireless device said they did not have the hand function to use one; a third (36%) said wireless devices were not compatible with their other aids. AAC respondents were more likely than other respondents to own a tablet.

Keywords

Augmentative and Alternative Communication (AAC), cellphone, smartphone, tablet, usability

Introduction

The spoken or written communication of approximately 1.3% of the U.S. population (4 million people) is so limited that it cannot meet daily communication needs (Beukelman and Mirenda 2013). Similar percentages have faced this challenge in Canada (Statistics Canada 2003), the United Kingdom (Enderby and Philip 1986) and Australia (Bloomberg and Johnson 1990). Mainstream information and communication technologies (ICT; cell phones, smartphones and tablets) offer considerable potential to promote independence and participation of people with disabilities (Center for an Accessible Society 2014). The introduction of mobile technologies has "offered many potential benefits to individuals with complex communication needs who require AAC, including increased awareness and social acceptance of AAC in the mainstream population, greater consumer empowerment in accessing AAC solutions, increased adoption of AAC technologies, greater functionality and interconnectivity, and greater diffusion of AAC research and development" (McNaughton and Light 2013). Additionally, Nguyen et al. demonstrated that when mobile phones were interconnected with the individuals' AAC device, users were able to use the phone in its many modes of operation, resulting in a sense of independence, safety and security (2008). Mobile phone use also contributed to improving communication skills and self-confidence to engage in conversation and social interactions.

Furthermore, smartphones and tablets increasingly are used to mediate other areas of social interaction beyond interpersonal communication. Shane, et al. (2012) noted that modern consumer ICT is used for searching for information, online banking and commerce, entertainment (books, news, video), education, health and safety (e.g., telemedicine), personal organization tools (address book, calendar, clock) and public services like airport check-in. Smart mobile devices, consequently, offer great opportunity of AAC users to "access the world",

while simultaneously creating challenges to ensure that AAC users are not left behind as mobile technology advances. As Beukelman and Mirenda (2013) have observed, for most of us "[…] daily communication is so effortless and efficient that you hardly think about it when you interact with others face-to-face, over the phone [landline or mobile], through email, by texting, or through social media." For those with complex communication needs, little is known about their access to and use of wireless technologies. Early research by Bryen, Carey and Potts (2006) found that adults who have complex communication and mobility needs and who rely on Augmentative and Alternative Communication (AAC) have limited access to cell phones. These researchers identified a large gap in cell phone access (20% for their sample of adults using AAC, compared to 57% for a nondisabled U.S. population in 2000).

The purpose of this research is to understand access and use of wireless technologies such as cell phones, smart phones and tablets by adults with disabilities who use AAC technologies. Data are presented and analyzed from the national Survey of User Needs conducted by the Rehabilitation Engineering Research Center for Wireless Technologies (Wireless RERC). Originally launched in 2002, the Survey of User Needs (SUN) has been updated 3 times to keep up with the pace of technological change. The results presented in this paper are based on the fourth and most recent version of the questionnaire (SUN 4) launched in the fall of 2012. Respondents were invited to participate online, on paper sent via U.S. mail, and via telephone or face-to-face interview. SUN 4 is structured around 5 areas of inquiry: 1) demographics, 2) disabilities and assistive technology, 3) ownership and use of wireless devices, 4) wireless activities, and 5) wireless services and plans. SUN data have formed the basis for publications on general use and usability of wireless technology by people with disabilities (Morris, Mueller, Jones 2014), operating system preferences by blind and deaf users (Morris and Mueller 2014),

and wireless use by stroke survivors (Morris, Mueller, Jones 2010). Questions on demographics are based on the American Community survey. Some questions are informed by the Pew Research Center's several surveys on technology use (e.g., Duggan, 2013; Smith, 2013).

Several core questions are addressed. Do adults who use AAC also access and use mainstream wireless communication technologies at the frequency as others with disabilities and the general population? If so, which types of devices (simple "feature" phones, smartphones, tablets) do they use? What barriers to owning/using mobile wireless technology do AAC users experience? What activities do AAC users engage in with their wireless technology? Use of mainstream wireless technologies by adults who use AAC and adults with disabilities who do not use AAC are compared.

Discussion

The protocol for this study was approved by the local institutional review committee at the grant recipient's home institution. After IRB approval, information about the revised SUN4 was sent to individuals who use AAC. Data were collected from September 6, 2012 through October 9, 2013 using convenience sampling to draw a sample of individuals who rely on AAC devices for face-to-face communication. Individuals with disabilities who use AAC technologies constitute a small but diverse population. Furthermore, the developmental and acquired disabilities that can lead to complex communication needs are varied, making it difficult to reach this diverse population. Consequently, recruiting a representative sample of adult AAC users presents difficulties. Participants were recruited through the Wireless RERC's Consumer Advisory Network (CAN), a nationwide network of consumers with disabilities.

In addition, the research team recruited via the Wireless RERC's internet and social media outlets, including the Wireless RERC website, and Twitter, Facebook, and LinkedIn

accounts. Targeted recruiting was also carried out by asking individuals working at national, state and local organizations to disseminate the invitation to participate to their networks of people with disabilities who rely on AAC, including: the Federal Communications Commission (FCC), American Foundation for the Blind, Hearing Loss Association of America, Telecommunications for the Deaf and Hard of Hearing (TDI), Coalition of Organization for Accessible Technology, Paralyzed Veterans of America, Shepherd Center, and others. Finally, information about the SUN was posted to ACOLUG, an international Listserv for people who use AAC and contacting potential participants via email and face-to-face meetings.

Sampling

The SUN sample of respondents is small (n = 38) and unequal when compared to adult respondents with other disabilities (n = 998). For these reasons, descriptive statistical analysis was conducted instead of inferential statistical analysis. Data from the two samples (AAC users and all others with disabilities) are compared. The sample of respondents who use AAC was about 10 years younger than the comparison sample with more males responding than females (Table 1). They were mostly white, and had household incomes of less than $35,000, which is lower than the comparable sample of those with disabilities not using AAC. Respondents who use AAC and others with disabilities who do not use AAC are well educated with more than 75% and 90%, respectively, having at least some college education. As such, both samples are likely to be highly literate and may over-represent individuals with higher household incomes and access to education. Data from the 2011 American Community Survey show that 33% of adults 18 years of age or older with a disability had at least 1 year of college education (Ruggles 2010). Similarly, both samples have a relatively strong employment history with higher than expected percentages of respondents being either employed full time or part time, or retired.

Earlier studies that have been based on samples of adults with disabilities who rely on AAC utilized a younger, less educated and less likely to be employed sample (e.g., Bryen, Carey and Frantz, 2003; Bryen, Carey, and Potts, 2006).

Table 1. Demographics of the sample of respondents with disabilities who use AAC and all respondents with disabilities Not using AAC

All respondents 18 years of age or older	**AAC Users (n=38)**	**All respondents with disabilities *NOT* using AAC (n=998)**
Completed survey on own	65%	90%
Age mean (standard deviation)	42 (16.44)	51 (14.25)
Gender (% female)	40%	59%

Race/ethnicity (%)	**AAC Users (n=38)**	**All respondents with disabilities *NOT* using AAC (n=998)**
African American	13%	11%
Asian/Pacific Islander	3%	4%
Hispanic/Latino	3%	4%
Native American	0%	2%
White/Caucasian	74%	82%

Gross annual household income (%)	**AAC Users (n=38)**	**All respondents with disabilities NOT using AAC (n=998)**
Less than $35,000	62%	46%
$35,000-$49,999	3%	15%
$50,000-$74,999	16%	17%
$75,000 or higher	19%	22%

Education (%)	AAC Users (n=38)	All respondents with disabilities NOT using AAC (n=998)
No high school diploma or GED	11%	2%
High school diploma or GED	24%	9%
Some college	16%	20%
Associates or Bachelors degree	34%	40%
Graduate degree	26%	30%

Employment (%)	AAC Users (n=38)	All respondents with disabilities NOT using AAC (n=998)
Full time	31%	40%
Part time	22%	13%
Retired	14%	20%
Not employed	33%	28%

Users and non-users of AAC with disabilities both reported having multiple disabilities (Table 2). The two samples reported generally similar frequencies of cognitive (concentrating, remember, and making decisions), hearing and seeing difficulties (Table 2). However, substantial greater percentages of ACC users reported difficulty with speech and physical function, skills that could be critical to access and robust use of current wireless technologies. As expected, AAC users more frequently reported having difficulty speaking than other respondents with disabilities (82% and 13%, respectively). They also reported more frequently having difficulty walking, standing, climbing stairs (66% and 38%); using hands and fingers (66% and 24%) and arms (61% and 16%). Overall, those who use AAC appear to have more numerous disabilities compared to adults with other disabilities in this sample (3.5 and 1.8 respectively).

Table 2. Difficulties reported by AAC users (%) and Respondents with disabilities who do not use AAC*

All respondents 18 years of age or older	Adults who use AAC (n=38)	Respondents with disabilities *NOT* using AAC (n=998)
Difficulty speaking	82%	13%
Difficulty walking, standing, climbing stairs	66%	38%
Difficulty using hands and fingers	66%	24%
Difficulty using arms	61%	16%
Difficulty concentrating, remembering, making decisions	21%	25%
Difficulty hearing	34%	36%
Hard of Hearing	32%	24%
Deaf	5%	12%
Difficulty seeing	21%	28%
Low vision	13%	16%
Blind	5%	8%

*The percentages of respondents who reported blindness and low vision percentages do not add to the same value as that for "difficulty seeing." The same applies to respondents with difficulty hearing.

Use of mainstream wireless technologies

AAC users reported substantially lower levels of ownership or use of mainstream wireless technologies compared to other respondents with disabilities – 70% and 92%, respectively (Table 3). Barriers to ownership and use differed considerably between the two groups, with AAC users citing several barriers at substantially higher rates than non-users of AAC, including: lack of hand function (55% and 12%, respectively); incompatibility with other aids (36% and 1%); lack of speech (27% and 4%), and complexity of devices (27% and 6%). These data point to considerable accessibility challenges that are unique to the population of

AAC users. Other barriers to ownership/use of wireless technology were cited at similar rates by both groups, including: lack of need or desire (18% and 12%) and cost of wireless service (27% and 23%). Notably low percentages of both groups cited lack of sight, hearing and knowledge as barriers.

Table 3. Use of Wireless Devices by Adults Who Use AAC and Others with Disabilities

Wireless device used by Adults who use AAC and other disabilities	Adults who use AAC (n= 38)*	Others with disabilities (n = 998)*
Do you own or use a wireless device such as a cell phone or tablet? (% yes)	70%**	92%**

Table 4. If you do NOT own or use a wireless device, why not? (Check all that apply)

Reasons for not owning a wireless device	Adults who use AAC (n=11)**	Others with disabilities who do not use AAC (n=82)
I don't need or want one	18%	12%
Devices cost too much	36%	23%
Service costs too much	27%	23%
Devices are too complex	27%	6%
I don't know how to use one	9%	11%
I don't have the hand function to use one	55%	12%
I don't have the sight to use one	0%	5%
I don't have the hearing to use one	9%	6%
I don't have the speech to use one	27%	4%
They are not compatible with my other aids	36%	1%

*Percentages do not add to 100 percent, as respondents were asked to check all that apply.

**The number of AAC respondents who do not own or use a wireless device is small.

Percentages are reported in order to facilitate comparison with other respondents with disabilities

who do not use AAC and who do not own or use a wireless device.

Among respondents who own or use wireless technology, the rate of smartphone use among AAC users and all other respondents with disabilities is approximately equal (53% and 57%), respectively. The rate of tablet use is actually greater among AAC users than others with disabilities (53% and 35%). In contrast these AAC users own basic cell phones at much lower rates than other respondents with disabilities and the general population (13%, 28% and 36%, respectively; Table 5). These results suggest that smartphones and tablets are more accessible and/or useful to adults who use AAC than basic cellphones, likely a result of the touchscreen interface, larger screens, and wider array of features and functions available on smart devices compared to simple phones. These data also reflect growing use of mainstream tablets with specialized AAC apps for face-to-face communication instead of dedicated speech generating devices (RERC on Communication Enhancement 2011; McNaughton and Light 2013).

Table 5. If you own or use a wireless device, what kind do you use? (Check all that apply)

Device	Adults who use AAC (n= 38)	Others with disabilities (n = 998)	General population*
Basic phone (e.g., Motorola Razr, Pantech Breeze, Nokia 6350, Owasys)	13%	28%	36%
Smartphone (e.g., iPhone, Android phone, BlackBerry, Windows phone)	53%	57%	55%
Tablet (e.g., iPad, Kindle Fire, Galaxy Tab, Nexus 7, BlackBerry PlayBook)	53%	35%	35%

*Sources: Rainie, Lee. "Cell phone ownership hits 91% of adults." Pew Research Internet Project. 6 June 2013. Web. 22 May 2015.

Rainie, Lee and Aaron Smith. Tablet and E-reader Ownership Update, 18 October 2013. Web. 22 May 2015.

Response data show that AAC users reported high rates of customization of their wireless devices to make them easier to use (Table 6). AAC users who own or use mainstream wireless technology reported high rates of customization of their wireless devices to make them easier to use (88%), much higher than other respondents with disabilities who own or use wireless technology (53%). Physical accessories (protective skins, headsets, lanyards, etc.) were the most common type of modification (58% and 35% of AAC users, respectively) followed by software and mobile apps (35% and 18%). These data reflect the tendency among the sample of AAC users to have multiple physical disabilities in addition to speech limitations, and consequently greater accessibility challenges than others with disabilities.

Table 6. Have you CHANGED OR ADDED anything to your primary wireless device to make it easier to use? (Check all that apply)

Changes or Additions to primary wireless device	Adults who Use AAC (n=27)	Others with disabilities (n=998)
No changes or additions	12%	47%
Physical accessories: protective skin, headset, lanyard, stylus etc.	58%	33%
Assistive devices: head switch, EMG switch, AAC device, neck loop, etc.	27%	7%
Software – text-to-speech software, screen reader, app downloads	35%	18%
Improvised solutions – handstrap, Velcro, wheelchair mount, etc.	27%	3%
Other	19%	8%

Despite their greater tendency to customize their devices, AAC users report using a broad range of functions on their devices, comparable or to an even greater degree than that reported by others with disabilities (Table 7). Text messaging was by far the most common activity reported for both groups (89% and 75%, respectively). Web browsing, email, and social networking were

also highly ranked activities, somewhat more so for AAC users than for other respondents with disabilities. Notably, voice calling was reported by both groups at approximately the same frequency (58% and 59%, respectively). The data do not show how AAC users participate in voice calls, whether through direct electronic connection between the AAC device and the cellphone, by placing the cell phone or smartphone near the speaker of the AAC device, or some other means. This key question requires further investigation. Relatively high levels of participation in a broad range of wireless activities by AAC users might reflect the high levels of education of the SUN sample. However, it should also be kept in mind that 30% of the sample of AAC users had not overcome the initial barriers of cellphone and tablet use.

Table 7. Do you ever use your primary wireless device to do any of the following?

(Check all that apply)*

Primary uses	Adults who use AAC	Others with disabilities
Text messaging	89%	75%
Web browsing	73%	60%
Email	69%	62%
Keeping a directory of contacts	69%	64%
Downloading applications (apps)	69%	48%
Keeping a calendar of appointments	65%	50%
Social networking (Facebook, LinkedIn, Twitter, etc)	65%	46%
Voice calling	58%	59%
Navigating or wayfinding (using GPS and/or maps)	54%	47%
Sharing photos or video online	54%	49%

Primary uses	Adults who use AAC	Others with disabilities
Using voicemail	46%	51%
Watching video	46%	38%
Listening to music	46%	38%
Playing games	42%	41%
Video calling	39%	22%
Shopping	35%	30%
Recording voice notes or reminders	27%	23%
Monitoring your health	23%	13%

*Includes cellphones, smartphones, and tablets. Respondents were asked to identify the activities they pursue on their primary and secondary wireless devices, if they have either. This table displays the responses only for the primary mainstream wireless device.

Conclusion

Cellphones (and to a lesser degree smartphones) are still primarily used for spoken communication, though this may be changing for younger generations. Speech limitations often are accompanied by physical limitations making access to mainstream technology even more challenging. Ownership and use of mainstream wireless information and communications technology is lower among AAC users than others with disabilities. AAC users who own mobile ICT devices have a greater tendency to own smartphones and tablets than simple phones, and more commonly make changes or additions to their devices to make them easier to use. These survey data point to considerable barriers that are unique to this population.

Works Cited

Beukelman, David R., and Pat Mirenda. (2013). *Augmentative & Alternative Communication: Supporting Children and Adults with Complex Communication Needs*, 4th Edition. Baltimore: Paul H. Brookes Publishing Company, 2013. Print.

Bloomberg, Karen and Hilary Johnson. A Statewide demographic survey of people with severe communication impairments. *Augmentative and Alternative Communication,* 6 (1990): 50-60. Print.

Bryen, Diane N., Allison C. Carey, and Beverly Frantz. Ending the silence: Adults who use augmentative and alternative communication and their experiences as victims of crimes. *Augmentative and Alternative Communication*, 19.2 (2003): 123-134. Print.

Bryen, Diane N., Allison C. Carey, and Blyden B. Potts. Technology and Job-related social networks. *Augmentative and Alternative Communication*, 22.1 (2006): 1-9. Print.

Center for an Accessible Society. (2014). *Disability and the digital divide*. Retrieved on February 19, 2014, from http://www.accessiblesociety.org/topics/webaccess/digitaldivide.htm.

Duggan, Maeve. Cell phone activities 2013. *Pew Research Internet Project*. Web. 27 March 2014.

Enderby, Pam and Robin Phillip. Speech and language handicap: Towards knowing the size of the problem. *British Journal of Disorders of Communication*, 21.2 (1986): 151-165.

McNaughton, David and Judith Light. "Editorial: The iPad and mobile technology revolution: Benefits and challenges for individual who require augmentative and alternative communication." *Augmentative and Alternative Communication,* 29 (2013): 107–116.

Morris, John, and James Mueller. Blind and Deaf Consumer Preferences for Android and iOS Smartphones, in P.M. Langdon, J Lazar, A Heylighen, and H Dong, editors, *Inclusive*

Designing: Joining Usability, Accessibility, and Inclusion. London: Springer, 2014.

Morris, John, James Mueller, Michael Jones. "Toward Mobile Phone Design for All: Meeting
the Needs of Stroke Survivors", *Topics in Stroke Rehab.* 17.5 (2010): 353–361. Print.

Morris, John, James Mueller, Michael Jones. Wireless Technology Uses and Activities by People
with Disabilities, *J. on Technology and Persons with Disabilities*, 2 (2014): 29-45.

Narasimhan, Nirmita and Axel Leblois. (2012). Forward. *Making mobile phone and services
accessible for persons with disabilities.* G3ict. Web. 10 April 2015.

Nguyen, Toan, Rob Garrett, Andrew Downing, Lloyd Walker, David Hobbs. "An interfacing
system that enables speech generating device users to independently access and use a
mobile phone." *Technology and Disability*, 20 (2008): 225-239. Print.

Rainie, Lee. "Cell phone ownership hits 91% of adults." Pew Research Internet Project. 6 June
2013. Web. 22 May 2015.

Rainie, Lee and Aaron Smith. Tablet and E-reader Ownership Update, 18 October 2013. Web.
22 May 2015.

Rehabilitation Engineering Research Center on Communication Enhancement. "Mobile devices
and communication apps: An AAC-RERC White paper." Web. 15 April 2015

Ruggles, Steven J., Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder,
and Matthew Sobek. *Integrated Public Use Microdata Series: Version 5.0* [Machine-
readable database]. Minneapolis: University of Minnesota, 2010. Web. 4 May 2015.

Shane, Howard, Sarah Blackstone, Gregg Vanderheiden, Michael Williams, Frank DeRuyter.
"Using AAC Technology to Access the World." *Assistive Tech.* 24 (2012): 3–13. Print.

Statistics Canada. *A profile of disability in Canada, 2001.* Ottawa: Statistics Canada (2003).
Web. 6 May 2015.