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Use of Mobile Technology by Adults Who Use Augmentative and Alternative Communication: Voices from Two Countries

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Abstract

Mobile technology – cell phones, smartphones and tablets – has expanded communication and social interaction, commerce, and access to information for many people with disabilities. Little is known about the use of these mainstream technologies by adults who use augmentative and alternative communication (AAC). Information comparing their use by adults who rely on AAC from both high-income and low or middle-income countries is nonexistent. This article presents data on the use of mobile technology by 38 adults from the United States and 30 adults from South Africa who use AAC. Results, focusing on outcomes and benefits, indicate that most of the participants from both countries use some form of mainstream mobile technology. Most report that their mobile devices are important, but some find it difficult to use requiring a variety of modifications. More than 50% of participants from each country used their mobile devices for text-messaging, web browsing, keeping a directory of contacts, voice calling, sharing photos or videos online, listening to music, and social networking. Recommendations are made for industry and people who rely on AAC.

Keywords: augmentative and alternative communication, AAC, cell phones, mobile technology

Introduction

Use of mobile technology – cell phones, smartphones and tablets – has grown dramatically. By the turn of this century, cell phone use had

reached a majority of the population in Canada, the United States, Australia, Germany, Singapore, the United Kingdom, and Italy (Bryen & Moolman, 2015). Although Africa had only 15 million cell phone users at the turn of the century, this grew to 387.7 million in 2011, becoming the second largest mobile phone market in the world after Asia (Dlamini Zuma, 2014).

According to the Pew Research Center (2015), cell phones (portable telephones that use cellular technology) are as common in the United States (a high-income country) as they are in South Africa (a low- and middle-income country). Smartphones (cell phones that run complete operating systems and that can access the Internet and applications ("apps") with features such as calendars, media players, GPS navigation, and web browsing) are not as widely used due to cost, but are rapidly gaining popularity (Bryen & Moolman, 2015). Slightly more than 34% of South Africans own smartphones compared to 64% in the United States (Pew Research Center, 2015).

Cell phones and, more recently, smartphones and tablets have become increasingly ubiquitous because they are portable and make personal or work-related communication possible from almost anywhere (Stock, Davies, Wehmeyer, & Palmer, 2008). Access to mobile technology, a subset of the larger information and communication technology (ICT), has expanded communication, social interaction, and commerce, and has improved access to information via the Internet. Furthermore, mobile technology is not dependent on costly infrastructures required for the use of landline telephones and desktop computers where penetration in sub-Saharan Africa is close to zero (Pew Research Center, 2015).

Mobile Technology and People with Disabilities

The potential of mobile technology to improve the lives of people with disabilities remains largely untapped (Scope, 2013). According to the Center for an Accessible Society (2014), mobile technology has potential to substantially broaden the lives and increase the independence of people with disabilities. Increasingly, they can now log in and order groceries, shop and pay for appliances, research health questions, participate in online discussions, navigate cities, travel and catch up with friends, or make new ones at any time and from anywhere.

Internationally, the importance of mobile technology in equalizing opportunities for people with disabilities has been reinforced by the United Nations Convention on the Rights of Persons with Disabilities (CRPD). Article 9 of the CRPD notes that information and communication technologies, including mobile technology, enable people with disabilities to live more independently and participate more fully in all aspects of life (United Nations, 2006). Despite these benefits, people with disabilities still have more limited access to mobile technology than their non-disabled peers with only 35% of persons with disabilities in North America having access to these technologies compared to 75% of people without disabilities (Duchastel de Montrouge, 2014).

Mobile Technology for People Who Rely on Augmentative and Alternative Communication

The CRPD recognized the importance of mobile technology for the approximately 1 billion individuals with disabilities worldwide, including those with complex communication needs who require augmentative and alternative communication (AAC) approaches. Nguyen, Garrett, Downing, Walker, and Hobbs (2008) demonstrated that when mobile phones were interconnected with the individual's AAC device, they were able to effectively use the phone in its many modes of operation, resulting in a greater sense of independence, safety, and security. The use of mobile phones also contributed to improving their communication skills, resulting in greater self-confidence in conversation and social interactions.

Smartphones and tablets are increasingly used to mediate other areas of social interaction beyond

interpersonal communication. Shane, Blackstone, Vanderheiden, Williams, and DeRuyter (2012) noted that modern consumer technology is used for searching for information, online services such as banking, entertainment (books, news, video), education, health and safety, personal organization tools such as address book, calendar, clock, and customer services like airport check-in. Smartphones, consequently, offer great opportunity for people who use AAC to access the world, while simultaneously creating challenges to ensure that AAC users are not left behind as mobile technology advances. Finally, mainstream mobile devices are more stylish, which has resulted in them becoming fashion accessories compared to AAC devices, which lack the "cool factor" and often look as if they were designed for children or carry other markers that signify disability in some way (Foley & Ferri, 2012).

Despite the potential benefits of mobile technology, little information has been available on the actual use of these technologies by adults with complex communication needs who use AAC, how they select and adapt them, and their experiences using them. Early research found that adults who rely on AAC had limited access to cell phones (Bryen, Carey, & Potts, 2006). A gap was reported in cell phone use (20% for their sample of adults who use AAC compared to 57% for the non-disabled US sample). Later research by the Rehabilitation Engineering Research Center on Wireless Technology (Wireless RERC, 2014) found that adults who relied on AAC used mobile devices at substantially lower rates than their peers from other disability groups, such as those who have visual or hearing disabilities. Morris and Bryen (2015) provided a more positive picture about the use of mobile technology by adults in the US who rely on AAC. However, respondents in their study continued to lag behind respondents with other disabilities as well as behind the general population in their use of these mainstream technologies. Given the worldwide expansion in the use of mobile technology and the increased need to make these powerful technologies more accessible to people with disabilities, the question remains whether adults who use AAC in both high-income and low- or middle-income countries are using them at similar rates and for similar purposes and activities.

Purpose of the Study

The purpose of this research is to describe the use of consumer mobile technology by adults who rely on AAC in the United States (a high income country) and South Africa (a low- or middle-income country). By studying this rapidly growing and important means of communication, we will have a better understanding of current use, barriers, and needed changes from two different cultural, contextual, and socio-economic perspectives. Based on the results of this research, recommendations can focus on both local and international initiatives needed to ensure equal access to mobile technology for individuals with disabilities who rely on AAC technologies.

Method

A descriptive survey design (McMillan & Schumacher, 2010) was used to describe the responses of 38 adults from the United States and 30 adults from South Africa who rely on AAC using the Survey of User Needs (SUN4) (Morris, Mueller, Jones & Lippincott, 2014).

Materials

The Survey of User Needs (SUN) was originally launched in the United States in 2012 by the Rehabilitation Engineering Research Center on Wireless Technology, also known as the Wireless RERC. The SUN has been updated three times in order to keep up with the rapid pace of technological change and to ensure that data particularly relevant to people who use AAC were included (Morris et al., 2014). SUN4 can be viewed at http://www.wirelessrerc.org/content/projects/sun-overview. SUN4 has four parts. Part 1 covers demographic variables (i.e., age, gender, ethnicity, highest educational level attained, annual household income, living conditions, type of employment, and

whether the survey was completed independently or with help). Part 2 focuses on the participant abilities and disabilities, as well as the types of mobile technology devices used. Part 3 focuses on the participant use of mobile devices, for example whether they own a mobile device, the types of mobile devices they use and the activities they were used for, satisfaction with their mobile device, how the participant decided on the particular device, as well as the types of changes that were made to it. Finally, Part 4 focuses on the various activities and functions for which the mobile devices are used and how often they are used. Questions also focused on social networking activities and the use of mobile apps.

The content validity of SUN4 was established by conducting interviews with subject matter experts in the mobile device and service industries and regulatory agencies, accessibility and assistive technology experts, advocates for people with disabilities, and people with disabilities themselves, as part of the development process. A few items were adapted from other established survey research, including the National Health Interview Survey (NHIS) conducted by the US Centers for Disease Control and Prevention (CDC), and the Pew Research Center's on-going research on mobile device use (Duggan & Smith, 2013). Finally, the typology used to identify respondents' functional abilities was adapted from the American Community Survey (ACS).

Five adaptations focusing on ensuring cultural, contextual, and metric equivalence were made to the SUN4 for use in the South African context. These were: (a) changes to the ethnic categories used, (b) changes to the categories in which highest level of education was described, (c) categories used to describe household income and the metric used (South African Rand not United States Dollar), (d) the examples of mobile technologies and service providers specific to the South African context were included as well as a category for low technology AAC (communication boards), and (e) metric used for the costing of apps was changed (Bornman, Bryen, Moolman, & Morris, 2016).

Participant Recruitment

For the United States sample, convenience sampling was used to obtain a sample of adults with complex communication needs who rely on AAC for face-to-face communication. Study participants were recruited through the Wireless RERC's Consumer Advisory Network, a nationwide network of consumers with disabilities. Recruiting was also done 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. Finally, information about SUN4 was posted to the Augmentative Communication Online User's Group (ACOLUG), an international listserv for people who use AAC, and was sent to individuals working at national, state, and local organizations. As a result of these recruitment efforts, a total of 38 adults with complex communication needs who use AAC completed SUN4.

For the South African sample, three recruitment strategies were used: recruitment from (a) an empowerment project for adults with complex communication needs who use AAC, (b) e-mail targeted at this population, and (c) outreach to institutions for individuals with severe disabilities. From this recruitment process, a total number of 30 South African adults with complex communication needs who use AAC were identified and contacted. Inclusion criteria for both countries were the same. To be eligible for this study, participants had to (a) be adults, 18 years or older; (b) have complex communication needs, (c) rely on some form of specialized AAC for face-to-face communication, and (d) provide consent. Details about the South African and the United States samples are provided in Tables 1 and 2.

Procedures

In South Africa, human subjects research approval was obtained from the University of Pretoria. All

Table 1

United States (US) and South African (SA) Participants' Demographic Information

Demographic information	% of US participants (*N*=38)	% of SA participants (*N*=30)
Completed SUN4 on their own	68%	13%
Mean age (in years) and SD *Gender (% female)*	42 (*SD*.=16.4) 39%	33 (*SD*=12.0) 37%
Race		
• Black or African American	13%	33%
• White	74%	67%
• Asian/Pacific Islander	3%	NA
• Hispanic/Latino	3%	NA
Household income (above $35K / 60K Rand)	38%	40%
Education		
• Not applicable or no schooling	3%	NA
• Attended primary school	5%	10%
• High school diploma or GED	16%	14%
• Post high school education	76%	17%
• Attended special school	NA	59%
Employment status		
• Employed full time	29%	3%
• Employed part time	21%	13%
• Retired	13%	3%
• Unemployed	32%	80%
Living setting		
• Urban/suburban area	79%	90%
• Rural area	21%	10%
• Lives alone	19%	7%

Note: **The 2015 official poverty levels for a household of four were based on the *Federal Register* by the U.S. Department of Health and Human Services under the authority of 42 U.S.C. 9902(2) for the United States and from http://theconversation.com/how-current-measures-underestimate-the-level-of-poverty-in-south-africa-46704 for a household of four in South Africa.**

potential participants received detailed information about the study making it clear that participation in the study was voluntary and that there would be no negative consequences if they declined participation or withdrew at any time. Potential South African participants completed an informed consent form. All potential participants consented. In the United States, because of the non-invasive nature of the survey questions and the inclusion of only adults, the research received a waiver of documentation of informed consent from the review board at the researchers' institution for the participants from the United States.

In the United States, participants completed the survey via SurveyMonkey®, a web-based survey service. Although all participants were offered alternative methods for responding (e.g., email, phone, or

Table 2

Type of Difficulty Experienced by Participants from the United States (US) and South Africa (SA)

Type of difficulty	*% US participants (N=38)*	*% SA participants (N=30)*
Frequent worry, nervousness, or anxiety	24%	17%
Difficulty concentrating, remembering, or making decisions	21%	27%
Difficulty seeing	21%	13%
Difficulty hearing	34%	7%
Difficulty using arms	61%	60%
Difficulty using hands and fingers	66%	70%
Difficulty walking and climbing stairs	66%	73%
Difficulty speaking so people can understand	82%	100%

Note: **Percentages add to more than 100% because several participants experienced multiple difficulties.**

face-to-face interview), none was requested. In contrast, most South African participants relied on someone to record their responses -- either their primary caregivers or trained research assistants.

Data Analysis

Descriptive statistics were used for the data analysis given that this research was exploratory in nature. Information from the survey was coded in SurveyMonkey® and frequencies and percentages were calculated for each country. Due to some differences in the recruitment of participants and data collection procedures between the two countries, inferential statistics were not used.

Results

Despite geographic, demographic, and economic differences between the United States and South Africa, there were many similarities between the two samples. Table 1 shows that the gender and ethnic membership in the two samples were similar with more male than female participants. Participants mostly lived in urban or suburban areas, lived with others, and had incomes below their respective official poverty levels. The two samples were both over-represented by participants who are white, despite the fact that Black South Africans are a numerical majority.

Education levels and employment status did differ between the samples from the two countries. In the United States sample, 92% reported completing high school, obtaining a GED, or having some post high school education. In contrast, only 31% of the South African participants reported completing high school, obtaining a GED, or having some post high school education. Furthermore, 50% of the participants from the United States reported being employed either full or part-time. This is in contrast to 80% of the South African sample reporting being unemployed.

As shown in Table 2, participants from both countries reported experiencing multiple disabilities. More than three-quarters of both samples reported having complex communication needs (i.e., difficulty speaking so people can understand). The majority of respondents from both countries also reported having difficulties using their arms, using their hands and fingers, and difficulty walking and climbing stairs. This finding shows that participants from both countries reported having multiple disabilities, not just complex communication needs. A small percentage of participants from each country reported having difficulty with nervousness and anxiety,

Table 3
Percentages of Specialized Assistive Technologies Used by Participants from the United States (US) and South Africa (SA)

Type of specialized assistive technology	*US participants (N=38)*	*SA participants (N=30)*
Screen reader	16%	7%
Screen magnifier	5%	3%
Hearing aid	26%	3%
Speech-generating AAC device	100%	57%
Text-to-speech software	45%	53%
Fabricated AAC communication board	NA	50%
Wheelchair	61%	70%
Crutches, cane, or walker	21%	7%

Note: **Percentages add to more than 100% because several participants used more than one type of assistive technology.**

remembering, decision-making, and seeing.

Participants from each country were asked about the types of specialized technologies they use to address their disabilities. Results shown in Table 3 indicate that the majority of participants from each country use high-tech AAC devices, either specialized speech-generating devices (SGD) or text-to-speech software. A high percentage from each country also reported using wheelchairs. Given the moderate rate of hearing difficulties among the participants from the United States, it is not surprising that they also reported using more hearing aids than those from South Africa. The types of specialized assistive technology used by participants from each country reflect the functional difficulties previously reported in Table 2.

Data presented in Tables 4 and 5 illustrate mobile technology device ownership and describe the source(s) used to select this technology. When asked about their ownership and use of mobile technology devices, the majority of participants from both countries reported ownership. It is interesting to note that for both samples, the highest percentage of ownership was that of smartphones -- 67% for South African participants and 49% of those from the United States. Both countries reported smaller percentages of ownership of basic cell phones and tablets.

As shown in Table 5, participants reported using a variety of sources to select the particular mobile device they use. The largest percentage reported that their selection was based on recommendations from family members or healthcare professionals. Participants from the United States also relied on online consumer sources such as blogs and listservs, with 50% of participants from the US selecting their devices based on recommendations from online consumer sources. This potential resource was not used at all in South Africa. Websites of mobile service companies were used less frequently by participants from the United States (39%) and even less by South African participants (7%). The device package labels with the list of features, as well as information provided by a salesperson, were also used infrequently in both countries. It is important to note from Table 5 that many of the participants from each country used more than one resource to select their mobile device. Finally, almost one-third of the South African participants reported receiving their mobile technology as a donation, gift, or as a loan.

Table 4
Percentage of Participants' Ownership of Mobile Device in the United States (US) and South Africa (SA)

	% US participants (N=33)	*% SA participants (N=30)*
Owns a mobile device	85%	100%
• Basic cell phone	6%	23%
• Smartphone	49%	67%
• Tablet	21%	10%
• Other (e.g., laptop)	9%	0%

Table 5
How Mobile Technology was Selected by Participants from the United States (US) and South Africa (SA)

Sources of information	*% US participants (N=28)*	*% SA participants (N=30)*
Recommendations from friend, family, healthcare professional	61%	33%
Package label with list of features	18%	13%
Salesperson	18%	13%
Online consumer sources (blogs, listservs, news, etc)	50%	0%
Website of mobile services companies	39%	7%
Website of mobile device makers	25%	30%
Advertising on TV, radio, or in magazines or newspapers	29%	13%
Other (e.g., donation, gift, borrowed)	21%	30%

Note: **Percentages add to more than 100% because several participants used multiple sources of information.**

Data presented in Table 6 summarizes participants' overall purpose for using their mobile devices, their importance and satisfaction, ease of use, and changes made to their mobile technology. The majority of participants from the United States reported using their mobile devices for both professional and personal uses while the South African participants reported that their devices are used primarily for personal purposes. This finding reflects the differences between the countries in the employment status of participants (refer back to Table 1). Regardless of the purpose, there was almost unanimous agreement among participants from both countries that the use of mobile technology was important.

This was not the case for satisfaction and ease of use with these mobile technologies. Several participants from each country shared some level of dissatisfaction with their mobile technology, noting difficulty with the ease of use.

When asked about changes/modifications made to their mobile device, almost half of South African participants reported that no changes or additions were made to their mobile devices (47%). Respondents from the United States provided a slightly different view with only 14% reporting not making any changes to their off-the-shelf mobile devices. Exploring the nature of the changes, the following modifications were made to their mobile

Table 6

Use, Importance, Satisfaction, Ease, and Changes Made to Mobile Devices by Participants from the United States (US) and South Africa (SA)

Use of mobile device	*% US participants (N=28)*	*% SA participants (N=30)*
Purpose for use of mobile technology		
• Professional use (work or school)	0%	3%
• Personal use	28%	67%
• Both professional and personal	61%	27%
• Emergencies only	11%	3%
Importance of use of mobile technology		
• Very important	89%	83%
• Somewhat important	7%	13%
• Not very important	4%	3%
Satisfaction with mobile technology used		
• Very satisfied	29%	50%
• Somewhat satisfied	54%	33%
• Neither satisfied nor dissatisfied	10%	10%
• Somewhat dissatisfied	7%	0%
• Very dissatisfied	0%	7%
Ease of use of mobile technology		
• Very easy to use	29%	43%
• Easy to use	36%	30%
• Somewhat hard to use	25%	17%
• Hard to use	3%	0%
• Can't use it without help	7%	10%
Changes/additions made to mobile devices		
• No changes or additions	14%	47%
• Physical accessories added, such as protective skin or case, headset, Bluetooth device, screen overlay, lanyard, stylus	61%	33%
• Assistive devices added, such as head switch, EMG switch, AAC device, neck loop, TTY	32%	7%
• Software added, such as a third party text-to-speech, screen reader, screen magnifier, app store downloads	39%	27%
• Improvised solutions, such as hand strap, Velcro, wheelchair mount	32%	7%
• Other, such as larger font, different screen glass for head pointer, protective screen	18%	10%

devices:

- Physical accessories were added, such as a protective skin or case, headset, Bluetooth device, screen overlay, lanyard, or stylus;
- Assistive devices were added, such as head switch, switch, AAC device, neck loop, or TTY;
- Software was added, such as a third-party text-to-speech, screen reader, screen magnifier, or other app store downloads;

- Improvised solutions were made, such as hand strap, Velcro, or wheelchair mount; and
- Other changes were reported, such as larger font, different screen glass for head pointer, or protective screen.

The robust features and functions built into mobile devices make them especially attractive for individuals who rely on specialized AAC devices. Table 7 shows the types of activities in which the participants engaged when using their mobile device. Most of the 18 activities listed in the survey were engaged in by some of the participants from each country. More than 50% of participants in each country engaged in text messaging, web browsing, keeping a directory of contacts, voice calling, sharing photos or videos online, listening to music, and social networking. Based on the combined percentage being greater than 100% in each country, it can be noted that more than one activity was used by at least some of the participants from each of the two countries.

Finally, all participants were asked to indicate if they had experienced any of 11 distinct situations using their mobile devices in the previous 30 days. As shown in Table 8, the experiences identified by the largest percentage of participants were "Making plans with others" (79% for the United States, 67% for South Africa); "Getting information that I needed right away" (68% for United States, 47% for South Africa); and "Using for entertainment or when I was bored" (45% for the United States and 63% for South Africa).

Table 7

Use, Importance, Satisfaction, Ease, and Changes Made to Mobile Devices by Participants from the United States (US) and South Africa (SA)

Type of activity	*% US participants (N=28)*	*% SA participants (N=30)*
Text messaging	93%	80%
Web browsing	79%	57%
Email	71%	37%
Keeping a directory of contacts	75%	73%
Downloading apps	71%	43%
Keeping a calendar of appointments	71%	43%
Social networking – Facebook[2], LinkedIn[3], Twitter[4], etc	71%	57%
Voice calling	57%	50%
Navigating or wayfinding (using GPS and/or maps)	61%	23%
Sharing photos or videos online	57%	67%
Using voicemail	54%	13%
Watching videos	50%	40%
Listening to music	50%	60%
Playing games	43%	33%
Video calling	39%	3%
Shopping	39%	0%
Recording voice notes or reminders	29%	10%
Monitoring your health	25%	0%
Other	18%	17%

Note: **Percentages add to more than 100% because several engaged in more than one activity.**

Table 8

Use, Importance, Satisfaction, Ease, and Changes Made to Mobile Devices by Participants from the United States (US) and South Africa (SA)

Type of experiences with mobile technology	*% US participants (N=28)*	*% SA participants (N=30)*
Was frustrated – mobile device took too long to use	29%	30%
Had difficulty entering a lot of text	43%	30%
Had difficulty reading – screen or the text was too small, screen reader couldn't read it out loud	39%	17%
Used my mobile device for entertainment or when I was bored	61%	63%
Pretended to use my mobile device to avoid interacting with people around me	11%	10%
Was in an emergency situation where having my mobile device really helped	21%	27%
Used my mobile device to get information that I needed right away	68%	47%%
Used my mobile device to get directions while outside of my home or office	50%	23%
Used my mobile device to make plans with others	79%	67%
Turned off for a period of time to get a break from using it	11%	13%
Was in a situation where I had trouble doing something because I didn't have my mobile device with me	18%	37%

Note: **Percentages add to more than 100% because several participants had more than one recent experience with mobile technology.**

Discussion

Before summarizing the major findings related to outcomes and benefits, it is important to highlight that conducting a bi-national study is not without its inherent difficulties. Despite economic (e.g., high income vs. middle or low income), geographic (e.g., North America vs. sub-Saharan Africa), and demographic differences between the two countries (e.g., United States' population of more than 320 million as opposed to a South African population of less than 54 million in 2015; majority of United States' population is white versus the majority of South Africa's population is Black in 2015), the two samples of adults with complex communication needs were similar in several important ways. The majority of the study participants from both countries were white, male, had household incomes below the median income for their country, lived in urban or suburban settings, were either unemployed or worked part time, lived with other people, and experienced multiple disabilities associated with complex communication needs. Participants from both countries used a variety of specialized technologies to address their disabilities with a large majority using speech generating devices and text to speech devices to address their complex communication needs, as well as using wheelchairs to address their physical disabilities.

Some relevant differences between the participants from the two countries were, however, noted. They included age, where the participants from South Africa were younger. Employment status and education level also differed, where more participants from the United States were employed full-time and achieved higher education levels compared to

participants from South Africa.

Outcomes and Benefits

The large majority of participants from both countries owned or used some form of mainstream mobile technology. This finding compares favorably with 2014 data about cell phone ownership by the general population in United States (89%), Africa (89%), and South Africa (90%) (Pew Center, 2015). In contrast to working landlines, which continue to be common in the United States (60%), working landlines are almost non-existent in South Africa (2%). Low- or middle-income countries, such as South Africa, have entered the digital and cellular ages, bypassing the need for landline phones and desktop computers. This may be a key reason that one of the major findings of this study showed that smartphones were used more frequently than cell phones not just in the high-income country but also in a low- or middle-income country.

Among the participants, texting was the most common activity in both countries. This compares quite favorably with data from the study of cell phone use in the general population of Africa (Pew Research Center, 2015). Although mobile technology has different uses for different people, it is clear that communication and social interaction is important whether or not you live in the United States or in South Africa and whether you have a disability or not. Texting uniquely serves the communication needs of those who rely on AAC, since it bypasses the need for speech. Due to the fact that sending and receiving text messages is asynchronous, it compensates for the fact that using speech-generating devices is much slower than speech. Furthermore, it is hypothesized that texting may be especially attractive to individuals with complex communication needs because abbreviated spelling has become so typical to all of us when texting. (e.g., less fatiguing and less time-consuming).

A majority of respondents from both countries also use their mobile devices to keep a directory of contacts and to participate in social networks. Once again, this finding demonstrates the importance of socially connecting with others and supports the findings of Caron and Light (2015). Browsing the web for entertainment or for obtaining information was a popular activity for more than 50% of mobile technology owners in this study. Other activities, such as getting health information and shopping, were engaged in by fewer participants, but done more frequently by participants from the United States than those from South Africa. This may be attributed to the lower availability of these services in South Africa. That video calling was used infrequently by the South African participants (3%) is possibly related to the high cost of data use or, alternatively, because WIFI is not yet freely available throughout the country.

Outcomes from this study demonstrated that most respondents noted the importance of using their mobile devices. This finding supports recognition that mobile technology holds great promise to revolutionize lives as it provides all individuals, including those with complex communication needs, the opportunity to connect with others, and also to access education, commerce, employment, and entertainment from anywhere and mostly at any time. (Caron & Light, 2015; Foley & Ferri, 2012).

Despite the promise that mobile technology holds to enhance the lives of individuals with complex communication needs, data from this study also found that its use was difficult for approximately one-third of the participants from both countries. In addition, for those who could use this technology, a variety of device changes or modifications were needed. As such, an additional burden is likely to be placed on this population to retrofit the device so that it is accessible and easily used. This finding underscores the United Nations call to promote the design, development, production, and distribution of accessible information and communications technologies and systems at an early stage, so that these technologies and systems become accessible at minimum cost (United Nations, 2006), and the need for using principles of universal design when

developing and manufacturing mobile technology.

Limitations

Designing and conducting a bi-national study is a complex process, especially when trying to ensure that each sample is representative of the demographics of each country while also trying to ensure that the sample from each country is comparable. The complexity is more so when the target population, adults with complex communication needs who use AAC, is relatively small in size, heterogeneous, and not easily accessible due to multiple disabilities affecting speech, language, and mobility. As a result, there were within sample limitations in addition to between sample limitations.

Within countries, each sample of people who use AAC was not representative of the overall population. They were more literate and more highly educated. They mostly lived in urban/suburban areas with very few from each country living in rural areas. They were also mostly white. In addition, although household incomes of each country represented the currencies for their country and reported as their respective median income (Refer back to Table 1), the income threshold of the two countries is not the same. The purchasing power of the South African Rand versus the United States dollar differs. For example, in the 2015 UBS Prices and Earnings Review, the amount of time an average worker in different cities across the globe must work to earn enough to purchase staple consumer items (e.g. a smartphone), was calculated. The working time required to buy one such smartphone in New York City is approximately 24 hr. compared to Johannesburg, which is 86.9 hr. Considering an average 40-hr. work week, this would imply that in the United States one half-week's work will buy this smartphone, while just more than two weeks will be required in South Africa to buy the same phone (UBS, 2015).

Because complex communication needs resulting in the need for AAC is a relatively low incidence disability, it was also difficult to obtain a larger and more representative sample. With a relatively small sample size, we could not do some basic comparative statistical procedures, nor could we explore the relationship between key demographics, such as gender, age, and education and mobile device ownership and use in each country. As such, the results of this study should be viewed with some caution. However, this study on the use of mobile technology is the first of its kind in each country and in two very different countries. It can be used as a credible baseline for further replication.

Recommendations

Recommendations for researchers. First, there is a need to replicate this study, striving wherever possible, to get a larger and more representative sample from each country. Of importance is the need to secure better representation from marginalized ethnic and racial minorities who have complex communication needs and who use AAC. This may be quite difficult since programs providing AAC services that serve as sources from which to recruit research participants may also underserve members of minority groups.

Special effort should also be made to recruit participants from rural populations. Odendaal, Duminy, and Saunders (2008) suggest that in South Africa there may be a digital and cellular divide between rural and urban populations. This recommendation also applies to future research in the United States since participants from rural areas were underrepresented in both the countries in this study. However, given that mobile technology has the potential to reach rural areas, it is important to learn if they are, indeed, reaching people who have complex communication needs living in rural areas.

There is also a need to replicate this study given the more recent advances in mobile technology and the activities for which they can serve. For example, within the past two years, manufacturers of smartphones have recognized the need to build in features to accommodate the access needs of people with visual disabilities, those with hearing

disabilities, those with motor disabilities, and those with learning disabilities. This is especially true of iPhones, Androids, and a variety of tablets. Furthermore, there is rapid expansion of activities that can be done using cell phones and smartphones. For example, more and more commerce and banking are being conducted using these mobile devices.

Recommendations for the mobile technology industry. Cell and smartphone designers and manufacturers are encouraged to expand their built-in accessibility features to address the needs of people with complex communication needs who frequently have multiple disabilities. Vision is already being addressed via voice over, zoom, speak selection, larger text, contrast, and more. Hearing and learning disabilities are also being addressed. Most relevant to individuals with complex communication needs is physical and motor accessibility features, including switch control and assistive touch. As shown by the data from this study, most people with complex communication needs have motor disabilities in addition to their speech difficulties. Some also have learning, visual, and hearing disabilities in addition to their motor and speech disabilities. Not only must these access features be available on new mobile devices, but also they must be widely marketed so family members or professionals who serve and support this population know they exist. This is especially critical because results from this study indicate that family members and professionals in each country are the ones who most frequently recommend mobile devices to adults with complex communication needs.

Recommendations for the assistive technology industry. Manufacturers of specialized AAC devices should consider expanding their designs of software or apps that can easily be downloaded onto the platforms and operating systems that are used in mainstream mobile devices. Mainstream mobile devices are more powerful and certainly more image-enhancing than current specialized speech generating devices. Specialized assistive communication technologies, such as speech-generating devices, have rates of abandonment as high as 30% (Foley & Ferri, 2012). Research on the rate of abandonment of mainstream mobile devices by this population could yield important policy and clinical implications.

Recommendations for individuals with complex communication needs who use AAC. Individuals with complex communication needs who rely on AAC would benefit from learning more about the benefits of having access to and use of mobile technology such as cell phones, smartphones, and tablets. Without them, they will have fewer opportunities for social interactions, communication with a wide variety of individuals with and without disabilities, fewer opportunities for employment and commerce, less access to information and commerce, and more. They should also become more aware of the accessibility features that are already built into existing mobile devices, as well as needed accessibility features that are possible but remain absent in these mainstream devices. This information will enable them to be well-informed consumers. Additionally, armed with this information they can become effective advocates in working with policy makers at the local, national, and international levels.

Conclusions

The findings of this research suggest that most of the adults with complex communication needs in the United States and South African samples who have access to AAC also own or use mainstream mobile devices for a variety of purposes and to engage in a variety of activities. However, for some, use of these devices is not easy. Furthermore, the burden of adapting and modifying their devices for easier use is placed on the person, rather than being built into the device, using principles of universal design or design for all. This situation must change if social, informational, and economic inclusion is to occur. For countries that have ratified the CRPD, there is a means to monitor the current situation. The CRPD can also be used as an instrument for change (cf, G3ict & ITU, 2012). Hopefully this study will provide

people with complex communication needs and their advocates with needed information to effectively advocate for equal access to mobile technology in our ever-growing digital world.

Declarations

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