Assets, Actions, Attitudes: Hearing and Vision Impaired Mobile Technology Personas

J. T. Morris and J. L. Mueller

Abstract: Designers and engineers utilize personas and user profiles to give life and substance to user research findings. The pace of development and diffusion of mobile wireless technologies make modeling of consumer profiles ever more critical, especially for people with disabilities, for whom mobile technology can be either empowering or disenfranchising. Fueled by global competition and government policy in the US and elsewhere, inclusive design has become a priority for wireless device manufacturers, software engineers, and service providers. This paper discusses the development and use of personas as a critical tool to help stakeholders (the technology industry, regulators, designers and students) understand the needs and preferences of customers with disabilities, and to raise awareness of the importance of designing for people with disabilities – in short, to visualize inclusion. The paper presents data from the biennial Survey of User Needs, a national survey in the United States conducted by the Rehabilitation Engineering Research Center for Wireless Technologies (Wireless RERC). Data are presented on the assets, actions/activities and attitudes of 4 groups of survey respondents: blind, low vision, deaf and hard of hearing. These data inform the development of a user type for each group. Regular interaction with wireless customers with disabilities has enabled us to "flesh out" these user types to help its industry partners better understand their customers with disabilities.

1 Introduction

For people of all ages and abilities, independence and social inclusion are fundamental to health of both body and mind. As mobile wireless technology evolves, equitable access becomes increasingly essential to personal independence, social inclusion and employability. Many consider access to mobile wireless technology a basic human right. Indeed, the United Nations (2006) Convention on the Rights of Persons with Disabilities (CRPD) states that parties to the convention agree to: "undertake or promote research and development of, and to promote the availability and use of new technologies, including information and

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communications technologies, mobility aids, devices and assistive technologies, suitable for persons with disabilities, giving priority to technologies at an affordable cost" (Article 4).

This article discusses the development and use of personas to guide designers and engineers in developing solutions for people with sensory limitations: blindness, low vision, deafness and/or hard-of-hearing. Personas are presented for each limitation, based on data from the Survey of User Needs (SUN), a national survey in the United States on use and usability of mainstream mobile wireless technology by people with disabilities, conducted by the Rehabilitation Engineering Research Center for Wireless Technologies (Wireless RERC).

2 Personas and Mobile Technology

In his book on designing for users, The Inmates are Running the Asylum (2004), Alan Cooper described how effective personas can be when used in the product development process, and how dismally design can fail when users are denied a voice in the product development process. Cooper described a fundamental difference between designing for "users" and designing for personas: Users have few demands and are expected to be "elastic" – to "bend and stretch" to accommodate the design. Personas, on the other hand, are clear, specific expressions of users' characteristics and demands, so that the design can be adapted to meet these needs.

Because personas are compilations of many real people, their presence in the design process is personal and engaging. Designers pay attention to the needs expressed by personas, rather than assuming their customers will simply adapt to their designs. Personas focus on real users and their needs, so that designers do not fall into the common trap of designing only for themselves. Since few designers have disabilities, this focus is especially important in designing mobile wireless products that acommodate the needs of customers with disabilities.

Over the years social science researchers and technology marketers have identified user types and personas of mainstream consumers in various ways. Some have been based on a technology platform, others on the operating system, such as Blackberry, iOS, Android (Morris and Mueller 2014). Others start with the brand of smartphone (e.g., iPhone), and try to identify personal qualities of owners. One wry, but apt, typology identifies seven iPhone user types, including: Fanboy, Unappreciative, Over User, Desk Job, Hacker, Senior Citizen and Complainer (OMG Mugshots 2014).

A study by the Pew Research Center (2007) went beyond devices and operating systems to identify several distinct technology user types based on its own survey research. Development of these user types began with technology ownership and use (referred to as "assets), adding activities that users engage in with their technology ("actions"), as well as their perceptions of how technology impacts their work, family and leisure pursuits ("attitudes").

The Pew's typology of technology users in the general population comprises three general categories (Elite users, Middle-of-the-road users, and Few Tech

Assets), and 10 subcategories, including Omnivore, Connector, Lackluster Veteran, Inexperienced Experimenter, etc. Though developed using 2007 survey data, most of these tech user types are still recognizable today, perhaps with updated descriptions of their assets, and perhaps less so their actions and attitudes. For this article, we adopt the Pew's focus on assets, actions/activities, and attitudes to generate personas with disabilities based on our 2015 SUN research data.

Though personas are fictional characters, they are composites of many real individuals. As the Wireless RERC has gathered user data, personas have emerged that depict the characteristics and lives of real individuals and the cultures and life experiences of their cohorts. Through ongoing user research, new personas have been developed and promoted through the Wireless RERC's publications, presentations, and other outlets. Personas are *not* intended as a substitute for user research or testing, but rather to connect with real users and engage them as customers. In fact, personas can help identify the right users to serve as product testers by modeling user characteristics.

Since its inception in 2001, the Wireless RERC has developed innovative techniques for sharing the wealth of information it has gathered from consumers with wireless industry partners, fellow researchers, and the designers and engineers of tomorrow's technologies. Personas have proven especially effective in sharing input from the hundreds of participants in the RERC's surveys, focus groups, and other user research activities.

Based on data from some 1200 respondents to its first Survey of User Needs (SUN), the Wireless RERC developed an initial set of personas with disabilities in 2004. These personas helped the Wireless RERC bring the needs of wireless customers with disabilities to the attention of industry professionals (Mueller 2004, Mueller et al. 2005) through workshops at industry sites and at the Wireless RERC. These workshops spawned a robust, collaborative user testing program, providing industry partners with face-to-face interaction with customers with disabilities.

Updated personas served a central role in the RERC's "Getting Wireless" annual design challenge for industrial design students at two U.S, universities from 2010 to 2014. Student work in this project received international recognition, including first place in LG's "Design the Future" competition (2010), a Social Design Award from the Victor J. Papanek Foundation (2011), and "Best Accessibility Innovation" selection in the UX Awards (2013). Students and industry participants in the RERC's training activities have described these experiences as having a profound impact on their design practice.

3 Methodology

First launched in 2002, the Wireless RERC's Survey of User Needs (SUN) has been periodically updated as technology has evolved. Now in its fifth version (SUN 5), this unique survey on wireless technology use by Americans with all types of disabilities has come to be an important reference for the wireless industry, regulators, people with disabilities and advocates, and other researchers.

Between June-November 2015, 590 people with one or more of the four sensory limitations or six other functional limitations identified in Table 1 completed the questionnaire. These categories are based on those used by the United States Census Bureau's (2014) American Community Survey (ACS), augmented with categories adapted from the U.S. Centers for Disease Control and Prevention's (CDC n.d.) National Health Interview Survey (NHIS). The SUN permits finer segmentation of respondents, based on use of assistive technology and devices (e.g., using a wheelchair as a subtype of "difficulty walking").

Convenience sampling was used to collect data via Web, telephone, regular mail, and in-person interviews. Most respondents reported having more than one disability or limitation. Females constitute 58% of all respondents. The high mean age of 54 years across all disability types is partly attributable to exclusion of minors under age 18, due to the need for additional procedures in research with vulnerable populations. Data for constrained-response survey questions presented here are summarized using frequency analysis converted into percentages. Data for one open-ended question asking respondents to describe with a single word how they feel about their primary mobile device required using a grounded-theory approach to organize responses into themes e.g., strong positive affect (awesome, incredible), strong instrumental (essential, necessary), basic instrumental (handy, useful), etc.

Table 1 Assets: Hearing and vision impaired respondents' other disabilities

	Difficulty thinking, remember, concentrate	**Difficulty using hands, fingers**	**Difficulty using arms**	**Difficulty walking**	**Difficulty speaking to be understood**	**Frequent worry, anxiety**
Deaf (n=40)	10%	5%	5%	23%	23%	15%
Hard of hearing (n=190)	14%	4%	4%	20%	7%	18%
Blind (n=15)	7%	3%	0%	3%	0%	0%
Low vision (n=57)	25%	14%	16%	37%	16%	35%

4 Assets, Actions and Attitudes

Tables 2 to 6 provide a summary of the assets, attitudes and actions of vision- and hearing-impaired users. Table 2 shows demographic information (Assets) and employment (Action) that may drive technology use. Mean ages of deaf/hard of

hearing respondents are substantially higher than those of blind/low vision respondents. Hard of hearing respondents have much lower employment rates, likely due to high mean age.

Table 2 Assets and actions: Selected demographics by disability type

	Mean age/ standard deviation (years)	Gender (% Female)	Non-white	Annual household income (% below $50,000)	Live alone	Employed at least part time
Deaf	57 / 15.9	72%	15%	50%	35%	55%
Hard of hearing	64 / 15.7	63%	10%	42%	33%	34%
Blind	49 / 13.9	53%	33%	60%	21%	50%
Low vision	48 / 13.8	57%	26%	51%	30%	54%

Table 3 shows that blind and deaf respondents have much higher rates of smartphone ownership, but deaf and hard of hearing users have much higher rates of tablet ownership. Respondents who indicated that they own or use a mobile device were asked to identify all types that they use. Consequently, percentages add to greater than 100%.

Table 3 Assets: If you own or use a mobile phone or tablet, what kind do you use? By disability type.

	No device	Basic phone	Smartphone	Tablet
Deaf	10%	8%	85%	63%
Hard of hearing	10%	14%	70%	52%
Blind	7%	0%	100%	40%
Low vision	7%	12%	70%	44%

Table 4 reveals an interesting contrast between deaf and blind respondents: a much higher percentage of deaf users said their devices were easy or very easy to use, but a much lower percentage reported being satisfied with their devices. Blind respondents reported the reverse: relatively low percentages reported easy use, but high percentages were satisfied or very satisfied. Blind and low vision users

reported using their devices for work at higher rates than deaf and hard of hearing users. Our experience suggests that blind users are substantially challenged using all technology, but they recognize its critical role in supporting their independence.

Table 4 Attitudes and actions: Importance, ease of use, satisfaction with wireless device; work and personal use of wireless device, by disability type

	How important (% very important)	How easy to use (% easy or very easy)	How satisfied (% satisfied or very satisfied)	Use it for work	Personal use
Deaf	91%	89%	80%	44%	100%
Hard of hearing	82%	82%	84%	42%	94%
Blind	87%	73%	93%	73%	100%
Low vision	89%	81%	86%	70%	92%

Table 5 shows much higher usage rates for the most frequently used mobile device functions by blind and deaf users, compared with low vision and hard of hearing users. Blind users use voice calling the most by far, but also use text based communications at high rates. Table 6 summarizes respondents' one-word description of their wireless devices. Some deaf, hard of hearing and low vision users offered no description; all blind users responded. Blind users were most effusively positive about their devices. Only deaf users mentioned safety and security benefits of mobile devices.

Table 5 Actions: Most common wireless activities, by disability type

	Most common	2nd	3rd	4th	5th
Deaf	Text messaging (89%)	Email (86%)	Web browsing (83%)	Wayfinding GPS (75%)	Sharing photos video online (72%)
Hard of hearing	Text messaging (76%)	Email (76%)	Web browsing (70%)	Voice calling (61%)	Sharing photos video online (60%)
Blind	Voice calling (93%)	Email (93%)	Web browsing (93%)	Text messaging (87%)	Wayfinding, GPS (87%)
Low vision	Text messaging (75%)	Email (75%)	Web browsing (73%)	Wayfinding GPS (69%)	Voice calling, sharing photos (65%)

Table 6 Attitudes: Most common single word descriptors for your wireless device, by disability type

	Most common	**2nd**	**3rd**	**4th**	**5th**
Deaf (none 6%)	Great, awesome, addicted, all encompassing (20%)	Functional, handy, helpful, useful (15%)	Survival, safety, emergencies, confident (15%)	Important, irreplaceable, necessary (8%)	Underused, just a device, does bare minimum (8%)
Hard of hearing (none 5%)	Fantastic, miracle, amazing, wonderful (14%)	Convenient, handy, helpful, useful (14%)	Vital, needed essential, important, lifeline (13%)	Good, fair, satisfactory, okay, adequate (10%)	Complicated, annoying, frustrating (4%)
Blind	Great, amazing, wonderful, (40%)	Useful (33%)	Frustrated (7%)	Accessible (7%)	Decent (7%)
Low vision (none 8%)	Amazing, fantastic, magical, addicted, love (23%)	Frustrating, challenging limited, shortsighted (9%)	Essential, necessary, needed (7%)	Handy, useful (7%)	Adequate, satisfied, okay, reasonable (7%)

4.1 Vision and Hearing Impaired User Types and Personas

Here we summarize the survey research data on assets, actions and attitudes presented above into a single broad user type for each of the four disabilities discussed:

- **Deaf: Pragmatic omnivores (omni-mobiles?)**–Many have difficulty being understood when speaking; very high rate of ownership of smart devices; highest ownership of tablets. Though they state that their devices are easy to use, respondents report lowest satisfaction among the four groups – likely a result of deaf users' ability and desire to do even more with their devices. Despite lowest rates of usage for work, many regard devices as tools, including for safety and security.
- **Hard of Hearing: Hearing technology integrators/selective users**– Highest mean age in sample; most have hearing aids or cochlear implants; lower use of smart devices than blind and deaf users; lowest rate of usage for work. Like low vision users, these users have the lowest rates of use of top 5 device functions.

- **Blind: Mobile dependent enthusiasts**–Few of these users report other disabilities. All have wireless devices: 100% own smartphones and use screen reader technology, but have lowest ownership of tablets among this group. Use of the top five functions are the highest among the four groups; lowest rate for ease of use, but highest satisfaction (likely resulting from recognition of the critical role of technology in supporting their independence); strong positive feelings for devices.
- **Low Vision: Multiply challenged selective users**–This group has by far the highest rates for having other physical, emotional and cognitive difficulties among the four groups; low rates of use of top five device functions similar to hard of hearing users; high rate of usage for work, second to blind users; highest rate of non-response to singe-word descriptor for device (21%).

Other demographic and contextual characteristics can significantly impact use of mobile technology. We apply these additional chracteristics to "flesh out" the user types into recognizable personas. Table 7 presents one persona for each user type based on conversations with participants in our focus group research.

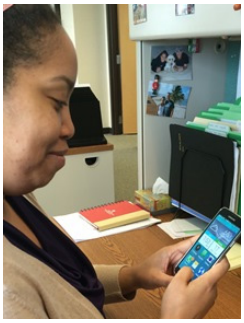
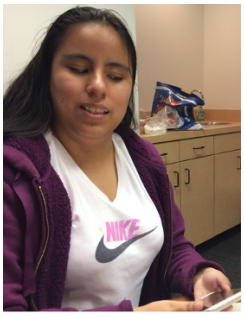
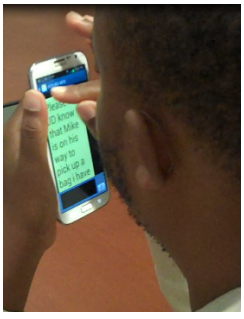
The user types and personas presented here offer a unique – but not exclusive – perspective on the needs, hopes, challenges, feelings and frustrations of individuals representing four disability types. Additional segmentation of the respondents in each group would offer still more sharply defined personas.

5 Conclusion

User types and personas must necessarily change as technology evolves. For example, wireless pagers represented an important mobile communications innovation for deaf users in the 1990s and early 2000s. A decade later, they had all but disappeared from the technology landscape. Simple mobile phones (referred to as "feature phones" by the U.S. wireless industry) still hold some market share, with a number of companies offering them as solutions for seniors (e.g., Tracfone, GreatCall Jitterbug, Doro PhoneEasy 626). But these simple phones have long since ceded their hold on the general market and public consciousness.

Initially, smartphones posed challenges to people with certain limitations. Until the advent of Apple's VoiceOver and Android's TalkBack screenreaders, blind users struggled with the tactilely featureless surface of touchscreens. Users with low sensitivity in their fingertips or limited hand control struggled to adjust to the precision of touchscreen interfaces. At the same time, some people with developmental disabilities gravitated toward touchscreen tablets, particularly Apple's iPad, which provided the platform for low cost speech generation for those with complex communication needs or limited motor function.

Table 7 Hearing and vision impaired mobile technology personas

	**SAMANTHA** is deaf. She works as an administrator at a primary school for deaf children. She considers wireless access essential to her lifestyle. She lives in the city, has a wide circle of friends, and stays active in local community affairs and events. Sam relies on her smartphone for communication at work – video calls, text messaging, email. She owns a Samsung Galaxy S5 mobile phone because of its large screen and relative affordability among high-end smartphones. In her leisure time, Sam enjoys watching YouTube and other videos on her tablet.
	**KURT** is hard of hearing. He has uses bilateral hearing aids and corrective lenses for age-related loss of visual acuity and hearing. He is retired after a long career in the federal government. Kurt finally bought his first smartphone many years after they came to dominate the marketplace. He likes the many features. But he mainly uses just voice and text-based communications. Kurt loves music and has a large collection, but prefers to listen on his powerful home system.
	**LORENA** is 24 years old and has been blind since a young age. She is studying to be a voice-writing court stenographer and will work as an independent service provider upon graduation. She's an avid book reader, using mobile app on her on her "amazing" iPhone 5s. Lorena uses VoiceOver to navigate her iPhone's touchscreen, which has enabled her to listen to her music library on iTunes, surf the web, send/receive text messages/emails, check weather, read news, navigate the city, and request/track location of paratransit buses provided by the city transit agency.
	**HOWARD** is a 30 year old social worker and is legally blind due to diabetic retinopathy, which also causes him glare sensitivity. Diabetes has also limited the sensivity in his fingers. Although his vision loss, which began in his late teens, slowed his educational progress, he is currently studying to be a lawyer. Howard uses an Android-based smartphone with a 6-inch screen, on which he uses large-text and reverse contrast display options. Though he can use all functions on his smartphone at work, he prefers his tablet and laptop for leisure activities requiring vision.

The wireless landscape continues to change in evolutionary as well as disruptive ways. Amid this changing landscape, personas will continue to be an effective vehicle for directing industry focus to real customers with and without disabilities. The Wireless RERC continues to adapt the personas described in this paper to assist designers and engineers in meeting the challenges and opportunities presented by new technology and an increasingly inclusive society.

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