

Hearing Aid Compatibility of Cellphones: Results from a National Survey

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Abstract

Decades of technological development have not guaranteed compatibility between cellphones and hearing aids. Federal regulations have attempted to reduce the variability in interoperability between these two types of devices by requiring cellphone handset manufacturers and wireless service providers to offer a certain percentage of their devices with sufficiently reduced electromagnetic radiation (meeting American National Standards Institute's M3 and T3 ratings for acoustic and inductive coupling) so that they may be operable with hearing aids. These hearing aid compatibility (HAC) regulations also require labeling on packaging and information on the websites of wireless vendors to help hearing aid users identify compatible phones. This paper presents findings from a national survey research project conducted in 2013 by the Rehabilitation Engineering Research Center for Wireless Technologies (Wireless RERC) to understand the current experiences of users of hearing aids and cochlear implants with regard to compatibility of their mobile wireless phones with their hearing technology. Data are analyzed for all respondents who use hearing aid or cochlear implant technology, as well as by age and type of aids (behind-ear, in-ear, bone-anchored, cochlear implant).

Keywords

Hearing aid, compatibility, cellphone, mobile phone

Introduction

Since 2005 federal regulations have required mobile phone handset manufacturers and wireless service providers to offer a certain percentage of their devices with sufficiently reduced levels of electromagnetic radiation (meeting American National Standards Institute's M3 and T3 ratings for acoustic and inductive coupling) so that they may be generate less interference in order to be operable with hearing aids. Further, these regulations require labeling on the exterior of cellphone packaging, printed material inside the packaging, and information on the websites of wireless vendors. The goal of these regulations is to ensure that hearing aid compatible cellphones are readily available to consumers, and that sufficient information is provided to make these compatible phones easy to find.

This article presents findings from the Hearing Aid Compatibility (HAC) Survey, a national survey conducted by the Rehabilitation Engineering Research Center for Wireless Technologies (Wireless RERC). Response data are analyzed to address several core questions related to the experience of finding, purchasing and using a cellphone by people who use hearing technology. Analysis also includes respondents' knowledge of the M and T ratings of their cellphones and their hearing aids, which is critical to choosing a compatible cellphone. Data are analyzed for all respondents who use hearing aids or cochlear implants. Additionally, the data are analyzed by age and type of hearing technology used. This analysis helps assess the impact of federal HAC regulations.

Scope of the Issue

Estimates of the number of people living with hearing loss and the number who own hearing aids vary based on whether hearing loss is self-reported or diagnosed by a physician. Kochkin (2009) estimated this group at 11.3% of the population (34.25 million people). Ikeda,

Murray, and Salomon (2008) estimated that 6%-7% of the U.S. population, or approximately 20 million people, are hearing impaired.

Kochkin (2009) further estimated that approximately 24.6% of the estimated 34.25 million Americans with functional hearing loss have hearing aids (approximately 8.43 million people). Applying the same percentage to Ikeda, Murray and Salomon's (2008) estimate of the hearing impaired population in the United States yields approximately 5.6 million Americans who own hearing aids. This range of 5.6 to 8.4 million people reflects a reasonable growth rate from the estimated 4.2 million hearing aid users in the U.S. in 1994 (Russell, Hendershot, LeClere, & Howie, 1997), given growth of the general population, age composition changes, and possible change in the rate of use of hearing aids. The ongoing aging of the U.S. population since 2009 suggests that the number of hearing aid users in the current period could be higher still.

In the meantime, mobile wireless phone usage has also increased considerably. Among American adults, cellphone ownership rose from 82% in 2009 to 91% in 2013 (Brenner 2013). Though cellphone ownership generally is lower for older individuals, the Pew estimates that 76% of seniors age 65 and older owned cellphones in 2013, up from 57% in 2010 (Lenhart 2010). Survey research conducted by the Wireless RERC indicates that 84% of individuals who are hard of hearing use either a regular cellphone or a smartphone (Morris, et al. 2013).

Hearing Aid Compatibility Regulations

The Federal Communications Commission (FCC) established benchmarks for 2005, 2006, 2008, 2009, 2010, and 2011 to increase the number of hearing aid-compatible digital wireless phones complying with the ANSI standard for both acoustic and inductive coupling (Federal Communications Commission).

There are two ratings systems for reporting the electromagnetic interference generated by a cellphone or hearing aid. First, all digital handsets are rated for their ability to reduce interference with hearing aids operating in acoustic (or microphone) mode – from M1 to M4, with M4 being the best. They are also rated for their ability to operate with hearing aids that contain a telecoil (a tightly wrapped piece of wire that converts sounds into electromagnetic signals) and operate in inductive coupling mode. Ratings for inductive coupling range from T1 to T4. The FCC considers mobile handsets to be hearing aid compatible if they are rated at least M3 for acoustic coupling and at least T3 for inductive coupling.

There are two air interfaces used for cellphone transmission in the United States: Global System for Mobile (GSM) used by AT&T and T-Mobile) and Code Division Multiple Access (CDMA) used by Verizon Wireless and Sprint Nextel). For acoustic coupling, each service provider (nationwide and non-nationwide) is required to meet at least an M3 rating for 50% or 10 of the handset models it offers to consumers, whichever is less, per digital air interface. For inductive coupling, each service provider is required to meet at least a T3 rating for one-third or 10 of the handset models it offers to consumers, whichever is less. Manufacturer requirements for providing minimum numbers of T3 and M3 rated mobile phones are somewhat different but intended to have the same effect. See the FCC's Guide to Hearing Aid Compatibility of Telephones for additional details (FCC).

These benchmarks also require manufacturers to clearly label the packaging of their hearing aid compatible telephones with M and T ratings, and provide explanation of the FCC requirements on package inserts. Service providers are required to provide a means for consumers to test hearing aid-compatible handset models in their retail stores. Beginning on

January 15, 2009, both manufacturers and service providers were required to post information about their hearing aid-compatible handset offerings on their Web sites.

Background to the Survey on Hearing Aid Compatibility Survey

The Hearing Aid Compatibility (HAC) Survey is a multi-year survey on the cellphone shopping and use experiences of people who use hearing technology, conducted by the Rehabilitation Engineering Research Center for Wireless Technologies (Wireless RERC), which is funded by the U.S. Department of Education's National Institute on Disability and Rehabilitation Research (NIDRR). The survey was conducted annually from 2006 to 2010, and again in 2013. Data analysis in this article focuses exclusively on the most recent survey conducted from April 8, 2013 to December 20, 2013.

Of the 656 people who completed the 2013 survey, 567 reported using hearing aids or cochlear implants. Convenience sampling methods were used to draw a sample of adults over age 18. The protocol for this study was approved by the local institutional review committee at the grant recipient's home institution, as well as the authors' home institution. Minors under age 18 were not recruited due to concerns over conducting research with vulnerable populations. The questionnaire was made available in English and Spanish.

Participants were recruited through the Wireless RERC's Consumer Advisory Network (CAN), a nationwide network of consumers with disabilities. The research team also engaged its Internet and social media assets, including Yahoo! Groups, the Wireless RERC website, and its Twitter, Facebook and LinkedIn accounts. Contacts among organizations focused on communications technology, hearing loss and aging at the national, state and local levels were engaged to disseminate the invitation to participate to their networks of people with disabilities.

Females represent 65% of respondents who use any sort of hearing technology. The relatively high mean age of 58 years (with a median age of 60 and a standard deviation of 15.9 years) for these respondents reflects in part the decline in hearing associated with aging, and in part the exclusion of minors under the age of 18. More than half of the respondents who used some kind of hearing technology, used behind-the-ear aids (60%), with another 11% using in-the-ear aids. More than a quarter (27%) had cochlear implants. Just over 1% of respondents had bone anchored hearing aids.

Discussion

Data analysis focuses on the impact of age and type of hearing technology used as independent variables possibly impacting the behaviors and experiences of respondents. Elsewhere we have shown that age has a stronger effect on cellphone use than other demographic variables like income (Morris, et al. 2014; Wireless RERC 2013). That research supports observations that young people are earlier and more enthusiastic adopters of technology than older people. The type of hearing technology used by respondents might also impact levels of interference and sound quality. Respondents with devices that are more exposed to the cellphone, like behind-the-ear aids, might be more likely to experience interference (American Speech Hearing Association; Federal Communications Commission).

Respondents of all age ranges and types of hearing technologies reported high rates of cellphone ownership, with no discernible impact of either variable on ownership/use (Table 1).

Table 1. Do you currently own or use a cellphone?
(By age and hearing technology used)

Age	% Yes
18-29	96%
30-49	88%
50-64	90%
65 or older	89%
Overall	90%

Hearing Technology	% Yes
Behind ear aids	88%
In the ear aids	96%
Bone anchored hearing aids	100%
Cochlear implant	89%
Overall	90%

A strong majority (81%) of all respondents who use hearing technology and own a cellphone reported being able to use their current cellphones while using their hearing technology (Table 2). Although only 29% of respondents with bone anchored hearing aids said they could use their cellphones with their technology, the number of these respondents was very low (7 total). Consequently, it is difficult to make generalizations about this group. Behind the ear aids are most exposed to interference from other devices. Yet, users of this hearing aid design reported some of the highest rates of compatibility with their cellphones (82%).

Table 2. Can you use your current cellphone while using your hearing aid, cochlear implant or other hearing tech? (By age and type of hearing technology)

Age	% Yes
18-29	77%
30-49	82%
50-64	82%
65 or older	81%
Overall	81%

Hearing Technology	% Yes
Behind ear aids	82%
In the ear aids	78%
Bone anchored hearing aids	29%
Cochlear implant	84%
Overall	81%

Despite the relatively high rates of reported hearing aid-cellphone compatibility, a substantial percentage (19% across all respondents) said they were unable to use their cellphone with their aids. This suggests that HAC regulations still fall short in promoting compatibility of hearing aids and cellphones. This is reflected in low levels of satisfaction with cellphone sound quality (Table 3). Fewer than half (46%) of all respondents reported that they were satisfied or very satisfied with the sound quality of their cellphones. Notably, the youngest age group was least likely than the other age groups to say they were satisfied or very satisfied with their

cellphones. As expected, those with behind-the-ear aids were least likely to report being either satisfied or very satisfied with their cellphones.

Table 3. How SATISFIED are you with your cellphone? Clarity is good. You can hear and understand the other person. Volume is loud enough. (By age and hearing technology)*

Age	% Satisfied or Very Satisfied
18-29	35%
30-49	49%
50-64	49%
65 or older	43%
Overall	46%

Hearing Technology	% Satisfied or Very Satisfied
Behind ear aids	42%
In the ear aids	54%
Bone anchored hearing aids	50%
Cochlear implant	51%
Overall	46%

Low rates of satisfaction with cellphone sound quality are reflected in low percentages of respondents who said that it was easy or very easy to find a cellphone that worked with their hearing technology (Table 4). Only a quarter of all respondents (25%) reported the task as being easy or very easy. As expected, younger respondents more frequently reported that their search was easy or very easy compared to older respondents. There was little variation in ease of

finding a compatible cellphone among users of different hearing technologies. The substantially higher rate for respondents with bone-anchored hearing aids (33%), is unreliable because of the low number of respondents in this group.

Table 4. How EASY was it to find a cell phone that works with your hearing aid, cochlear implant or other hearing tech? (By age and hearing technology)

Age	% Easy or Very Easy
18-29	32%
30-49	27%
50-64	24%
65 or older	24%
Overall	25%

Hearing technology	% Easy or Very Easy
Behind ear aids	23%
In the ear aids	29%
Bone anchored hearing aids	50%
Cochlear implant	27%
Overall	25%

Knowledge of Interference Ratings, Sources of Information

A key part of federal HAC regulations is the requirement to include ratings for resistance to electromagnetic interference on the outside of the packaging and in the materials inside the packages of compatible handsets. Wireless companies must also include HAC information on their commercial websites. Since not all handsets are required to be compatible, providing multiple methods of identifying compatible phones could in theory help consumers shop for the phone they need. Also, cellphones may have both microphone (M) and telecoil (T) ratings. Therefore, it is especially important to make the different ratings easy to find and understand.

However, low percentages of respondents (Table 5) knew the M and T ratings for their hearing aids (29% overall) and cellphones (39% overall). These results suggest that the HAC regulations might have generated some success in informing hearing aid users, because knowledge of M and T ratings is substantially higher for cellphones than for hearing aids. The HAC regulations do not apply to hearing aids, which are regulated under the U.S. Food and Drug Administration. Therefore, their impact on educating the public about hearing aid ratings is expected to be less than about cellphones.

Table 5. Do you know the M and T ratings of your hearing aid and cellphone?

(By age and hearing technology)

Age	% Yes for Hearing Aid	% Yes for Cellphone
18-29	20%	36%
30-49	33%	39%
50-64	33%	44%
65 or older	24%	35%
Overall	29%	39%

Hearing Technology (% yes)	% Yes for Hearing Aid	% Yes for Cellphone
Behind ear aids	33%	37%
In the ear aids	13%	16%
Bone anchored hearing aids	14%	29%
Cochlear implant	26%	55%
Overall	29%	39%

Online research was the most commonly used source of information on cellphones by respondents who use hearing technology (Table 6). Sales personnel and recommendations from friends, family and others were about equally consulted. The package label was the least common source of information overall.

Table 6. How did you find your cellphone? Check all that apply. (By age)

Age	Recommendation	Package label	Sales person	Online research	Other
18-29	19%	12%	31%	19%	31%
30-49	20%	21%	9%	34%	21%
50-64	24%	13%	19%	30%	33%
65 or older	24%	11%	27%	26%	26%
Overall	23%	14%	21%	29%	28%

Respondents reported low rates of satisfaction with the HAC information they received from websites of service providers and manufacturers, cellphone packaging, or retail staff (Table 7).

Only 25% of those who consulted websites or packaging were satisfied or very satisfied with the HAC information provided; and only 29% of those who consulted retail staff were satisfied or very satisfied.

Table 7. How SATISFIED are you with HAC information received from websites and packaging, and retail staff? (% satisfied or very satisfied)

Method for Receiving Information	% Satisfied or Very Satisfied
Websites and packaging by service providers and manufacturers*	25%
Retail staff**	29%

* Respondents who own a cellphone and use hearing technology, AND who researched online or used package information to find their cellphone.

** Respondents who own a cellphone and use hearing technology, AND who consulted a salesperson to find their cellphone.

Conclusions

Hearing aid compatibility regulations implemented by the FCC are intended to ensure that compatible cellphones are readily available on the market and that HAC information can be found on the websites of cellphone manufacturers and service providers. Yet, many consumers who use hearing aid technology report low levels of satisfaction with the sound quality of their devices and high levels of difficulty finding compatible phones. Furthermore, strong majorities of consumers who use hearing aid technology report low levels of satisfaction with the HAC information they received from cellphone packaging, industry websites, and retail personnel.

These low levels of satisfaction and high degrees of difficulty finding compatible cellphones result in part from complex interactions between cellphones and hearing aids, as well as from social dynamics related to how people learn about and use technology. Hearing aids and cellphones are distinct pieces of electronic equipment designed for specific tasks and uses. Electromagnetic interference between these devices can be highly variable, and dependent on how specific models of each device interact. The wireless industry, FCC, advocates and technology specialists all advise consumers to “try before you buy.” HAC regulations likely have helped make compatible cellphones more available and easier to find. However, real challenges in these areas remain.

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