
Industry's Ability to Develop and Market Technology to Alter Hearing Handicap

Capacité de l'industrie à développer et à lancer sur le marché une technologie en vue d'atténuer le handicap auditif

Steve Unger, BAsC
Assistive Listening Device Systems (ALDS)
Richmond, British Columbia

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Abstract

Tremendous advances have been made in the development of technical aids for hard-of-hearing people. While hearing aids amplify sound, they seldom improve speech understanding, especially in the noisy situations encountered in everyday life. Therefore, other assistive listening technologies are required. Hundreds of such devices have been created, yet their utilization is less than warranted by their usefulness. This results in limited markets for manufacturers and higher prices for consumers. Reluctance to exploit the potential of available technologies stems from the poor coping skills of hard-of-hearing people. Such skills rely on understanding the nature of one's disability, the adjustments necessary to overcome the resulting handicap in different communication environments, and the willingness to learn to use technology. In the absence of these prerequisites, industry's ability to develop and market ever-improving technologies is severely curtailed.

Abrégé

De grands progrès ont été réalisés dans le développement d'aides techniques pour les personnes malentendantes. Bien qu'elles amplifient le son, les prothèses auditives améliorent rarement la compréhension, surtout dans les situations bruyantes rencontrées quotidiennement. D'autres aides de suppléance à l'audition sont donc nécessaires. Des centaines de dispositifs de ce genre ont été créés, et cependant leur usage est moins que justifié par leur utilité, d'où des marchés très limités pour les fabricants et des prix très élevés pour les consommateurs. Le peu d'enthousiasme des personnes malentendantes à tirer parti des technologies à leur disposition prend source dans leur médiocrité à se sortir d'affaire. Pour y réussir, le malentendant doit comprendre le caractère de son infirmité, les ajustements nécessaires pour surmonter le handicap qui en résulte dans diverses situations; il doit aussi avoir la volonté d'utiliser les progrès de la technologie. En l'absence de ces prérequis, la capacité de l'industrie à développer et à lancer des technologies toujours plus avancées est grandement réduite.

Over the past twenty years, tremendous advances have been made in the development of technical aids for hard-of-hearing people. It is generally believed that hearing aids can solve most listening problems, but this is not the case. Hearing aids are indeed excellent in providing amplification, but seldom can they improve the user's ability to understand speech, particularly in noisy, everyday listening situations. For this reason, other assistive technologies are also required to allow the hard-of-hearing person to function in the adverse acoustical environments encountered in everyday life. Laboratory and industrial research have led to the creation of hundreds of devices to serve this need, yet the utilization of such devices is not as widespread as warranted by their usefulness. This results in limited markets for manufacturers and higher prices to the consumer.

The reluctance to fully exploit the potential of available assistive technologies can be traced to three co-dependent factors: (a) the lack of good coping skills of hard-of-hearing people; (b) the lack of societal understanding and acceptance of hearing impairments; and (c) the high price of assistive technology. In the absence of such skills and societal understanding, the ability of industry to develop and market ever-improving technologies at lower prices is severely curtailed.

The lack of coping skills is not only a problem for industry; it also influences many other aspects of the psychosocial adjustments that a hard-of-hearing individual makes when dealing with hearing loss and progressive communication difficulties.

Hearing Aids

Hearing aids are the best known and most popular form of device for hard-of-hearing people, but they have many limitations and will perform poorly in many circumstances.

Hearing aids are excellent at providing sound amplification and, therefore, work well in quiet environments (Plomp, 1978). In noisy environments, their performance is usually poor.

The Communication Problem

The goal behind the design of most communication aids for hard-of-hearing people is to increase the extent to which these listeners are able to discriminate sounds and comprehend spoken language. Speaking louder to someone in a foreign language will not increase his or her ability to comprehend; he or she simply does not understand what is said. In an analogous manner, unless speech is presented to hard-of-hearing people free of interfering noises and free of degradation due to poor acoustics, then these people cannot comprehend, no matter how loudly the message is delivered. This is where the limitations of hearing aids become apparent. If speech has been degraded by echo or distortion and mixed with noise, all inputs, desired and undesired, are amplified by the hearing aid. Thus the amplification quality of a hearing aid does not necessarily facilitate comprehension.

Noise and poor room acoustics are probably the largest environmental obstacles to hearing accessibility for hard-of-hearing people. Such environments include restaurants and pubs where the noise is overwhelming, largely because of background conversations; conference rooms in which nearby people are understandable but those across the room are not because of distance or ventilation noise; and theatres and classrooms which have poor acoustics (see Hodgson, this issue). What can be done in such situations?

Assistive Devices

Assistive devices (ADs) provide hard-of-hearing, late-deafened, or Deaf people additional or alternative communication assistance to supplement or substitute for hearing aids. There are four main classes of assistive devices: assistive listening devices, visual communication systems, alerting devices, and telecommunication devices. To provide background information, I will briefly describe the basic principles behind each class of assistive technology (see Spahr, 1992; Compton, 1989; Gilmore, 1992; Laszlo, 1994; Palmer, 1992; Ross, 1994; SHHH, 1989).

Assistive listening devices (ALDs) reduce the length of the acoustical (sound) pathway between the desired sound source and the hard-of-hearing listener. In other words, an ALD artificially places the speaker's mouth much closer to the listener's ear. Because the transmission is non-acoustical, the signal suffers no degradation or interference due to echo,

noise, poor room acoustics, or other factors during transmission. A clear signal pathway is paramount for a hard-of-hearing person trying to comprehend information or listen to music in a noisy environment. The length of the acoustical pathway is reduced through the use of a transmitter and receiver pair employing a transmission medium other than an acoustical one. The transmission medium is either frequency modulated radio waves (FM), a magnetic field (known as induction or loop), or infrared light (IR). Most ALDs can be used with or without a hearing aid.

Visual communication systems are designed for people who find it difficult or impossible to make use of acoustical information. These non-acoustical systems use visual text to transmit information and can either replace or enhance acoustical material. The captioning of television shows, in which a written transcription of the speaker's words appear in a box at the bottom of the screen (similar to subtitles), requires modestly priced and commonplace equipment, and can be highly effective in increasing the enjoyment of television for hard-of-hearing, late-deafened, or Deaf people. Newer systems which transcribe live speech during a meeting, seminar, or conference may drastically improve comprehension by people with hearing loss.

Alerting devices can be invaluable to a hard-of-hearing, deafened, or Deaf person, and can potentially save that person's life. Such devices use visual or tactile stimuli to alert. Visual stimuli are usually bright flashing lights, while tactile stimuli are produced by vibrators that may, for example, be placed under the pillow of a person when he or she sleeps. These devices signal a myriad of conditions: the phone is ringing, someone is at the door, there is a fire, or it is morning and time to wake up.

Telecommunication devices include telephone-hearing aid interfaces and TTYs. The most important telephone-hearing aid interface is accomplished via magnetic field. Hearing-aid-compatible telephone handsets generate a magnetic field that can be picked up by the "T-coil" (or "T-switch") of equipped hearing aids. TTYs are small typewriter-like terminals operated through the telephone network. Text typed into one TTY is transmitted and displayed on another TTY across the city or country. Computerized E-mail communication and the Internet are the most recent tools for barrier-free communication.

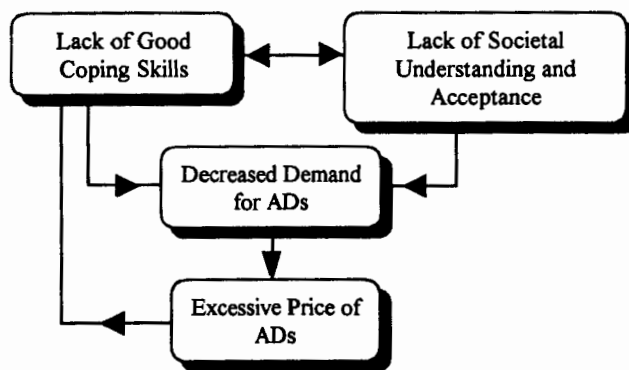
The Assistive Device Market

It is estimated that 10% of the population is hard of hearing. In Canada, this translates into approximately 3 million people; in North America, the number would be close to 30 million. Statistically, assistive device manufacturers have a

large market. Realistically, however, this is not the case. Industry has created hundreds of devices which could greatly aid communication in the daily lives of hard-of-hearing people. But only a small portion of the hard-of-hearing population use these technologies. Why? In order for AD manufacturers to grow, develop ever-improving technology, or simply survive, they must ask themselves, "Where did the market go?"

Obviously, the AD market did not mysteriously disappear: the truth is that hard-of-hearing people are reluctant to purchase and use assistive technologies. As mentioned earlier, this reluctance to fully exploit the potential of available assistive technologies can be traced to three co-dependent factors: (a) the lack of good coping skills in hard-of-hearing people; (b) the lack of societal understanding and acceptance of hearing impairments; and (c) the excessive price of ADs. Each factor may be a cause or an effect of the other factors, thereby creating a cyclical situation (see Figure 1). This cyclical relationship must be examined and understood to effectively solve the problems faced by industries involved in the marketing of ADs.

Figure 1.



In many cases, hard-of-hearing people are not aware that they have an impairment. A person's hearing may degenerate so slowly that he or she does not realize some hearing ability has been lost. This experience is common among people as they age. Furthermore, in many cases, hard-of-hearing people refuse to acknowledge that they are having trouble hearing and understanding. Pride and confidence in one's ability to cope without assistance seem to prevent such people from admitting to themselves, or to others, that they cannot hear. People who do not know or who are unwilling to admit that they have an impairment are not going to buy assistive devices; this is where one part of the AD market went.

To help hard-of-hearing people communicate effectively, we must understand the nature of their impairment and the handicap imposed by that impairment. Such people

must learn to communicate in different listening environments. Listening to a conversation in a quiet room is very different from listening to that same conversation in a noisy room; this is especially true for hard-of-hearing people who have reduced ability to discriminate or localize speech sources. Hard-of-hearing people must learn to communicate within the confines of their hearing disability; adjustments must be made, and technology can greatly aid hard-of-hearing people in overcoming non-ideal listening environments. But people who do not understand their impairment cannot effectively overcome that impairment. As stated previously, industry has developed hundreds of devices to aid hard-of-hearing people, but which of these should a particular hard-of-hearing person use? There is no simple answer. Many types of assistive devices are suited to many different listening situations and physical locations. In other words, a hard-of-hearing person who does not understand his or her impairment will not know which technology to use in a particular listening situation; therefore, by default, he or she will not use any technology. Thus more of the AD market is lost.

ADs are a relatively new technology. In fact, although they may have some background knowledge on assistive devices, many audiologists, otolaryngologists, and hearing-aid dispensers are unfamiliar with the implementation and operation of these devices and their potential benefit to hard-of-hearing clients. Thus they do not recommend assistive technology to their hard-of-hearing clients (Riko, Cummings, & Alberti, 1979). Therefore, hard-of-hearing people are often left to discover ADs on their own. Consumer associations such as CHHA (Canadian Hard of Hearing Association) and SHHH (Self Help for Hard of Hearing people) in the US provide peer experience and information on ADs, but ultimately, discovering the right AD is a matter of trial and error. Often, the AD that works for one person may not work for another and, with the relatively high cost of ADs, hard-of-hearing consumers are reluctant to purchase and experiment with a great variety products. The AD market thus diminishes further.

To benefit from technology, one must learn how to use it properly. This is not necessarily an easy matter. Also, to maximize the benefit that may be derived from using ADs, one must understand some of the concepts behind the operation of such devices. Hard-of-hearing people and hearing-care professionals must invest the time to learn how to use ADs effectively. Often, assistive equipment is not maintained or operated properly, the batteries are allowed to run low, or improper accessories are used. Hard-of-hearing people using such equipment are still unable to hear; they become frustrated and blame the equipment, and thus have less confidence in ADs. If one doesn't know how to use a technology, that technology will seem to have little usefulness and it may even come to be feared. This pheno-

menon is exemplified by many people's apprehension about and disdain for computers. Likewise, hard-of-hearing people who do not know how to use assistive technology often do not believe in its benefits, and consequently, they will not purchase ADs. The size of the AD market is thus reduced even more.

In addition, no standardization exists for assistive devices. A system from one manufacturer works differently from that of another manufacturer. Often these systems will not work together. Such lack of compatibility contributes to hard-of-hearing people's sense of frustration. Also, some very inexpensive but low-quality devices are being misrepresented and sold as ADs by their marketers and promoters. Because these devices are so inexpensive, people tend to purchase and use them first. Once hard-of-hearing people discover the low quality of these products (which not only do not help, but frequently hinder their listening abilities), they develop an aversion to all ADs. No standard of quality or clear evaluation method exists to classify and rate the effectiveness of a particular AD in different listening environments. Consequently, consumer confidence is low, confusion regarding assistive technology is high, and disreputable companies are able to introduce low-quality products into the marketplace. The AD market is further reduced.

Once a hard-of-hearing person understands his or her impairment and has begun to make the necessary adjustments, possibly by purchasing an AD, he or she must still overcome social stereotypes and his or her own fears. Are hard-of-hearing people forced to appear to function "normally" because society does not easily recognize hearing impairments and does not offer assistance to or acceptance of hard-of-hearing people? Social stigma is a very powerful force, and most people are unwilling to appear different from the majority. Wearing or using a hearing aid or assistive device tends to make the wearer stand out. (An interesting and telling exception is the wearing of eye glasses. Glasses are seen as socially acceptable, most likely because of their widespread, varied use as an optical aid and their incorporation into fashion.) In addition, hard-of-hearing people are often stereotyped as less intelligent or able. Common communication difficulties of hard-of-hearing people, such as altered speech, poor pronunciation, and apparent slowness in understanding, are often misunderstood and incorrectly interpreted, thereby perpetuating the stereotype. Our Western culture values independence and self-reliance. Assistive devices facilitate the development of such qualities for hard-of-hearing people. Ironically, and much to the concern of the hard-of-hearing person, ADs can be antithetically interpreted by our society, thus supporting the stereotype rather than counteracting it. As a result, hard-of-hearing people who do not wish to be seen as less able by society (or themselves) may decide that they can cope

without assistance. Often this decision spawns disastrous results. In trying to avoid ostracization, they indirectly bring it upon themselves. Thus the AD market shrinks even more.

The aforementioned factors reduce the potential AD market from 10% of the population to, in my estimation, a real market of much less than 1%. This limits the viability of the assistive device industry, even before the time-consuming and expensive process of selling assistive technology begins.

Selling Assistive Devices

To understand the process of selling ADs, consider the process of selling a camera to an amateur photographer; this procedure consists, essentially, of a single step. In comparison, the selling of an assistive device consists of many steps. First, the hard-of-hearing customer's particular impairment, and the listening environments he or she has difficulty hearing in, must be discerned by the AD salesperson. Second, the customer must be educated concerning the types and benefits of available ADs. Finally, the appropriate AD must be selected by the salesperson. In addition, the salesperson frequently teaches the hard-of-hearing customer about his or her new AD. Thus an AD salesperson must also be a consultant and teacher. The steps of this selling process may be repeated many times if the initial trial is not successful. In addition to convincing hard-of-hearing customers about the benefits of assistive technology, the salesperson must also contend with the issue of price: assistive technology is expensive.

The High Cost of Assistive Devices

Many devices, varying widely in application and benefit, are produced by industry to aid hard-of-hearing people. However, these devices are not nearly as popular as their potential benefits warrant. First, many hard-of-hearing people lack a comprehensive understanding of their impairment and its impact on daily communication. Second, many hard-of-hearing people do not know how to effectively use ADs, or are not aware that forms of help besides hearing aids exist. Third, our society understands little about hearing impairments, and has little patience or tolerance towards hard-of-hearing people. This attitude often forces hard-of-hearing people, who fear being ostracized, to cope without ADs. The overall economic result is a relatively small consumer demand for assistive devices. Few companies are therefore willing to invest in the development and marketing of ADs. For the most part, the developers and marketers of ADs are either small, specialized firms dedicated to the interests of hard-of-hearing people, or small divisions of larger companies who have developed ADs to support the

sales of other products. The AD market is not seen by industry as a lucrative one because of its small size. Therefore, in general, assistive devices are not mass produced but manufactured in small batches.

The companies manufacturing these products are not set up for high volume production, and so they incur high fixed costs. Fixed and setup manufacturing costs are distributed among the total number of pieces produced; thus a \$1000 fixed cost would add \$1000 to the cost of a 1-piece production run, but only \$1 to a 1000-piece run. As well, discounts apply when purchasing large volumes of constituent components. For example, one may be able to buy 100 microphones at a unit cost of \$2.00 each, or 100,000 microphones at a unit cost of \$0.69 each. High fixed costs, small production runs, and lack of volume discounts keep the cost of ADs high, leading to a high final price for the consumer. (This consumer will not understand that a small, infrared transmitter costs more than a microwave oven because only a few hundred infrared transmitters are being made while millions of microwaves are produced.) The high prices make ADs prohibitively expensive for hard-of-hearing people. They are deterred by the high price tags of ADs, which in turn keep those prices high. If more hard-of-hearing people knew about and purchased ADs, more hard-of-hearing people could afford ADs.

Little funding exists for research and development of new assistive technology or for the education of hard-of-hearing people regarding the benefits and availability of these technologies. To change this predicament, hard-of-hearing people themselves must be the driving force. If government and industry do not perceive a need, nothing will be done. Hard-of-hearing people are integral in the design and development of new products and in ensuring that governments allocate the proper resources for the evolution of new technologies. Therefore, the developments of new assistive technology and more efficient manufacturing practices are slow. The companies doing the development tend to be small, with few resources.

Conclusions

The solution to the AD conundrum is education. Hard-of-hearing people must be educated concerning the nature of their handicap and the greater accessibility that assistive technologies can offer them. Also, and as importantly, hard-of-hearing people must learn to use ADs effectively in order to expand their communication abilities. Audiologists and hearing-care professionals must be educated concerning the benefits and operation of ADs for their hard-of-hearing clients. This situation will be partially solved by the recent inclusion of AD training in the curriculum of many

audiology training programmes. Industry must also supply hard-of-hearing people and hearing-care professionals with information and training about ADs, and request input from hard-of-hearing people regarding new technology. Society must become better educated about and empathetic towards people with hearing impairments and the aids they use.

In this process, hard-of-hearing people must be the initiators and facilitators. With the assistance of ADs, hard-of-hearing people can show society (and themselves) how capable and valuable they are. This will encourage our society to adopt an attitude whereby hard-of-hearing people are encouraged and able to include themselves in discussions, meetings, and other idea-exchanging sessions. But until hard-of-hearing people begin purchasing higher quantities of assistive devices, the hands of industry are tied. An increased demand for ADs will increase the quantities manufactured by industry, and thereby reduce the cost, increase choice, and improve quality. Communication aids for hard-of-hearing people will then become affordable and available, and hard-of-hearing people will be able to participate in our society in whatever capacities they wish.

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Please address all correspondence to: Steve Unger, 2-11220 Voyageur Way, Richmond, BC V6X 3E1

References

- Compton, C. (1989). *Assistive devices: Doorways to independence*. Washington, DC: Gallaudet University Press.
- Gilmore, R. (1992). Assistive listening systems: How ASHA members fit in. *ASHA*, 34, 44-47.
- Laszlo, C.A. (1994). Engineering aspects of assistive device technology for hard of hearing and deaf people. *Canadian Acoustics*, 22, 77-78.
- Palmer, C. (1992). Assistive devices in the audiology practice. *American Journal of Audiology*, 1, 37-51.
- Plomp, R. (1978). Auditory handicap of hearing impairment and the limited benefit of hearing aids. *Journal of the Acoustical Society of America*, 63(2), 533-548.
- Riko, K., Cummings, F., & Alberti, P.W. (1979). The role of communication aids in the rehabilitation of hearing impairment. *Journal of Otolaryngology*, 8, 13-19.
- Ross, M. (Ed.), (1994). *Communication access for persons with hearing loss*. Timonium, MD: York Press.
- SHHH. (1989). *Handyman hints for hard of hearing helps*. Bethesda, MD: Self Help for Hard of Hearing people.
- Spahr, F.T. (Ed.), (1992). *Americans with Disabilities Act: The dream... An accessible America*. *ASHA*, 34.