AI and Other Hearing Technology Advances

BY LINDA KOZMA-SPYTEK

Every year in January, thousands of people descend on Las Vegas for "the most powerful tech event in the world"—the Consumer Electronics Show (CES). And the Hearing Loss Association of America (HLAA) is there. For more than 10 years, HLAA has been attending CES as a guest of the Consumer Technology Association (CTA) Foundation, together with other consumer organizations representing people with disabilities. And in that time, accessibility has had a growing presence, increased prominence and more featured content at the show.

The theme of CES this year was "AI for All." This catch phrase refers to efforts to ensure AI (artificial intelligence) is beneficial, inclusive and accessible for everyone. AI already is present and integrated to varying degrees in all kinds of technologies, including the most recent technology advancements driving hearing and communication access.

It is likely that you are not only familiar with but have used AI-powered features and applications on a device that many people consider essential—the smartphone.

If you have ever:

- said "Siri" or "Hey Google" to ask a question
- searched the internet using a picture
- responded to texts, email or made a note by speaking into your phone
- pointed your camera at a restaurant menu while traveling to translate the food options
- inlocked your phone by scanning your fingerprint

…then you have used technology powered by AI.

What is AI?

To provide an easy-to-understand definition, I went directly to OpenAI's popular AI-powered platform, ChatGPT. When asked to define AI, this sophisticated chatbot replied:

> "Artificial intelligence (AI) refers to the ability of computers or machines to perform tasks that normally require human intelligence. This includes abilities such as learning from experience, understanding and responding to language, recognizing patterns, solving problems and making decisions."

Why is AI gaining so much interest and attention now, after 50 years of development? Many believe that content creation, or generative AI, triggered the recent growth in public awareness, accompanied by increased concerns for its ethical and societal implications.

Examples of what generative AI can create:

- written text such as reports, stories and poems
- images, art and 3D models in wide-ranging styles
- music and sound from various genres
- human-like voice and speech
- short videos and animations
- computer code and simple software applications

Examples of how generative AI can improve access through content creation:

- recent advances in real-time speech-to-text transcription services for people with hearing loss
- virtual avatars that perform sign language interpretation
- AI-generated voices for people who have lost the ability to speak
- descriptions of images and video for people with vision loss

Advances in Hearing and Communication Access Technologies

What follows is a high-level overview of numerous advancements over the last decade in distinct, yet often overlapping, areas. Due to space limitations, this discussion is not comprehensive. For instance, biotechnologies, including regenerative and gene therapies aimed at improving hearing, represent a rapidly evolving field that should be addressed separately.

Sound Processing in Hearing Aids, Cochlear Implants and Other Applications

AI can play a role in how hearing aids and cochlear implants process sound to improve speech clarity. This includes the development of techniques to enhance sound quality and reduce noise in challenging environments. Yet, sophisticated sound processing can be power hungry. To address this, techniques have been developed to extend battery life and reduce charging times for rechargeable hearing devices.

Most consumers with hearing loss would also like improved speech clarity for media from movies to the radio, as background music and sound effects can make dialogue and commentary hard to understand. In the spring of 2023, Amazon introduced an AI-based sound processing feature called **Dialogue Boost** into their Prime Video service. The technology identifies segments within video content where the dialog may be obscured by other sounds and then improves the level of the dialog relative to the level of the background sounds. Smart TVs and the audio technology they employ can also provide some degree of dialogue enhancement through adjustable features often found in their audio or sound settings menus, or through accessories such as sound bars.

Device Connectivity via Bluetooth

Wireless communication enabled by Bluetooth technology has greatly improved connectivity for hearing and assistive listening devices. While Bluetooth is not an AI technology, they work together. In hearing aids, AI systems are starting to be used to track physical activity and health using sensors that capture the information, while Bluetooth technology sends it to an AI-powered smartphone app that analyzes, summarizes and displays the data.

Another breakthrough in this area is direct streaming of audio for phone calls, music and media from smartphones and other devices to hearing aids and cochlear implants. First introduced a decade ago by Apple, this capability is now integrated into most currently available hearing aids and smartphones. It's also being considered for inclusion in new hearing aid compatibility rules by the Federal Communications Commission (FCC).

Until now, Bluetooth connectivity has required the one-to-one pairing of two devices, limiting its application to personal listening only. Access to audio information in public settings, like theaters, airports and lecture halls, has been provided by assistive listening systems using other forms of wireless communication, such as FM, infrared, **hearing loops** and Wi-Fi. However, a new Bluetooth capability called **Auracast** will enable audio to be broadcast wirelessly for easy reception by various consumer electronics products (e.g., earbuds and headphones) as well as hearing devices, all without the need for pairing.

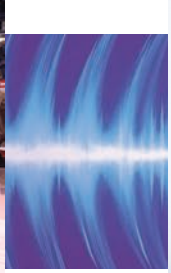
At CES, several companies announced or showcased products that support Auracast:

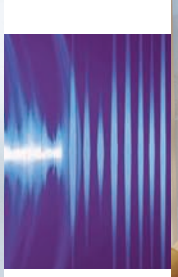
- **earbuds and TVs from Samsung**
- **headphones from Sennheiser**
- **hearing aids and a TV streamer from ReSound**
- **portable speakers from JBL**
- **assistive listening systems from Ampetronic and Listen Technologies**

Personalization and Customization of Listening Experiences

Because AI can learn from experience, recognize patterns and make decisions, it can assist in automating the customization of your listening experiences by analyzing the choices you make over time under real-world conditions. For example, a hearing device may track specific adjustments to your hearing aid settings that you make to optimize listening in noisy versus quiet sound environments. After learning your behavior and recognizing the associated sound environments, the AI-powered hearing device can automatically and appropriately adjust your hearing aid settings for you.

Another important example is the new class of self-fitting, **over-the-counter (OTC) hearing aids**. Available since their approval by the FDA in 2022, many self-fitting OTC devices guide consumers through an app-based process that evaluates their hearing and fine tunes the settings without the involvement of a hearing health care professional.






Smart Devices with Native Accessibility Features

As smartphones have evolved, more accessibility features are being built in by manufacturers, reducing the need for third-party, downloadable applications. One benefit of these native accessibility features is that they usually continue to be supported by the manufacturer and receive scheduled updates through the phone's operating system. Typically found under the "Settings" menu and listed under "Accessibility," common features include:

- compatibility with a wide range of hearing aids and cochlear implants
- wireless Bluetooth connectivity to stream phone and video calls and audio content directly to compatible hearing devices
- automatically generated, real-time captions for phone and video calls and audio content
- customizable vibratory or visual notifications for environmental sounds like sirens, alarms and alerts that the phone learns using AI-supported sound recognition
- sound enhancements that provide a way to customize the phone's audio based on the user's hearing profile, to control background noise levels or for the phone to act as a remote microphone

Automatic Speech Recognition

Automatic speech recognition (ASR) as implemented today is an AI technology. At its most fundamental level, ASR uses computing systems and AI-based techniques to identify and process human speech. Over the last dozen years, ASR-powered virtual voice assistants like Apple Siri, Google Assistant and Amazon Alexa have been used on billions of computers, tablets and smart devices to understand and respond to voice commands. For people who are Deaf and rely on sign language rather than spoken language, devices that are only accessible using voice commands represent a real barrier. Automatic sign language recognition is actively in development, but still in its infancy compared to ASR.

Should I wait for technology to improve or get help now?

- If your hearing health is affecting your daily life, work, relationships or overall well-being, then get help now.
- Addressing hearing loss earlier can lead to better outcomes and lessen health risks from untreated or undertreated hearing loss.
- Most hearing devices and assistive listening technologies available today are effective and offer significant benefits; you can always upgrade in the future.

More recently, another primary use of ASR has been to convert spoken words into text, which has meant on-demand, real-time access to captions for people with hearing loss. ASR-based captions have widespread use for face-to-face conversation, telecommunications, live and prerecorded media, presentations and videoconferencing. Despite advancements, ASR caption performance can be quite variable because audio quality, environmental noise, diverse speech characteristics and other factors all impact accuracy to varying degrees.

Integration with Augmented Reality

One issue with current caption displays is that they may require the user to look away from their viewpoint of interest. If you're having a conversation but must look down to your phone to see captions of what the other person is saying, rather than looking at their face, the experience can feel odd for both parties and even interrupt conversational flow. Several startups (e.g., **XRAI**, **Xander**, and **Transcribe Glass**) are working to integrate automatically generated, real-time captions into glasses enabled by AI. The glasses allow captions to be overlaid onto whatever the person is looking at in the real world.

Hearing Assistive Technology Survey

Why don't more people with hearing loss use assistive technology? A recent survey released by the Committee for Communication Access in America (CCAA) sheds some light on this puzzling issue. More than 1,500 people with hearing loss or other hearing related conditions answered questions about their experience of various assistive listening systems (ALS), mandated in many public places by the Americans with Disabilities Act (ADA).

- 37–69% of respondents with a severe-to-profound hearing loss reported always using ALS when available.
- 80% used prescription hearing aids and 2% wore over-the-counter (OTC) hearing aids.
- HLAA was highly represented among the 42% affiliated with an organized hearing loss support group.

Find out more at **bit.ly/3TCByXq** or scan the QR code at right.

There is even work on delivering sign language interpretation through similar smart glass technology.

Teleaudiology—Remote Hearing Health Care

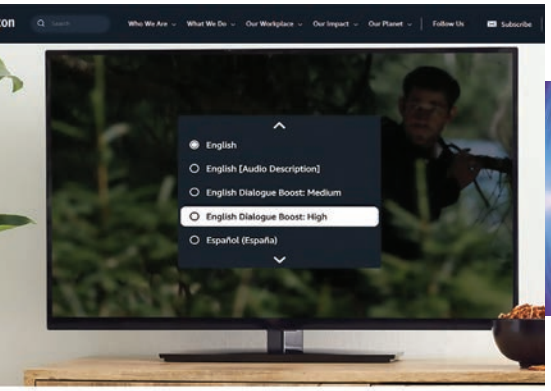
Remote programming of hearing devices, self-fitting hearing aids and hearing health monitoring through smart devices is changing the landscape of hearing health care delivery. Teleaudiology relies on the use of reliable internet and telecommunications technology such as specialized videoconferencing platforms, to provide convenient, easy access to hearing health care. Most of the major hearing device manufacturers offer some form of remote care, from consultation to programming adjustments. And there is a growing list of companies and platforms that offer telehealth services and direct-to-consumer hearing aid purchases. Remote care is necessarily limited because specialized equipment and in-person assessments may be required. It nevertheless can provide a level of access that people living in rural locations, in underserved communities and with transportation challenges would otherwise not have.

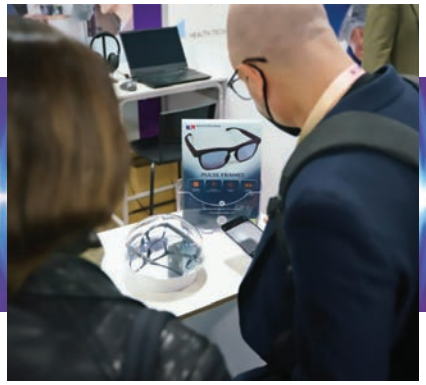
The Curb Cut Effect—Hearing and Communication Access Going Mainstream

"Technology is the great equalizer . . . [it] is constantly evolving to remove barriers."

Dimitri Kanevsky, Ph.D.
Speech Research Scientist, Google
Lead Developer, Live Transcribe

Technology that removes barriers for people with disabilities often provides all users with benefits. This is known as the "curb cut effect," after the most familiar and commonly cited accessibility feature that affords community-wide benefits. Among technologies developed for people with hearing loss, the best example of this is closed captioning of media, which was first developed in the 1970s to make television programming accessible. Today, captioned media is commonplace, from broadcast television to websites like YouTube that enable individual content creators to provide their own captions. And it is widely used by people with and without hearing loss.





The more mainstream the experience and expectations, the more likely market forces will help access move forward in terms of awareness and availability. Both in the U.K. and the U.S., studies have found that younger adults (Gen Z and Millennials), who are less likely to have hearing loss, use captions at much higher rates than older adults (Baby Boomers), who are more likely to have hearing loss. One explanation given for these results is that captions are the norm for younger people. They are used to experiencing media with captions, and they expect captions to be available.

For many people without hearing loss, captions are both a convenience and an enhancement, but not generally a necessity for access. This distinction between "nice to have" and "need to have" is important. Although broad market appeal for features and functionality in mainstream products and services that also provide accessibility helps to move access forward, it has yet to ensure access. While legislation is necessary, the rapid evolution of technology often outpaces regulation. Effective, sustained advocacy will continue to be key in achieving this goal for the foreseeable future.

Considerations as Technology Advances

Products and services need to deliver value and quality by reliably and effectively meeting consumers' needs and expectations and solving real problems. In doing so, technology helps to remove barriers. However, many factors that accompany technological developments and their use need to be considered. Let's look at a few:

- equity in access to new technology
- awareness and education on use of products and services
- availability of desirable feature and functionality across price points
- protections to address data privacy and security concerns

Considerations like these can't be ignored, but safeguards are slow to keep up as technology development speeds forward and becomes even more pervasive in every aspect of our lives. There will be trade-offs and unintended consequences related to technology development, particularly around AI. Many are optimistic that more accessibility barriers will fall as technology advances, but they remain concerned about whether issues like equity, privacy and security will get the attention they deserve. As Aleksander Madry, a professor of computing at the Massachusetts Institute of Technology, told a Congressional panel in 2023, "we're at an inflection point" with a lot of important, difficult, yet necessary, conversations that need to happen now. HL

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Advocating for the Future of Hearing Technology

As the leading voice for Americans with hearing loss for nearly 45 years, HLAA has been instrumental in **advocating for laws** to ensure that technology remains accessible for all — from the Americans with Disabilities Act (ADA) in 1990 to the current Communications, Video and Technology Accessibility Act (CVTA). We will continue our advocacy on behalf of the 50 million Americans with hearing loss, now and far into the future.

ICAAT — If you'd like to continue the conversation around AI and technology, join the Industry-Consumer Alliance for Accessible Technology (ICAAT) Tech Forum, where you can discuss your experiences, knowledge and ideas around a variety of technology topics. See Advocacy column on page 22 for more details.