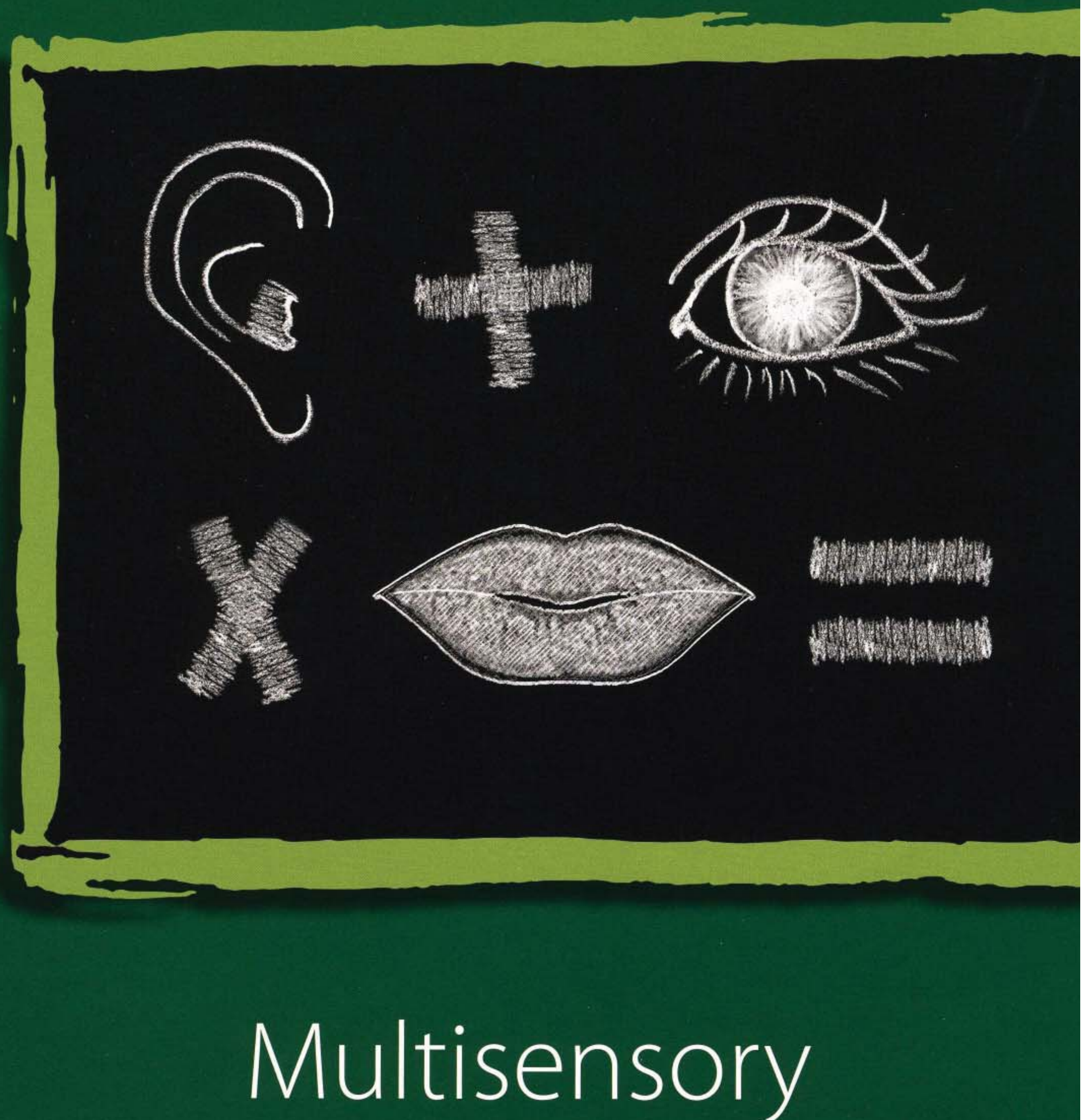


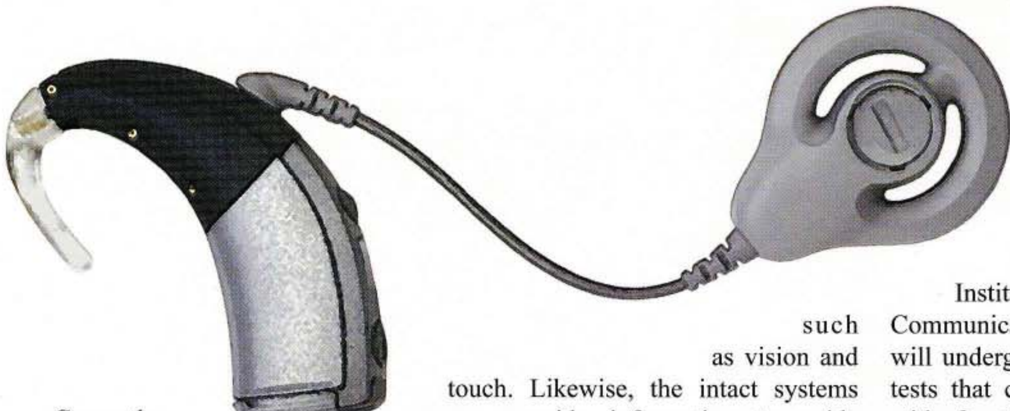
Multisensory
Hearing

Can a person born deaf, or with a profound prelingual hearing loss, who is implanted with a cochlear implant as an adult, recognize environmental sounds and, more importantly, spoken words?

An intriguing question that has puzzled philosophers for hundreds of years is whether a person born blind, then given the ability to see as an adult, would be able to recognize objects known previously only through touch and hearing. Cochlear implants, devices that deliver electrical stimulation directly to the auditory nerve, present an equally intriguing question: Can a person who is born deaf, or suffers a profound hearing loss prior to developing speech and language skills (i.e. prelingual), who then receives a cochlear implant as an adult, recognize environmental sounds or spoken words? Until recently, prelingually deaf adults were widely considered to be poor cochlear implant candidates. Today, more optimistic outcomes seem possible for these people.

The poor outcomes seen in the past with cochlear implants in prelingually deaf adults were viewed as consistent with what is known about cochlear implants in prelingually deaf children. In general, the earlier a deaf child or infant receives a cochlear implant, the more optimistic the expected outcome. Therefore, prelingually deaf adults are generally not expected to receive much benefit from a cochlear implant. In fact, researchers think that there might be a critical period for cochlear implantation of children, around the age of seven years, beyond which ability to learn to use the implant is reduced. Presently, surgeons advise prelingually deaf adult patients that they might improve their perception of environmental sounds if they obtain an implant; but they should not expect to understand speech just by listening.

Several recent studies, including one conducted at the House Ear Institute's Communication Neuroscience Laboratory, have shown that some prelingually deaf adults actually do benefit from receiving a cochlear implant. At the same time, other individuals appear to be unable to use the information presented by their device. Evidence suggests that some individuals who benefit little when using the cochlear implant by itself, nevertheless benefit greatly when they can also see the person who is talking. They combine visual and auditory cues. Given that outcomes can range from no benefit to relatively good benefit, prelingually deaf adults have a very difficult decision to make when considering whether or not to seek a cochlear implant.



Currently, a project is underway in the Communication Neuroscience Laboratory to learn how to predict who among prelingually deaf adults will benefit from a cochlear implant. The project is funded by the National Institute on Deafness and Other Communication Disorders and is led by Lynne E. Bernstein, Ph.D.

Project researchers are taking a novel, multisensory approach to the problem of predicting whether and/or how a cochlear implant will be of benefit. Some experiments are attempting to determine whether the ability to combine sensory cues from vision and residual hearing through amplification might be a predictor of cochlear implant outcome. Another possible predictor under investigation is lip-reading ability. A third predictor of interest is perception of mechanical vibration applied to the fingertip.

Behind the multisensory approach this project uses is an expanding body of neuroscience research studying the effects of neural plasticity. The research demonstrates that lifelong profound hearing loss exerts important effects on brain organization and function related to vision and also to touch. However, when one sensory system is compromised – in this case the auditory system – the brain can compensate by combining the weak or distorted information from the compromised system with the strong or clear information from intact systems, such as vision and touch. Likewise, the intact systems can provide information to guide acquisition of new information when a sensory prosthesis, such as a cochlear implant, is obtained. The ability to combine information across sensory systems or to perceive speech through lip-reading might then be a positive indicator for success with a cochlear implant.

Preliminary results have shown that prelingually deaf adult cochlear implant users who demonstrate the most success with their device are also individuals who benefit greatly from combining vision and hearing during speech perception. When these individuals are tested using sentence materials, the results show that the combination of vision and hearing through their cochlear implant results in substantially better speech perception than by hearing alone or vision alone. Furthermore, those same individuals are ones who had used hearing aids throughout their lives, even though their hearing alone was not adequate for communication. In effect, they relied on being able to see the person with whom they were speaking, and supplemented their lip-reading with their residual hearing.

Based on these early results, the Communication Neuroscience Laboratory is now enrolling and testing prelingually deaf adults who plan to obtain cochlear implants through the House Clinic for a new research study. During this project, funded by the National Institute on Deafness and Other Communication Disorders, participants will undergo a range of experimental tests that can include brain imaging with functional magnetic resonance imaging (fMRI), electrophysiological testing and various psychophysical measures. After receiving their cochlear implant, they will be invited to return for additional testing and for training using multisensory stimuli. Research study team members are Julie Martinez-Verhoff, Au.D., Jintao Jiang, Ph.D., Ewen Chao, Brian Chaney, Benjamin Files, and John Jordan. Research results will be reported to the scientific community in a continuing effort to understand the role of cochlear implants in improving hearing and speech perception. ❖

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