The Neural and Genetic Bases of Age-Related Hearing Loss
By D. Robert Frisina, Sr., and Robert D. Frisina, Jr.

Age-related hearing loss—presbycusis—is the number one communicative disorder, and one of the top three chronic medical conditions of our aged populace. Until we have the means for prevention or cure, this communication deficit is inevitable in some form or another for everyone as we age. Improved understanding of the neural and genetic bases of presbycusis will allow for the successful development of preventions and biomedical treatments.

Problems in the Ear
The classical clinical sign of presbycusis is a progressive loss of sensitivity to high frequency sounds. Since normal speech perception requires the processing of vowels and consonants, and since consonants have primarily high frequencies, consonant confusions and concomitant declines in speech perception occur as one develops a high-frequency hearing loss. This high frequency hearing loss is due to pathology of hair cells, microvascularity and eighth cranial nerve cells in the high frequency (basal) turn of the cochlea—the portion of the inner ear used for hearing.

In our audiology research laboratories at the International Center for Hearing and Speech Research at NTID, we have conducted experiments during the past decade on over a thousand human listeners, ages 18-98, utilizing a rigorous set of audiology and speech perception tests. Classical tests measure the sensitivity and health of the cochlea, mostly under quiet listening conditions.

In contrast, state-of-the-art paradigms measure the capabilities of the ear (peripheral auditory system) and the brain (central auditory nervous system) under both quiet and more realistic background noise listening situations (e.g., Tadros et al., 2005).

Otoacoustic emissions are a novel neurophysiological means of assessing the health of the cochlear outer hair cell system. The cochlea has two systems of hair cells. The inner hair cells convert sound into the code of the nervous system, and are the major source of sound information that travels along the auditory division of the eighth cranial nerve to the brain. The outer hair cells provide electromechanical amplification for the inner hair cells so that one can perceive low level sounds (for example, whispers) under quiet conditions. If tones are put into the ears with tiny speakers, sounds will emanate from the ears a very short time later (less than a second). These sounds coming out of the ears, or echos, are a physiological index of the health and function of the cochlear outer hair cell system. We have discovered a correspondence between age-related declines in the outer hair cell system of human listeners and our experimental mice, using otoacoustic emissions. This is part of the age-related hearing loss that occurs in the ear.

Brain Deficits
More sophisticated audiological and speech perception tests allow us to understand changes that take place in the ear versus those that have a central (brain) component in presbycusis. For instance, the Hearing-in-Noise-Test (HINT) assesses how speech perception in background...

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With Daniela Janáková (Charles University, Prague, Czech Republic), Jerry Berent coordinated the second Prague international conference on Teaching English to Deaf and Hard-of-Hearing Students at Secondary and Tertiary Levels of Education in the Czech Republic, August 23-27, 2004, which was supported by the Nippon Foundation of Japan through NTID’s PEN-International. Berent’s lectures included “Optimizing the teaching-learning experience for deaf and hard-of-hearing learners,” “Input enhancement in teaching English to deaf and hard-of-hearing students,” and “Coding deaf and hard-of-hearing students’ successful and unsuccessful English productions.” The conference proceedings are edited by Daniela Janáková (Eurolex, Bohemia, 2005).

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With this installment of the Bulletin we celebrate the 37th anniversary of our parent institution, the Rochester Institute of Technology (RIT), and welcome some new and not-so-new faces to these pages. RIT has been home to the National Technical Institute for the Deaf (NTID) for 37 years. In those years the faculty and staff have worked hard to provide a cultural and academic home to deaf and hard-of-hearing students pursuing careers in social work and the arts, but more often in what we now call STEM (science, technology, engineering, and mathematics). However, our work extends beyond the students currently enrolled at RIT. We are also charged with discovery and with providing new information and strategies to colleagues in the US and around the world. The authors in this anniversary edition of the Bulletin represent well this dual vision of a technical college for the deaf on the campus of a large technical university in upstate New York.

Best practices surface as a result of research and experience. Student experience is the foundation of the article by the team of RIT students — Anarose Ross, Erin Vlahos, Stephanie Shubert, Jill Snieck, and Dan Shatt — brought together to work on Project Access by Sue Foster and Gary Long and support from the US Department of Education. Together with interpreters and professors from RIT’s College of Science, the team has documented strategies that improve students’ access to information in science classrooms. While we know a good deal about the etiology of hearing loss in infants and small children, we know relatively little about age-related hearing loss. The article by the Frisinas (Directors of the NIH-supported International Center for Hearing and Speech Research) gives us a glimpse of the results of their groundbreaking research: how aging affects the auditory system and what genes will tell us about aging and hearing loss.

As Julie White and Jerry Berent note in their article on the NTID Institutional Review Board, there has been dramatic upswing in research activity at RIT in recent years. This in part explains why the university now needs a dedicated professional to guide faculty in procedures that assure protection of students who become subjects and collaborators in our research. Happily, that professional — Julie White — is someone who knows both the issues and grant-getting. Her co-author, Jerry Berent, is current chair of the NTID IRB and a member of the Department of Research.

As always, we invite your comments on these articles and research conducted at NTID (watch these pages for a new research agenda). You may send us your ideas and comments by visiting our web site (go to www.rit.edu/research and click on 'Comments on NTID Research Agenda') or by contacting me through the NTID Research Bulletin (address below).

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Your comments, questions, and requests for more information are welcome. See following address. If you wish a copy of the latest issue of NTID E-news or Publications of if you know of colleagues who would enjoy receiving the NTID Research Bulletin, please send names and addresses to:

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Ronald R. Kelly, Gerald P. Berent, Gary Blurto-Vallée, and Jeffrey Porter are conducting mathematics-related research on deaf and hearing students’ abilities to use English language quantifiers and spatial relationships in word problems as part of their 18-month NSF Catalyst Project titled Science of Learning Center on Mathematics and Deaf Learners. In addition, RIT and NTID teachers will join TESOL (www.tesol.org) to submit TESOL-related proposals for next year’s TESOL Convention, March 15–19, 2006.

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