

Clinical Relevance for the Veteran

SUMMARY OF SCIENTIFIC/TECHNICAL PAPERS IN THIS ISSUE

by Harry Levitt, PhD, Guest Editor

On the Evaluation of a New Generation of Hearing Aids. Robyn M. Cox, PhD (*p.* 297)

Purpose of the Work. A new generation of hearing aids is being developed which offer the promise of novel speech processing capabilities and methods of automatic loudness control. Fitting and evaluation strategies for these new instruments are likely to differ from those currently used for traditional linear hearing aids. This paper reviews the issues involved in order to develop fitting and evaluation procedures appropriate for use with this new generation of hearing aids. **Procedures.** The problems inherent in hearing aid evaluation are reviewed and specific ways of addressing these problems are described. Procedures appropriate for hearing aids that have advanced signal processing capabilities are identified. These include several new tests developed by the authors. Of particular concern are performance evaluations in the field; the relative merits of different approaches to this problem are discussed. **Results.** Techniques have been identified which will avoid the pitfalls of traditional methods of hearing aid fitting and evaluation. These include several new techniques developed by the authors for evaluating hearing aid benefit in everyday environments and for measuring relevant audiological characteristics of the listener. **Relevance to Veteran Population.** Modern hearing aids with new technological features are being fitted to veterans on a substantial scale. It is important that clinicians use fitting and evaluation procedures appropriate for these new instruments.

Preferred Frequency Response for Two- and Three-Channel Amplification Systems.

Donald Dirks, PhD; Jayne Ahlstrom, MS;
P. Douglas Noffsinger, PhD (*p.* 305)

Purpose of the Work. Hearing aids have recently been developed that provide more than one channel of amplification, each channel amplifying a different band of frequencies. The purpose of this investigation was to compare the preferred frequency-gain responses of hearing aids with two and three channels of amplification. **Subjects and Procedures.** Nine subjects with mild to moderately-severe sensorineural hearing loss participated. Three subjects had hearing loss that increased gradually with frequency, four subjects had hearing loss that increased rapidly with frequency, and two subjects had hearing loss that did not vary significantly with frequency. Each subject listened to continuous speech through a computer-simulated hearing aid and provided judgments of relative preference as the hearing aid was adjusted. A statistically efficient adjustment procedure was used under computer control. **Results.** The three-channel system provided greater flexibility in the choice of bandwidths for amplification, but no significant differences were observed between the preferred frequency-gain responses that were obtained, on the average, for the two- and three-channel systems. Both systems, however, showed a range of preferred frequency-gain responses depending on the bandwidths selected for each channel. The three-channel system showed a greater spread in the choice of preferred frequency-gain characteristics. **Relevance to Veteran Population.** Many technologically advanced hearing aids use more than one channel of amplification. This paper provides information on the relative differences between two- and three-channel systems in determining preferred frequency-gain responses. Information of this type is needed in order to develop more effective multichannel hearing aids and improved methods of prescribing these hearing aids.

Do Adaptive Frequency Response (AFR) Hearing Aids Reduce 'Upward Spread' of Masking?

David A. Fabry, PhD; Marjorie R. Leek, PhD;
Brian E. Walden, PhD; Mary Cord, MA (*p.* 318)

Purpose of the Work. One approach to the problem of background noise in acoustic amplification is to reduce the gain at low frequencies when intense low-

frequency noise is present. This technique has been used in several modern hearing aids with mixed results. This paper investigated whether a high quality hearing aid of this type (e.g., noise and distortion generated internally by the instrument itself were negligible) could produce significant improvements in speech recognition at high noise levels and whether such improvements could be related to upward spread of masking, an effect in which intense low-frequency sound reduces the audibility of high-frequency sounds. **Subjects and Procedures.** Eight adults with sensorineural hearing losses that increased rapidly with frequency in the region between 1,000 and 2,000 Hz participated. Four adults with normal hearing also participated. The masking effect of low-frequency noise at two levels (moderate and intense) was measured in each subject. Speech recognition scores were obtained for each noise level under two conditions of amplification, with and without attenuation of the low frequencies. This attenuation was applied equally to both speech and noise, as would occur in a hearing aid of this type. **Results.** The more intense low-frequency noise produced more masking in the high frequencies than the less intense noise. For five of the eight test subjects, attenuation of the low frequencies reduced this upward spread of masking substantially. This reduction in high-frequency masking was reflected in the speech recognition scores. Attenuation of the low frequencies produced a small increase in speech recognition for the low-intensity noise but a relatively large increase in intelligibility for the high-intensity noise. **Relevance to Veteran Population.** Amplification of background noise is a particularly troublesome problem for hearing-aid users. Given the large number of veterans who wear hearing aids, this is a problem of great concern. The method of noise reduction investigated in this study provides some alleviation of this problem under certain conditions (steep high-frequency hearing loss, intense low-frequency noise, and a hearing aid that does not produce significant internal noise or distortion).

Effects of Prolonged Lack of Amplification on Speech-Recognition Performance: Preliminary Findings.

Shlomo Silman, PhD;

Carol A. Silverman, PhD; Michele B. Emmer, MS;

Stanley A. Gelfand, PhD (p. 326)

Purpose of the Work. Several recent studies have shown that lack of amplification in an impaired ear over a prolonged period of time can result in decreased speech recognition ability for that ear. The purpose of this study was to investigate the effects of lack of amplification to the unaided ear in adults with a symmetric binaural hearing loss who have been fitted with a monaural hearing aid. A second objective was to investigate the effect of amplification on speech recognition performance in the aided ears of persons fitted with either monaural or binaural hearing aids. **Subjects and Procedures.** Forty-seven adults with symmetric binaural hearing loss were fitted with hearing aids; 19 were fitted monaurally and 28 binaurally. An additional 19 normal-hearing adults served as controls. Three speech recognition tests were administered to each subject 6–12 weeks after hearing aid fitting and again approximately one year later. **Results.** For the subjects fitted with a monaural hearing aid, the difference in speech recognition test scores between the aided and unaided ears was found to change significantly after one year of hearing-aid use. The unaided ear showed a small reduction in test score while the aided ear showed some evidence of an increase in test score. No significant differences were observed over the same time period for either the binaurally aided subjects or the normal-hearing controls. **Relevance to Veteran Population.** The data obtained in this study indicate that lack of amplification in one ear can lead to poorer speech recognition over time for that ear while the ear that is amplified might also show a small improvement in speech recognition over time. An important implication of this finding is that veterans with hearing losses requiring amplification should be fitted with hearing aids as soon as possible so as to avoid further deterioration in speech reception skills resulting from prolonged lack of amplification.

High-Frequency (8-20 kHz) Testing Techniques and Instrumentation for Early Detection of Ototoxicity.

Stephen A. Fausti, PhD; Richard H. Frey, BS;

James A. Henry, MS; Deanna J. Olson, MS;

Heidi I. Schaffer, MA (p. 333)

Purpose of the Work. Veteran patients with certain types of serious illnesses are often treated with therapeutic drugs which have the potential of causing hearing loss. Since many of these patients

already have some degree of hearing impairment, it is necessary to develop sensitive tests that would indicate if there is likely to be any significant increase in hearing loss resulting from the use of these drugs. A sensitive early indicator is a reduction in auditory sensitivity at high frequencies. The purpose of this study was to compare the relative efficiency of measuring hearing thresholds in the low- and high-frequency ranges for the purpose of early detection of hearing loss. **Subjects and Procedures.** Eighty-three patients receiving aminoglycoside antibiotics or medication for chemotherapy participated in the study. Baseline audiological data, including hearing thresholds, were obtained prior to treatment. Hearing thresholds were then obtained at regular intervals during treatment, immediately after termination of treatment, and at 1- and 6-months post-treatment. Auditory brainstem responses were also obtained on a subset of subjects. **Results.** Increased hearing loss was observed in about 70% of the patients. About half of these hearing losses were first detected by changes in the high-frequency range only, a third by changes in the low-frequency range only, and the remainder by changes in both frequency ranges concurrently. Measurement of auditory brainstem responses to high-frequency tone bursts showed a 90% success rate in detecting significant changes in auditory thresholds. **Relevance to Veteran Population.** The survival rate of critically ill patients is increasing with the ongoing development of powerful new therapeutic drugs, but there is the danger of consequent damage to the patient's hearing as a result of using these new drugs. Early detection of possible hearing damage is of vital importance in these circumstances. With early detection leading to subsequent changes in the drug regimen, it should be possible to avoid serious damage to the auditory system. The results of this study will pave the way to the development of effective protocols for monitoring the hearing of

patients receiving treatment of this kind including objective techniques, such as measurement of the auditory brainstem response, which can be used with seriously ill patients who are unable to respond to conventional behavioral methods of measuring auditory thresholds.

Development and Use of Auditory Compact Discs in Auditory Evaluation: A Clinical Report.

Richard H. Wilson, PhD (*p. 342*)

Purpose of the Work. An essential component of auditory evaluation, including hearing-aid evaluation, involves measurement of speech reception ability. Recent advances in audio technology allow for the development of improved test materials using compact discs in which high quality recordings are stored digitally and can be accessed rapidly and conveniently in a clinical setting. The purpose of this investigation was to develop test materials for auditory evaluation using this new technology. **Procedures and Results.** Ninety-seven VA Audiology Clinics were surveyed to determine which speech recognition/identification materials were needed by VA audiologists. A set of test materials, based on the results of this survey, was chosen and digital recordings were made of these materials and transferred to two compact discs. The first disc contains speech recognition/identification test materials for basic auditory evaluations. The second disc was developed for assessing central auditory perceptual abilities and includes both speech and tonal materials. **Relevance to Veteran Population.** The two sets of auditory test materials in compact disc form have been designed specifically for use in VA Audiology Clinics. These digitized test materials are superior to test recordings currently in use in several respects. These include improved sound quality, greater ease of use, and access to test materials that previously were not readily available.