

## HEARING AID RESEARCH AT ONTARIO'S HEARING HEALTH CARE RESEARCH UNIT (HHCRU)

Donald G. Jamieson  
Hearing Health Care Research Unit  
The University of Western Ontario  
London, ON N6G 1H1 CANADA

### OVERVIEW

The Hearing Health Care Research Unit (HHCRU) was established in July, 1989 by the Ontario Ministry of Health as part of its new Health System-Linked Research Units Program. This approach to health research links a clinical partner with an academic sponsoring agency in an attempt to increase the relevance and effectiveness of health research.

HHCRU is a partnership between the Otologic Function Unit (OFU), a shared audiology/vestibular service between Mount Sinai Hospital and The Toronto Hospital, and the Aural Rehabilitation Group in the Department of Communicative Disorders at the University of Western Ontario (UWO). Krista Riko, the Director of the OFU, represents the Clinical Partner on the Unit's Steering Committee. The Unit Director is Dr. DG Jamieson of UWO.

The focus of HHCRU is hearing-related assessment and rehabilitative services, with a view to improving the efficiency and effectiveness of these services. The ultimate aim is to minimize the handicap that accompanies hearing loss.

### THE UNIT

Within the linked research unit, the partners focus on the clinical questions that need to be addressed to improve hearing health care service delivery. The grant from the Ontario Ministry of Health covers two-thirds of the basic costs to support the Unit's infrastructure, with the remainder covered by UWO and the OFU. The costs for the individual research projects undertaken by Unit researchers must be provided by specific grants from federal and provincial granting agencies, by contributions from foundations, and through contracts with companies and government departments. Members of the Research Unit also participate in the Ontario Rehabilitation Technology Consortium (ORTC). This Consortium brings researchers, consumers, clinicians, engineers, and industrial partners together to develop, evaluate and make available new assistive devices and technologies.

### CURRENT PROJECTS

The research undertaken by the Unit is organized into several projects which are both identified as important by the Clinical Partner and as feasible and appropriate by one or more of the Unit's researchers. Research is organized into three themes: (1) Development and Evaluation of Diagnostic Technologies and Services; (2) Development and Evaluation of Therapeutic Technologies and Services; and (3) Cost-effectiveness of OFU Operations. Projects relating to amplification systems have been, or are being, undertaken with the first two of these areas. Some examples are

provided below.

### SELECTED RESULTS RELATED TO HEARING AIDS *The hearing aid test system (HATS)*

Clearly, the accurate measurement of the electroacoustic hearing aid performance is a necessary precursor to all behavioral hearing aid evaluations -- and thus to the improvement of hearing aid design. Unfortunately, standardized hearing aid testing procedures do not provide information of the form and type required either for clinical hearing aid evaluation or for behavioral research to advance the state of hearing aid fitting and application (cf., Jamieson, 1992). Standardized tests were developed to address issues of manufacturing quality control, not to address clinically-relevant questions. Further, standardized tests are unable to characterize the real-life electroacoustic performance of modern, signal-processing hearing aids. In fact, many modern hearing aids *adapt* their electroacoustic characteristics to the acoustic environment -- so that their response in real life situations is often considerably different from that observed in a test situation.

To address these issues, we are developing a suite of "consumer-based" hearing aid testing procedures. Schneider and Jamieson (1993) describe the development and application of the first MLS-based testing procedure for hearing aids. Jamieson and Schneider (1993) report additional aspects of the test suite, including its use to study hearing aid performance in various types of acoustic environments (including performance with real-life background noise bias signals) and the presentation of test results to address specific clinical questions.

### *Development and Evaluation of Advanced Hearing Aid Signal Processing Procedures*

The most common complaint of hearing aid wearers is their difficulty hearing in a background of noise. Hearing aid companies devote considerable effort and money to the design and marketing of procedures which might reduce the impact of such background noise. Our group continues to be involved in research to develop and evaluate new signal processing schemes which might have advantages for hearing impaired listeners (e.g., Jamieson & Brennan, 1992; Jamieson & Cornelisse, 1992).

### *Hearing aid selection methods*

A continuing challenge for audiologists is the prediction of which hearing aid characteristics are likely to produce the maximum benefit for a given individual. The Desired Sensation Level (DSL) method is a systematic approach to electroacoustic selection and fitting, which seeks to ensure that

amplified speech will be audible, comfortable and undistorted across the broadest relevant frequency range possible. The theoretical and empirical basis of this approach has been developed over more than a decade of research (cf., Seewald, 1992; Seewald, Zelisko, Ramji & Jamieson, 1992). The current implementation of this system, version 3.1, implements the entire procedure in an easy-to-use program for IBM/AT-compatible computers. Systems are now being used in audiology clinics throughout North America and Europe.

***Development of an advanced signal delivery system to assist in hearing aid selection***

In conventional hearing instrument fitting average adult values are applied in lieu of measurements on each individual client. Clearly, for any individual hearing instrument user, this approach can result in inaccurate fitting. ***This is a particular risk for children.*** The signal delivery project seeks to develop new systems and fitting protocols to make it easy to personalize fittings for individuals of all ages. A clinical protocol and prototype system for custom hearing aid fitting in adults has been developed and is being incorporated into the hearing aid analysis and fitting system produced by Etymonic Design Inc. In addition, a procedure and prototype system for predicting the performance of hearing instruments in young children has been developed and tested.

**DISSEMINATION AND IMPACT BEYOND THE OFU**

HHCRU communicates its findings through published research reports, conference presentations, workshops and special initiatives. The results of some of our projects are now being distributed internationally.

One of our research "products" is the set of systematic procedures for hearing aid selection contained in the DSL approach (Seewald, 1992). We have also developed procedures to assess speech intelligibility performance (e.g., Cheesman, 1992; Gagné, Tugby & Michaud, 1991) and are implementing these for routine use in Audiology clinics.

We have also developed the ***Canadian Speech Research Environment (CSRE)*** software for speech recording, editing, analysis, synthesis, and testing using IBM/PC-compatible computers (Jamieson, Ramji, Kheirallah & Nearey, 1992). Our own uses of ***CSRE*** include the development of speech intelligibility test procedures (e.g., Cheesman, 1992; Cheesman, et al., 1992) and evaluating amplification systems (e.g., Jamieson and Brennan, 1992). ***CSRE*** is now used in laboratories and clinics in 12 countries to support basic and applied research, and clinical evaluation.

**REFERENCES**

Cheesman, MF (1992) An automated technique for estimating speech reception thresholds in multi-talker babble. *Journal of Speech-Language Pathology and Audiology*, 16, 223-27.  
 Cheesman, MF, Lawrence, S, & Appleyard, A (1992) Pred-

iction of performance on a nonsense syllable test using the Articulation Index. *Proceedings of the Second International Conference on Spoken Language Processing*, 1123-26.  
 Gagné, J-P, Tugby, KG, & Michaud, J (1991) Development of a Speechreading Test on the Utalization of Contextual Cues (STUCC): Preliminary findings with normal-hearing subjects. *Journal of the Academy of Rehabilitation Audiology*, 24, 157-70.  
 Jamieson, DG (1993) Consumer-based electroacoustic hearing aid measures, *Journal of Speech Language Pathology and Audiology Monograph Suppl. 1*, January, 87-97.  
 Jamieson, DG, & Brennan, RL (1992) Evaluation of speech enhancement strategies for normal and hearing-impaired listeners. *Proceedings of European Speech Communication Association Conference on Speech Processing In Adverse Conditions*, 155-57.  
 Jamieson, DG, and Cornelisse, L (1992) Speech processing effects on intelligibility for hearing impaired listeners. In JJ Ohala, TM Nearey, BL Derwing, MM Hodge, and GE Wiebe (Eds.) *Proceedings of the Second International Conference on Spoken Language Processing*, Edmonton: University of Alberta, pp. 1035-1038.  
 Jamieson, DG, Ramji, K, Kheirallah, I, & Nearey, TM (1992) CSRE: The Canadian speech research environment. *Proceedings of the Second International Conference on Spoken Language Processing*, 1127-30.  
 Jamieson, D.G. and Schneider, T. (1993) Electroacoustic hearing aid measures relevant to consumers. In B. Granstrom, S. Hunnicutt and K-E., Spens (Eds.). *Proceedings of the European Speech Communication Association Conference on Speech Technology for the Disabled*. Stockholm, Sweden: Royal Institute of Technology, pp. 31-34.  
 Schneider, T. and Jamieson, D.G. (1993) A dual-channel MLS-based test system for hearing aid characterization. *Journal of the Audio Engineering Society*. (in press).  
 Seewald, RC (1992) The desired sensation level method for fitting children: Version 3.0. *Hearing Journal*, 45:36-41.  
 Seewald, RC, Zelisko, D, Ramji, K, & Jamieson, DG (1992) *DSL 3.0 User's Manual*. London, ON: Hearing Health Care Research Unit, The University of Western Ontario.

**ACKNOWLEDGEMENTS**

The work described here reflects the coordinated efforts of the full Hearing Health Care Research Unit team, at both London and Toronto. The Unit's work is supported primarily by the Ontario Ministry of Health, by the Ontario Rehabilitation Technology Consortium, and by Unitron Industries Ltd.. For addition information contact Ms. L. Kieffer, HHCRU, University of Western Ontario, London, ON, CANADA, N6G 1H1.