

BOOK REVIEW

FM AUDITORY TRAINING SYSTEMS: CHARACTERISTICS, SELECTION, AND USE. 234 pages. (\$24). (1992). Mark Ross, Editor. York Press, P.O. Box 504, Timonium, MD 21094. (ISBN 0-912752-31-9)

Frequency Modulated (FM) systems have been used for over 25 years in various educational and clinical settings. As an assistive listening device for hearing-impaired people, FM serves as an invisible cable that increases the level of the signal and improves the signal-to-noise ratio. Despite all of the research that documents the benefits of FM, professionals are still encountering difficulty convincing school administrators of its viability. To address this need, and to assist professionals who work with FM in realizing the full potential these systems have to offer, a conference sponsored by the New York League for the Hard of Hearing was held in March, 1991. Mark Ross has compiled the works of many experts who presented at this conference to produce the book *FM Auditory Training Systems: Characteristics, Selection, and Use*. Although the title may be somewhat out of date, the information presented within is state-of-the-art. Ross states in the preface, "FM systems are the most significant therapeutic tool developed for hearing-impaired children since the advent of personal and group amplification devices," and as editor of this book, he has done an excellent job of presenting a wealth of relevant information that is useful to all individuals who engage in regular contact with FM systems.

In the opening chapter, Arthur Boothroyd presents an overview of the physical properties of FM signal transmission. Boothroyd begins by reviewing the effect sensorineural hearing loss has on the auditory system including threshold elevation, dynamic range reduction, loss of discrimination ability, and increased noise susceptibility. Current trends in hearing aid technology are reviewed followed by a discussion of the rationale for utilizing FM systems in the management of sensorineural hearing loss.

This chapter continues with an overview of the FM transmission process. Included is an explanation of the modulation/demodulation process, differences between AM and FM transmission, and the effect of bandwidth on the fidelity of the signal. Boothroyd's chapter also informs the reader on some of the potential problems inherent to FM systems including the risk of interference from competing FM signals, difficulty in managing input from multiple sound sources, and problems associated with a low microphone compression knee point.

Boothroyd appropriately cautions the reader that FM should not be viewed as "magic" and presents strategies for promoting successful use as well as cautioning on the potential for misuse. This chapter presents an excellent overview of

the physical properties of FM transmission and leads nicely into the chapter by Mark Ross on room acoustics and speech perception.

In the second chapter, Ross delves into a discussion of the poor acoustic characteristics that are common to classroom settings, specifically noise and reverberation, and their effect on speech perception for both hearing impaired and normally hearing individuals. An excellent overview of the physical properties of noise is presented. For the reader who is unfamiliar with this area, Ross does an excellent job defining key terms such as reverberation time, signal-to-noise ratio, precedence effect, and critical distance, and he reviews several classic studies which look at speech perception scores in normal and hearing impaired children as a function of reverberation time and signal-to-noise ratio. All of this lends support to the need to improve conditions within the listening environment and sets the stage for the remaining chapters in the book which focus more specifically on FM as a means of doing so.

Chapter 3, by Linda M. Thibodeau, presents an introduction to the specifics of current FM equipment including components, features, accessories, and available options. This chapter is excellent introductory reading for all individuals who presently work with FM or will do so in the future.

Three general areas are addressed: transmitter options, receiver options, and batteries. Relative to FM transmitters, this chapter presents information on microphone options, transmitter frequencies, and the transmission of signals from auxiliary sound sources. The section on FM receivers includes information on environmental microphones, receiver frequencies, input/output connections, coupling methods, and controls to adjust the gain, frequency response, SSPL, and FM ratio for each user. In the final section, battery types and charger options are discussed.

Good use is made of photographs and graphics to supplement the text in Thibodeau's chapter. However, some of the graphic representations, although informative, are somewhat cryptic. In addition, Appendix B contains a table of hearing aids with direct audio input and telecoil capabilities. This information is extremely helpful to those who dispense hearing aids but readers should be aware that the listing is not comprehensive since several prominent manufacturers do not appear.

As an audiologist who routinely evaluates and fits FM systems, I found the chapter on electroacoustic considerations by Richard C. Seewald and K. Shane Moodie to be most interesting. Little can be assumed regarding the electroacoustic performance of FM systems and Seewald and Moodie present strong evidence of this fact. The authors stress the need for consistency between the electroacoustic end result of a child's hearing aid, and the same hearing aid coupled to an FM system. Unfortunately, there is a lack of consistency and the authors present an excellent overview detailing the sources of variability that can impact upon the electroacoustic end product. Specific attention is paid to variability resulting from different coupling modes and volume control settings. An excellent review of the relevant literature citing variability within and between FM

systems is presented.

Electroacoustic considerations that are essential for an FM system to meet its potential are discussed. The authors emphasize the need to evaluate the basic electroacoustic performance of the system prior to the fitting process, followed by an evaluation of real ear electroacoustic performance characteristics that ensure the unit is compatible with the child's residual hearing characteristics and ensure a reasonably consistent amplified signal over time and across listening conditions. Measurement options including 2cc coupler based procedures, and real ear measurements in the form of sound field aided thresholds and probe tube microphone measurements are reviewed along with the benefits and limitations of each.

A significant portion of this chapter is devoted to providing a step-by-step protocol for utilizing 2cc coupler and probe tube microphone measurements to match the output of the user's appropriately fitted hearing aid to that of the user's hearing aid coupled to an FM system. This section is extremely relevant to all professionals who evaluate and fit FM systems.

Chapter 5, by Antonia Brancia Maxon, discusses selection and use of FM for school-age children. Maxon states that all school-age children with hearing loss are candidates for FM and reviews data from three different studies that reveal changes in the demographic make-up and use characteristics of FM in educational settings since the late 1970s. Specific cases are included to illustrate that FM, due to the improved signal-to-noise ratio it provides, is beneficial for all types and degrees of hearing impairment.

Maxon goes on to discuss the selection process including how to demonstrate the need for FM in a child's educational setting and various issues that must be taken into consideration during the selection/recommendation process. Particular emphasis is placed on approaching these issues as a team comprised of an audiologist, a school-based case manager, the parents, and the child. The final section of this chapter addresses methods of validating the FM fitting and strategies for effective use of FM throughout the school environment.

Chapter 6, authored by Chris Hawrylak Evans, deals with troubleshooting issues and is highly recommended for all professionals who come in contact with FM equipment. This chapter begins with recommendations on how to go about purchasing FM equipment and how to maintain, monitor, and troubleshoot the equipment once it has been received. Particular attention is paid to the fundamentals of troubleshooting including symptoms, causes, and solutions to common problems. This chapter presents a logical step-by-step protocol on how to conduct a daily listening check of each FM component for all coupling modes and signal options. Special emphasis is placed on including the child in the maintenance and troubleshooting process. I found the one-page quick reference tables detailing the listening check procedure to be particularly useful.

Also included in Evans' chapter are practical tips on maintaining a record of your inventory and storing your equipment. Sample record keeping forms are provided. A glossary of key terms appears in Appendix A, but I feel it would

be more helpful to place this at the end of the book since several chapters refer to these terms.

The primary focus of the chapter authored by Jane Madell is on the selection and use of FM as a primary amplification device for infants and preschool children with severe and profound sensorineural losses. Madell begins with a review of relevant literature pertaining to the development of auditory skills and the relationship between auditory stimulation and the development of verbal language during a child's critical period for language acquisition. The need for appropriate amplification in this process is well documented and Madell presents a valid case as to why an FM system should be considered a viable alternative to personal hearing aids for this population.

Issues related to the selection of an appropriate FM system for this age group are discussed in Madell's chapter with specific attention devoted to selecting an appropriate receiver, transmitter microphone, and coupling mode. A protocol for conducting behavioral testing with an FM system on this population is presented along with a review of test stimuli options, test conditions, and test room set-up. A sample test form is included as well as an excellent schematic of the test room set-up.

Also addressed in the chapter by Madell are some of the questions and concerns commonly expressed by parents and the audiologist's role in alleviating their fears and concerns. In addition, strategies are presented for helping parents realize the need for and understand the benefits of FM use, and how to effectively use FM with their child. The role of the parent and the child in monitoring the equipment and troubleshooting minor problems is discussed.

Chapter 8, authored by Diane Brackett, is an excellent follow-up to Madell's chapter. Picking up where Madell's chapter left off, Brackett discusses the role of FM in the language learning process for hearing-impaired infants and preschoolers. Use of FM by parents in the home and in other environments makes it possible for these children to be exposed to the raw material of language learning by increasing audibility and reducing the negative impact of poor listening conditions. Brackett presents an equation where language learning can be considered as the sum of following components: audibility of the speech signal, repeated exposure to language, and meaningful context. Brackett discusses how this equation is unbalanced for hearing-impaired children due to the reduced audibility of speech and discusses how parents can more evenly balance the equation in conjunction with the use of an FM system as a child's primary means of amplification. Psychosocial implications for parents who utilize FM with their hearing impaired child are also discussed.

Brackett reviews a study conducted at the New York League for the Hard of Hearing which investigated phonemic recognition skills in profoundly hearing impaired children who used FM as their primary mode of amplification. The results of this study revealed that those children using FM as their primary mode of amplification demonstrated improved and more rapidly developing perceptual skills than children who used hearing aids alone.

Training is an essential component in the development of spoken language by hearing impaired children. Brackett's chapter discusses the importance of training in conjunction with FM use and presents strategies on how parents can organize their own speech input to facilitate the child's integrative development of auditory, speech, and language skills.

Classroom soundfield amplification that employs a wireless FM microphone is a relatively new option in assistive technology designed to improve the signal-to-noise ratio in educational settings. Although the use of traditional FM systems may be preferable in most instances, soundfield amplification systems have several advantages that make it a viable option for certain classroom settings. In Chapter 9, Carol Flexer presents an overview of soundfield amplification technology and discusses the various populations who might benefit from this technology.

Flexer reiterates the rationale for enhancing the speech signal in the classroom, mainly that "auditory discrimination is associated with the development of basic competencies that are essential for success in school." She includes some interesting data on classroom acoustics obtained using the Bruel and Kjaer Rapid Speech Transmission Index (RASTI) System as well as several relevant studies that investigated the effectiveness of classroom soundfield amplification systems compared to other treatments.

This chapter offers practical information to the reader such as various factors to consider when going about selecting an appropriate sound field amplification system, strategies to assist in convincing school personnel of the value of classroom amplification, and techniques for effective use of soundfield amplification in the classroom.

Some professionals have a limited view of the application of FM systems. In the final chapter in this book, Ellen B. Pfeffer discusses alternate uses of FM amplification systems. Included is the use of FM with populations such as mildly hearing impaired children, children with unilateral hearing loss, and children with normal hearing who exhibit learning disabilities or central auditory processing disorders. Various uses of FM with adult populations in educational, vocational, and social settings are also presented. Case studies, including audiologic results with and without FM, are presented to support the use of FM by each of these populations.

Overall, I found the information contained within this book to be exceptional. Ross has done an excellent job compiling a comprehensive and up-to-date resource that is relevant to all professionals in the field. There is some degree of redundancy from one chapter to another, but this is fairly common in edited books and Ross states that this is necessary to maintain the integrity of each of the different chapters.

It is my opinion that this should be required reading for graduate speech-language pathology and audiology students. It would serve nicely as a supplemental text for an educational audiology, hearing aids, or aural rehabilitation course. Sections of this book are also relevant to classroom teachers, support personnel,

school administrators, and parents. A book of this nature on such a relevant topic is long overdue.

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