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Volume 60

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ASA Press

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The Auditory System at the Cocktail Party

With 41 Illustrations

ASA Press

Springer

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The Acoustical Society of America

On 27 December 1928 a group of scientists and engineers met at Bell Telephone Laboratories in New York City to discuss organizing a society dedicated to the field of acoustics. Plans developed rapidly and the Acoustical Society of America (ASA) held its first meeting 10–11 May 1929 with a charter membership of about 450. Today ASA has a world-wide membership of 7,000.

The scope of this new society incorporated a broad range of technical areas that continues to be reflected in ASA's present day endeavors. Today, ASA serves the interests of its members and the acoustics community in all branches of acoustics, both theoretical and applied. To achieve this goal, ASA has established technical committees charged with keeping abreast of the developments and needs of membership in specialized fields as well as identifying new ones as they develop.

The Technical Committees include: acoustical oceanography, animal bioacoustics, architectural acoustics, biomedical acoustics, engineering acoustics, musical acoustics, noise, physical acoustics, psychological and physiological acoustics, signal processing in acoustics, speech communication, structural acoustics and vibration, and underwater acoustics. This diversity is one of the Society's unique and strongest assets since it so strongly fosters and encourages cross-disciplinary learning, collaboration, and interactions.

ASA publications and meetings incorporate the diversity of these Technical Committees. In particular, publications play a major role in the Society. *The Journal of the Acoustical Society of America* (JASA) includes contributed papers and patent reviews. *JASA Express Letters* (JASA-EL) and *Proceedings of Meetings on Acoustics* (POMA) are online, open-access publications, offering rapid publication. *Acoustics Today*, published quarterly, is a popular open-access magazine. Other key features of ASA's publishing programinclude books, reprints of classic acoustics texts, and videos.

ASA's biannual meetings offer opportunities for attendees to share information, with strong support throughout the career continuum, from students to retirees. Meetings incorporate many opportunities for professional and social interactions and attendees find the personal contacts a rewarding experience. These experiences result in building a robust network of fellow scientists and engineers, many of whom become lifelong friends and colleagues.

From the Society's inception, members recognized the importance of developing acoustical standards with a focus on terminology, measurement procedures, and criteria for determining the effects of noise and vibration. The ASA Standard Program serves as the Secretariat for four American National Standards Institute Committees and provides administrative support for several international standards committees.

Throughout its history to present day ASA's strength resides in attracting the interest and commitment of scholars devoted to promoting the knowledge and practical applications of acoustics. The unselfish activity of these individuals in the development of the Society is largely responsible for ASA's growth and present stature.

Series Preface

The following preface is the one that we published in Volume 1 of the Springer Handbook of Auditory Research back in 1992. As anyone reading the original preface, or the many users of the series, will note, we have far exceeded our original expectation of eight volumes. Indeed, with books published to date and those in the pipeline, we are now set for over 60 volumes in SHAR, and we are still open to new and exciting ideas for additional books.

We are very proud that there seems to be consensus, at least among our friends and colleagues, that SHAR has become an important and influential part of the auditory literature. While we have worked hard to develop and maintain the quality and value of SHAR, the real value of the books is very much because of the numerous authors who have given their time to write outstanding chapters and to our many coeditors who have provided the intellectual leadership to the individual volumes. We have worked with a remarkable and wonderful group of people, many of whom have become great personal friends of both of us. We also continue to work with a spectacular group of editors at Springer. Indeed, several of our past editors have moved on in the publishing world to become senior executives. To our delight, this includes the current president of Springer US, Dr. William Curtis.

But the truth is that the series would and could not be possible without the support of our families, and we want to take this opportunity to dedicate all of the SHAR books, past and future, to them. Our wives, Catherine Fay and Helen Popper, and our children, Michelle Popper Levit, Melissa Popper Levinsohn, Christian Fay, and Amanda Fay Seirra, have been immensely patient as we developed and worked on this series. We thank them and state, without doubt, that this series could not have happened without them. We also dedicate the future of SHAR to our next generation of (potential) auditory researchers—our grandchildren—Ethan and Sophie Levinsohn, Emma Levit, and Nathaniel, Evan, and Stella Fay.

Preface 1992

The Springer Handbook of Auditory Research presents a series of comprehensive and synthetic reviews of the fundamental topics in modern auditory research. The volumes are aimed at all individuals with interests in hearing research including advanced graduate students, postdoctoral researchers, and clinical investigators. The volumes are intended to introduce new investigators to important aspects of hearing science and to help established investigators to better understand the fundamental theories and data in fields of hearing that they may not normally follow closely.

Each volume presents a particular topic comprehensively, and each serves as a synthetic overview and guide to the literature. As such, the chapters present neither exhaustive data reviews nor original research that has not yet appeared in peer-reviewed journals. The volumes focus on topics that have developed a solid data and conceptual foundation rather than on those for which a literature is only beginning to develop. New research areas will be covered on a timely basis in the series as they begin to mature.

Each volume in the series consists of a few substantial chapters on a particular topic. In some cases, the topics will be ones of traditional interest for which there is a substantial body of data and theory, such as auditory neuroanatomy (Vol. 1) and neurophysiology (Vol. 2). Other volumes in the series deal with topics that have begun to mature more recently, such as development, plasticity, and computational models of neural processing. In many cases, the series editors are joined by a co-editor having special expertise in the topic of the volume.

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Volume Preface

The cocktail party is the archetype of a complex auditory scene: multiple voices compete for attention; glasses clink; background music plays. Other situations of daily life, including busy offices, crowded restaurants, noisy classrooms, and congested city streets, are no less acoustically complex. The normal auditory system exhibits a remarkable ability to parse these complex scenes. Even relatively minor hearing impairment, however, can disrupt this auditory scene analysis.

This volume grew out of the Presidential Symposium, "Ears and Brains at the Cocktail Party," at the Midwinter Meeting of the Association for Research in Otolaryngology, held in 2013 in Baltimore, Maryland. In this volume, the authors describe both the conditions in which the auditory system excels at segregating signals of interest from distractors and the conditions in which the problem is insoluble, all the time attempting to understand the neural mechanisms that underlie both the successes and the failures. In Chap. 1, Middlebrooks and Simon introduce the volume and provide an overview of the cocktail party problem, putting it into the perspective of broader issues in auditory neuroscience. In Chap. 2, Shinn-Cunningham, Best, and Lee further set the stage by elaborating on the key concept of an *auditory object*, which can be thought of as the perceptual correlate of an external auditory source and the unit on which target selection and attention operate. In Chap. 3, Culling and Stone address the challenges of low-level separation of signal from noise and consider the mechanisms by which those challenges may be overcome. They introduce the distinction between *energetic* and *informational* masking. Next, in Chap. 4, Kidd and Colburn develop the concept of informational masking by focusing on speech-on-speech masking.

Computational models can aid in formalizing the basic science understanding of a problem as well as in generating algorithms that exploit biological principles for use in solution of practical engineering problems. In Chap. 5, Elhilali considers the challenges of creating useful computational models of the cocktail party problem. Then, in Chap. 6, Middlebrooks considers the importance of spatial separation of sound sources for stream segregation and reviews the psychophysics and physiological substrates of spatial stream segregation. Next, in Chap. 7, Simon reviews new developments in the field of experimental human auditory neuroscience.

A cocktail party is no place for infants and children. The auditory scene, however, is easily as acoustically complex on a noisy playground or in a crowded classroom. Young people apprehend these scenes with immature auditory systems and not-yet-crystallized language recognition. Werner, in Chap. 8, considers multiple stages and levels of development. Next, in Chap. 9, Pichora-Fuller, Alain, and Schneider consider older adults in whom maturity of language skills and stores of knowledge can to some degree compensate for senescence of the peripheral and central auditory systems. Finally, in Chap. 10, Litovsky, Goupell, Misurelli, and Kan consider the consequences of hearing impairment and the ways in which hearing can at least partially restored.

Successful communication at the eponymous cocktail party as well as in other, everyday, complex auditory scenes demands all the resources of the auditory system, from basic coding mechanisms in the periphery to high-order integrative processes. The chapters of this volume are intended to be a resource for exploration of these resources at all levels: in normal mature hearing, in early development, in aging, and in pathology.

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