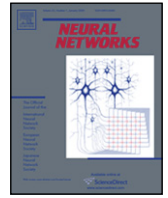




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## Neural Networks

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## Book review

**Auditory Neuroscience. Making Sense of Sound, Jan Schnupp, Israel Nelken, Andrew King. The MIT Press (2011). ISBN: 0-262-11318-X, \$40.00**

One of the more challenging tasks an instructor can face is to teach neuroscience to students who lack strong training in mathematics. Similarly, even for students with strong computational backgrounds, it can be difficult to concisely convey the most important topics with up to date research references that link physiology, psychophysics, and computational modeling in this relatively young and dynamic research field. With their new textbook on brain mechanisms in auditory processing, "Auditory Neuroscience – Making Sense of Sound," Jan Schnupp, Israel Nelken, and Andrew King provide an excellent resource to help overcome these challenges. The text links and discusses findings from physiological, cognitive, and computational auditory neuroscience, with emphasis on neural correlates of sound perception. Of note to readers of this journal, neural network models of auditory processing are not directly treated. A highly useful website ([www.auditoryneuroscience.com](http://www.auditoryneuroscience.com)) accompanies the book, providing a multitude of links to example sound and video recordings as well as instructive animations of computational models.

The book is written engagingly, sometimes in humorous tones, as if the authors entertain a conversation with the reader. One thing it is not is boring. Science teaching should be fun, a feat accomplished by this book. The first chapter, which assumes little mathematical training in its readership, introduces the necessary signal processing concepts in what is perhaps the most compelling non-mathematical introduction into linear filters and physical acoustics that I have encountered in a textbook.

The second chapter, entitled simply "The Ear," mostly explains cochlear processing. It introduces outer and middle ear function, basilar membrane responses and auditory nerve function, explaining *en passant* concepts such as spectrograms, cochleagrams, and neural histograms. Already at this early stage in the book, the authors describe typical speech sounds and how they are encoded at the auditory periphery. The last part of this chapter surveys the ascending auditory pathway from auditory nerve fibers to cortex.

Chapters 3 to 6 are structured by perceptual tasks. Chapters 3 through 5 cover single-source perception of pitch, speech, and sound localization. Chapter 6 treats concepts of auditory scene analysis in acoustic mixtures. With didactical skill the authors motivate each topic by pointing out acoustic scenarios that readers are likely to encounter in everyday life. Each of these chapters then illustrates how multiple neural representation levels provide information pertaining to the relevant perceptual task. I was

pleased to find that the chapter on pitch includes a subsection about Western music (something that surprisingly few other auditory textbooks treat) before engaging the reader in facts and paradoxes about the neural coding of pitch.

Throughout these chapters, the authors thoroughly condense and simplify the literature, often citing and highlighting only a few selected studies. This facilitates clarity, and leaves room for students to comprehend the concepts behind current research hypotheses, without being overwhelmed by myriad detailed facts. In fact, as an overview of recent work, written from the unique perspective of three outstanding researchers in auditory neuroscience, I found chapters 3 through 6 to be the most intellectually stimulating parts of the book. For an instructional book, however, it left me wishing for a more diverse bibliography that would allow students to develop an appreciation of the history and plurality of approaches in previous studies. For instance, chapter 6 mostly focuses on source segregation but circumvents auditory attention and memory, making relatively few connections to the vast body of literature in psychophysics, EEG, MEG, and fMRI.

Chapter 7 provides an overview of development, plasticity, and learning in the auditory system. It treats critical periods of development, changes in auditory circuits, and examples of plasticity in the adult brain. The authors point out the direct relevance of this research on how hearing-impaired or profoundly deaf individuals can learn to use hearing aids and cochlear implants, but do not delve into the question of individual differences in performance. Chapter 8 is rather short, giving a brief outlook on hearing aids and cochlear implants, with a historical section on hearing aids that is both informative and entertaining.

Overall the book is well suited for its targeted audience: advanced undergraduates in biological or medical sciences, audiology, psychology, neuroscience, or speech science. The book also excels as a concise and engaging guide for any novice who, perhaps in self-guided study, would like to familiarize herself or himself with current questions in auditory neuroscience. I highly recommend this book to instructors of undergraduate and beginning graduate courses in auditory neuroscience.

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