

MENC HANDBOOK
OF MUSICAL
COGNITION AND
DEVELOPMENT

EDITED BY RICHARD COLWELL

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Richard Colwell

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Preface

The use of research findings is critical to the success of music teaching and learning. There is probably no area of greater importance in the 21st century than research involving music and its impact on the development and use by the human brain. The popular press has reported partial findings of research indicating the importance of music in human development. It is important that teachers and researchers have a full understanding of the findings of valid studies in order that our knowledge not be misused. Andreas Lehmann, a German scholar, assembled an outstanding team that wrote chapters on our knowledge of perception and cognition for the *New Handbook of Research on Music Teaching and Learning* published by Oxford University Press in 2002. In this text, we provide an up-date of that material with the addition of a chapter on Music and Neuroscience by John W. Flohr and Donald A. Hodges.

This up-date is the result of the efforts of Ms. Kim Robinson and Ms. Eve Bachrach of Oxford University Press and Mike Blakeslee of the National Association for Music Education—MENC, believers in the importance of disseminating research findings to the profession. It is our hope that the publication of separate, small, economical, books on specialized research topics will make the material more accessible to users in a variety of fields. Music cognition is a vital topic for scholars in medicine, psychology, in educational psychology, and in music theory, as well as for music educators. One will note that we have selected authors from all of these fields and authors from continental Europe, Great Britain, Canada, and the United States. It has been my pleasure to work through with them with the assistance of Professor Lehmann issues of language, definitions, and concepts to make the material clear to not only English speakers but those who use English as a research tool. Accurate definitions apply to the topic of each chapter although the authors have coordinated their writing to avoid duplication and to cover the material of music perception and cognition as succinctly as possible in only seven chapters. Although the chapters stand alone

as a research resource, they have also been organized to be read in the normal textbook fashion, from the introduction to the end of chapter 7.

It has been my pleasure to work with not only the authors but with the National Association for Music Education and Oxford University Press in this exemplary cooperative project. As one who does not normally think about how music works within the human, I have found these chapters enlightening as I'm sure will both sophisticated and those of us who are less sophisticated in brain functioning and its responses.

Contributors

JANE W. DAVIDSON is professor of performance studies in the Department of Music at the University of Sheffield and specializes in research on performance skills acquisition, expression, and social dynamics. Her recent edited volume, *The Music Practitioner*, explores the uses of research for the practicing musician. A former editor of *Psychology of Music*, she is currently vice-president of the European Society for the Cognitive Sciences of Music. She also holds a visiting professorial post at the University of Western Australia. Besides her academic career, as an ex-professional opera singer, she specializes in directing. She has more than thirty productions in her repertoire, having worked on the wildly contemporary (*Death and the Madman*, for Drama per musica in Portugal) to the pastoral and lyrical, including Mozart's rarely performed *Betulia Liberata*. Over the years, she has worked with the Hong Kong Cultural Centre, London International Opera Festival, the Edinburgh Festival, Wigmore Hall, Extemporary Dance Theatre, Théâtre de Complicité, Opera North, and Drama per Musica on a range of music theatre projects.

JOHN W. FLOHR received his doctorate in music education from the University of Illinois-Urbana. He has performed as a professional musician and taught at the college, public school, and preschool level. He is professor of music at Texas Woman's University-Denton, serves as current president of the Texas Music Educators Conference, and recently was faculty fellow at the national Arts Education Partnership. He specializes in early childhood music education and has authored research papers, books, videos, audio recordings, and computer programs in music and music education. His most recent book is *Musical Lives of Young Children*.

HEINER GEMBRIS holds a degree in music education from the Academy of Music Detmold and in musicology from the Technische Universität Berlin. He worked as a music teacher in secondary public schools for several years. In 1985, he earned his doctorate with a study on music listening and relaxation. After an employment at the University of Augsburg, he was appointed professor for systematic musicology at the University of Münster (1991), and later at the University of Halle/Wittenberg (1998). Since 2001 he has been head of music edu-

cation and Music Psychology at the University of Paderborn and has directed the Institute for Research on Musical Ability (IBFM). Heiner Gembris has occupied numerous leading positions in scientific organisations and is member of the scientific board of national and international journals. His main research interests concern the effects of music listening, music preferences, and the nature and development of music abilities across the lifespan. In 1998, he published a textbook in German on musical talent and development (2nd edition 2002).

WILFRIED GRUHN is professor emeritus of music education at the University of Music (Musikhochschule), Freiburg, Germany. He served as chair of the Music Education Department, and worked as co-editor of several German journals for music education. His research areas include musicology, music education, and psychology. He specialized in the neurobiology of music learning, perception, and cognition and collaborates with neurologists in interdisciplinary projects. Currently he is director of the Gordon-Institute for Early Childhood Music Learning in Freiburg, Germany.

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REINHARD KOPIEZ has been professor of music psychology at the School of Music and Drama in Hannover, Germany since 1998. He earned his PhD in 1990 from the Technical University of Berlin. After appointments as assistant professor for musicology at the Technical University of Berlin and later for systematic musicology at the school of music in Wuerzburg. Since 1998 he has been vice president of the German Society for Music Psychology (DGM) and since 2002 its president. He is also a member of the executive council of the European Society for the Cognitive Sciences of Music (ESCOM). Kopiez has written several books and numerous chapters and articles for national and international publications. His main areas of research interest are performance research, rhythm perception, and music in everyday-life. Some recent publications include: (1998) *Fussball-Fangesaenge* [Singing at soccer games], Wuerzburg: Koenigshausen; (2003a) Intonation of harmonic intervals: adaptibility of expert musicians to equal temperament and just intonation, *Music Perception*, 20(4), 383–410; (2003b) Tempo and loudness analysis of a continuous 28-hour performance of Erik Satie's composition "Vexations," *Journal of New Music Research*, 32(3), 243–258; (2003c) Stability of motor programs during a state of meditation: electrocortical activity in a pianist playing 'Vexations' by Erik Satie continuously for 28 hours, *Psychology of Music*, 31(2), 173–186.

ANDREAS C. LEHMANN is currently professor of systematic musicology and music psychology at the *Hochschule für Musik Würzburg*, Germany. He earned a degree in music education and a Ph.D. in musicology, both from the *Hochschule für Musik und Theater* in Hannover, Germany, from 1998 to 2000 he worked as a junior faculty ("Wissenschaftlicher Assistent") with Heiner Gembris in the musicology department at the *Martin-Luther University* in Halle. Between 1993

and 1998 he was a postdoctoral fellow in the Department of Psychology at the *Florida State University*, Tallahassee, Florida, where he worked with K. Anders Ericsson in the area of cognitive psychology. Andreas Lehmann received in 1997 a Young Researcher Merit Award from the *European Society for the Cognitive Sciences of Music (ESCOM)*, and he has co-edited a book on practice and published a number of chapters and journal articles. Currently, Andreas Lehmann is also associate editor of the journal *Musicae Scientiae* and vice-president of the German music education research organization (*AmpF*). In his research, he is mainly interested in studying the structure and acquisition of high levels of instrumental music performance skills such as those displayed by advanced music students and professional performers. This research on practice and performance has real-life applications for music education and is of theoretical importance for many other domains of expertise.

FRANCES RAUSCHER is an associate professor in the Department of Psychology at the University of Wisconsin Oshkosh. She holds degrees in cello performance and experimental psychology. Her research focuses on the relationship between music exposure and cognitive performance in adults, humans, and rats. She has publications in music cognition, cognitive neuroscience, developmental psychology, and social psychology, and has given presentations in North America, Europe, and Australia.

E. GLENN SCHELLENBERG is a professor in the Department of Psychology at the University of Toronto at Mississauga with a cross-appointment in the graduate faculty in the Department of Human Development and Applied Psychology at the Ontario Institute for Studies in Education at the University in Toronto. He received his doctorate from Cornell University in 1994 in human experimental psychology. His primary research area focuses on cognitive developmental issues in the auditory domain with a special interest in music perception and cognition particularly on reciprocal influences between basic psychological processes and musical structure. He is also interested in the cognitive (nonmusical) consequences of formal music lessons. Ongoing research projects are investigations of how one becomes an enculturated listener, the development of children's memory for familiar songs, effects of aging and musical training on pitch perception, developmental perspectives of absolute pitch, and the impact of music lessons on cognitive development. His extensive record of publications not only in developmental and cognitive psychology but in social psychology has recently earned him the Premier's Research Excellent Award for 2002–2007.

WILLIAM FORDE THOMPSON is director of the CCIT and a professor in the Department of Psychology at the University of Toronto at Mississauga. He is also an associate member of the Unit for the Study of Musical Skill and Development. After receiving his doctorate in psychology from Queen's University, he began an exemplary career in music perception and cognition. He is an accomplished composer, writing music for the theater that has been staged throughout Canada and on CBS Radio. He is an officer in the Society for Music Perception and Cognition and heads Experiment Creator, which tests and teaches concepts related to audio-visual content. His research interests are in decoding speech prosody, acoustic cues and speech, visual influences on perception, and recognition

of emotion in cross cultural situations. His most recent book is *Music Thought and Feeling: The Psychology of Music*, Oxford University Press, 2006.

BRUCE TORFF is associate professor of curriculum and teaching at Hofstra University in Hempstead, New York. An educational psychologist, Torff has published numerous books and articles on topics in cognitive-developmental psychology, teacher education, and musical cognition. His books include *Understanding and Teaching the Intuitive Mind* and *Multiple Intelligences and Assessment*. Torff earned a doctorate and two masters degrees at Harvard University, where he worked with Howard Gardner and served as a project director at Project Zero, Gardner's research organization. Torff also held a postdoctoral appointment at Yale University in collaboration with Robert J. Sternberg. Torff is active as a leader of professional-development workshops for educators and is also a jazz pianist and songwriter.

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**MENC Handbook of Musical Cognition
and Development**

Introduction

Music Perception and Cognition

ANDREAS C. LEHMANN

Research in perception and cognition in music has seen tremendous growth over the last two decades (see Levitin, 1999). The reason for this expansion is not that music research has emerged only recently as a new discipline; instead, it appears that whoever had been interested in music years ago but did not dare to do music research can now freely admit to his or her “vice.” As a result, the field has become extremely diversified and includes psychologists, sociologists, and anthropologists as well as AI researchers, physiologists, and acousticians. Many of them are active musicians with varying degrees of firsthand experience, while other scientists simply think that music is a convenient domain for their purposes. There are also artists who use their working environment to undertake new types of action research (see J. W. Davidson, 2004, e.g., chapters 11 and 22). Common to all is the desire to find out more about how our brain processes the auditory input we then experience as music. Unfortunately, the issues that entice researchers are not always identical to those that appeal to music educators, who, after successful mastery of the scientific jargon, are often disappointed to discover how difficult it is to apply the findings to the classroom. Admittedly, some research done today might only prove its usefulness many years from now in the context of future research.

In the wake of recent advances in neurobiology, trying to separate perception and cognition has become less appropriate and useful. Where, for example, does music cognition actually begin? Does it start in the cochlea or right after the cochlea, or does it emerge out of the simultaneous firing of neurons in different cortical areas? And how does our individual genetic makeup influence music perception and cognition? Where do our memories

and feelings enter into the perception and cognition game? As a result, and in order to be of maximal use for music educators, here we did not adhere to a strong division of perception and cognition but rather understood cognition in its broader sense, namely, how it applies in the context of experience, training, development, and culture.

This book with its seven chapters does not purport to cover the whole range of topics relevant to music perception and cognition. We have tried to capitalize on emergent issues and research done since the publication of the first Handbook (Colwell, 1992). In our experience, music educators as a group are likely to look at the research presented in the following 7 chapters. We should keep in mind, however, there is probably not *the* music educator, as there is not *the* music psychologist. Any choice of issues discussed, references cited, or references omitted (due to space limitations) will have to be the result of subjective decisions. A review of the literature is never objective, because the writer has an agenda, which is to introduce a personal view on a topic. With the help of the many reviewers who made thoughtful suggestions to improve the draft chapters, the printed chapters should now match the needs of aspiring or in-service music educators and music education researchers.

The chapters follow a certain logic in that the first five chapters proceed from the basic neurological and cognitive processes to a panoramic view of musical development and the theories behind research on learning. The last two chapters concentrate on music performance skills, musical expression, and the audience. A chapter that was not originally part of the *Musical Cognition and Development* part of the 2002 Handbook is the one by Flohr and Hodges on Music and Neuroscience. Here the authors circumscribe the research methods and results currently available in the area of neuroscience. It is obvious that we are starting to better understand how music is processed in the brain, and how nature and nurture interact. This chapter in fact provides the necessary backdrop to some of the others presented in this volume. Wilfried Gruhn and Frances Rauscher introduce neuropsychological and neurophysiological research as it relates to learning. They also introduce some learning theories that essentially can be viewed as theories of cognition, and they clarify one hotly debated topic in music education, namely, the question of transfer of learning, which sometimes serves as a justification for music education in schools. William Forde Thompson and E. Glenn Schellenberg are experts in basic music cognition with all its developmental and cultural implications. Their chapter abounds with pointers to current research methodology and brings to our attention the processes in music perception we often take for granted (e.g., melody perception, timbre, rhythm). Heiner Gembris gives a more panoramic survey of topics and issues in developmental psychology. While emphasizing cognitive aspects, he also incorporates sociological and cultural aspects. This chapter is closely tailored to the questions frequently asked by music educators. Bruce Torff comes from the general area of educational psychology. His chapter places research on music perception and cognition into the larger context of research on

music learning and development with its changing epistemological facets. The contextualist perspective presented by Torff is today an accepted and important position for music education. Reinhard Kopiez reviews the area of performance research in which great progress has been made internationally. Most interestingly, researchers are no longer interested solely in motor programming and internal clocks (although these topics are still under scrutiny) but also interested in knowing how we communicate and understand musical expression. As a trained musicologist, the author is able to bring modern research into contact with its historical roots. Jane W. Davidson and I sum up some of the research in skill acquisition, which stresses the environmental aspects of music learning, especially in learning to play an instrument. In some ways, this chapter acts as a counterweight to the chapter by Gruhn and Rauscher, which emphasizes the “hardware” aspects of musical learning.

For those readers looking for an update in one of the areas mentioned earlier, each chapter should provide a suitable point of entry. For the novice reader the chapters offer a thorough introduction into the topics of music psychology that are relevant to music educators.

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Music and Neuroscience

1

JOHN W. FLOHR

DONALD A. HODGES

Relationships among the brain, music, and musical abilities are of interest to musicians, psychologists, and neuroscientists. The purpose of this chapter is to provide a detailed and critical overview of the neuroscientific research dealing with music and music education. Unfortunately, a direct translation from neuroscience research into music education at this time is very problematic. Although our understanding of brain and behavior has increased at an exponential rate over the past 10 years, theories of brain functioning and our understanding of the neurobiological forces that shape musical behavior are still in their infancy. The focus will be on ideas helpful to music education from what is known about music and the brain. The chapter is organized into three sections.

1. *Strategies for conducting neuromusical research.* A review of the methodological approaches to conducting neuroscientific research in music. The neuroscience tools reviewed in this section have in many ways revolutionized our ability to examine both the function and structure of the brain. (For a more complete review, see Hodges, 1996b.)
2. *Overall development.* A review of findings relating to overall development, selected topics, and theories and theoretical areas.
3. *Future directions.* A generalized summary of findings and recommendations and considerations for future research directions.

Strategies for Conducting Neuromusical Research

How does one go about studying the phenomenon of music in the brain? The brain's immense complexity, in combination with the subtleties and in-