ANNALS OF THE NEW YORK ACADEMY OF SCIENCES

Volume 930 June 2001

THE BIOLOGICAL FOUNDATIONS OF MUSIC

Editors

ROBERT J. ZATORRE AND ISABELLE PERETZ

This volume is the result of a conference entitled **The Biological Foundations of Music** held by the New York Academy of Sciences on May 20–22, 2000 at The Rockefeller University, New York, New York.

CONTENTS	
Preface. By ROBERT J. ZATORRE AND ISABELLE PERETZ	ix
Part I. The Origins of Music	
Musical Predispositions in Infancy. By SANDRA E. TREHUB	1
The Quest for Universals in Temporal Processing in Music. By CAROLYN DRAKE AND DAISY BERTRAND	17
Music, Cognition, Culture, and Evolution. By IAN CROSS	28
Is Music an Evolutionary Adaptation? By DAVID HURON	43
Part II. The Musical Mind	
Similarity, Invariance, and Musical Variation. By STEPHEN MCADAMS AND DANIEL MATZKIN	62
Tonal Cognition. By CAROL L. KRUMHANSL AND PETRI TOIVIAINEN	77
Part III. The Neurons of Music	
Neurobiological Foundations for the Theory of Harmony in Western Tonal Music. By Mark Jude Tramo, Peter A. Cariani, Bertrand Delgutte, and Louis D. Braida	92
Intracerebral Evoked Potentials in Pitch Perception Reveal a Functional Asymmetry of the Human Auditory Cortex. By CATHERINE LIÉGEOIS- CHAUVEL, KIMBERLY GIRAUD, JEAN-MICHEL BADIER, PATRICK MARQUIS, AND PATRICK CHAUVEL	117
The Neural Processing of Complex Sounds. By TIMOTHY D. GRIFFITHS	133

Part IV. The Musical Brain

Music and the Neurologist: A Historical Perspective. By JOHN C. M. BRUST	143
Brain Specialization for Music: New Evidence from Congenital Amusia. By ISABELLE PERETZ	153
Cerebral Substrates for Musical Temporal Processes. By SÉVERINE SAMSON, NATHALIE EHRLÉ, AND MICHEL BAULAC	166
Cerebral Substrates of Musical Imagery. By ANDREA R. HALPERN	179
Neural Specializations for Tonal Processing. By ROBERT J. ZATORRE	193
Exploring the Functional Neuroanatomy of Music Performance, Perception, and Comprehension. By LAWRENCE M. PARSONS	211
Comparison between Language and Music. By MIREILLE BESSON AND DANIELE SCHÖN	232
Musical Sound Processing in the Human Brain: Evidence from Electric and Magnetic Recordings. By MARI TERVANIEMI	259
How Many Music Centers Are in the Brain? By ECKART O. ALTENMÜLLER	273
Part V. Musical Expertise/Brain Plasticity	
The Brain of Musicians: A Model for Functional and Structural Adaptation. By GOTTFRIED SCHLAUG AND CHI CHEN	281
Representational Cortex in Musicians: Plastic Alterations in Response to Musical Practice. By C. Pantev, A. Engelien, V. Candia, and T. Elbert	300
The Brain That Plays Music and Is Changed by It. By ALVARO PASCUAL-LEONE	315
Cortical Plasticity and Music. By JOSEF P. RAUSCHECKER	330
Part VI. Music and Related Cognitive Abilities	
The Sounds of Poetry Viewed as Music. By FRED LERDAHL	337
Music and Nonmusical Abilities. By E. GLENN SCHELLENBERG	355
Part VII. Poster Papers	
Are Music and Language Homologues? By STEVEN BROWN	372
Ambiguous Musical Figures: Sequential Grouping by Common Pitch and Sound-Source Location versus Simultaneous Grouping by Temporal Synchrony. By MARTINE TURGEON AND ALBERT S. BREGMAN	375
Explaining Harmony: The Roles of Interval Dissonance and Chordal Tension. By NORMAN D. COOK	382
Associations and Dissociations among Music Training, Tonal and Temporal Order Processing, and Cognitive Skills. By CHRISTINE K. KOH, LOLA L. CUDDY, AND LORNA S. JAKOBSON	386
Playing the Piano by Heart: From Behavior to Cognition. By RITA AIELLO	389

Absolute Pitch, Early Musical Instruction, and Spatial Abilities. By EUGENIA COSTA-GIOMI, RAMONA GILMOUR, JEANNE SIDDELL, AND ELIZABETH LEFEBVRE	394
Infant Long-Term Memory for Music. By JENNY R. SAFFRAN, MICHELLE M. LOMAN, AND RACHEL R.W. ROBERTSON	397
Phases in Children's Rhythmic Development. By SILVIA MALBRÁN	401
Variance Decomposition of Tempo Drift in Isochronous Rhythmic Tapping. By GEOFFREY L. COLLIER AND R. TODD OGDEN	405
Effects of Music Perception and Imagery on Sensorimotor Synchronization with Complex Timing Patterns. By Bruno H. Repp	409
Estimates of Sequence Acceleration and Deceleration Support the Synchronization of Internal Rhythms. By AMANDINE PENEL, MARIE RIVENEZ, AND CAROLYN DRAKE	412
Frontal Lobe Contributions to Perception of Rhythmic Group Structure: An EEG Investigation. By PHILIP G. HARRIS, RICHARD B. SILBERSTEIN, GEOFF E. NIELD, AND ANDREW PIPINGAS	414
Cortical Representations of Temporal Structures in Music. By MICHAEL GROSSBACH, HELEN KUCK, MARC BANGERT, AND ECKART ALTENMÜLLER	418
Neapolitan Chords Activate the Area of Broca: A Magnetoencephalographic Study. By Stefan Koelsch, Burkhard Maess, Thomas C. Gunter, and Angela D. Friederici	420
Cortical Dynamics and the Perception of Tone Sequence Structure. By ANIRUDDH D. PATEL AND EVAN BALABAN	422
On Practice: How the Brain Connects Piano Keys and Piano Sounds. By MARC BANGERT, UDO HAEUSLER, AND ECKART ALTENMÜLLER	425
Electrical Brain Activity Associated with Automatic and Controlled Processing of Melodic Contour and Interval. By L.J. TRAINOR, K.L. McDonald, and C. Alain	429
Transcranial Magnetic Stimulation Produces Speech Arrest but Not Song Arrest. By LAUREN STEWART, VINCENT WALSH, UTA FRITH, AND JOHN ROTHWELL	433
Development of the Happy-Sad Distinction in Music Appreciation: Does Tempo Emerge Earlier Than Mode? By S. Dalla Bella, I. Peretz, L. Rousseau, N. Gosselin, J. Ayotte, and A. Lavoie	436
Frontal EEG Responses as a Function of Affective Musical Features. By C.D. TSANG, L.J. TRAINOR, D.L. SANTESSO, S.L. TASKER, AND L.A. SCHMIDT	439
Musical Processing in High Functioning Children with Autism. By P. HEATON, L. PRING, AND B. HERMELIN	443
Impact of Music Therapy on the Communication Skills of Toddlers with Pervasive Developmental Disorder. By YEOU-CHENG M. MA, JOSEPH NAGLER, MATHEW H.M. LEE, AND IZUMI N. CABRERA	445
Music and Testosterone: A New Hypothesis for the Origin and Function of Music. By HAJIME FUKUI	448

A Dynamic Systems Model of Musically Induced Emotions: Physiological and Self-Report Evidence. By JULIAN F. THAYER AND MEREDITH L. FAITH	452
Subject Index	457
Index of Contributors	461
Financial assistance was received from:	
Major Funders	
• THE CHARLES A. DANA FOUNDATION	
 THE DAVID AND LUCILE PACKARD FOUNDATION 	
Supporters	
 FONDAZIONE PIERFRANCO E LUISA MARIANI, PEDIATRIC NEUROLOGY, MILAN ITALY 	
 INTERNATIONAL FOUNDATION FOR MUSIC RESEARCH 	
 NATIONAL ASSOCIATION OF MUSIC MERCHANTS, INC., INTERNATIONAL MUSIC PRODUCTS ASSOCIATION 	
NATIONAL INSTITUTES OF HEALTH NATIONAL INSTITUTE OF CHILD HEALTH AND HUMAN DEVELOPMENT (NICHD)	

• NATIONAL SCIENCE FOUNDATION

AND STROKE (NINDS)

The New York Academy of Sciences believes it has a responsibility to provide an open forum for discussion of scientific questions. The positions taken by the participants in the reported conferences are their own and not necessarily those of the Academy. The Academy has no intent to influence legislation by providing such forums.

NATIONAL INSTITUTE OF NEUROLOGICAL DISORDERS