

# Preface

This special edition of Danish Musicology Online about Music and brain research in Denmark presents contemporary Danish music and brain research, which combines musicological theories and empirical research methods from music psychology and neuroscience. During the last couple of decades modern neuroscience has initiated studies on the psychological mechanisms and physiological processes in the brain that enable us to create art and to understand art, including the mechanisms that enable us to perform music and listen to music.

As early as the 1400 hundreds, Leonardo da Vinci supposedly implied that combined studies on art and science allow an enhanced insight into “the science of art” and “the art of science”. Similarly, the relatively new interdisciplinary music and brain research contributes to the musicological understanding of music by means of its neurophysiological underpinnings, while simultaneously increasing the knowledge available for the natural sciences about the basic functioning of the human brain, when it creates and experiences art. Thereby, new ways by which the brain applies detailed and often multiple simultaneous, automatic, pre-attentive mechanisms to analyze and unite musical sounds and interpretations of these sounds as music, which shape our conscious experience of music, are continuously discovered and described. The transitions between concrete analysis of sounds, notes, and musical structure are relatively difficult to describe, on the one hand, because of the rich details of the musical sounds and notes, on the other hand, due to the complexity of the way our brains apply different memory systems, when it processes these musical impressions, an issue which will be treated in the articles of this special edition. Furthermore, more general discussions take place, also in the articles of this special edition, about how possible innate, human, musical abilities, the human body and brain, as well as learning in diverse cultural and educational environments are partly shaping the way we listen to music, understand music, perform music, and thereby the way we interact in sound and music environments.

The interdisciplinary music, psychology, and brain research, within musicology often named *cognitive musicology* (a term which originates in the broad interdisciplinary research project under the title *cognitive science*, initiated in the time after the second world war from the 1950s-60s and forward) has developed within musicology in the United States and Europe during the 1970s, 80s, and 90s, and has further become present in Denmark during the 2000s. For example, earlier Danish research in music psychology has been discussed in a special edition of the Danish journal *Psyke og Logos* from 2007 under the title “Musik og psykologi”. The Danish research has so far been conducted around the universities in Aalborg, Aarhus and Copenhagen. Aalborg University’s Center for Documentation and Research in Music Therapy and Institute of Architecture, Design and Media Technology have thereby conducted research on music therapy and computer models inspired by the way the brain processes sound

and music, respectively. Research in music, psychology, and brain structures and functions have been conducted in collaborations between Department of Dramaturgy and Musicology, School of Communication and Culture, Aarhus University, Department of Psychology and Behavioral Sciences, Center for Semiotics, The Royal Academy of Music, and Center of Functionally Integrative Neuroscience, MINDLab, and Music In the Brain at Aarhus University Hospital. Interdisciplinary investigations on how the brain processes tonality and timbre have further been conducted at the University of Copenhagen's section for Musicology at the Department of Arts and Cultural Studies and at the Danish Research Center for Magnetic Resonance at Hvidovre Hospital.

The first article and the last two articles in this special edition concerns the relatively broad questions: what is music and brain research? and how can neuroscience contribute to the understanding of general terms such as "musical expertise" and "the musical human"? The second and third article contemplate the more specific topics about how the brain detects dissonance and timbre, by including different memory systems and ways of listening.

First, the term *cognitive musicology* as well as the different facets of the modern cognitive musicology and its historical presuppositions in the psychology of music – from the 1800 hundreds and the 1900 hundreds early adventurous pioneers, to the modern computer algorithms and colorful images of brain activity – is introduced. Furthermore, the introductory article discuss the possibilities and problems that emerge from the combination of as different scientific disciplines as humanist, holistic, and descriptive musicology with empirical, psychological, and neuroscientific studies based on quantitative measurements.

The following article by Jens Hjortkjær explains the recent contributions of neuroscience to deepen the understanding the term timbre, or instrument sound, and its phenomenological and physiological underpinnings in activation of particular neurons in the brain while listening to music. It is explained how psychoacoustics, phenomenology, and neuroscientific research altogether points towards the fact that our brains are optimized to often provide us with an experience that timbre is something that relates to properties of particular physical objects in our environment, such as the length, shape, and material of an object.

Hereafter, the more specific issue about the necessity of a memory model in computer modeling of sensory dissonance in music is treated by Kristoffer Jensen. This article demonstrates, by means of measurements and computer models, why the phenomenon of *sensory dissonance* should be discussed by including considerations about the sound of the music instrument and previous sounds that reverberate in the listener's short term memory. Furthermore, it is shown how the calculations of a new computer model to some extent are consistent with the way human listeners perceive the degree of dissonance in melodies.

The following article about musical expertise, by Niels Chr. Hansen, illuminate the subject of how neuroscience can contribute and extend our understanding of the term expertise, among other things by emphasizing that musical expertise does not exclusively refer to a performance expertise but also a receptive expertise. By discussing sev-

en possible perspectives on musical expertise, previous, less precise explanations are mentioned and clearer definitions drawn from music psychology and neuroscience are suggested, which might have implications for the development of music teaching, practicing, and dissemination.

Finally, the concluding article about the dimensions of musicality and the relationship between biology, culture, and musicology, by Ole Köhl, discusses how communal human reference objects in physical environments, human body, and the cultural environments in which we are situated, take part in shaping our application and understanding of music. In addition, the concluding article returns to the general discussion, introduced in the first article, about the possibilities and challenges of contemporary music and brain research in Denmark.

I would like to thank the authors for their inspiring contributions, the peer-reviewers for their constructive comments and suggestions, and Mads Krogh and the DMO editors for their interest in this special edition. I hope the special edition will provide the reader with an inspiring insight into the contemporary interdisciplinary music and brain research, which takes place in Denmark, and motivate fruitful scientific discussions.

*Niels Trusbak Haumann*

*Department of Dramaturgy and Musicology,*

*School of Communication and Culture, Aarhus University*