Part E

Music Em

Part E Music Embodiment

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One of the main goals of systematic musicology is to understand the effects of musical (acoustical) structure on human behavior. Throughout the 20th century, this understanding was approached by considering music perception and its effect on behavior. That approach was strongly influenced by developments in the Gestalt psychology of the 1920s, the information psychology and cybernetics of the 1960s, and especially the empirical and computational approaches of the cognitive sciences since the 1980s. However, thanks to the advent of technologies that facilitated the tracking of human movement (with video cameras and sensors) it became possible to focus on new areas of music interaction as well, such as music performance and musical gesturing (while listening). These new areas of study started to emerge in the late 1990s (despite some historical antecedents in the 1920s) and they culminated in a new approach that is nowadays known as *embodied music cognition*.

Embodied music cognition puts emphasis on the human body as a contributing factor in listening, dancing and playing music. The former focus on music perception has therefore been replaced by a focus on music-related action. Understanding the effect of music on human behavior is approached from an embodied perspective. Music perception is also now reconsidered from this perspective. The rationale is that the perception of music is influenced by the way in which music is interacted with, and these interactions influence how musical structures are perceived. But these interactions depend on bodily constraints, such as physical, biomechanical, and biological possibilities and restrictions of the human body.

Embodied music cognition is in fact a natural outcome of the cognitive research paradigm that characterized the systematic musicology of the late 20th century. Its emphasis on action, and on the principles that support action (such as motor control) has broadened the concept of cognition, and this broad perspective can be considered as a major characteristic of the new approach. The rapid acceptance of this new approach by the music research community is probably due to the explanatory and predictive power of the embodiment concept; to its ability to cope with music perception as well with music performance; to its potential to generate new types of technological applications that involve both action and perception in domains such as music and wellbeing, music engineering, and neuroscience of music; and last but not least, to its influence in ethnomusicology, where studies of social interaction draw upon research results from embodied interactions with music. Embodied music cognition has rapidly evolved in the direction of a new embodied music interaction paradigm. In the near future, it is likely that the term *cognition* will disappear and be replaced by the term *interaction*. Essentially, it means that the effects of music on human behavior are based on interactive processes that involve perception *and* action.

The chapters of this section reflect the work in progress in this branch of systematic musicology. Despite its rapid acceptance by the community, embodied music cognition is still a very young research paradigm. Its epistemological and methodological foundations have barely been addressed. Its basic concept of embodiment needs further refinement in view of new findings. Its support by empirical studies requires further substantiation. Its technological basis requires a constant update with the rapid ongoing developments of technology in our society. The chapters introduce basic concepts and basic methods, and they focus on different application areas of interactions, such as music making and wellbeing.

Chapter 34 (*What Is Embodied Music Cognition*, by *Marc Leman*, *Luc Nijs*, *Pieter-Jan Maes*, *Edith Van Dyck*) explains what embodied music cognition is about. The chapter gives an overview of the major concepts behind this research paradigm of systematic musicology, including its basic ontology and epistemology, and the architecture of embodiment (involving concepts such as prediction, emergency, enactment and expression). This basis is then followed by an overview of some analytical and empirical studies, which illustrate contributions of the embodied music cognition approach to the understanding of expressive gestures, synchronization and entrainment, and the effects of action on perception.

Chapter 35 (*Sonic Object Cognition*, by *Rolf-Inge Godoy*) goes deeper into the nature of the musical material that forms the basis of human interaction with music. This material is described in terms of sonic objects. Starting from the work of Pierre Schaeffer and others, the chapter considers the nature of sonic objects in relation to human interaction behavior. A major breakthrough in our understanding of sonic objects was realized when sonic objects were associated with body motions, shape cognition and actions. This new way of understanding sonic objects offers new possibilities for sound synthesis control, and new possibilities for interaction.

Chapter 36 (*Investigating Embodied Music Cognition for Health and Wellbeing*, by *Micheline Lesaffre*) provides a framework that aims to validate musicological know-how in applications for health and wellbeing. The chapter defines the field of health and wellbeing and ongoing work in music therapy. It then explains that

the unique contribution of the embodied music cognition approach is related to user-driven and technology-driven research in which measurement and analysis of embodied interaction with music offers a path to evidence-based validation.

Chapter 37 (*A Conceptual Framework for Music-Based Interaction Systems*, by *Pieter-Jan Maes*, *Luc Nijs*, and *Marc Leman*) looks at the role of technology in music interaction. It is claimed that interactive systems can reinforce interactions with music, such that the overall experience with music is intensified, and the social, cognitive, affective, and motor skills are made stronger. The chapter introduces an overall model for music interaction based on an embodied music cognition framework that also includes the benefits of reward processing and motivation, and social interaction. Examples are given of an educational technology for learning to play a music instrument, and a technology that facilitates the synchronization of human movement to music.

Chapter 38 (*Methods for Studying Music-Related Body Motion*, by *Alexander Refsum Jensenius*) presents an overview of methods for music-related motion description. The focus is on qualitative and quantitative description methods that prepare the ground for further analysis of human-music interaction behaviour, such as methods for describing qualitative motion, or methods for describing motion features such as quantity and centroid. A distinction is made between camera-based systems and sensor-based systems. All technologies have strengths and weaknesses and the right choice depends on the research question and analysis methods.