The Musical Gestures Project
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Hallgjerd Aksnes, Rolf Inge Godøy[1], Tellef Kvifte, and Even Ruud
Department of Music and Theatre
University of Oslo
P.B. 1017 Blindern
N-0315 Oslo
Norway

1. Introduction

This is a broadly conceived research project on musical gestures. The project is based on the conviction that there are intimate links between music, understood as sonic art, and gestures, understood as human bodily movement. We believe more focused research on this topic is necessary, both because the topic concerns our basic understanding of music as a phenomenon, and because better knowledge of musical gestures can be beneficial to several practical and theoretical music-related activities.

Needless to say, there are many different kinds of gestures associated with music, but it could be useful to consider gestures in view of the following three main categories:

- *Sound-producing gestures*, such as hitting, stroking, bowing, blowing, singing, kicking, etc. Mental images of such gestures, including the associated modes of execution such as fast, slow, hard, soft, short, long, etc., are usually indissociable from our notions of musical sound, evident in music-related metaphors (e.g. "hammering", "sweeping", "caressing", etc.) and mimicry (e.g. playing "air drums" or "air guitar").
- *Sound-accompanying gestures*, including all kinds of movements we can make to music such as marching, dancing, and more vague sound-tracing gestures such as following the melodic contours, rhythmical/textural patterns, timbral or dynamical evolutions, etc. with our hands, arms, torso, etc.
- *Amodal, affective or emotive gestures*, including all the movements and/or mental images of movements associated with more global sensations of the music, such as images of effort, velocity, impatience, unrest, calm, balance, elation, anger, etc., gestural images and concepts which are also encountered in dance (e.g. Laban 1980).

These categories of gestures often overlap, and a gesture may belong to more than one category, e.g. energetic drumming may be perceived both as sound-producing gestures and as emotive images of joy or elation. Musical gestures thus encompass a large territory stretching from details of sound-production to more global emotive and aesthetic images of music (Middleton 1993), and also include considerations of cultural-stylistic vs. more universal modes of expression (Juslin & Sloboda 2001). In all cases, we believe musical gestures manifest the primordial role of human movement in music. For

[1]Corresponding author. E-mail: r.i.godoy@imt.uio.no, phone: (+47)22854064.

this reason, we speak of *embodied perception and cognition* in music in the sense that we as listeners relate musical sound to mental images of gestures, i.e. that listening (or even merely imagining music) also is a process of incessant mental re-enactment of musical gestures.

We believe the idea of embodied perception and cognition could represent a change of paradigm in music theory and other music related research, research which has often tended to exclude considerations of bodily movement from its conceptual apparatus in favour of focus on more abstract, notation-based elements of music. In our project, the focus on musical gestures provides us with a coherent and unifying perspective for what we see as a much needed renewal of music theory and other music research. Fortunately, recent developments within the cognitive sciences, music technology, and technologies for capturing and representing gestural data (Cadoz & Wanderley 2001), converge to give us very favourable circumstances for this shift of focus towards musical gestures.

2. Aims and relevance

The main aim of this project is as follows: *Work towards a coherent theory of the relationship between musical sound, human gestures and musical concepts*. This means making a broad survey of music-related gestures in view of accumulating systematic knowledge of what kinds of gestures are actually made (and/or imagined) by musicians, by listeners, by dancers, etc., in other words to give more explicit representations of what is often "tacit" or "procedural" knowledge. Also, this means working towards a better understanding of how gestures are integral to the mental coding of music, i.e. how our images of music are not only sonorous, but also gestural, and how these gestural images shape our musical concepts.

Furthermore, there are four sub-aims here:

- *Capturing and representing gestures*. Using readily available technology for capturing (recording) gestures, the aim here is to refine techniques for processing and representing gestural information, and to make useful representations of this in the form of script notations, graphs, animations, as well as qualitative, verbal/metaphorical descriptions.
- *Classify gestures*. The aim here is to develop useful overviews of gesture types within different contexts and styles so as to have a more systematic knowledge of gestures and their links with musical sound and their aesthetic-emotive significations.
- *Understanding gestural coding of music*. This means exploring the links between sonorous and gestural images in view of understanding the multi-modal nature of musical memory and imagery.
- *Demonstrate practical applications of musical gestures* as tools in performance, improvisation, composition and music education.

We believe more systematic knowledge about the relationship between music and ges-

tures is relevant for several music-related domains, i.e. for both theoretical research and for practical applications, such as in the following:

- *Analysis, interpretation, understanding*: Music understood as a "gestural languages" or as "scripts" within different styles and musical cultures.
- *Psychology of music and music therapy*: Music regarded as embodied, amodal, affective-emotional gestural expression in therapeutic and educational contexts.
- *Dance and other music-related movement* (music videos, film music, theatre music, etc.): A better understanding of gesture-related phenomena such as synchronicity, concurrent and/or divergent contours, gaits, effort, velocity, balance, etc., could enhance our understanding of such composite forms of art.
- *Music theory, composition, improvisation, arranging, orchestration*: Relating to music not by abstract scores, but rather by gestural scripts, enhancing methods for timbral and textural discrimination by images of sound-production, as well as enhancing methods for gestural control in computer music applications.
- *Performance*: More well-articulated knowledge of sound-producing gestures, i.e. better knowledge of what kinds of movements are necessary for intended timbral and expressive results.

3. Theory

Musical gestures is a highly interdisciplinary topic and will require several different -- but concurrent and complimentary -- approaches. The different theoretical approaches of the senior researchers in this project can be summarized under the headings of *motor-mimetic theory* (Godøy), *performance control* (Kvifte), *emotive gestures* (Aksnes), and *affective scripts* (Ruud), and will be briefly presented below. However, a common and unifying perspective for all our efforts is given by the following principle: *Musical experience involves gestural experience*. This principle is based on an *ecological* and *cross-modal* understanding of auditory perception and cognition, meaning the inclusion of learned (and maybe also innate) schemata from several sense modalities in the perception and cognition of sound (Bregman 1990). This means assuming an incessant top-down working of schemata, or that perception is also a matter of always making *hypotheses* (to use an expression from Berthoz 1997) as to what are the sound-generating gestures behind the sounds that we hear. Specifically, what has been presented as variants of the so called "motor theory" of perception (Liberman and Mattingly 1985) has claimed that images of how we believe sounds are produced are essential for our perception of sound. The idea of motor theory has been controversial, but recent advances in neuroscience have increasingly provided support for the close relationship between perception and motor images (e.g. Berthoz 1997, Fadiga et al. 2002). Also, both informal accounts (Sudnow 1978) and experimental studies (Mikumo 1998) indicate that motor images may enhance the memory of musical sound, and various studies of musical imagery (Godøy & Jørgensen 2001) point to the essential role of mental images of gestures in triggering mental images of musical sound.

Studying mental images of sound-producing gestures will here be grouped under the

heading *motor-mimetic theory* to denote the mental imitation or re-enactment of sound-producing gestures in the perception and cognition of music. Briefly stated, motor-mimetic theory is based on the following main ideas:

- Mental images of musical sound may be regarded as composite, comprising *action components* (sound-producing and/or sound-modifying actions, see e.g. Godøy 2001) and *resonance components* (associated with objects and materials, see e.g. Handel 1995 and Freed 1990). A conceptual separation of the two main components of "what we do" and "the effects of what we do" reveals what is the gestural contribution to mental images of musical sound, and this "silent" gestural contribution to musical sound can then be studied in view of principles of *motor programmes* (Rosenbaum 1991) and *motor imagery* (Jeannerod 1995).
- Mechanical-physiological and neuro-cognitive constraints on sound-producing gestures (e.g. the need for rests, the need to breathe, demands of coordination, etc.), will in many cases result in the emergence of *gesture-units*, something also reflected in segmentations of musical sound, and something which may form the basis for a gesture typology, e.g *ballistic* (with discontinuous effort) and *sustained* (with continuous effort) gestures (Godøy 1999). Also, singular sounds (tones, chords) may fuse into more superordinate gesture-units such as motives and phrases by the phenomenon of *coarticulation*, a phenomenon found in speech and other domains of human action and based on physiological as well as cognitive constraints (Rosenbaum et al. 1995), and in turn form the basis for scripts for more extended musical passages.
- Such gesture scripts are in fact *motor programmes*, i.e. mental images of how something is done, and may also entail *motor equivalence* (Rosenbaum 1991), meaning that there may be alternative ways of executing a certain script (e.g. playing a melody with my left hand on the piano instead of with my right hand, or playing a melody on a flute instead of on a violin). Motor equivalence may be a model for understanding generalizations, generativity, and prototypicality (as this term was defined in Rosch et al. 1976) in that one motor programme, e.g. hitting a drum with a particular mallet, may be seen as an instance of the more general class, e.g. of hitting with any mallet, which again belongs to the very general class of hitting, i.e. of ballistic gestures.
- *Motor imagery*, understood as the mental running through of motor programmes, has several attractive features for exploring musical gestures in musical imagery: Mental simulation of musical passages with *variable velocity*, i.e. at any speed between very fast and very slow, with *variable resolution*, i.e. may encompass anything between the production of a single sound (e.g. a stroke on a drum) and and quite extended passages (e.g. a long symphonic movement), and with *variable acuity*, i.e. anything between exact re-enactments and vague or inexact tracings of contours (Godøy 2001).

Clearly, sound-producing gestures have a double status in music as they are both necessary in the man-instrument (or more generally, man-machine) interaction and are conveyors of musical expressivity. These considerations will be grouped under the heading of *performance control* and will be organized around the following aspects:

- *Organology*: Systematization of control organs (the parts of the instruments that may be used to influence the sound) on different types of instruments, ranging from

(seemingly) simple acoustic instruments to recent electronic instruments (Kvifte 1989).

- *Musical instrument-related gestures*: Systematization of gestures used to control musical instruments (Bielawiski 1979, Kvifte 1989).
- *Man-machine interaction*: Systematization of the interaction of human gestures and the control organs of the instruments (Kvifte 1992) in the light of general problems of man-machine interaction in the face of new technology (Bijker 1995).
- *Mental organization*: How performers mentally organize and visualize the control organs as well as the interaction between gestures, control organs, and musical/aesthetic entities (Kvifte 1989).

Expressive gestures, or music-related gestures in general, often trigger images of familiar bodily gestures, gestures which in turn are intimately linked with our emotions. Under the heading *emotive gestures* there will be a focus on the metaphorical projection of music-related gestures as a basis for aesthetic-emotive meaning in music, including the following main elements:

- Theories from cognitive semantics on body-based metaphors and image schemata (Johnson 1987) and their applications in musicology (Aksnes 2002).
- Past and more recent theories from philosophy and literature theory on embodied cognition (various texts by Merleau-Ponty, Shusterman, Sheets-Johnstone, Barthes, etc.).
- Developmental research, in particular studies on the infants learning of amodal, affective gestures through interaction with parents (Stern 1985).
- Neurophysiological observational data (PET, fMRI, EEG, MEG) as well as recent theories on the biological basis for consciousness and the crucial role of the body and emotions for all cognition (Damasio 1994, various papers in Godøy & Jørgensen 2001).

A further focus on the emotive aspects of musical gestures will be provided under the heading *affective scripts*, and the point of departure here will be the music psychotherapeutic method of Music and Guided Imagery. Based on recent research on internal representations in encounters with music and on the emergence of metaphors in psychotherapeutic contexts, this research aims towards an enhanced understanding of gestures in musical experience in general. Specifically, the following elements will be included here:

- Studies of how musical sound triggers mental images of affect, motor images, and bodily sensations. Such images tend to emerge within "scenes" which are organized in narrative sequences, sequences which in turn are organized by certain "scripts" (Ruud 2003).
- Theories from psychotherapy, affect theory, and metaphor theory (Monsen and Monsen 1999, Bonde 2000).
- Theories from psychology of music on emotions and music (Juslin and Sloboda 2001).
- Theory from Guided Imagery and Music (GIM) together with material from transcriptions of interview sessions with GIM participants.

Although musical gestures may appear to be a highly composite and multi-facetted topic, musical gestures remain in terms of personal, subjective musical experience something rather obvious (or "simple") and salient (e.g. images of energetic drumming are quite unmistakable). For this reason, we believe we will be able to integrate topics such as organology, motor theory, auditory perception, performance, music theory, musical semiotics and aesthetics, and psycho-dynamical theories, into the common framework of *musical experience as gestural experience.*

4. Method

As extensions of the theoretical bases for this project, there will be six principal elements of method here:

- *Review studies*: Given the large amount of available material on motor control, motor imagery, and sensory integration, the first stage of this project will focus on making a review of relevant research in these domains, making summaries which may serve as the basis for models and a more coherent theory of musical gestures.
- *Interviews*: Qualitative studies of how musicians, listeners and dancers think about music-related gestures in view of performance strategies, expressivity, musical memory, musical imagery, musical affect, etc., to get an "inside" perspective on musical gestures.
- *Observation studies*: Sound-producing and sound-accompanying gestures will be analyzed for shape, direction, segmentations, velocity, etc. Technologies for recording, processing, and displaying gestures are now readily available (video, various sensors, modified instruments, and software such as *MAX/MSP/Jitter* and *EyesWeb*).
- *Experiments*: Firstly, envisaged experiments will be with listeners making judgments on rhythmical groupings, melodic contours and timbre classifications based on incrementally varied performances, i.e. with listeners mentally reconstructing assumed underlying gestures. Secondly, experiments will be on imagery centred tasks such as recalling passages of musical sound with or without accompanying gestural imagery, based on methods successfully used in Mikumo 1998, but here extended to elements such as rhythmical groupings, textures, and timbres.
- *Simulations*: Modelings of excitatory gestures with various virtual instruments (based on physical models) will be made to simulate expressive gestures, principles for rhythmical groupings, melodic contours, and timbral features. Simulations will follow an "analysis by synthesis" approach where control variables of the gestures (velocity, force, shape, degree of coarticulation, etc.) will be correlated with listeners judgements of audible results.
- *Practical applications*: Step-by-step procedures ("action-scripts") for applying gestural imagery in composition exercises (including rhythmical, textural, modal, harmonic and melodic elements) and in orchestration exercises (with emphasis on textures and timbres), will be worked out and tested in actual teaching situations at the Department of Music and Theatre at the University of Oslo.

Conceptual models of how we believe images of gesture and images of sound interact,

based on the data obtained from the reviews, interviews, observations, experiments, simulations, and practical applications, will be continuously updated throughout the project. These models will also take into account research on auditory modeling (e.g. Leman 1995), as well as research on gestures in other domains (e.g. McNeill 1992).

References

Aksnes, H. (2002). *Perspectives Of Musical Meaning. A Study Based on Selected Works by Geirr Tveitt*. Oslo: Unipub AS (dr.art. dissertation, University of Oslo).

Berthoz, A. (1997). *Le sens du mouvement.* Paris: Odile Jacob.

Bielawiski, L. (1979). Instrumentalmusik als Transformation der Menschlichen Bewegung. Mensch - Instrument- Musik. *Studia Instrumentorum Musicae Popularis VI.*

Bijker, W. E. (1995). *Of bicycles, bakelites, and bulbs : toward a theory of sociotechnical change*. Cambridge, Mass. : MIT Press,

Bonde, L. O. (2000). Metaphor and Narrative in Guided Imagery and Music. *Journal of the Association for Music and Imagery, Vol 7*.

Bregman, A. S. (1990). *Auditory Scene Analysis.* Cambridge, Mass. & London: The MIT Press.

Cadoz, C. and Wanderley, M. (2001). Gesture-Music. In M. M. Wanderley and M. Battier (Eds.), *Trends in Gestural Control of Music* (CD-ROM) (pp. 28-65). Paris: IRCAM.

Damasio, A. R. (1994). *Descartes' Error*. New York: G. P. Putnam's Sons.

Fadiga, L., Craighero, L., Buccino, G., Rizzolatti, G. (2002): Speech Listening Specifically Modulates the Excitability of Tongue Muscles: a TMS Study. *European Journal of Neuroscience, Vol. 15*, pp. 399-402

Freed, D. J. (1990). Auditory correlates of perceived mallet hardness for a set of recorded percussive sound events. *Journal of the Acoustical Society of America, 87,* 311-322.

Godøy, R. I. (1999). Cross-modality and conceptual shapes and spaces in music theory. In I. Zannos (Ed.), *Music and Signs* (pp. 85-98). Bratislava: ASCO Art & Science.

Godøy, R. I. (2001). Imagined Action, Excitation, and Resonance. In R. I. Godoy and H. Jorgensen (Eds.), *Musical Imagery* (pp. 239-252). Lisse: Swets and Zeitlinger.

Godøy, R. I. & Jørgensen, H. (Eds.) (2001). *Musical Imagery*. Lisse: Swets and Zeitlinger.

Handel, S. (1995). Timbre Perception and Auditory Object Identification. In B. C. Moore (Ed.), *Hearing* (pp. 425-461). San Diego: Academic Press.

Jeannerod., M., (1995). Mental Imagery in the Motor Context. *Neuropsychologia, Vol. 33, Nos. 11,* 1419-1432.

Johnson, M., (1987). *The Body in the Mind.* Chicago: The University of Chicago Press.

Juslin, Patrik N. and John A. Sloboda (Eds.) (2001). *Music and Emotion. Theory and Research*. Oxford: Oxford University Press.

Kvifte, T. (1989). *Instruments and the Electronic Age. Towards a Terminology for a Unified Description of Playing Techniques*. Oslo: Solum Forlag.

Kvifte, T. (1992). Musical instruments and man-machine-interaction or why play the tin whistle when you got a synthesizer. *Cybernetics & Human Knowing, vol. 1, no. 2-3,* pp. 41-49.

Laban, R. (1980). *The Mastery of Movement* (fourth edition by Lisa Ullmann). Plymouth: Northcote House Publishers Ltd.

Leman, M. (1995). *Music and schema theory: Cognitive foundations of systematic musi-*

cology. Berlin, Heidelberg: Springer-Verlag.
Libermann, A. M., & Mattingly, I. G. (1985). The motor theory of speech perception revisited. *Cognition, 21*, 1-36.
McNeill, D. (1992). *Hand and mind: What gestures reveal about thought*. Chicago, IL: University of Chicago Press.
Middleton, R. (1993). Popular music analysis and musicology: bridging the gap. *Popular Music, 12/2*, 177-190.
Mikumo, M. (1998). *Encoding strategies for pitch information*. Japanese Psychological Monographs No. 27 (The Japanese Psychological Association)
Monsen, J. T. and Monsen, K. (1999). Affect and Affect Consciousness: A Psychotherapy Model Integrating Silvan Tomkins' Affect- and Script Theory Within the Framework of Self Psychology. In Arnold Goldberg (ed.) *Pluralism in Self Psychology. Progress in Self Psychology. Vol 15*. Hillsdale: The Analytic Press.
Rosch, E., Mervis, C. B., Gray, W. D., Johnson, D. M., & Boyes-Braem, P. (1976). Basic Objects in Natural Categories. *Cognitive Psychology, 8*, 382-436.
Rosenbaum, D. A. (1991). *Human Motor Control.* San Diego: Academic Press, Inc.
Rosenbaum, D. A., Loukopoulos, L. D., Meulenbroek, R. G. J., Vaughan, J., & Engelbrecht, S. E., (1995). Planning Reaches by Evaluating Stored Postures. *Psychological Review, Vol 102, No. 1,* 28-47.
Ruud, E. (2003). *'Burning Scripts'. Affect Consciousness, Script Theory and the BMGIM. A Sketch of a Theory*. Department of Music and Theatre, University of Oslo. Unpublished manuscript.
Stern, D. N. (1985). *The Interpersonal World of the Infant: A View from Psychoanalysis and Developmental Psychology*. New York: Basic Books.
Sudnow, D. (1978). *Ways of the Hand*. Cambridge, Mass.: Harvard University Press.