

Embodied music cognition and mediation technology

Briefly, what it is all about:

Embodied music cognition = Experiencing music in relation to our bodies, specifically in relation to body movements, both visible (overt) and imagined (covert)

Mediation technology = Various technologies for capturing, storing, transmitting, and generating music

In sum: Human music making, music perception and music cognition in our technological world

## Chapters:

- 1 Musical experience and signification
- 2 Paradigms of music research
- 3 Ecological conceptions
- 4 Corporeal articulations and intentionality
- 5 Corporeal articulations and imitation
- 6 Interaction with musical instruments
- 7 Search for and retrieval of music

# 1. Musical experience and signification

## Experience and description:

- Music is everywhere; music is one of the most important cultural (and economic) factors of our lives
- Behavioral resonance, awareness, description: Trying to capture essential elements of musical experience
- The need for description: How do we get information about peoples' musical experience and how do we represent and interpret this information?

## Description and subjective interpretation:

- Signification practice: Verbal accounts of musical experience
- Hermeneutics methodology: Interpreting music by way of various metaphors and/or narratives
- Dealing with intentionality: Assigning purpose to music, e.g. programmatic intentions
- Mediating access to music: Can these various verbal accounts of music be useful in accessing music, i.e. in music information retrieval, google-like searches for music, etc.?

## The subjectivist approach:

- **Dualism:** Split between the physics of sound and the mental/emotional features of music. But is this dualism well-founded? - The embodied paradigm will say no.
- **Relativism:** Are descriptions of music completely arbitrary, totally subjective? – Probably not, as there will in many cases be quite clear inter-subjective agreements. But what is the basis for such inter-subjective agreement?

## The action-based approach:

- Linguistic description: Various problems with expressing musical experience in words; sometimes we may experience verbal expressions as meaningful, sometimes as quite inadequate
- Non-linguistic description: Primarily body movement as a source of information on musical experience, i.e. observe how people move to music and/or imagine to music move to music
- (Comment: There are various bio-sensors that can give us some information about musical experience)
- Technology-mediated access: Challenges of how to interface with large collections of musical sound. Maybe body motion could be of use here

## 2. Paradigms of music research

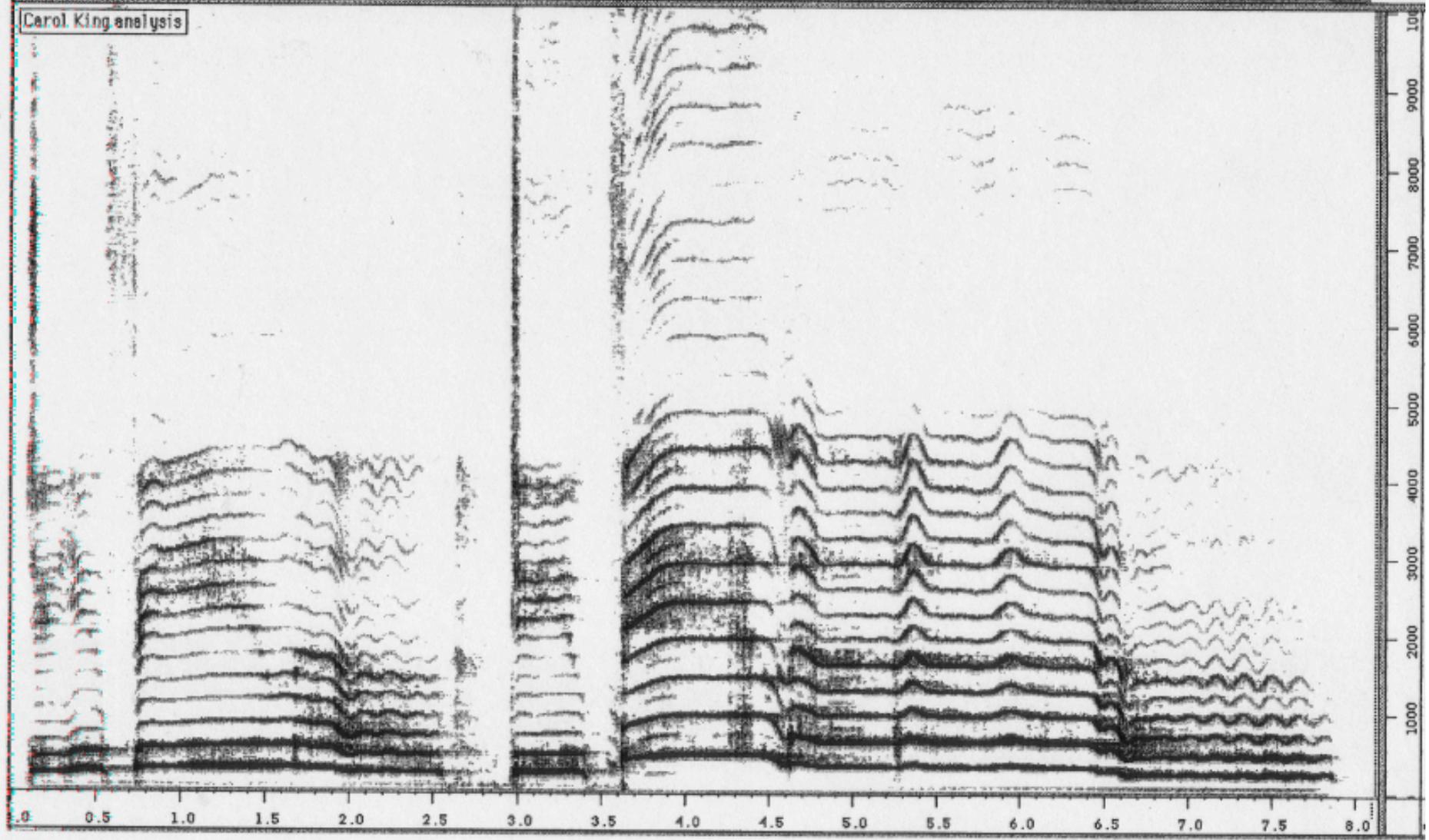
## From music philosophy to music science:

- Antiquity: Various interesting reflections on movement and music as well as behavioral effects of music
- Renaissance to enlightenment: Split between mathematics and experience
- Eighteenth century: Rule-based approach to musical composition
- Nineteenth century: Beginning interest in psychophysics, gestalt theory, and phenomenology

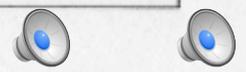
## The cognitive paradigm:

- Pioneers: Helmholtz, Wundt, Brentano
- Gestalt psychology and systematic musicology: Ehrenfels, Stumpf, Koffka, Köhler, Wetheimer, as well as Kurt, Riemann, etc.
- Technology and information theory: Shannon and Weaver
- Phenomenology and new media technology: Schaeffer, musique concrète, later on Risset, Mathews, Chowning
- Computational modeling: Fodor (general), Laske, Longue-Higgins, etc. (music)
- Empirical modeling: Simulating perception and the emergence of patterns, from sub-symbolic to symbolic

Carol King analysis



Do you feel love, do you feel love.



## The paradigm of embodied cognition:

- A tradition of embodied cognition: In music, Truslit, Bekking, and other pioneers
- Gesture modeling: Physical sound synthesis and motor theory of perception, i.e. an ecological approach to both the generation and the perception/cognition of musical sound

Note on distal vs. proximal:

- Distal = that which is situated away from the body
- Proximal = that which is situated near to the body
- Distal cues in listening = the cause and significance of sounds, e.g. hearing footsteps as someone coming, not as an acoustic pattern
- Proximal cues in listening = the acoustic-sensory features of sounds, e.g. various acoustic attributes of footsteps such as spectrum and dynamic envelope, etc.

### 3. Ecological conceptions

## Direct perception and inference:

- The concept of affordance: Gibson's observation that we are goal-directed and/or purposeful in our perceptions of the world
- What do we perceive first?
- What are the most salient features?
- What is the gist of the music?

## The action-reaction cycle:

- A general model for perceiving by way of adjusting actions, hence the components of PLAY, CHANGE, JUDGE, LISTEN
- Ratchet effect: This cycle manifest on the grand scale of cultural and instrument development
- Intentional actions: Goal-directed development of musical instruments and other musical conventions, e.g. tuning

## Nature and culture in interaction:

- Natural and cultural constraints: Trying to understand what's given by physics and biology and what's given by culture. General issues of 'nature-nurture'
- Explaining cultural constraints: Certain psychoacoustic facts can be observed, e.g. roughness in sounds, yet cultures may prefer a certain amount of roughness in sound

## Simulating the emergence of cultural constraints:

- Stimulus-source relationships: Disambiguation and categories in language, i.e. sounds are put into meaning categories
- Inference from stimulus-based cues: Not clear that cultural constructs can be inferred from psychoacoustics, i.e. there are too many cultural variations
- Both direct perception and inference: Actually about the interaction of short-term memory and long-term memory and categorization (suggestion: have a look at Bob Snyder's *Music and memory*)

## Culture as a resonance system:

- Actually, a kind of “evolutionary” perspective on culture
- An attempt to understand the dynamics of nature and culture as a phenomenon of ‘resonance’
- Natural and cultural resonances: Nature-culture interaction will gradually build up solid memories, conventions, and categories, cf. figure 3.5
- Human resonances: Individual action-perception loops at different timescales
- Cultural resonances: Selection of certain artifacts and practices from a large number of possibilities

## Perspectives for a technology of music mediation:

- The interaction of biological and cultural factors in music experience, cf. figure 3.6
- Case study: Cultural preferences in the making of bells and bell sounds. Starting with equal physical conditions, how do cultural preferences emerge?

## 4. Corporeal articulations and intentionality

## Descriptions:

- General comment: Corporeal articulations are body movements
- The challenge: Find ways of gathering and representing information about musical experience from different people
- First-person and third-person descriptions: “I do, I feel”, etc. and “She, he, etc. does, feels”, etc.
- Second-person descriptions: “me-to-you” relationships

## Corporeal intentionality:

- The intentionality engine: Inner “will” to act, visible for others by way of actions
- Evidence for action/perception couplings: Theories of imitation and mirror neurons
- Perception, thinking, and understanding as a matter of (mostly invisible) mental simulation of what others (you, she, he, they) are doing. This mental simulation is similar to actually visibly imitating what others are doing, but is (usually) inhibited before it becomes visible
- Action-oriented ontology: Actions as the basis for meaning in both ourselves and others

Action basis for pretty much everything:

- The radical view of human sensing, thinking, and feeling as based on motor sensations
- Even abstract thinking such as mathematics and logic understood as based on motor sensations
- Substantial amount of research now support the idea of very close ties between sensing, thinking, feeling and various motor sensations, e.g. “theory of mind-reading” based on motor empathy

## Expressive meaning formation in music:

- Imitation (overt or covert) as the basis for empathy with others
- Music transmits sensations of motion and emotion by way of its capacity to induce sensations of movement by imitation

Music, movement, and intention understood as corporeal articulations:

- Playing music: Obvious links between sound and sound-producing actions so that these actions become part of our images of musical sound
- Dance and response: Obvious links between sound and spontaneous bodily responses to music
- Pure listening? More and more clear that musical listening is a multi-sensory experience
- Consequences for a theory of music perception: Taking multi-modality and human action into account
- Consequences for a technology of music mediation: How can multi-modality and action be exploited?

## 5. Corporeal articulations and imitation

## Corporeal articulations as imitation:

- True imitation: Evidence for imitation in humans, overt and/or covert
- Music as imitation: Imitation in learning and in listening

## Degrees of empathic musical involvement and imitation:

- Synchronization: Tapping to the beat, entrainment
- Embodied attuning: Probetones vs. vocal responses, as well as collecting gesture responses from listening subjects
- Empathy: Making and recording various movements to musical excerpts
- Distinctions between synchronization, attuning, and empathy: Different facets of related phenomena

## Mimesis theory and expression:

- Music imitates, music expresses
- Capturing what is expressed in music
- Consequences for music research

## 6. Interaction with musical instruments

## Multimodal experience and multimedia technology:

- Traditional musical instruments also a kind of multimedia technology
- And: Music itself as basically multimodal, also in western culture, and clearly so in other cultures
- Multimedia micro-integration: close linkage of different media and modalities made possible by technology, i.e. possible to combine movement, vision, and sound in one setting and study the interactions of these components in a systematic way

## The communication of intended action:

- *Guqin* music
- Corporeal articulations and elementary movements in the production of the sound
- Gestural control and its effect on sound: various nuances
- Monitoring the listener's movements: Capturing listeners movements to the same music
- A model of musical communication: Understanding the perception-action loop and trying to develop more interactive possibilities for the listener, e.g. haptic feedback in addition to auditory feedback

## Constraints of interactive communication:

- Biomechanical control and haptic feedback: The constraints of the instrument and the possibilities of capturing the music-related movements
- Constraints of electronic music mediation: Electronic music interfaces have no energy transfer, no resistance, no haptic feedback
- Motivation: Why should people bother to use various technologies for interfacing with music? Such technologies should be experienced as attractive and engaging
- Group effects in musical communication: Possible to study group interaction with interface technologies

## Multimedia environments:

- Autonomous social agents: Transfer a certain amount of autonomy to the technology, enhancing the users possibilities of control
- Connection with multimedia technology: Prospects of a broad range of inputs and of intelligent feature extraction from human movement
- A platform for musical expressiveness: Possibilities for extracting expressive cues from human movement

## 7. Search for and retrieval of music

## Conceptual architecture:

- Audio files in a database
- Feature extraction and classification
- Description
- Match with users descriptions
- Recommendations

## Musical querying:

- Querying based on audio examples
- Corporeal-based querying
- Symbolic/linguistic querying

## Mediation technology:

- A scenario for multimodal querying
- A model for multimodal query processing

## Examples of search-and-retrieval systems:

- Audio identification using fingerprinting
- Query by voice
- Midlevel description for polyphonic music
- User profiling and semantic description

## Conclusions:

- Embodied music cognition = change of paradigm, a shift towards an ecological, body-centered understanding of music
- Human action the key to understanding many musical and social phenomena of music
- Challenge now of developing technology in ways that are in line with the embodied music cognition view