Gesture-Sound Interaction and Embodied Music Cognition

Theoretical Concepts and Design Methods

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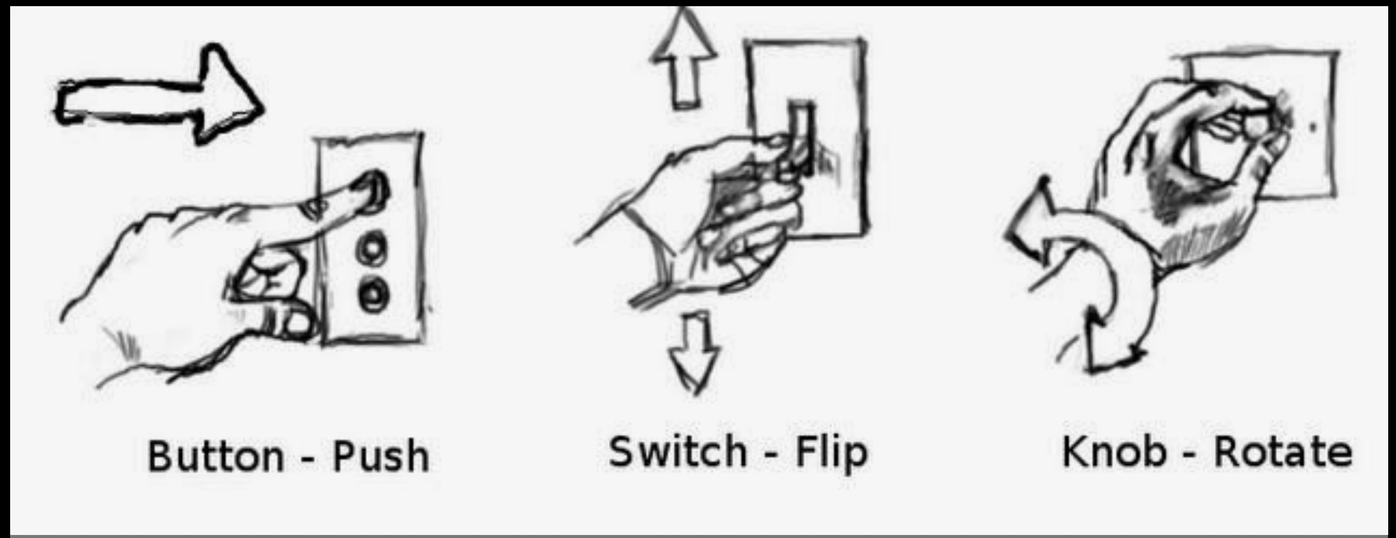
Gestural Sonic Affordance

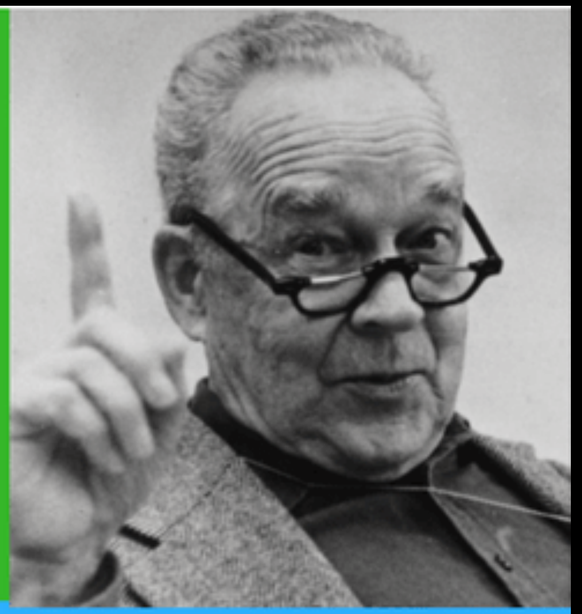
Affordance
in interaction design

- Affordance is a concept in interaction design dealing with the kinds of usage an object invites of the user
- The concept originates in the field of ecological psychology, where it describes qualities an object in an environment offers to subjects



Source https://medium.com/@akadiyala/role-of-affordances-in-digital-transformation-and-internet-of-things-fa2896970480

> The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. The verb to afford is found in the dictionary, but the noun affordance is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment.
>
> Gibson, James. J. (1979) The Ecological Approach to Visual Perception. (p. 127)



> The term affordance refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used. A chair affords ("is for") support, and, therefore, affords sitting.
>
> Norman, Donald. (1988) The Design of Everyday Things (p. 9)

Source: https://www.linkinglearning.com.au/understanding-affordances-part-one/

affordances by Norman and Gibson.

Gibson's Affordances

- Offerings or action possibilities in the environment in relation to the action capabilities of an actor
- Independent of the actor's experience, knowledge, culture, or ability to perceive
- Existence is binary – an affordance exists or it does not exist

Norman's Affordances

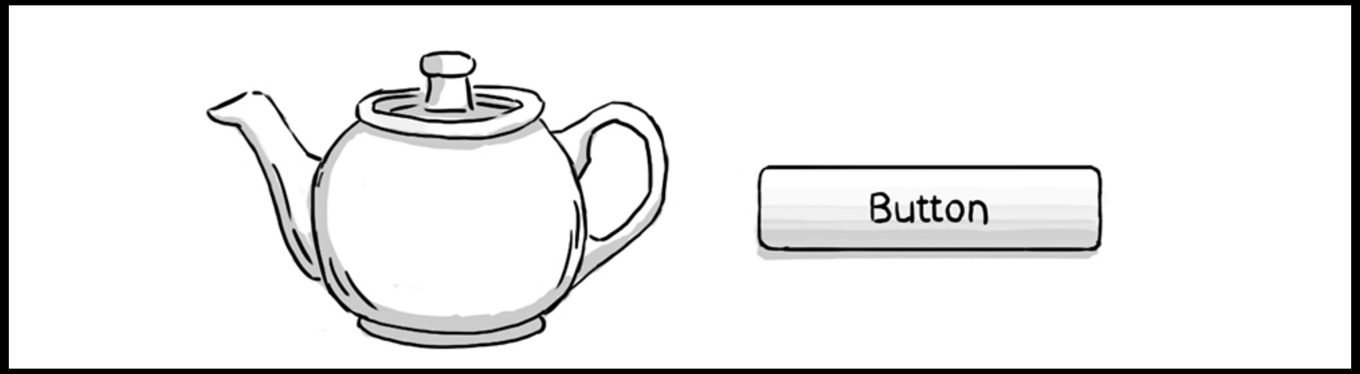
- Perceived properties that may or may not actually exist
- Suggestions or clues as to how to use the properties
- Can be dependent on the experience, knowledge, or culture of the actor
- Can make an action difficult or easy

Table 1: Comparison of affordances as defined by Gibson and Norman.

Affordances : Clarifying and Evolving a Concept
J. McGrenere

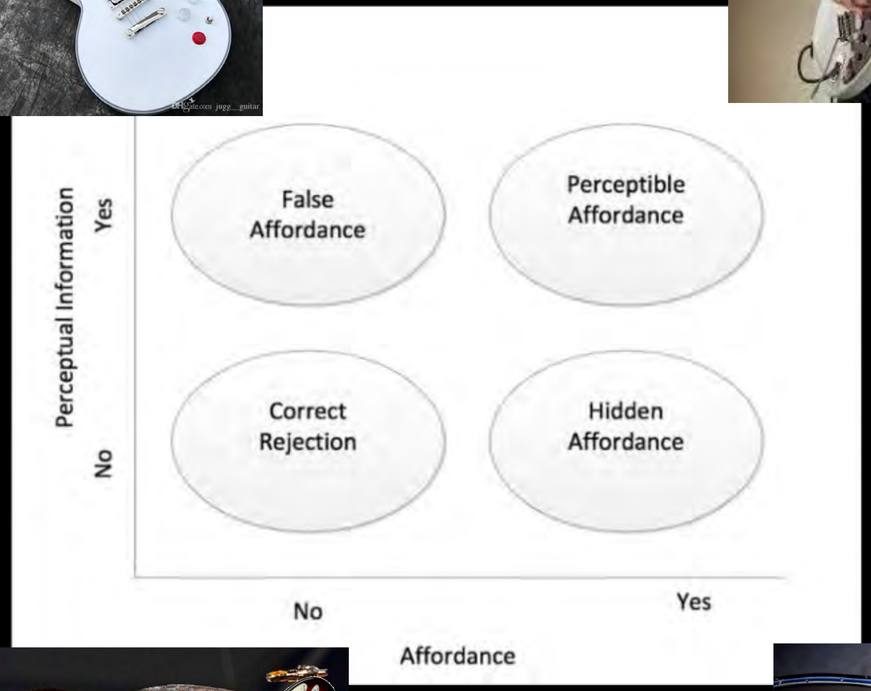
Affordance in Human-computer interaction

Physical affordance vs perceived affordance



Source: https://demodern.com/blog/public-touchscreens

Categories of affordances based on perceptual information



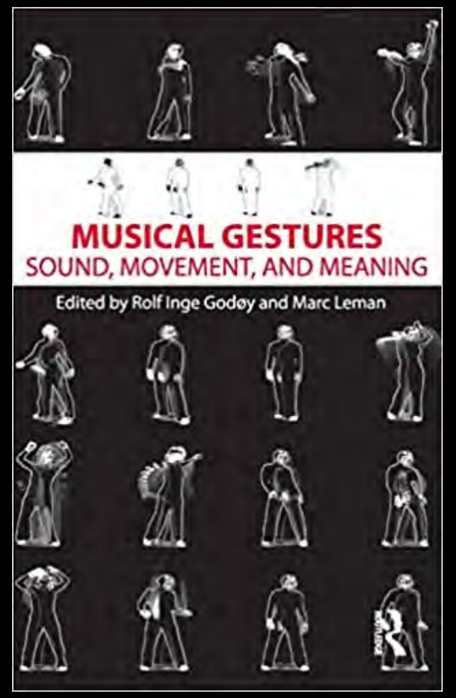
Perceived by Users \ Intended by library	yes	no
yes	**Intended and Perceived** -online catalogue -reference librarians -journal databases -inter-library loan	**Perceived but not Intended** -unauthorized distribution of journal articles to friends -students' fear of technology dependance
no	**Intended but not Perceived** -students unaware of information literacy instruction -students do not see new icons or announcements	

Affordance theory: a framework for graduate students' information behavior
Elizabeth (Bess) Sadler
Lisa M. Given

Gaver, W. W. 1991. "Technology Affordances." Proceedings of the 1992 ACM Conference on Human Factors in Computing Systems.New York: Association for Computing Machinery, pp. 79–84.

So does sound have gestural affordances?

- Godøy, R. I. (2010). Gestural Affordances of Musical Sound. In R. I. Godøy & M. Leman (Eds.), Musical gestures: Sound, movement, and meaning. Routledge.



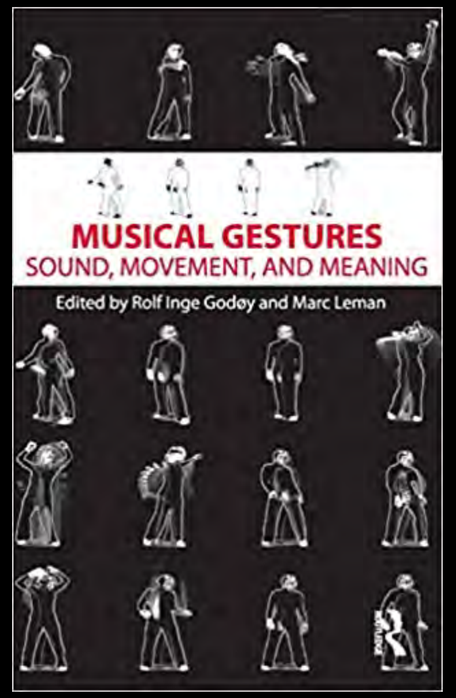
Gestural affordance of musical sound: Charlie Chaplin - The Great Dictator - Barber Shop Scene (Brahms' Hungarian Dance No. 5)

https://www.youtube.com/watch?v=H19jByxrqIw

So does sound have gestural affordances?

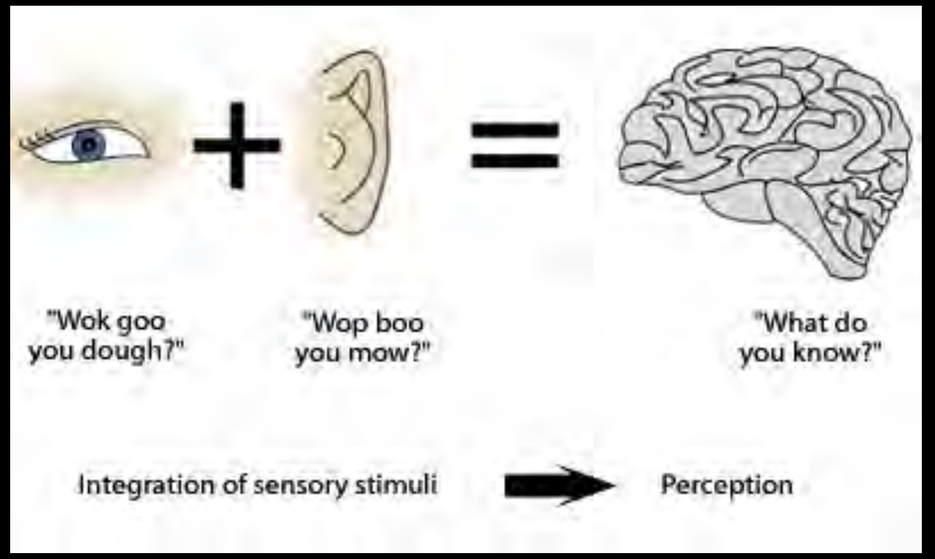
- Godøy, R. I. (2010). Gestural Affordances of Musical Sound. In R. I. Godøy & M. Leman (Eds.), Musical gestures: Sound, movement, and meaning. Routledge.

“Thus, there is a two-way process here where sound induces images of movement, and conversely, where previously learned images of sound-related movement are projected onto sound”



Multimodal perception: the McGurk effect

- Speech perception is more than auditory perception. People attend to visual information, such as lip movements and facial gestures associated with speaking, as well as to the actual auditory information, or spoken words.
- In the 1970s, Harry McGurk and John MacDonald presented research participants with videotapes with different spoken syllables, such as "ba" and "ga" dubbed over the original pronunciations. Instead of perceiving either the visual stimulus or the auditory stimulus, people perceived speech that was somewhere in between the two syllables.
- The predominant explanation for this effect is that the brain attempts to integrate the auditory and visual stimuli in a way that best represents each stimulus.



Source: http://www.psych.ualberta.ca/~varn/Psyco/C7_MCGURK%20Folder/body03.html

The McGurk effect

https://www.youtube.com/watch?v=2k8fHR9jKVM

Skilled musicians are also subject to the McGurk effect

- It has been argued that skilled musicians are not subject to the McGurk effect. *Proverbio A, Massetti G, Rizzi E, Zani A. 2016 Skilled musicians are not subject to the McGurk effect. Sci. Rep. 6, 30423. (doi:10.1038/ srep30423)*

- However, a recent study disproves that showing that “musicians are subject to the McGurk effect, and to at least as much extent (if not more) as non-musicians are”
Politzer-Ahles, S., & Pan, L. (2019). Skilled musicians are indeed subject to the McGurk effect. Royal Society Open Science, 6(4). https://doi.org/10.1098/rsos.181868

So does sound have gestural affordances?

- Atau Tanaka’s sonic experiments and user-centred design approach.

Atau Tanaka: Does sound have affordances?

https://youtu.be/IyOUVixqmTU?t=1900

Gestural sonic affordances

A recap:

- Some sound features, especially energy envelopes, suggest movements with similar features (impulsive, sustained, iterative…);
- The temporal evolution of sound features such as pitch, timbre, loudness may suggest similar movement in larger temporal scales;
- Many modalities (auditory, visual, haptic…) are engaged in the perception of movement connected to sound (cf. McGurk effect);
- The morphology of the instrument affects how the body engages with sound;
- Cultural ecologies affect gesture-sound interaction.

From Affordances to Constraints

- Affordances suggest possibilities of interaction;
- An interaction designer may be concerned with defining a set of such possibilities.
- Moving within such set of possibilities can be seen as a source for creativity.
- Reading -> *Magnusson, T. (2010). Designing constraints: composing and performing with digital musical systems. Computer Music Journal, 34(4), 62–74.* https://doi.org/10.1162/COMJ_a_00026

Robert Henke: Give me limits!

https://youtu.be/iwOaYxSJGqI?t=1028

Using affordances and constraints to inspire a gestural sound performance

Tuned Constraint

https://www.youtube.com/watch?v=jdVw22D3NNM

Questions & Discussion

Next:

- *Work groups*
- *Instructions on how to post to the discussion board*

Gestural Sonic Objects

Sonic Objects

Some definitions

- *Fragments of musical sound (0.5 – 5 s) that can be perceived holistically as a coherent and meaningful unit.*
- The idea stems from the seminal work of composer **Pierre Schaeffer** and his collaborators, and emerges from the practical work in electroacoustic composition of the 1950s and 1960s also known as musique concrète. [1]
- Concept extended to include gestural qualities -> **Gestural Sonic Objects**. [2]

[1] **Schaeffer, P. (1966).** Traité des objets musicaux: essai interdisciplines. Paris, France: Edition du Seuil.
[2] **Godøy, R. I. (2006).** Gestural-Sonorous Objects: embodied extensions of Schaeffer's conceptual apparatus. Organised Sound, 11(2), 149–157.

Sonic Objects

Some definitions

- The sonic object is not the sounding body.
- The sonic object is not the physical signal.
- The sonic object is not a fragment of a recording.
- The sonic object is not a symbol notated in a score.
- The sonic object is not a state of the mind.
- *The sonic object is an intentional unit, meaning that it has several aspects, both sequentially and in parallel,* ***that are kept together in our minds by our active mental focus.***

Godøy, R. I. (2018). Sonic Object Cognition. In R. Bader (Ed.), Springer Handbook of Systematic Musicology (pp. 761–777). Berlin Heidelberg: Springer. https://doi.org/10.1007/978-3-662-55004-5_35

Gestural Sonic Objects

Dynamic typological categories

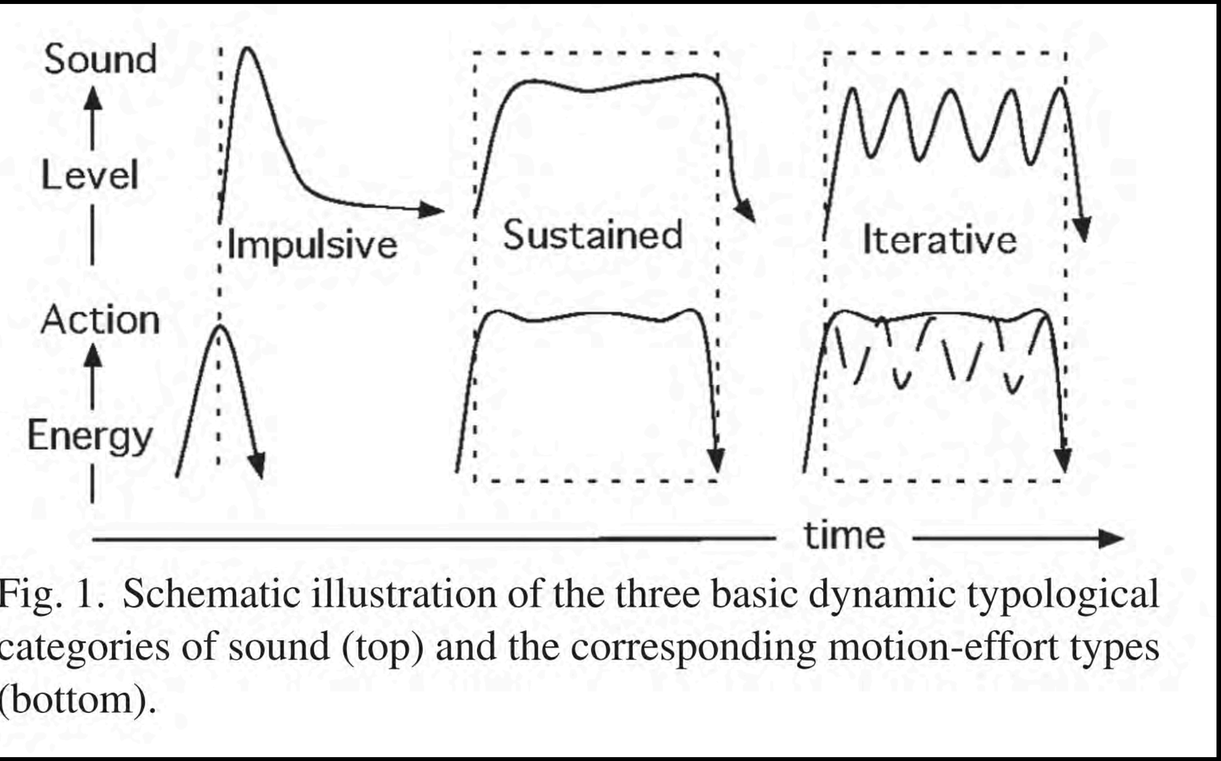


Fig. 1. Schematic illustration of the three basic dynamic typological categories of sound (top) and the corresponding motion-effort types (bottom).

Godøy, R. I., Song, M., Nymoen, K., Haugen, M. R., & Jensenius, A. R. (2016). Exploring Sound-Motion Similarity in Musical Experience. Journal of New Music Research, 1–13. https://doi.org/10.1080/09298215.2016.1184689

Fragmente²

- Fragmente² (2019) is a choreomusical composition by Kerstin Frodin and Åsa Unander-Scharin based on the Japanese composer Makoto Shinohara's solo piece for tenor recorder Fragmente (1968).

Fragmente² ~ excerpt

Gestural Sonic Objects in Choreomusical Composition

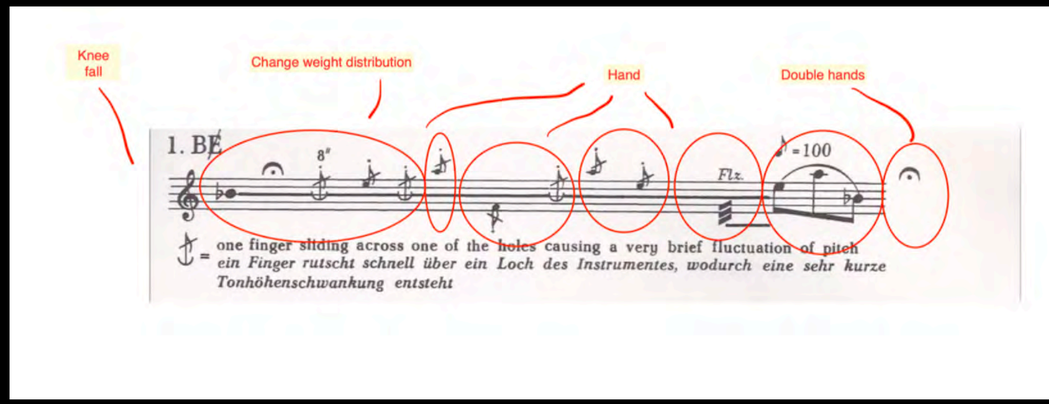
Creating collective tools for analysis (Kerstin Frodin & Åsa Unander Scharin)

A choreomusical interaction on equal terms demands an attunement between the performers which resembles the interaction between musicians in chamber music performance, or between dancers in a complex choreography. By hand, we have built up an ontology that takes its basis in the collective work.

Our analysis of Fragmente composed during the avant-garde era was inspired by Pierre Schaeffer's phenomenologically grounded framework for music analysis discussed in his book Treatise on Musical Objects 1966/2017 as well as Godøy's (2006) concept of gestural-sonorous object related to embodied cognition.

The analysis we made of Shinohara's Fragmente in the initial phase, based on the conceptual framing drawn from Schaeffer and Godøy, was the first step of what turned out to be a fruitful method for developing concepts of choreomusical interaction. Rather than objects, the notion of components seemed more relevant to apply in the choreomusical context we are situated in.

Hence, to elaborate the interaction in each fragment, we divided the music and choreography into sound and movement components. Our "component-method" provided us with tools for analysing our artistic work and discussing our respective materials in a very concrete manner.



Gestural Sonic Objects in Choreomusical Composition

Layers of interaction (Kerstin Frodin & Åsa Unander Scharin)

Our interaction has come to revolve around the following interaction concepts:

***Counterpoint**: We aim for a relation in which the parts are of equal importance and most often do not act in unison.*

Joint – action

***Leader - Follower impulse**: An impulse trigging a sound or a physical movement could come from either of us or be carried out jointly.*

Cause and effect

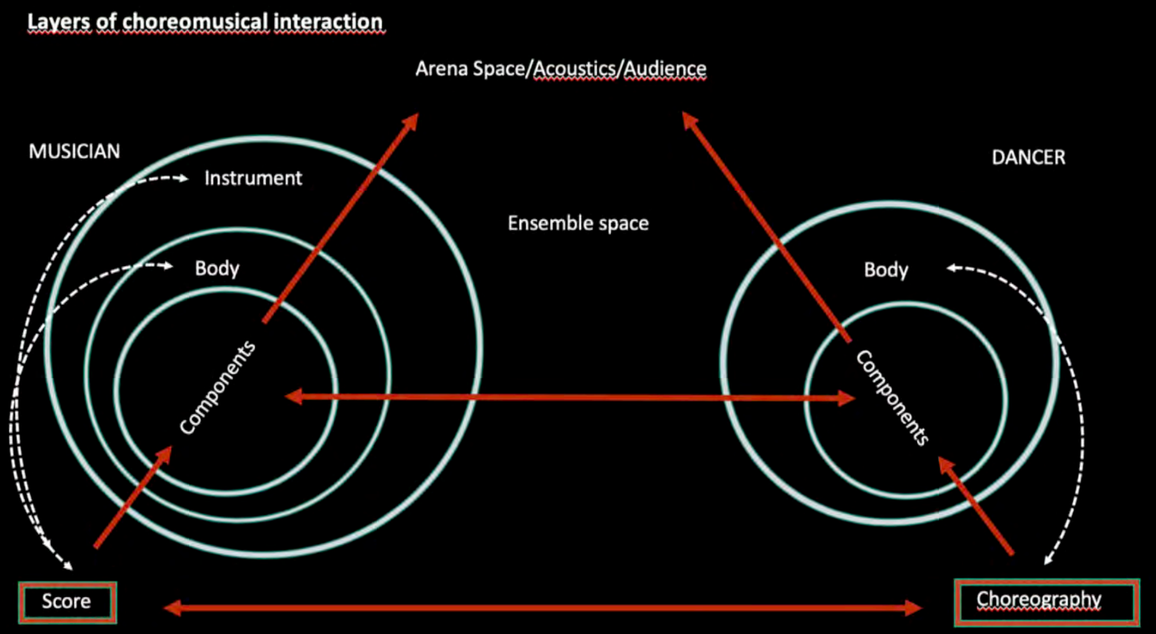
Parallel actions

***Elasticity**: Throughout the work, the musical and choreographic materials allow a certain elasticity. We are so familiar with each other's parts that we can play with this elasticity during performance. We know where it is possible to stretch and where we have to go with the flow.*

***Zero-points**: A "Zero-point" is the space between two objects. These places can serve as connection points where we are the most attentive towards each other and where the timing is more flexible.*

***Spatial perspective**: In general, we aim for contrasting spatial solutions. Our interaction changes drastically depending on whether we are physically close or distanced.*

The graphic model below depicts how different layers of choreomusical components interact in our performance of Fragmente.



*Fragmente*²

Multimodal recordings

- We recorded data from a full performance, including multichannel audio and video, motion capture, EMG (finger flexors), and insole pressure.

Gestural Sonic Object Annotation

Procedure

- Find the beginning and end of each object (segmentation)
  - A fragment perceived holistically as a coherent and somehow meaningful unit.
  - Meso timescale: 0.5 - 5 s. “*The duration limits of a sonic object are determined at one end by the minimal duration necessary to perceive salient features and at the other end by a maximal duration for perceiving the object as a singular and coherent entity, i. e., as not readily divisible into smaller parts.” (Godøy 2018)*

Somaesthetics

Somaesthetics in interaction design

- “Somaesthetics is an interdisciplinary field of inquiry aimed at promoting and integrating the theoretical, empirical and practical disciplines related to bodily perception, performance and presentation.” (source: https://en.wikipedia.org/wiki/Somaesthetics)
- As an interaction design approach, it focuses on making people more aware of their felt bodily experiences. (cf. e.g. Höök, K., Caramiaux, B., Erkut, C., Forlizzi, J., Hajinejad, N., Haller, M., … Tobiasson, H. (2018). Embracing First-Person Perspectives in Soma-Based Design. *Informatics*, *5*(1), 8. https://doi.org/10.3390/informatics5010008

Introduction to Somaesthetics: Richard Shusterman

https://youtu.be/Uxe73YY56Zg?t=38

From Höök et al. (2018)

But what sets apart aesthetic movements of the soma from just any movement or any experience?

In his writings, Shusterman repeatedly comes back to the need to disrupt habits, to focus and become more aware so as to be able to discern the different parts of a movement or emotion, feeling every small change in your body. For example, training your breathing to achieve better focus, or correcting your eating habits from what is “habitual” to shape new, more reflective, thoughtful actions.

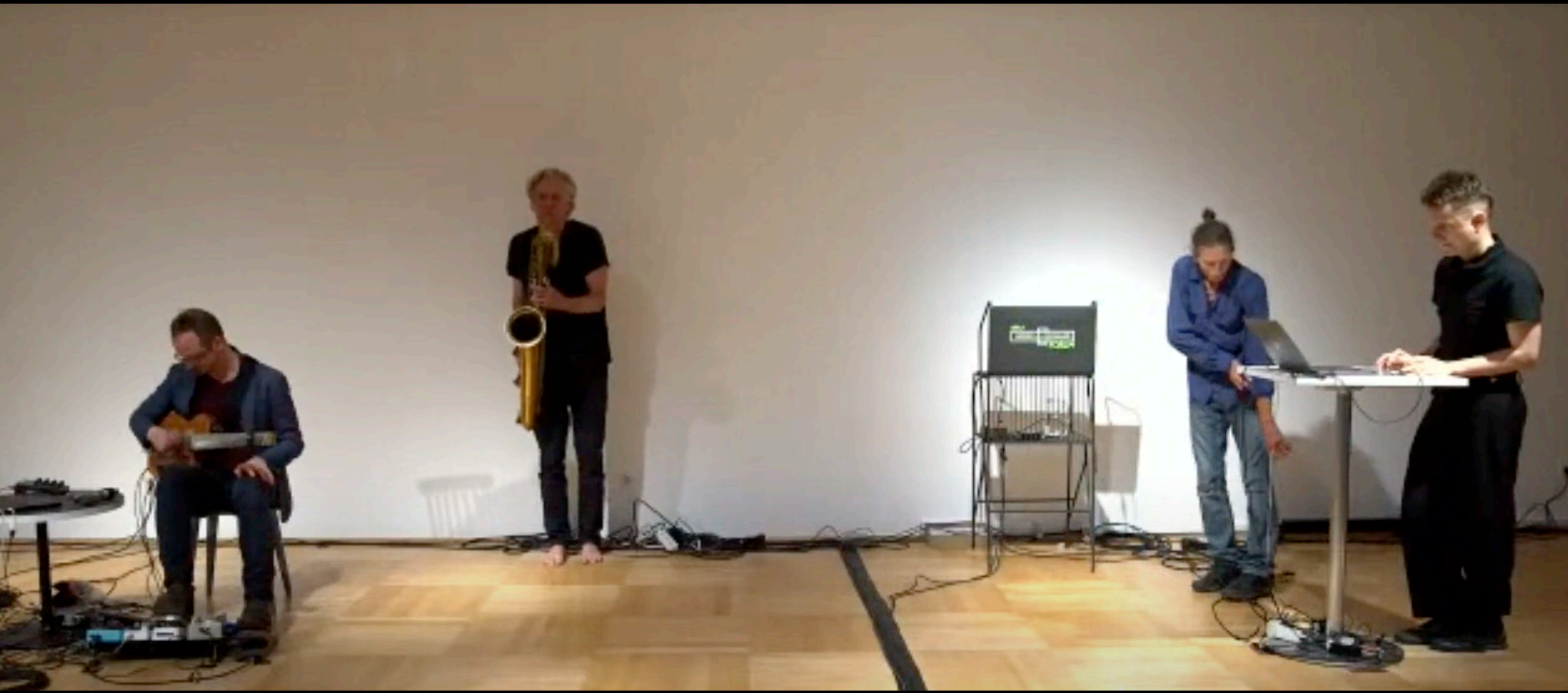
Marco Donnarumma - Nigredo

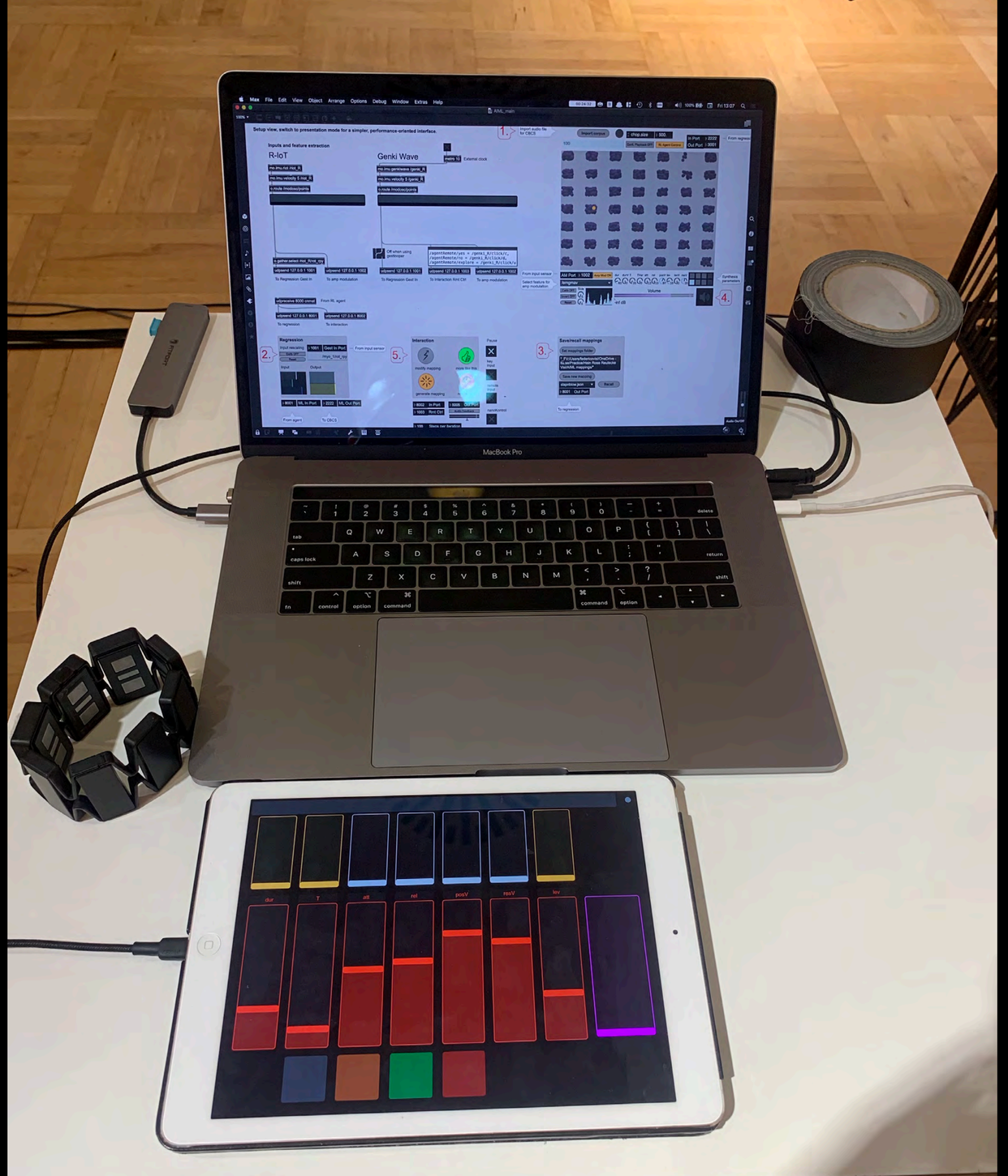
https://vimeo.com/69743476

Questions & Discussion

Next:

- *Live Max patching: impulsive and sustained interactions*
- *A case study: the setup for the performance at the International Conference on Improvisation, Ecology and Digital Technology*




Setup view, switch to presentation mode for a simpler, performance-oriented interface.
Inputs and feature extraction
R-IoT
Genki Wave
Regression
Interaction
Save/recall mappings
MacBook Pro
dur
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att
rel
posV
resV
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Performance at the International Conference on Improvisation, Ecology and Digital Technology

https://youtu.be/c_wbJNrobzw?t=18589