BOOK OF ABSTRACTS

Edited by:
Schiavio, A., Xypolitaki, E., Scuderi, C., Seither-Preisler, A., & Parncutt, R.
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Conference on Interdisciplinary Musicology
CIM19
“Embodiment in Music”
Centre for Systematic Musicology, University of Graz
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WELCOME NOTE

It is a great pleasure to welcome all delegates to CIM19 - the Conference on Interdisciplinary Musicology! Whether participating in Graz or remotely, we wish you a pleasant stay within the conference community.

After a successful last meeting in Poland, we are delighted the present host is the Centre for Systematic Musicology of the University of Graz, Austria. CIM’s first edition was held here in 2004, and since then the conference was organized in institutions in China, Estonia, Canada, Greece, and England among others.

With 4 keynotes, and more than 70 contributions from delegates from all over the world, CIM19 continues the tradition of its predecessors by celebrating musicological diversity and promoting epistemologically distant collaborations. All presentations offer interdisciplinary insights that provide a meeting point for researchers, students, scholars, and performing artists interested in the rich interplay between Embodied Cognition and Music.

CIM has its own society (SIM - the Society for Interdisciplinary Musicology) and its own international peer-reviewed journal (JIMS - the Journal of Interdisciplinary Music Studies). The best presentations at the conference are invited for publication in a special issue of JIMS. Other presenters are invited to revise and submit their papers to JIMS for publication in a regular issue.

During the conference we will host our Society’s general meeting, where the next CIM will be announced. Please make sure you also attend the conclusive session, where emergent themes will be discussed by two of our keynotes, and where the prizes for the best conference papers will be awarded.

We are confident CIM19 will broaden your perspective of embodiment in music, inspiring novel collaborative research and theory in the field. We hope you will enjoy these three full days of conference. A warm welcome to you all!

The organizing committee:

Andrea Schiavio
Richard Parncutt
Cristina Scuderi
Annemarie Seither-Preisler
Nils Meyer-Kahlen
Elli Xypolitaki
Sandra Tanzmeister
Thursday 26

08.30 - 10.15  Registration
10.15 - 11.00  Welcome
11.00 - 11.30  Coffee break
11.30 - 12.30  Keynote 1 (Renee Timmers)
12.30 - 14.00  Lunch
14.00 - 16.00  Session 1a & 1b
16.00 - 16.30  Coffee break
16.30 - 18.30  Session 2a & 2b
20.00  Reception at Graz Town Hall, invited by The City of Graz

Friday 27

09.00 - 11.00  Session 3a & 3b
11.00 - 11.30  Coffee break
11.30 - 12.30  Keynote 2 (Fred Cummins)
12.30 - 14.00  Lunch
14.00 - 16.00  Session 4a & 4b
16.00 - 16.30  Coffee break
16.30 - 17.30  Keynote 3 (Anthony Chemero)
17.45 - 18.30  Virtual socialising
19.30  Conference dinner at Glöckl Bräu

Saturday 28

09.00 - 10.00  Keynote 4 (Dylan van der Schyff)
10.00 - 10.30  Coffee break
10.30 - 11.45  Posters & Flash Talks
11.45 - 12.30  SIM General Meeting
12.30 - 14.00  Lunch
14.00 - 16.30  Session 5a & 5b
16.30 - 17.00  Coffee break
17.00 - 18.00  Final session
What is the role of cross-modal correspondences in linking movement and time in performance? Even though it is well-established that temporal aspects and movement are closely linked and it is self-evident that this relationship is cross-modal, literature on cross-modal correspondences and literature on time and tempo in music performance have had surprisingly little interaction. In this paper, I explore how work on cross-modal correspondences could inform and enhance our understanding of time and tempo in music performance. Specifically, cross-modal correspondences provide a number of predictions of how time and tempo may be co-expressed in movement. Furthermore, I discuss the role of action for the shaping of correspondences between modalities. The relevance of this discussion is to better understand how performers communicate and plan performance, and to enhance our understanding of phenomena such as synaesthesia. Examples from the literature and some new data are discussed to support and reflect on the arguments. Implications and hypotheses for future research are presented.

Renee Timmers is Reader in Psychology of Music at The University of Sheffield, where she directs the MAs in Psychology of Music, and the research centre Music, Mind, Machine in Sheffield. Trained in musicology and psychology in the Netherlands, her research employs interdisciplinary methods and techniques to enhance the understanding of how music is performed and experienced. Specifically, her work includes publications on expressive music performance, expression and perception of emotion in music, interactions between music cognition and emotion, and cross-modal experiences of music. Recently published volumes include Expressiveness in music performance: Empirical approaches across styles and cultures (OUP, 2014) and The Routledge companion to music cognition (Routledge, 2017). She has served on the editorial board of several of the leading journals in psychology of music and is currently President of the European Society for the Cognitive Sciences of Music (ESCOM). Within this role, she continues to promote interdisciplinary perspectives on music cognition, and the organisation of virtual and live events to connect researchers from geographically as well as disciplinary diverse areas.
Audition as sense-making, and its contribution to the shared human lifeworld

Embodied and enactive theories of cognition bring concepts from general systems theory to bear in interpreting the way that bodies interact with their surrounds. This allows a radical reconceptualization of the manner in which the lifeworld arises. Framing such activity as sense-making, rather than the construction of perceptual representations, allows us to highlight the reciprocal nature of our dance with the world. Three distinguished modes of sensemaking will be considered, beginning with touch, which provides the prototype for understanding this dance. The physiological basis for touch makes the reciprocity manifest, and emphasises the whole body. Extending this framing to vision reveals vision too to be a mode of active interaction with the world, but its anchoring in the body is, in an important sense, more distributed, less immediately stamped by the structures of the body. Audition presents puzzles here, as the reciprocity in auditory sensemaking is less evident yet. However, I will argue that in music making, the reciprocity is suddenly made very clear, allowing collective sensemaking. This potential for collective construction of the lifeworld is evident in the role of many collective practices including rituals of all kinds, and provides a window into the generation of the human lifeworld for which, in many accounts, language is often held accountable.

Fred Cummins is co-director of the cognitive science programme at University College Dublin. He obtained a PhD with joint major in Cognitive Science and Linguistics in 1997 from Indiana University. His empirical work has been largely concerned with joint speech or chant, as found in prayer, protest, sports, education, and beyond. Joint speech arises any time multiple people utter the same words at the same time. This topic raises questions of relevance to many areas, including ritual studies, anthropology, music and ethnomusicology, neuroscience, phonetics, movement studies, and the philosophy of enaction. In joint speech, we approach human vocal coordination in a way that obliterates any strong distinction between speech and music. Joint speech is the topic of a recent book The Ground From Which We Speak: Joint Speech and the Collective Subject (2018, Cambridge Scholars). His more recent work combines themes from embodied and enactive cognition to try to understand how we are multiply constituted and how we might seek to understand ourselves as incorrigibly plural. This challenge leads to a form of Dialogical Realism that eschews certainty to work instead towards Joint Actionable Consensus.
Music in Embodiment

The last few decades have seen an increasing focus on embodiment in the cognitive sciences. Although this shift of focus is controversial in some circles, most cognitive scientists and philosophers of cognitive science would agree that embodied cognitive science has provided previously unavailable insights, especially in the areas of perception and action. Given this, it is natural that the focus of this conference is the role of embodiment in musical cognition. This presentation has the opposite focus. That is, rather than asking what insights embodied cognitive science might bring to musicology, I will look at the ways that studying music perception and performance gives us insight into embodied cognition more generally. To this end, I will describe experiments on auditory perception and musical performance. I will argue that the results of these experiments have implications that extend well beyond the realm of music.

Anthony Chemero got his Ph.D. in Philosophy and Cognitive Science from Indiana University in 1999. From then to 2012, he taught at Franklin & Marshall College (F&M), where he was Professor of Psychology. In 2012, he became Professor of Philosophy and Psychology at the University of Cincinnati. Anthony’s research is both philosophical and empirical. It is focused on questions related to dynamical modelling, ecological psychology, artificial life and complex systems. He is author of more than 70 articles and the book Radical Embodied Cognitive Science (2009, MIT Press), which was a finalist for the Lakatos Award. His second book, co-authored with Stephan Kaufer, will appear on Polity Press. He is currently editing the second edition of the MIT Encyclopedia of the Cognitive Sciences.
In folk psychology, the term ‘empathy’ refers to the ability to understand or feel the experience of another person. This might involve, for instance, inferring the thought processes of an individual, which can allow one to understand why that person makes the choices they do. This would also include some awareness of the other person’s history, of their beliefs and background. Accordingly, empathy can entail complex imaginative and deductive processes where we place ourselves in their position or, in a sense, ‘enter into’ their mental lives. But empathy can also involve a more basic awareness of the corporeal and emotional-affective states of the people we encounter. This ability appears to be rooted in a fundamental capacity to associate the bodily movements, gestures, expressions, and vocal inflections we perceive in others with states we experience ourselves. In this talk I consider such phenomena in the context of human musicality. I begin with a brief overview of research and theory and then introduce two perspectives that appear to offer a way forward – Simulation Theory (ST) and Interaction Theory (IT), respectively. Here I argue that while both approaches offer important insights, IT may be especially well-suited for examining musical experiences. This is because it overcomes the ‘internalist’ bias that tends to guide other perspectives – where mental processes are understood in terms of representational content (e.g., ‘simulations’) limited to the brain. Taking this further, I then outline a 4E framework (embodied, embedded, extended, and enactive) for musical empathy that draws on recent work in affective neuroscience, developmental studies, social cognition, and dynamical systems theory. To conclude, I explore how an IT approach guided by the 4E model of cognition could provide a useful orientation for future research as it highlights the role of the situated body in musical experience, extending the domain of musical empathy beyond the brain and into the living socio-material environments where musical events unfold.
TALKS
Accompaniment to Arab Vocal Improvisation Based on Statistical Machine Translation: Objective and Subjective Evaluation

Fadi Al-Ghawanmeh¹², M. Amine Menacer² & K. Smaïli²

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Background in Arab music
Mawwal is a traditional form in Arab music. It usually consists of several poetic verses narrated over an improvised melody in a particular maqam. During vocal improvisation, instrumental accompaniment functions as a background, limited to either a drone tonic, or following the singer's melodic path (Hamam, 2008). However, once the singer completes a phrase or a sentence, the accompanist(s) performs a recapitulation, or translation. This raises instrumental creativity to an advanced level, and shapes interactivity in a musical form known to be tightly connected to modal ecstasy (Racy, 1998).

Background in Natural Language Processing
In early research work and in the context of mawwal, we proposed a machine translation (MT) model to automate the transformation of vocal sentences into melodic instrumental sequences (Al-Ghawanmeh & Smaili, 2017). Due to the lack of musical scores and datasets of instrumentally accompanied mawaweel (plural of mawwal), and also to technical reasons not allowing us to transcribe accompanied mawaweel from audio with high accuracy, we built our own corpus. We recorded several hours of mawaweel accompanied by MIDI keyboardists performing in oud style. We then transcribed vocal parts using a transcriber designed for mawaweel (Al-Ghawanmeh, 2012). Our corpus consisted of numerical representations of transcriptions in which each vocal sentence had a corresponding instrumental translation, with a total size of 2,779 parallel sentences. This costly process limited the corpus size, and directed us to experiment with statistical MT instead of neural MT.

Aims
We aimed to improve the objective evaluation results of automatic accompaniment to mawwal by expanding the size of our parallel corpus. We also pursued a subjective evaluation experiment and one user experience interview, the latter aimed to discuss aspects including the bodily experience.

Main contribution
We expanded the size of our corpus to 4,041 parallel sentences and retrained the model. We then objectively evaluated the statistical MT using the bilingual evaluation understudy (BLEU) measure (Papineni, Roukos, Ward, & Zhu, 2002). The BLEU score increased by 13%. We also performed an experiment to subjectively evaluate our model. We asked three evaluators, all professional practitioners of Arab classical music, to complete a listening test. They listened to tens of randomly ordered parallel sentences, 53 of which had human-performed instrumental translations and 51 of which had computer-generated translations. The evaluators rated each translation into one of five ranks: from 5 (excellent) to 1 (very poor). The mean of the averages was 3.82 for human translations, and 3.13 for computer translations, interestingly labelling both
as "average" while pushing the boundaries of this category. This indicates a very good improvement as compared to ratings of translations of the same vocal sentences generated by the model before corpus expansion (mean of averages 2.56). Reliability across evaluators was measured using Fleiss Kappa, and values were 0.19 for human translations and 0.07 for computer translations. This exemplifies subjective disagreement based on the musicians' different backgrounds. Yet, the agreement is much higher for human translations. For human translations, the three averages of the three evaluators fluctuated in a narrow range between 3.7 and 4.0. The range, however, was much wider for computer translations: 2.64 - 3.74. In sum, human translations were readily recognized as acceptable while computer translations stoked more controversy. We also interviewed a singer who performed with this model for an exhibit (Al-Ghawanmeh & Smaili, 2018), and he discussed his user experience. He appreciated the machine speed, tuning, and successful adaptation of vocal melodic lines within instrumental responses. He considered this as a way to create modal ecstasy, despite a need to improve the translation of longer sentences. Interestingly, he criticised the machine's changes to the melodic progression and viewed it as undermining his absolute leadership. He further argued that the instrumentalist should not anticipate the start of the vocal sentence without a bodily cue - such as a hand gesture or eye contact - or a shared memory formed after several repetitions of a particular improvisation. Accordingly, he suggested adding control buttons in the model's interface to compensate for bodily gestures. He also suggested personalising the model to learn common attitudes of singers, as this would decrease distraction and leave the singer more space to communicate with the audience.

**Implications for musicological interdisciplinarity**

We believe that this contribution has important implications for understanding the future impact of artificially intelligent composition tools and interactive instruments. These “smart” means of music creation may seem to divide practitioners and experts on conceptions of quality and creativity, even among those in the same musical subfield. However, this study can encourage constructive dialogue around how conceptions of creativity shift in relation to technology, and how this impacts the subjective evaluation of new and different musical sentences. This project also provides alternative, forward-looking approaches to understanding how computer-generated accompaniment reconfigures the sociality of music making. Our future work will expand this study by enlarging and varying the corpus, to allow for experimenting with neural MT. We will also apply further listening tests and user studies to understand factors biasing subjective evaluation. We will analyze individual bias and look into its causes in both the environment and the subject's subjective bodily experience.

**References**


Playing without Mental Representations: GesTCom, a System for the Optimization of Embodied Interactive Learning of Complex Piano Notation Through Adaptive Multimodal Feedback

Pavlos Antoniadis

Team interaction - son - musique - mouvement
UMR STMS IRCAM-CNRS
Sorbonne Université, FR

Background in Performance Practice
As a pianist specializing in complex contemporary music, I address the following research question: If and why does complex piano music necessitate an embodied interactive paradigm, which differs from the traditional textual interpretation paradigm. I have addressed the question through practice-led research on contemporary piano performance practice, notably Iannis Xenakis (Kanach, 2010) and Brian Ferneyhough (Antoniadis & Bevilacqua, 2016).

Background in Musicology and Performance Studies
I have examined the performative turn in English- (Cook, 2013), French- (Lalitte, 2015) and German-speaking musicology (Hiekel & Lessing, 2014), identifying a central aporia, namely the problematic ontological status of the musical score in performance-oriented methodologies. Parallel to the performative turn, I have studied the embodied cognitive turn in systematic musicology, epitomized in the work of Marc Leman (2007; 2016).

Background in Cognitive Psychology
I addressed the research question: What could be the alternative to the textual interpretation paradigm. I introduced my embodied and technology-mediated alternative under the name “embodied navigation of complex notation”, drawing on the different strands of embodied cognition, indicatively (Chemero, 2009; Clark, 2016; Gibson, 1986; Rowlands, 2010) and tending towards a radical anti-representationalist dynamic stance.

Background in Human-Computer Interaction
I addressed the research question: How could the embodied navigation paradigm contribute to the development of interactive tools for the recording, analysis and integration of physical movement in augmented dynamic notational representations. I introduced technological implementations of notation as gesturally controlled interface, by investigating: gesture modeling conducted at IRCAM by the ISMM (Interaction-Son-Musique-Mouvement) (Bevilacqua, Schnell, Rasamimanana, Zamborlin & Guedy, 2011); interactive notations featured in TENOR (2015); new interfaces as presented by NIME; and ideas and concepts from the wider HCI (Human Computer Interaction), notably work on extreme users (Ex-situ).

Aims
Aim of this presentation is:
a) to argue that the role of mental representability while learning to perform complex notated piano music can be outsourced to the interaction between symbolic and environmental information, notably performative embodiment;
b) to do so in relation both to the traditional textual interpretation paradigm, as an extreme case of internalism in music learning, as well as in relation to the latest wave of predicting processing in embodied cognition, opposing the radical embodied cognitive strand;

c) to present the GesTCom, an interactive system materializing such dynamics of embodied and extended learning without mental representations, through the online updating of music notation and the use of augmented multimodal feedback.

**Main contribution**

I propose a novel paradigm of pianists’ interaction with complex music notation defined as embodied navigation. Its novelty lies in rethinking the classic notion of textual interpretation as embodied interaction, in a wider conception of musical performance as a dynamic system. In the radical version of the embodied navigation model, and in line with the radical embodied cognition proposed by Anthony Chemero, the processing of the musical text can be explained even without the need for mental representations, as dynamic interaction between the elements of the system: body, mind, instrument, notation and interactive systems. Such version does not negate the potential mental representability of the process, but claims that mental representations are epistemologically only contingent and not a sine qua non for musical performance. This embodied navigation paradigm is materialized in the GesTCom (Gesture Cutting through Textual Complexity), a dedicated interactive system that we have developed at IRCAM since 2014, in collaboration with the Interaction-Son-Musique-Mouvement team. It is a modular sensor-based environment for the analysis, processing and real-time control of complex piano notation through multimodal recordings. The system optimizes the performer's learning experience through longitudinal multimodal documentation, real-time activity monitoring through augmented multimodal feedback and real-time adaptation of the complexity of the music notation according to the user's developing skills along the learning curve.

**Implications for musicological interdisciplinarity**

My research is inscribed in what today constitutes a paradigm-shifting web of knowledge around musical performance. The relevant fields include both the humanities and the hard sciences, as well as reflection on contemporary artistic creation through the notion of artistic or practice-led research. In the humanities, traditional approaches stemming from historic & systematic musicology and music pedagogy are complemented by the performative turn in musicology, the wider field of performance studies, and aspects of complexity in post-1950 compositional and performative aesthetics. In the hard sciences, the role of embodiment in cognitive processes (embodied cognition / cognitive psychology), the study of physical movement through interactive technologies (Human-Computer Interaction) and the creation of new interfaces for musical expression are combined with computational approaches in musicology.

**References**


Multilevel-grounded Semantics of Music: Embodiment in Five Levels of Musical Meaning

Mihailo Antović  
*University of Niš, SRB*

**Background in Semiotics**
While some scholars deny that music can anyhow “mean” (Kivy, 2002), others look for musical signification in numerous phenomena: from formal structures alone (Bernstein, 1976) to psychological reactions to expectancies (Huron, 2006) resulting in proto-affective states that at one point transform into actual emotions (Sloboda, 2000) to full-fledged extramusical experiences and narratives accompanying music (Hatten, 2004). At least two recent trends in approaching musical meaning, thus broadly defined, can be found: (1) more direct use of constructs proposed by *cognitive linguistics*, such as “image schemas” (Brower, 2000), “embodiment” (Cox, 1999), “conceptual metaphor” (Larson, 2012), or “conceptual blending” (Zbikowski, 2002); and (2) reinstitution of the discussion of what *grounds* this meaning: from psychological affordances (Clarke, 2005) to bodily action (Leman, 2007).

**Background in Cognitive Science**
Conceptual Blending Theory (Fauconnier & Turner, 2002) claims that creativity stems from the peculiar human capacity to combine notions from disparate sources into structures boasting novel features. The Sphinx, for instance, is not just a mix of a person and an animal, but rather an integrated structure engendering new qualities, such as the ability of this “blended” creature to pose super intelligent riddles under the threat of prompt execution. Blending convincingly models how new concepts emerge across domains, from complex numbers to scientific neologisms, yet it has been criticized for the lack of ontological motivation. It is often unclear why some combinations work (the malicious human-lion) but others do not (e.g. a malicious human-sparrow). To address this, Coulson and Oakley (2005) introduced the notion of the “grounding box”, a set of background assumptions that interlocutors implicitly share in a conversation. For example, to understand the counterfactual “If Bill Clinton had been French, there would have been no Monika Lewinsky affair”, one needs to be implicitly aware of a range of contexts, from marriage and morality to differences between French and US political systems. The same applies to musical interpretation. Just *any* music cannot go well with just *any* description: rather there must be a series of contextual limitations – from purely physiological to broad cultural assumptions – that motivate semiosis.

**Aims**
The present contribution combines these insights into a coherent theory of musical signification, informed by the notion of embodiment, and based on actual participant descriptions of music from my group’s experimental studies. It aims to:  
(1) present the basic tenets of this emerging “multi-level grounded” musical semantics;  
(2) focus on the importance of embodiment in all five levels of signification that the theory proposes;  
(3) reanalyze 1,200 actual participant descriptions of musical pieces from a previous experiment (Antović, Stamenković, & Figar, 2016) to highlight the prevalence of references to bodily action.
Main contribution
The central idea of multi-level grounded semantics is that grounding is multilayered, where “lower” and “higher” grounding boxes are allocated along a continuum, providing hierarchical and partially recursive constraints on the generation of musical meaning. When a participant describes Wagner’s sword leit motif as “the descent of gods from Olympus” they indeed blend the musical qualities of the piece (Input Space 1) and cultural knowledge of Greek mythology (Input Space 2). Yet, the selection of the extramusical description is not entirely haphazard: nobody describes Wagner, for instance, as “peaceful recollection”. This is so because multiple grounding boxes constrain the process. The proposed grounds in the current state of the theory are: (1) physiological, causing involuntary tensions and relaxations through the manipulation of musical expectancies; (2) image-schematic, motivating cross-modal correspondences between the musical structure and the listener’s multisensory experience; (3) connotational, relating the music to non-narrative dynamic sensations, as in emotional states; (4) conceptual, fostering short extramusical narratives; and (5) elaborated cultural, resulting in richer descriptions strongly based on the listener’s cultural knowledge. Hence for our participants trills from Vivaldi’s Spring were reminiscent of “expectation”, “flight path”, “joyful atmosphere”, “budding of flowers” and “sun beams falling through thick branches while a rabbit is hopping over small rocks”. Similarly, Schubert’s Gretchen was interpreted as “tension”, “rotating whirlpool”, “fear of loss”, “a lamenting queen” and “a girl drinking, lamenting in a lonely corner of a bar”. Importantly, lower grounds always partly motivate higher ones: thus, the rich description of “Gods from Olympus” following Wagner would not be salient were it not for the frequent “tension”, “clash of forces”, “dramatic sentiments”, and “armies struggling” on the lower levels. The present contribution for the first time focuses on embodiment as a possible cognitive mechanism permeating the grounding system. On level (1) the physiological reaction to the manipulation of expectancies is typically visceral, sometimes resulting in involuntary bodily responses such as shudders. The schematic construction of cross-modal correspondences from level (2) is often accompanied by descriptions of movement along trajectories, which most cognitive linguists claim developmentally emerge from bodily activity. The connotative, conceptual and elaborated cultural levels typically describe either human emotions, often accompanied by bodily sensations, or events with human beings or animals performing actions. To corroborate this prevalence of (verbalized) embodiment in our participants’ descriptions, the presentation will provide qualitative and quantitative analysis of instances from my current databases explicitly referring to bodies and bodily activity (51.1% of all responses, peaking at 81.6% in musical stimuli abounding in staccato articulation / association of movement).

Implications for musicological interdisciplinarity
The current approach illustrates how musical semantics may profit from recent insights of linguistics, semiotics and cognitive science at large. Such a theory can then be used as a model for studying signification in other domains: I am currently developing extensions to visual perception and interpretation of poetry.

References


Unravelling the Question of Mapping and the Aesthetics of Digital Musical Instruments

Marije Baalman
Freelance artist/researcher/developer - nescivi, Amsterdam, NL

Background in Engineering
The development of new musical instruments for expression (i.e. NIME) or new digital musical instruments (Eduardo & Wanderley, 2006) uses methods and technologies from music technology, computer science and human computer interface (HCI) design. The teaching on this topic is taking place in different disciplines: live electronics, music technology, computer science and human computer interface design, each bringing in their particular point of view into the process.
Signal processing is an essential element in the design of these instruments: the decisions in how the signals and data from sensors and controllers is processed determine how the instrument will behave and how the interaction with the instrument will be experienced.

Background in Performative Arts
Artists (aided by engineers, or becoming engineers themselves to some degree) have been creating their idiosyncratic instruments in this manner for almost a century now, with in the recent decades a significant increase as the technological means have come within reach of more and more artists: technology is cheaper and through large online communities focusing on physical computing the technology is more accessible. Prominent examples of these artists and their work are found and discussed in the literature. Waisvisz (1999), the inventor of "The Hands" (Otto, 2017), believed that “... the algorithm for the translation of sensor data into music control data is a major artistic area; the definition of these relationships is part of the composition of a piece. Here is where one defines the expression field for the performer, which is of great influence on how the piece will be perceived.” The notion of instrumentality in this context has become a topic of research in musicology, as exemplified in (Bovermann, De Campo, & Weinzierl, 2016). In media art the aesthetics of interaction (Kwastek, 2013) is also discussed. Similar approaches and technologies are also used for interactive dance performances (Kozel, 2007), so it seems it is necessary to embrace a cross-discipline approach to study the performative aspects of these instruments. Especially since many of the practitioners in these fields move freely between the disciplines of music, theatre, dance and media art.

Aims
With this paper I want to argue for the need to study the mapping (the algorithm Waisvisz refers to) within digital musical instruments in detail, in order to be able to study, transfer and discuss the different aesthetic approaches taken in this process by artists.

Main contribution
Electricity allowed to make a separation between the physical manipulation of an object and the acoustic result of this action. Thus, an arbitrary connection can be made between the physical gesture and the sound that is generated. Although this connection is arbitrary, it is far from trivial. It may be personal, but it is not analytically impenetrable. The decisions made in
this process define the expression field of the performer and in itself are an artistic expression. Artists approach these decisions with concepts in mind for the interaction and the feel of this interaction they want to achieve with the instrument they are building. Often these decisions are entangled with their compositional ideas and performative concepts.

The design process is necessarily an embodied experience, where the artist goes through cycles of building, programming / mapping, playing and tuning, until a satisfactory result is achieved. Once the artist has practiced extensively with a given mapping of gesture to sound, it may be hard to revise both the physical interface and the mapping, as the artist has trained her muscle memory to the given configuration. The instruments themselves are designed for performance: to create an embodied way of creating electronic music.

There are numerous tools available to artists to create the mappings they desire, but it is rare that such instruments are documented outside the context of the particular tool(s) they are programmed in; with different nomenclature used in the different tools, it is even harder to find a method of transferring the knowledge about the mapping from one artist to another, or from artist to musicologist. This is even harder, when the given tool is no longer useable, as either the hardware or software that it is based upon becomes obsolete, stops functioning, and/or when necessary source files are unreadable (closed format) or lost.

In order to gain a detailed understanding of these idiosyncratic mappings in digital instruments, I feel there is a need to describe the techniques from e.g. interface design, signal processing, pattern recognition, machine learning, both in their technical terms (mathematical formulation and computational implementation) on a level that can be understood by artists and/or people with limited mathematical and/or computer science training, both on the technical and an aesthetic level: "why is this technique useful" and "how does this technique support this artistic concept?". Based on this groundwork, it is then possible to build up a methodology of documenting and describing digital musical instruments, combined with verbal descriptions from the artists who created them. This will allow musicologists then to study the aesthetics of these instruments and discern different styles that have emerged within this field.

**Implications for musicological interdisciplinarity**

The proposed methodology suggested above, implicates that in order to fully understand and study digital musical instruments, the fields of signal processing, interface design, music technology, performance studies will need to meet with musicology to analyse the aesthetic practices of artists in this field.

**References**


Negotiation and Creative Collaboration during Piano Duet Performance

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Background in Musicology
Most notated forms of music require interpretation of loosely-defined score instructions. For music ensembles, the interpretability of such repertoire presents a welcome challenge: on one hand, coordinating a shared interpretation can be difficult, especially if individual ensemble members interpret the music differently; on the other hand, establishing a unique group playing style can help them distinguish themselves in the crowded professional music scene. Ensemble musicians often learn a piece individually before rehearsing it together, and may have few opportunities for group rehearsal before performing publicly. An understanding of the processes involved in successfully and efficiently negotiating a shared interpretation is thus of interest to both researchers and practitioners.

Background in Cognitive Psychology
Ongoing research in the area of collaborative creativity has targeted the question of how groups achieve real-time coordination of actions when performing a creative action sequence. The literature highlights several processes that contribute to coordination in creative contexts. First, the responses that performers make to a given stimulus may converge as a result of their shared familiarity with the stimulus and task. Second, performers’ expectations for upcoming events in the action sequence are continuously reshaped as the sequence unfolds and they receive new feedback. Third, accommodation of changes to the action sequence happens quickly and at least partially automatically. And fourth, performers often modify their behaviour in some ways to maximize performance quality (e.g., visually signalling their co-performers or adopting more predictable behaviours if coordination is insecure; encouraging creative risk-taking if coordination is stable). The current study attempted to explore these processes in the context of piano duet performance.

Aims
The primary aim of this study was to describe the behaviour of pianists as they negotiated duet performances of a piece that they had previously learned individually. We investigated potential changes in “communicative” features of their body movements between solo and duet playing conditions, and tested for the emergence of leader-follower roles. We also tested whether the pianists would adopt more prototypical interpretations or, conversely, more divergent interpretations when performing the duet, compared to their solo performances.

Main contribution
Twelve pairs of highly skilled pianists individually practiced solo and duet versions of a short piece ("Minuet", by Ravel). We then recorded three solo performances from each partner before recording three duet performances. Audio, MIDI, and head movements were collected. Analysis of note timing showed greater expressive variability in solo performances than in duo
performances, but prototypicality of tempo and dynamic curves did not differ between solo and duet conditions. Leader/follower relationships in note timing emerged, with primos tending to lead. Quantity of motion was greater during solo performances than during duet performances, though movement during duet performances was smoother. Coordination in head movements also emerged during duet performances.

Implications for musicological interdisciplinarity
Our findings suggest that coordination emerges in performers' body movements during duet performance, as well as in their sound output. Performers' intent to collaborate, furthermore, manifests as changes in the communicative quality of their body movement. Contrary to our expectations, collaboration between musicians did not produce more divergent expressive profiles than were produced during solo performance; rather, pianists seemed to converge towards a prototypical interpretation. Finally, we observed evidence of leader/follower relationships, which likely facilitated negotiation of potentially conflicting interpretive ideas.
Sonic Affordances and the Lived Body in Two Contrasting Ritual Contexts

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Background in Medical Anthropology
In anthropology, rituals involving ‘spirit possession’ and ‘shamanism’ are usually treated as highly culturally relevant emanations of the human quest towards health and wellbeing. Embodiment concepts are more commonly applied in research about ‘spirit possession’ (e.g. Halloy, 2012) because in indigenous theories, a spirit or god takes control over the ritualists’ body. Contrastingly, for ‘shamanism’, indigenous people often express that the ritualists’ soul leaves the body in order to interact with spirits (e.g. Rouget, 1985). In both contexts, however, musicking plays crucial roles in these altered states; especially during the corresponding transitions.

Background in Musicology
Musicological analyses of music in ‘possession rituals’ most often treats intense drumming and singing as techniques for providing a sonic environment of sensory overflow in order to make possession possible, and for calling entities through specific rhythms or sung invocations (e.g. Jankowsky, 2007). Analysing ‘shamanic’ music mostly relies on the lyrics solo-performed by ritualists that describe her/his journeys in the spirits’ realms (e.g. Werlang, 2017). Physiological mechanisms that would trigger or guide altered states with these musics are constantly under debate. Phenomenological approaches to the experience of sound and music in such contexts are however rather scarce.

Aims
Applying a phenomenological analysis of ‘possession’ and ‘shamanism’, we bridge the conceptual gap between indigenous theories and scientific explanations of ‘trance states’ or, as we prefer: anomalous experience (Cardeña, Lynn, & Krippner, 2017). We show that the lived body (Leib) (e.g. Fuchs, 2018) is the central nexus for ritual interaction that localizes musicking, which in turn serves as a medium for involving spirits into human reality.

Main contribution
We base our analysis on empirical data—interviews and recorded rituals—obtained during year-long in-depth fieldwork among Afro-American practitioners of Vodou in the Dominican Republic (Cardeña & Schaffler, 2018; Schaffler & Brabec de Mori, 2015) and among Indigenous ritual specialists in the Western Amazon rainforests (Brabec de Mori, 2015). By presenting audiovisual material from two exemplary rituals, we show that the musical and other activities are embedded within a bounded ritual environment. In the case of Vodou, the ritualists’ mind is ‘gone’ during the possession state, ‘substituted’ by an entity that takes control over the body and voice, including (partial) amnesia. In the Amazonian case, no amnesia is reported, while the ritualist experiences a ‘substitution’ of the body that is ‘gone’ when entering
the spirits’ world: in this world, the singer’s voice makes up for his/her body: an absent body is ‘ensounded’ in the continuously singing voice. In both cases, the entity composed of ritualist and spirit during the anomalous experiential state extends through the ritual environment, thus embedding participants in the experience of the spirit’s presence, gaining authority and power that is culturally related to issues of health and well-being. We argue that during ritual the experience of mind, body, and environment is altered in an anomalous way (that is, decidedly different from the everyday), thus causing an ontological shift: the metaphysical can be experienced first-hand through the musically active lived body.

**Implications for musicological interdisciplinarity**

We conclude that the ritual involves an alteration of the mind-body-environment. The setting controls for the environment, in which a part of the mind or the body can be ‘substituted’ within a safe framework, thus producing culturally highly relevant meaning. We assume that also musical or sonic performances that are less pronounced as altering by participants can be analyzed in terms of shifts or alterations in the continuum of mind, body, and environment, specifically by applying a phenomenological approach that respects both ‘emic’ and ‘etic’ explanations of the performance situation.

**References**


Embodying Sociality: The Interactive Scaffolding of an Afro-Surinamese Dance Form

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Background in Ethnomusicology and Dance Studies
That music and dance are often inextricable components of a performance event is by now a relatively well-rehearsed assertion, particularly in relation to many performance traditions in Africa and the African Diaspora. Yet despite the widespread acceptance of this general claim, the character of interactions between dancers and musicians and a technical understanding of how aural and kinesthetic components of performance inform one another continue to be under-represented in analysis. Works that have sought to maintain an integrated approach to music and dance, sound and movement, include Rahaim (2012), Sanger (1989) Citro and Cerletti (2017), Kaminsky (2014, 2015), Gaunt (2006), Meintjes (2004) and Kurath (1966). My present research adds to this vital realm of scholarship, building on previous work in order to emphasize how performance roles and responsibilities foster a particular kind of social sensitivity—in particular, how musical cooperation in communal performance contains within it ways of recognizing individuals’ strengths and exercising particular modes of social care and support. In my emphasis on formal and structural components of communal performance recalls and offers an alternative to Lomax’s choreometrics (1969); it shares a particular affinity with scholarship on capoeira by Browning (1995) and Downey (2005), and Hamera’s (2007) research on dance and community formation.

Aims
Through detailed analysis, I demonstrate how awasa, a social dance form of the Suriname Maroons, employs an interactive scaffolding that links musical and choreographic activity on a fundamental level, embedding within the dance form a series of social relationships that reflect and galvanize community.

Main contribution
Even without any prior introduction to awasa—a social dance of the Ndyuka Maroons of Suriname—it is easy to become captivated by its performance. Drums maintain a flurry of sound in kaleidoscopically changing patterns, a lead singer and chorus cut through the dense percussive texture. The air buzzes with anticipation as each new dancer emerges from the perimeter, infusing the dance’s bent and angular positions with their own character and stylistic touches, every step adding the sound of ankle rattles to the musical mix. Yet whether or not a person understands the communicative work that undergirds the performance, collaboration is the prerequisite for all other aspects; it lays the groundwork for each expressive utterance, showcasing and amplifying performers’ talents.

This analytical presentation is my attempt to introduce the structural and interactive scaffolding that orders the more immediately accessible sounds and movements of awasa performance. I endeavor to establish a sense of the character and complexity of the genre, shedding light on the kinds of social and musical awareness, performance skills, and creative license associated with each performer’s role. A structural analysis makes clear how the interrelationships between performers shift constantly throughout the duration of each piece, fusing sonic and
kinesthetic activity to the point where musical and choreographic distinctions lose meaning and utility.

I conclude by demonstrating how the interactive logic that draws together participants within a performance enforces broader social ideals and principles. From the variety of interdependent lead and supporting performative roles to the ways that onlookers assist and encourage musicians and dancers, a successful performance activates social expectations and responsibilities that both enforce and enact community, fully merging the realms of ethics and aesthetics to instill within participants instilling an embodied sociality.

Implications for musicological interdisciplinarity

In my analysis, I make it a point to delve equally into musical and choreographic detail. While ethnomusicologists, dance scholars, and anthropologists frequently make explicit their focused interest in the sonic, choreographic, or textual dimensions of performance, I maintain that this kind of selectivity risks bypassing crucial logical, logistical, and creative facets that not only enhance, but help to constitute their chosen points of focus. Awasa is an ideal genre through which to explore the possibilities of integrated analysis, as the instrumentalists, singers, and dancers are deeply interdependent; a conversation initiated through sound is often continued through dance, and vice versa.

By articulating particular actions that link to social ideals outside of a performance context (for instance how improvisation between a lead drummer and dancer mirrors other Maroon practices of social exchange, or the manner in which onlookers mobilize to ensure a dancer’s modesty and safety), I outline an array of specific social sensibilities that are engrained and activated though performance. These provide an empirical grounding for what might otherwise be abstract references to community and social mobilization.

References


Music, Social Engagement, and Empathic Decision-making

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Background in Music Psychology and Anthropology
Music exists in a constantly circulating continuum of active/passive and/or participatory/presentational (Turino, 2008) contexts within every human culture on Earth, often accompanying social functions in some capacity. This suggests that a deeper understanding into why this accompaniment exists may yield knowledge into why humans have and/or engage in/with music in groups at all and what outcomes may come from such knowledge. In the context of this project, two contrasting selections of music were used to identify certain of music’s psychological (i.e. music preference and dispositional skills) and physiological (i.e. heart rate variability, galvanic skin response, and respiratory sinus arrhythmia) roles in social functions: Western-European bowed-stringed instrument music and Brazilian Carnival percussion music. Previous anthropological research has demonstrated important relationships between music and social behavior, specifically music’s roles in social communication (Mithen, Morley, Wray, Tallerman, & Gamble, 2006). Plethora interdisciplinary neuropsychological research documents music’s roles in facilitating shifts in states of mind (Becker, 2004), emotional states (Juslin & Sloboda, 2001), physiological states, (Davis & Thaut, 1989). This study was designed to examine the effects of differences in musical content specific to rhythm, tempo, instrumentation, and articulation upon empathic decision-making.

We used a multi-modal approach including psychophysiological (HRV/RSA and skin conductance) and self-report data to evaluate the impact of these qualitative aspects of musical pieces on empathic decision-making.

Aims
The purpose of this research was to determine linkages between music and human social engagement by investigating music’s effects upon psychophysiology in social settings.

Main contribution
Although it is known that music is widely used in social settings, the psychophysiological underpinnings of impacts of certain musical types (qualitative musical features) on empathic decision making in healthy young adults is unknown. We hypothesized that the previously listed attributes of music would facilitate an increase in empathic decision-making as compared to a control group, due to changes in the social engagement system as described in the Polyvagal Theory (Porges, 1995). The methods used in this study advanced previous interdisciplinary research in musicology and neuroscience, by structuring empathic decision making as an outcome measure of social engagement embedded within a music-listening intervention. The tool used to measure empathic decision making was Cyberball (Williams, Cheung, & Choi, 2000), a virtual ball-tossing game designed to assess social inclusion/ostracism. Previous work with Cyberball has not included music, as confirmed through email communication with the creator and software engineer of the game. Furthermore, the combination of music used (i.e. Western European bowed-stringed instrument music and Brazilian Carnival percussion music), psychological assessment tools (i.e. dispositional personality – Big Five Inventory-10, (Rammstedt & John, 2007); dispositional empathy – IRI, (Davis, 1983); dispositional musical skill – mini-PROMS, (Law & Zentner, 2012); and music preference – STOMPr, (Gosling &
Rentfrow, 2003), and physiological assessment tools (i.e. Empatica E4 wristband; Cardio edit and Cardio batch software) is previously unaccounted for in the relevant literature. Results confirmed music’s roles in facilitating increased empathic decision making as compared to a control group. Furthermore, music facilitated a decrease in pre-post sympathetic nervous system activity. A causal relationship between increased empathic decision-making and decreased sympathetic nervous system activity was not confirmed. Furthermore, our hypothesis that changes in parasympathetic activity would increase empathic decision-making was not confirmed.

Implications for musicological interdisciplinarity
This study was the first to evaluate relationships between music, social engagement, and empathic decision-making, utilizing these particular methods. Past and existing research on the intersections of ethnomusicology and neuroscience confirms the need to continue this line of interdisciplinary inquiry, in order to maintain an active curiosity investigating the psychophysiological mechanisms associated with the intersections of music perception and cognition, social engagement, and empathy.

References
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Sensing Swing: Score-dependency as a Factor in Swing Performances by Classical Musicians

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**Background in Swing**

Swing is a rhythmic performance style associated with jazz. It is a skill traditionally learned by ear, as it depends on the improvisational deployment of various microrhythmic variation techniques (Butterfield, 2011; Friberg & Sundström, 2003). Swinging performers alternatingly deviate from and synchronize with an underlying near-metronomic beat pattern (Ashley, 2002; Pressing, 2002). This process serves to perceptually highlight certain beats and so creates a physically engaging sense of forward motion in listeners (Butterfield, 2011)—causing groove, defined by Janata, Tomic, and Haberman (2012) as the urge to move to music. Therefore, swing seems to rely on physically entraining listeners to an implicit or explicit beat sequence and distorting their expectations through improvisational microrhythmic manipulation. This combination of improvisation and the deliberate manipulation of synchronisation involves several embodied processes: Most notably, the audio-motor integration of an (often externally supplied) beat with improvisational impulses and sensorimotor feedback from one’s instrument in order to physically engage audiences.

**Background in Score-dependency**

Classical musicians have self-reported difficulties in improvising (Feichas, 2010) and have been observed to struggle with playing by ear (Woody & Lehmann, 2010). As a result of their notation-driven performance practice and their difficulties playing by ear, Harris and de Jong find that many classical musicians are ‘de facto score-dependent’, i.e. limited in their ability to learn music without the aid of a score, and support this with neurological evidence (2015). Score-dependent performers’ lack of improvisational and ear-playing skills could therefore be argued to indicate a culturally motivated over-reliance on a technology (notation) to the detriment of wider musical skills (playing by ear and improvisation). Classical musicians are frequently accused of struggling to convincingly produce swing (London, 2012: 157; Schuller, 1961; Turnage & Lewis 2008). While this can be attributed to their specific musical enculturation, swing’s improvisational qualities make score-dependency a possible limiting factor arising from such enculturation.

**Aims**

This presentation presents results from a recent study on the relationship between classical musicians’ score-dependency and their ability to physically engage audiences when playing swing.

**Main contribution**

Swing is considered impossible to notate in detail due to its improvisational nature and microrhythmic complexity, allowing only a rough depiction in notation (Butterfield, 2011; Kenny, 1999; Schuller, 1968). However, classical musicians’ notation-focussed practice may leave them score-dependent (Harris & de Jong, 2015) and therefore relatively limited in
deviating from the prescribed score. As a result, classical musicians’ struggle with swing may reflect the qualitative effects of score-dependency.

This paper reports the results from a recent experiment in which classical musician’s score-dependency and swing performance was assessed and statistically analysed. First, score-reading classical musicians performed a series of ear-playing exercises, both without and with scores of varying details. The results determined each performer’s relative level of score-dependency on a scale of 1-7. In a second step, performers were asked to sight-read jazz tunes notated in two traditional and one experimental swing notation styles, both with and without aural priming. Their performances were recorded and the resulting recordings were assessed by enculturated jazz listeners. These listeners rated the recordings for levels of swing, groove, and enjoyment—thereby establishing three different sets of data points for physical engagement. A statistical analysis compared performers’ levels of score-dependency to their listener ratings. Specific results will be presented during the presentation.

Implications for musicological interdisciplinarity
The study has wider implications for music psychology research on cognition and embodiment in aural and notation-based music learning and performance. It further illuminates musicological research on swing and groove production, the effect of differing notation styles on score-based performance, and best practices in the notation of jazz rhythms for crossover performances.

References
Music Colour Synaesthesia – A Sensorimotor Account

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Background in Synaesthesia Research
Music-colour synaesthesia or simply ‘coloured-hearing’ is an umbrella term commonly applied to various types of synaesthesias that are elicited on hearing sound. Musical inducers may be broadly categorised into four groups comprising compositional style, timbre, tonality, and pitch (tone) (Peacock, 1985). Developments in synaesthesia research are beginning to address the historical assumption that synaesthesia operates under a single mechanism. Notwithstanding the general automaticity and consistency that characterises synaesthetic experiences, some forms of music-colour synaesthesia may not be so very different to normal cognition and may simply be an attempt to understand abstract concepts such as music unfolding overtime (van Leeuwen, Singer, & Nikolić, 2015).

Background in Philosophy
Having never been without their synaesthesia, synaesthetes are often surprised to discover that not everyone experiences music in the same way they do. For these individuals it just forms part of their normal perception. Perhaps the question we should be asking is not, ‘what is it like to have synaesthesia’ but, ‘what is it like not to have synaesthesia?’ With this in mind, perhaps more weight can be given to the notion that a phenomenon such a music-colour synaesthesia should not be viewed as a completely different and odd phenomenon but examined in the context of the development of research in music cognition. If looked upon this way we must consider the colours and shapes experienced in music colour synaesthesia as a fundamental part of the phenomenal character of musical experience, or the ‘what it is like’ to hear music, for synaesthetes (Chalmers, 1996; Nagel, 1974; Shoemaker, 1994).

Aims
The aim of this paper is to discuss how research in enactive music cognition might support a sensorimotor account of some forms of music-colour synaesthesia, arguing that music-colour synaesthesia should not be regarded as a separate and distinct condition within the confines of synaesthesia, but as an extension of general music cognition.

Main contribution
Recent developments in research in general music cognition move away from cognitivist accounts, reject representationalism, and embrace a more embodied standpoint (Schiavio, van der Schyff, Cespedes-Guevara, & Reybrouck, 2017; Schiavio, van der Schyff, Gande, & Kruse-Weber, 2019). Historically synaesthesia has been examined as a separate condition from normal perception and cognition. However, there is evidence that suggests that synaesthesia could be simply an ability developed by some, of understanding abstract concepts such as music unfolding overtime (van Leeuwen, Singer, & Nikolić, 2015). This paper describes how the role of embodied and enactive perception in general music cognition may be extended to some forms of music-colour synaesthesia, and how music-colour synaesthesia might be better understood as a sensorimotor phenomenon. It is acknowledged that there are difficulties reconciling synaesthesia with sensorimotor theory (Seth, 2014) but music-colour synaesthesia...
is not just about perceiving colours on hearing a tone or sound. In some forms it has been shown that it can be elicited from concept alone (Ward, Tsakanikos & Bray, 2006) and is often accompanied by shapes and textures. It is from this perspective that a skilful engagement with the environment and relevant sensorimotor contingencies may be identified. An argument is made for how the attributes of ‘bodiliness’ and ‘grabbiness’ (Hurley & Noë, 2003) might be found in a sonic environment, and how music listening might be perceived as an ‘act of doing’ (Clarke, 2005; Krueger, 2011; Reybrouck, 2005).

**Implications for musicological interdisciplinarity**

In recent research, it has become more apparent that it is important to take into consideration that synaesthesia is not just one single condition to be explained under a ‘one for all’ mechanism (Simner, 2012). Music-colour synaesthesia offers an opportunity to examine how some forms of synaesthesia may have developed as an extension to normal perception and cognition. Future research in music-colour synaesthesia should follow similar research avenues to those in general music cognition, which may lead to a testable theory that can account for the way the extra qualia experienced in music-colour synaesthesia appears the way it does.

**References**


Intercorporeality in Orchestral Performance

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Background in Music Theory
Many theorists have claimed that musical experience is embodied (e.g., Cox, 2016; Cusick, 1994; De Souza, 2017; Fisher & Lochhead, 2002; Kozak, 2015; Martens, 2016; Mead, 1999), and they have considered various ways that musical embodiment is mediated. Instrumental practice, for example, develops intersensory connections that let experts “hear” performative actions and “feel” sounds. Yet these studies generally privilege individual bodies, whether performing or listening. They do not adequately account for embodied social interaction in musical ensembles. Meanwhile, recent music-theoretical discussions of social interaction tend to overlook embodiment (e.g., Givan, 2016; Klorman, 2016). They examine small ensembles, such as jazz combos or classical chamber groups, without asking how sonic interplay might be physically grounded. How, then, can music-theoretical accounts of embodiment and interaction be integrated?

Background in Philosophy and Cognitive Science
The philosophy of Maurice Merleau-Ponty offers a model for such integration, insofar as his concept of “intercorporeality” connects embodiment and intersubjectivity (Merleau-Ponty 1964; Meyer, Streeck, & Jordan, 2017; Tanaka, 2015; Weiss, 1999). For Merleau-Ponty, human perception, cognition, and action do not start with isolated minds; rather, such processes are inherently social and physical. We interact with others from birth, and such interactions shape our bodily and perceptual capacities. This means that social relations are fundamentally embodied, and embodiment is fundamentally social. Many activities are impossible without partners, from early infant-caregiver interactions to various forms of work, sport, music, and dance. As Fuchs (2016) puts it, the partners in a dancing couple “move and feel in a way that is only possible within the interaction. . . . Each of them behaves and experiences differently from how they would do outside of the process.” Merleau-Ponty’s phenomenology resonates with empirical research in various fields, including studies of joint action, mirror neurons, and neural synchrony, as well as theories of extended and distributed cognition (e.g., Clark, 2008, 2016; Hutchins, 1995, 2014; Kirsh, 1999; Schiavio & Hoffding, 2015; Zbikowski, 2019). Moreover, writings on intercorporeality often mention the “musicality” of social interactions, albeit in a vague, anecdotal way. As such, music theory might not only draw on this discourse but also contribute distinctive insights to it.

Aims
This paper will develop a phenomenological analysis of embodied social interaction among players in a symphony orchestra, drawing on Merleau-Ponty’s theory of intercorporeality, complementary perspectives from cognitive science, and the author’s own experience as an orchestral violist.

Main contribution
The symphony orchestra serves as a case study. In orchestral performance, large numbers of players coordinate their actions and the sounds they produce. An account of orchestral
intercorporeality, however, would not simply emphasize communication among players who are essentially discrete. It would highlight distributed corporeal structures and fluid boundaries among bodies. While the conductor has a distinctive role here, intercorporeal relations within and across instrumental groups, particularly large string sections, are also important. The scale of the orchestra, additionally, reveals how embodied social interaction in music is thoroughly mediated. It depends on various techniques and technologies of coordination (De Souza, 2018). Orchestral performance, then, involves not only bodily exchanges among players but also their experience of a shared cultural world. Ultimately, this case study suggests how intercorporeality might inform thinking on musical interaction.

**Implications for musicological interdisciplinarity**

The paper brings together musicological, philosophical, and scientific perspectives on embodied social interaction. Its phenomenological foundation will support future research on music and intercorporeality, including both music-analytical and empirical investigations.

**References**


Does Musical Interaction in a Jazz Duet Modulate Peri-personal Space?

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Background in Philosophy
Music has been defined as a “biotechnology of group formation” (Freeman, 2000), because of its power to make people acting together and to establish social bonds through dancing, playing and synchronizing several social practices (McNeil, 1995). Even if more studied in the domain of time perception (Schäfer, Fachner, & Smukalla, 2013), the influence of music on space perception is a crucial aspect to understand the capacity of music to connect people, allowing for intercorporeality to take place (Schiavio & De Jaegher, 2017) also beyond a musical context (Fuchs & De Jaegher, 2009).

Background in Cognitive Neuroscience
Peri-personal space has a twofold nature, being defined as both the space of reaching and as a defensive zone around the body (Bufacchi & Iannetti, 2018; Hunley & Lourenco, 2018). It can be measured by single-cell recording (Graziano et al., 1997), multisensory integration (Canzoneri, Magosso, & Serino, 2012) and line bisection (Berti & Frassinetti, 2000) tasks and modulated by the use of tools (Iriki, Tanaka, & Iwamura, 1996) and by the presence and behaviour of a partner (Teneggi, Canzoneri, di Pellegrino, & Serino, 2013). To our knowledge, none of these methods has been applied in the context of an embodied musical interaction.

Aims
The aim of this ongoing study is to see whether and how a musical interaction between two (jazz) musicians can modulate their respective peri-personal space. We hypothesize that this is a neural mechanism underpinning the commonsense view according to which music brings people closer to each other.

Main contribution
Taking advantage of an audio-tactile integration task to measure peri-personal space, we set up an experiment in which 14 pairs of musicians had to play a jazz standard in two conditions, a cooperative and a non-cooperative one. In the former condition, the partner (who was always one of the researchers) played with the guitar the correct sequence of chords, whereas in the latter he played a systematically altered sequence of those chords. Musicians came back to the lab for the second condition after two to three weeks, in order to avoid a learning effect. A baseline condition was added, in which musicians had to accomplish the reaction time task without interacting with the partner, either before or after the two experimental conditions. The order of the three conditions was counterbalanced. We compared reaction times to audio-tactile stimuli across conditions (with sounds coming either from the near or from the far space), under the hypothesis that the response facilitation traditionally observed within peri-personal space boundaries would be extended to the extra-personal space after playing with a cooperative partner. If this is the case, we could argue that a (harmonic) cooperative musical interaction may get people together, extending their peri-personal space. Surprisingly, we found a
complementary result, that is, a shrinking of the peri-personal space after a non-cooperative interaction, as if the musician “escaped” from an upsetting partner, perceiving his own near space as far. The answers to the questionnaire concerning the partner’s playing correctness, agreeability and level of dismay and their correlation with reaction times were coherent with such interpretation.

Implications for musicological interdisciplinarity
We think that both philosophical and neuroscientific concepts and methods are crucial in understanding the phenomenon of joint music making. While music has mainly been explored in its temporal dimension, an embodied approach (Leman, 2016) has to come to grips with its spatial implications as well, insofar as it is based on the assumption that (music) cognition is grounded on the sensorimotor loops between a body and its (also social) environment (Thompson & Varela, 2001). Thanks to a well-established audio-tactile integration task, our study suggests that the “musical inter-corporeal bubble” surrounding two interacting musicians can explode, if the interaction is felt as a noncooperative one. This is one of the first experimental attempts to corroborate the idea that the space around us can be shaped by (the harmonic dimension of) the embodied interaction with a musical partner.

References
Investigating the Nature of Musical Improvisation - An Experimental Approach
Combining Physiological Measurements, Retrospective Ratings and Audience Participation

Nicolas Farrugia
 IMT Atlantique, FR

Background in Musicology and Anthropology
Musical improvisation is an important matter of study in modern studies (Bailey, 1993) as it is widespread, and implicitly refers to human freedom through its expression in socio-economic or ethnic contexts such as the free jazz movement (Carles & Comolli, 2015). A careful account of musical improvisation also challenges prevalent theories of musical philosophy (Alperson, 2016). As such, musical improvisation appears as a fruitful avenue to study dynamical interactions between creative, embodied minds (van der Schyff et al., 2018).

Background in Cognitive Neuroscience
Mc Pherson and Limb (2013) argue that studying musical improvisation requires collaboration between neuroscientists and artists in order to be both scientifically and ecologically valid. While early models attempt at determining the cognitive functions involved (Pressing, 1988) and their neural correlates (Beaty, 2015), few studies have investigated the link between musical improvisation and subjective reports of improvisers's states, such as time-consciousness (Peters, 2016) or flow (Luft et al., 2018).

Aims
We aim at investigating musical improvisation using a transdisciplinary approach during improvised public performances, combining physiological measurements and retrospective reports of an improviser, in addition to discussions with the audience.
We will present the results and lessons learned from the first instance of this project. A series of private rehearsals were conducted between December 2018 and March 2019, culminating in a public performance.

Main contribution
 General approach
The study is centered on a single subject, C.R., aged 45, a professional improviser playing clarinets in national and international performances. Each session was structured in the following way. C.R. played pieces in duet or trio lasting approximately 10 minutes. During each piece, we recorded audio and electroencephalography (EEG) of C.R. using a 5-electrode headband, as well as heart rate, using a portable wireless EEG device with a sampling rate of 250 Hz. Immediately following each piece, C.R. listened back to the audio recording, and performed a continuous retrospective rating using two factors. The first factor was "improvisation focus", or flow, and corresponds to how much C.R. felt he was "into" improvising more than concentrating on technical or planned aspects of playing. The second factor was "quantized subjective time", corresponding to how much C.R. felt he was currently thinking in longer or shorter note durations, irrespective of whether he was playing or not. These two factors were discussed and defined with C.R. during preliminary experiments with the author. At the end of each session, a short interview was performed with C.R. in order to
gather qualitative evidence regarding his mental and bodily states. This semi-structured interview included questions about the types of activity he performed on the day other than the rehearsal session, his urge to play (or not), his body state, and his thoughts about the improvised pieces he just performed.

Data analysis
We performed an analysis of the data collected during rehearsals, with the goal of identifying evidence for a discrete number of states experienced by C.R. during improvisation. First, we used clustering methods in order to identify static states as recurring similarity patterns in (1) the audio data, (2) the continuous rating data and (3) continuous EEG data transformed in the time-frequency domain. We performed clustering separately on the three types of data, and quantified the agreement between the outputs using clustering metrics (adjusted randomized index). Second, we attempted an analysis of dynamic, non-stationary states using hidden markov models. The overarching aim of this analysis is to uncover states that can meaningfully inform us on interactions between neural signals, retrospective reports and resulting musical performance.

Public performance and audience feedback
A first public performance will take place March 16th, 2019. The structure of the public performance will be similar to the rehearsals. Two ten minutes long pieces will be played. Following the two pieces, the audience will listen back to the pieces while C.R. registers the continuous rating. At the end of the listening phase, a discussion will be initiated with the audience, during which we will share a few highlights on the quantitative and qualitative data collected during the rehearsals and the performance. Next, we will open a discussion phase in order to gather insights from the audience on the nature of the improviser's states.

Implications for musicological interdisciplinarity
This project sets up an original methodology that cross-fertilizes between performance sciences, cognitive neuroscience, and qualitative inputs from the general public through a live experimental setting. We will share analysis methods and collected data in order to facilitate future work in the field, using open data and open source repositories.

References

Mike Shinoda’s Post Traumatic: Songwriting and Concert Tours as Embodied Therapeutic Acts

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Background in Music Theory and Analysis
The case studies for this paper are drawn from the lyrics and music of Linkin Park’s last album, One More Light (2017), and band-member Mike Shinoda’s solo album, Post Traumatic (2018), which followed the death of Linkin Park’s Chester Bennington. This paper notes a number of songs on One More Light that indicate a forebodingly dark sense of hopelessness, found throughout Linkin Park’s corpus of albums, but more markedly present on One More Light. The primary focus of the paper, however, is Post Traumatic and its representation of Shinoda’s therapeutic recovery. This poignant album includes stark lyrical discussions of Shinoda’s therapeutic process which are emulated in the music.

Background in Music Therapy
These musical analyses are observed through a psychological lens. The psychological portion of this paper centers on the work of, Bessel van der Kolk. In doing so, it explores van der Kolk’s idea that the body’s involvement in healing from trauma is as important as talk and pharmaceutical therapies. His findings note that “visiting the past in therapy should be done while people are biologically speaking, firmly rooted in the present and feeling as calm, safe, and grounded as possible” (van der Kolk 2014, 70). He posits that, in many post traumatic situations, traditional therapeutic talk-based methodologies are rendered ineffective when a patient’s physiological capabilities are hindered due to both psychological and neurological reactions to trauma. His research focuses on returning a patient’s familiarity with their own bodily functions and sensations before turning to talk therapies and pharmaceutical remedies (van der Kolk 2014, 72).

Aims
In looking at musical reflections of psychological and therapeutic processes, this paper explores songwriting and album promotion as a therapeutic act. Specifically, it addresses musical representations of this therapeutic act and explores the use of group singing as a therapeutic musical embodiment of Chester Bennington’s voice in live performance.

Main contribution
As noted above, Mike Shinoda’s 2018 solo album, Post Traumatic, serves as a record of his therapeutic process following the 2017 suicide of Linkin Park’s lead singer, Chester Bennington. The album serves as a therapeutic record and opens with recordings of friends’ messages of encouragement and support left on Shinoda’s voicemail immediately following Bennington’s death. This paper addresses three components of Shinoda’s therapeutic journey: 1) mental struggles revealed in his collaborative work with Bennington in Linkin Park, 2) expressions of the therapeutic process manifest in Shinoda’s album Post Traumatic, and 3) the continued act of therapy through the musical embodiment of Bennington’s voice in live performance of tracks performed after Bennington’s death. Each step in this therapeutic progression is processed through the lens Bessel Van der Kolk’s work, which cites three
possible paths toward therapeutic recovery after trauma: 1) the traditional talking cure, 2) medicine, and 3) an embodied experience, “by allowing the body to have experiences that deeply and viscerally contradict the helplessness, rage, or collapse that result from trauma” (van der Kolk 2014, 3). He notes that “most people I have worked with require a combination” of methodologies (van der Kolk 2014, 3). This paper demonstrates a similar combination of therapeutic experiences in Mike Shinoda’s musical progression.

Linkin Park’s last album with Chester Bennington, One More Light, contains several songs that express deep mental struggles. “Nobody Can Save Me,” “Heavy,” and “One More Light” are particularly notable examples, whose lyrics and music portray a mind filled with dark thoughts about life that are also reflected in anecdotes from friends and relatives recounting the days before Bennington’s death. Demonstrating a positive rise out of the dark days that surrounded his friend’s death, Shinoda’s album, Post Traumatic, tells the story of his therapeutic journey following this trauma and the support system that built up around him. Lyric and music analyses demonstrate ways that this album serves as a continued therapeutic act.

The final section of the paper explores the therapeutic embodiment of Chester Bennington’s singing in concerts led by Shinoda. Shinoda often incorporates the crowd into the performance of songs in which Bennington played a major role. The audience is encouraged to sing Bennington’s parts during Shinoda’s performances. This embodiment of Bennington’s voice allows for a continuation of the therapeutic process for Shinoda and audience alike. Research on group singing is explored to highlight the incredible power of this social act of embodiment. In exploring this musical embodiment, two particular concert videos are explored: 1) a live performance at the 2018 Reading Festival filmed by the BBC in which Shinoda asks the crowd to participate with him in a performance of Linkin Park’s “In the End” and 2) a more intimate record store performance in which Shinoda walks through the crowd while singing “Running from my Shadow” from his Post Traumatic album and shares more intimate experiences with his fans through dancing and singing. An examination of these videos shows a vocal embodiment of Bennington’s memory that serves a therapeutic function for Shinoda and his fans.

**Implications for musicological interdisciplinarity**

This paper connects the fields of music analysis, music therapy, and psychoanalysis through the use of music analysis to demonstrate a record of the therapeutic process that goes beyond just the lyrics. Video evidence reveals a therapeutic embodiment of this process manifest in group singing and shows that the therapeutic process can occur outside the confines of the therapist’s office.
Susanne K. Langer’s Philosophy of Feeling: The Embodied Mind in Process Philosophy

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Background in Arts and Science
By adopting embodiment in musical contexts, the synthesis of scientific and cultural analysis might call for an adjustment of conceptual and analytic tools on both sides. To put it bluntly, art theory and musicology can face hurdles in their attempt to sufficiently convey musical/artistic experience to science, as introspection or speculation hardly obtain the measure of scientific objectivity and method. Vice versa, overquantifying aesthetic experience with empirical and statistical research might fail to show more than a simplified abstraction of its full scope and psychophysical effects—especially when arts deliberately challenge them. Where to meet after decades of incision between nature and culture? How to handle the visceral cusp of emergent “art symbols” in experimental musics at present?

Background in History of Philosophy
The issues revolving this fractured relationship could move Susanne K. Langer’s philosophical work further into focus. Coming from mathematics and foundational studies in symbolic logic, she developed a semantic theory of art from process philosophy. Her conceptual set up aligns the epistemological value of aesthetic experiences by shifting musical form—as matrix of physical and virtual events—to its center, thereby offering an alternative within the linguistic turn. While twentieth century analytic philosophy was mainly involved looking through picture theory’s glasses, Langer’s shift to musical form provides tools for art and science’s joint quest in understanding how meaning comes about.

Aims
This presentation contributes to conceptual and methodological implications of embodiment and musics. It excavates the continuation of process aesthetics in philosopher and logician Susanne K. Langer who embeds a philosophy of mind in flesh—and even beyond.

Main contribution
“I’m scouting the possibility that rationality arises as an elaboration of feeling”
(Langer, 1957)

Popping up in the genealogy of more recent philosophical movements of New Materialism(s) (v.d. Tuin, 2015) and in the context of the affective turn (Massumi, 2011), Langer’s position in twentieth century aesthetics contrasts dominating image-theories. Her proposed semiology of art emphasizes musical form and continues a process philosophical agenda informed by Alfred N. Whitehead’s post-enlightenment critique (Lachmann, 2000). Her late philosophic and empirical engagement in Mind: An Essay on Human Feeling (1988) is even regarded to have seeded ideas relevant to the subsequent cognitive revolution (Dryden, 2007). As categorically materialist thinker, Langer aims to suspend the nature-culture divide by empirically researching
the processes of symbolization in artistic expression via the concept of feeling and its emerging form(s). Rationality arises here, from an intricate and dynamic texture of bodily intensities induced by events that particularly display as and in musical form as the “purest of symbolic media” (Langer, 1930).

Langer’s philosophy was not only tackling the mind-body problem ever since Descartes divided mind from its feeding flesh, but suggested—with a strikingly ecological notion—that mind is a product of and dependent from nature itself. Its emergence is embedded in chains and cascades of “acts”, and is determined as much by environmental and bodily processes, as it is by artificial structures, as in languages. Yet (and most likely therefore), her proposition encountered strong criticism from dominating Pragmatists, who accused her of arguing in favor of a sentimentalist theory and deliberately misjudged her use of the term feeling. Langer followed a sincere quest for intricate processes in and outside (non-human) organisms. However, her contributions in the field of analytic philosophy—the idea of an autonomous art symbol “isomorphic” of feeling—plus her later empirical studies involving cultural and scientific research were more than theorizing emotions. It was an attempt to naturalize mind and offer conceptual tools to capture the flux of vitality in living matter and its reflection as symbolic form.

Implications for musicological interdisciplinarity
Referencing examples from the current wild of electronic and experimental musics and the plurality of their subcultures, this presentation will lay out key concepts from Langer’s ontology (“feeling”, “art symbol”, “musical matrix”, “act”) in Langer 1953 and Langer 1988, and hopes to receive valuable critique from adjacent research areas and exchange ideas.

References
Embodied Musical Labour: The Problematic Place of Political Economy in Ethnomusicology

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Background in Political Economy
Political economy is an intellectual tradition born in Europe and generally used to define modern economic thought, an early example of interdisciplinary social science pioneered by Adam Smith and survived until the late 19th century (Krätke & Underhill, 2005). However, Capital by Karl Marx dedicated to its critique, as its subtitle, Critique of Political Economy reveals, discredited political economy in the same century. Therefore, neo-classical economy which is almost a reduction of political economy to mathematical approaches, dominated the economic thought, so far. Since then, political economy widely implies Marxist approach on the issue, ironically. Although Marx did not write specifically on music or embodiment, his labour theory of value pawed the way for the consideration of a specific relation between music and embodiment. As a result, while there is a growing interest of economists on music recently, quite a few of them applies political economy approach. In this sense, the ambitious study of Attali, Noise: The Political Economy of Music (1985) is still unique in the sense being written by an economist. Nevertheless, political economy approach of Attali tries to falsify Marx by demonstrating the invalidity of his labour theory of value when applied to music.

Background in Ethnomusicology
Although a certain interest of ethnomusicologists on economical issues is recently growing, economy and especially political economy have been a quite neglected topic within ethnomusicology. While there are a number of either Marxist or Marxism-inspired studies, it is the study of Timothy Taylor (2016) whom directly researched the relation between music and capitalism by applying political economy approach, besides other approaches. The studies of Charles Keil in 1960s and 1970s, Manuel Peña in 1980s and 1990s, and Christopher Waterman, Peter Manuel and Martin Stokes in 1990s show various degrees of interest in Marxism. However, this interest was mainly within the theoretical framework of Western Marxism which is mainly cultural rather than economical in its orientation. In this sense, the book edited by Regula Qureshi (2002), titled Music and Marx was groundbreaking in the sense her chapter demonstrates a political economy approach. In this sense, Mark Laver (2015) and Jason Beaster-Jones (2016) are other colleagues applied political economy approach. More recently a forthcoming handbook on economic ethnomusicology edited by Timothy D. Taylor and Anna Morcom shows more subtle interest of ethnomusicologists on economy.

Aims
Our aim is to discuss the main reasons of the distance kept ethnomusicology far away from political economy and then reveal the crucial problem of few studies about labour theory of value applied to music which would open new perspectives for the study of musical embodiment.
Main contribution

There are two main reasons, political and intellectual about the lack of interest of ethnomusicologists on political economy; historical coincidence of Cold War with the emergence of the discipline mainly in United States and the appearance of Marxism in Europe, called as Western Marxism. Anything reminiscent of Marxism seemed to be politically so dangerous in US that Charles Keil lost his fellowship after submitting a Marxist paper in 1960s (Sakakeeny 2005: 153). In a similar vein, Peter Manuel (1995) and Anthony Seeger (2013) talks about a phobia of Marxism in US. A kind of non-Sovietic Marxism emerged mainly after the October Revolution in Europe-known as Western Marxism which was against political economy, via critique of economical determinism. As a result, political economy could hardly find its way through musicology and more specifically ethnomusicology where Marxism could be rarely appeared at most by the meditation of Western Marxism. Therefore, the ethnomusicology could mainly contact with Marxism mainly by its involvement in popular music studies by the 1980s which was barely rooted in Western Marxism. On the contrary, the foremost intellectuals of our time such as Fredrick Jameson and David Harvey convincingly showed how political economy is crucial in understanding culture and thus Marxist political economy had not to be interpreted simply as an economic determinism.

Labour theory of value starts from the definition of labour as the expenditure of human muscle, brain and nerves. Even as early as 1844, Marx briefly described how the relation of ear, sense of hearing and music are socially constructed. Music is one of the examples which Marx discussed the quality of labour in terms of its productivity. Finally the labour is embodied in commodity as the main source of value which is measured by the socially necessary avarage labour-time. Unfortunately, a wrong interpretation of Marx’s example on music as referred by Raymond Williams for the first time in 1977, followed exactly by the studies of Qureshi and Taylor in ethnomusicology and other names in many other disciplines. Shortly, Marx writes that while piano maker is a productive labourer, piano player is not. Productivity is defined with respect to producing surplus-value. Therefore, this specific passage could only mean that piano player works for a revenue such as playing in a house party, which makes him unproductive, not a waged labour working for a capitalist entrepreneur.

In fact, Marx gives contrary examples for both music makers whom are productive and instrument makers whom are unproductive on the context in Capital, as well. Surprisingly, Attali as an economist makes a similar mistake while discussing the value produced by the composer which he thinks that falsify the labour theory of value, since composer is neither a productive nor unproductive labourer according to Marx. Nevertheless, Attali seems not to be aware of a third category in Marx which corresponds to the context of either peasants or handicraftsmen whom sell commodities produced by theirselves, not their own labour, as in the case of composer. It is true that Marx argues that this kind of labour does not fall under the capitalist mode of production. However, it is clear that his labour theory of value considers this case and the case of composer does not unvalidate it. Furthermore, studies in music history show that a very few number of composers earn their living only by composing which is still valid. As a result, labour theory of value presents new horizons for the study of music and embodiment in ethnomusicology since labour is the only source of value which is embodied in commodity and measured by labour-time as defined in political economy of Karl Marx. However, misunderstandings about this theory should be cleared out first within few studies of ethnomusicology applying political economy approach.
Implications for musicological interdisciplinarity
Our study tries to reintroduce political economy approach for ethnomusicology which we hope to widen the perspective of current ethnomusicological literature on music and embodiment and thus contribute for the interdisciplinary collaboration between these two disciplines.

References
The Feel of the Future: Embodying Expectation and Enacting Virtual Worlds in Musical Expression

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**Background in Musical Agency**

Although carrying different meanings, the idea of “virtual” or “musical agency” has been invoked in both music cognition and music theory as a productive way of approaching musical expression. In music cognition, musical agency describes the way that music can present a kind of guidance and drive to movement through synchronization to the sound (Leman, 2016). Grounded in the predictive capacities of the brain that naturally link sound to action, this perspective posits that musical expression has its basis in empathy as listeners imitate or internally simulate the human actions, gestures, and behaviors in the music as if it were a kind of virtual agent (Krüger 2014; Overy & Molnar-Szakacs, 2009). In music theory, virtual agency is an analytical conceit that treats musical elements metaphorically as agents, typically imbued with some sense of human motivation or will (Monahan, 2013). It connects musical details to various embodied and gestural understandings of a piece through practices of interpretation grounded in cultural and historical conventions, as well as in the analyst’s own experiences as a listener or performer (Hatten, 2018). Whereas music cognition tends to focus on generalized processes behind emotional expression, analyses of agency in music theory often emphasize transformations of emotional content that create a sense of drama.

**Background in Enactivism**

Enactivism’s account of perception and emotion provides a useful framework for incorporating certain temporal aspects of expression, like those explored in music theory, into the concept of musical agency employed in music cognition. Enactivism reconceives cognition in nonrepresentational terms as sense-making, where “meaning” emerges from the dynamical coupling between organism and environment. The concept of sense-making integrates traditionally separate functions such as perception and action (Noë, 2004) and appraisal and arousal (Colombetti, 2014). Because of their basis in an organism’s perpetually developing coordination with the world, these relationships naturally entail a kind of virtuality in their adaptive orientation toward the future. This protensional sensitivity in sense-making is intrinsic to action (Di Paolo, Buhrmann, & Barandiaran, 2017) and emotion (Thompson, 2007), and includes both in-the-moment transformations, and cumulative effects that emerge from the history of such changes, such as when an organism’s heightened attunement to its environment can result in longer-range sensitivities.

**Aims**

The purpose of this paper is to suggest how, within the embodied cognition behind music’s emotional expression, the careful shaping of expectations and time in music can function in a way that evokes ongoing interaction with a world, akin to the role of the environment for emotion in real life. I explore this premise by bringing an enactivist perspective of perception and emotion to the concepts of musical agency found in music cognition and music analysis. By emphasizing the role that temporality plays in sense-making, enactivism’s dynamical and nonrepresentational view of cognition, I argue that the sense of virtual “world” enacted in
musical emotional expression stems from music’s ability to engage sensitivities toward the future that are intrinsic to embodied experience.

Main contribution
I argue that the experience of musical agency can echo world-oriented aspects of emotion via this virtual, temporal dimension to sense-making. I propose that a listener’s agential embodiment of intramusical expectations can function in an equivalent manner to interactive encounters with an environment. Whereas current cognitive perspectives on musical agency tend to focus on direct synchronization between movement and sound, incorporating intramusical expectations into musical agency introduces a distinction between one’s agential projection and the music’s actual output. This potential for difference allows musical agency to manifest a sense of negotiation with a virtual world, as listeners enact their experience in coordination with the flow of the music through time. As seen in tension and release, the familiar embodied understanding associated with musical expectation, listeners commonly attribute interactive metaphors of force and action to musical predictions and syntax as well as a sense of agential will, which is central to experiencing music in affectively dramatic terms (Larson, 2012). I posit that the extension in time that listeners’ predictive sensitivities bring to musical agency effectively enacts a kind of presence (Noë, 2004) of the virtual world “inhabited” by that virtual musical agent, which is realized through that agent’s affectively-charged, embodied orientation toward future interaction. This presence forms the basis of the world-involving aspects of emotion expressed by music. Moreover, the accumulation of musically-enacted encounters can engender a kind of embodied attunement to the musical agent’s affective circumstances, which effectively widen the sensitivity toward that virtual world and expand its presence. This attunement enacts the feel of situation behind musical emotional expression in a nonrepresentational way that can become remarkably nuanced, but without necessarily reducing to a single, specific, real-world plot.

Implications for musicological interdisciplinarity
Illustrating this perspective with examples drawn from Schubert and Chopin, I argue that enactivism presents a means to expand the purview of musical agency into more complex kinds of emotional expression that form an important element of music’s function and aesthetic value in culture. Furthermore, it also points to a convergence between traditional expectation-based approaches to music perception and contemporary perspectives from embodied cognition.

References

Ecological Study of Baroque “Territorial” Dances

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**Background in Cultural/ Social History of Music**
Within the so-called baroque period, dance as a multi-faceted cultural practice experienced its ennoblement from a rather low form of leisure to a sophisticated form of art. On the one hand, Thoinot Arbeau’s (1588) attribution of dance to liberal arts marked its acknowledgement as a respectful object of learning and paved the way for the subsequent establishment of choreography. At the same time, practical skills in dancing became the means for social assent. On the other hand, dance became a popular genre of autonomous instrumental music. As diverse as they were, both these processes involved the necessity for the actors to discipline their bodily impulses (van Orden, 2002), whether by executing intricate movements or by sitting calmly while attending to an instrumental performance.

**Background in Empirical Music Psychology**
The discovery of the coupling of the sensory and motor stimuli by cognitive neuroscientists inspired numerous empirical studies of music psychologists. According to the motor theory of perception, even the passive observation of any (physical) action involves automatic or involuntary activation of the motor system (Hadley, 2015). Furthermore, the ecological theory of music perception seeks trace of an action component in passive perceptual experience: “the foot-tapping, head-nodding and body-swaying… are commonly observed in even the constrained circumstances of the Western art music tradition.” (Clarke, 2005)

**Aims**
The aim of my paper is to buttress the implications contained in this passage with multifarious research evidence. As a *case-study*, I use one of the numerous reconstructions of baroque dances from the so-called Beauchamp-Feuillet notation. As a *method*, I draw on Eric Clarke’s integrated approach of analyzing performances, whereby “Culture and ideology are just as material […] as are the instrument and human body…”

**Main contribution**
To be sure, these two disciplinary areas have already enjoyed some collaboration: Lawrence Zbikowski (2014) and Tamara Lee Caulkins (2018) borrow cognitivist methods for their inquiries into the relations between music and dance in the *Ancien Régime*. However, they do not focus neither on environmental nor on motor aspects. The inspiration for my paper is taken from a very different source, *A Thousand Plateaus* by Gilles Deleuze and Felix Guattari (1987). In the chapter on refrain, the French poststructuralists reconceptualize the notion of ‘territorialization’ initially elaborated by ethologists who referred to ‘territorial’ behaviour as extension of animal instincts. Furthermore, they draw upon biosemiotics and borrow Jakob von Uexküll’s conception of environment and his comparison of nature with symphony: *The territory is first of all the critical distance between two beings of the same species… Critical distance … is a question of keeping at a distance the forces of chaos knocking at the door. This is evident in territorial dances termed baroque or mannerist, in which each pose, each movement, establishes a distance of this kind (sarabands, allemandes, bourrees, gavottes…).*
There is a whole art of poses, postures, silhouettes, steps, and voices... Critical distance is not a meter, it is a rhythm... Two animals of the same sex and species confront each other: the rhythm of the first one ‘expands’ when it approaches its territory or the center of its territory; the rhythm of the second contracts when it moves away from its territory. (319-320).

Implications for musicological interdisciplinarity

The above-quoted passage by Deleuze & Guattari integrates such diverse fields as sociology, anthropology, ethology and biosemiotics with the history of early modern culture. What might seem rather far-fetched is their pointing at atavistic elements by such a peaceful activity as baroque dances. And yet, Mark Reybrouck (2012) concedes that ecological approach to music perception in general regards “the cognitive and perceptual system in the service of survival and orientation in the environment...”. David Huron (2012) enquires into the question of how music induces emotion by drawing a “number of musically-pertinent lessons” from ethology. Finally, the dancing practice of Baroque might be regarded as a form of ritual, and “[e]thologists study the continuities between animal and human rituals – particularly how rituals are used to control and redirect aggression, to establish and maintain hierarchy...” (Schechner, 2006)

I will argue that the dancing practice of Baroque adduced people to inhibit instinctive motoric reactions and thus sought to decouple auditory and motor stimuli. Furthermore, it was precisely the assimilation of dancing patterns in early autonomous instrumental music of Baroque that made the motor aspect of perception not evident, operating at virtual levels of mental representation instead (Reybrouck, 2015).

References


Musically Embodied Spaces

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Background in Philosophy
We understand the world through the body (Merleau-Ponty, 1962). As the interface between the ‘I’ and the world, the body allows us to perceive and to act upon the world. The body is the key for our experience of the world. Bourdieu (1977) saw a critical role of practice in shaping of the body and the mind as well. His concept of habitus, for instance, demonstrates a link between practice and formation of culturally informed body.

Human music-making involves different types of practices. We sing. We play a musical instrument. We listen to music. In some cultures, people practice music writing while other cultures consider dancing as music-making (Nettl, 2000). However, it is unclear how the different musical practices shape our body in particular ways and how these different embodiment processes in music-making contribute to our experience of the world. Therefore, we argue that different types of musical practices should be recognized individually.

Background in Cognitive Science
Time and space are two of the cognitive constructs through which we understand the world. Although space plays a role in most of our behaviors, it has been understudied in music research. In this study, we investigated how music-making relates to peripersonal space, space immediately surrounding the body. Peripersonal space is characterized by features including multisensory integration, body-part centered specificity, sensorimotor coupling, and plasticity (de Vignemont & Iannetti, 2015). In music performance, we make use of our vocal apparatus in singing whereas we interact with musical instruments primarily with our limbs. It seems that, among the features of peripersonal space, multisensory audio-tactile integration near and on hands are specific to instrument-playing body (Cheong & Will, 2018).

Although many studies have reported that musical training changes multisensory integration, a majority of them focused on audio-visual coupling. A recent behavioral study by Landry & Champoux (2017) reported modulative effects of musical training on audio-tactile integration. However, the authors considered neither effects of specific musical practices nor effects on spatial processing.

Aims
In this study we focused on two different modes in music performance (i.e., singing vs. instrument playing) and two features of spatial processing (i.e. multisensory audio-tactile integration, hand-centered specificity), and investigated whether space perception of the singing body is different from that of the instrument-playing body.

Main contribution
In order to see whether spatial processing varies with musical training and experience, we performed 1) a simple reaction time experiment and 2) a temporal order judgement experiment with instrumentalists, vocalists and non-musicians using a crossed vs. uncrossed arm paradigm. For the first experiment, auditory, tactile, and simultaneous audio-tactile stimuli were presented near and on hands. Subjects were asked to respond as soon as possible when they detect a signal.
Given previous studies reporting that people reacted faster for multimodal stimuli than unimodal ones, we hypothesized that instrumentalists would show smaller reaction time difference between unimodal and multimodal stimuli. Instrumental musical training might contribute to better audio-tactile spatial representation due to haptic exploration of musical instruments. We found that instrumentalists reacted significantly faster to tactile stimuli. The race model inequality test suggests a co-activation of audio and tactile sensory channels at the early stage of perception only in instrumentalists.

For the second experiment, we delivered a brief sound and a touch pulse in a pair near and on hands. Onsets between sound and touch were different. Subjects were asked to judge whether either sound or touch was presented first while we measured their reaction time and accuracy. Musicians reacted faster than non-musicians, and instrumentalists responded more correctly than vocalists and non-musicians. Instrumentalists showed the smallest absolute threshold and just noticeable difference. Interestingly, crossed vs. uncrossed arms led to significantly different just noticeable difference only in non-musicians.

Our experimental findings demonstrated different effects of specific musical training on multisensory spatial processing. Previous studies have already shown that musical training changes multisensory integration. However, most studies focused on audio-visual coupling and did not consider spatial processing. Our study provides supporting evidence for the modulative effect of musical training on multisensory processing in audio-tactile coupling. To the best of our knowledge, this would be the first study investigating whether different musical training leads to different experience of space experimentally. In sum, instrumental training may contribute to different representation of space if it is hand-centered and established by audio-tactile inputs.

**Implications for musicological interdisciplinarity**

From the philosophical perspective, we argue that musical practice not only changes our bodily perception through embodiment process but also affects the way we experience the world. From the cognitive science perspective, we explored whether specific musical practices, singing vs. instrument playing, may involve different perception of space pertaining to the body. Our experimental finding implies that different modes of music-making influence how we perceive, conceptualize and experience space in distinctive ways. Musically embodied spaces show a necessity of interdisciplinary investigation across phenomenology, musicology, cognitive science, etc. in order to understand a complexity and diversity of human music-making in a comprehensive way.

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Approaching an Enactive Perspective on the Aesthetics of Music Through Concepts of Sense-making and Affordance

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**Background in Cognitive Science (of Music)**
Alongside growing interest in 4E approaches to cognition, the ideas of embodied, embedded, enacted, and extended mind are also being increasingly applied to research on music. While 4E cognition denotes more a set of diverse research programs than a specific theory, there is certain groundwork done for more specifically enactive approach to music cognition (Schiavio, 2014). At the core of such an approach is to consider music in terms of bodily interaction, highlighting the sensorimotor basis of meaning making and interconnectedness of musical subject and object.

The enactive framework provides one perspective on embodiment, as well as several theoretical and methodological tools for considering the experience of music. However, the guiding idea in this presentation is the ideal of circulation between cognitive science and lived experience. As interpreted here, this means that scientific research should on the one hand be guided by first-person understanding of experience, which on the other should be enlightened by third-person findings of science.

**Background in (Philosophical) Aesthetics**
Despite the history of divergent views about its relation to scientific study, the field of aesthetics has generally been thought as one of the most resistant to the efforts of naturalization. From the viewpoint of aesthetics as a matter of refined subjective experience, the focus on short-term preference ratings or reduction of aesthetic experience to neural pleasure mechanisms has been seen rather insufficient for capturing the richness of the subject matter. Moreover, the ambiguous and evolving nature of art, as well as the diversity of aesthetic activities, can make the search for a scientific explanation seem like a futile endeavor altogether.

While aesthetics may be a subject that cannot be comprehensively naturalized, there is also a question of what kind of naturalistic framework would be suitable for such a project. The enactive approach, with its aforementioned dialogue between cognitive science and experience, appears as a promising option in this respect. While such work has already been initiated, there remains several questions concerning the specifics of enactive view on aesthetics, especially in the context of music.

**Aims**
The main aim of the presentation is to integrate the work done on the enactive view on aesthetics into the framework of enactive music cognition. The guiding question is how could aesthetic be understood within such framework? This is approached by discussing aesthetics in terms of affordances and emotional dimensions of sense-making, and by proposing conceptual tools for exploring the experience of aesthetics.

**Main contribution**
The basic question of aesthetics concerns the distinction between aesthetic and other kind of phenomena. Traditionally the focus has been on specific kind of objects/features or specific
kind of reactions, such as aesthetic emotions. Following the basic tenets of enactive cognition, aesthetics is understood as a property of dynamic interaction. Instead of automatic responses, enactive perspective stresses the active role of the subject, thus considering aesthetic experiences as forms of action and participation (Noë, 2015). Finally, the enactive view holds that aesthetics has its grounds in the body and in the normative sense-making actions of enacting a meaningful world.

Along these lines, Ioannis Xenakis and Argyris Arnellos (2014) propose a view of aesthetics as emotionally evaluative activity that aims to reduce the uncertainty of potential outcomes of interactions. Aesthetic refers to the normative evaluation of indications for affordances, thus constructing value-rich relation to the world and facilitating sense-making. This view suggests that aesthetic perception is potentially an integral part of sense-making, which is in line with the idea of aesthetics' relation to the foundations of human meaning-making (cf. Johnson, 2008).

Another line of clarification concerns the distinctive quality of aesthetic interactions through the concept of affordance, which refers to the possibilities of interaction with the environment relative to the abilities of the perceiving organism. Starting from the notion that we react differently to artistic representations of objects than to “real” objects, Shaun Gallagher (2011) has proposed that aesthetic experiences offer their own kind of affordances. Instead of priming for pragmatic action, these aesthetic affordances disrupt the ordinary engagements and create new possibilities for the perceiver.

In my presentation, I consider these two lines of thought in relation to the work done on enactive music cognition. Special attention will be given to ways of approaching the experiential quality of aesthetic aspects of sense-making and affordances. This is done by discussing concepts of image schema and vitality affects in the context of enactive cognition. Image schemata, recurring patterns of interactions that structure our understanding (Johnson, 2008), are taken as a potentially fruitful addition to affordances in considering the bodily basis of meaning. Vitality affects (Stern, 2010) relate to the fundamental felt dynamics of experience and as such may enrich the discussion of affective dimensions of sense-making.

**Implications for musicological interdisciplinary**

The presentation is hoped to spark ideas by providing one interpretation of embodiment seen through the aesthetics of music. For those interested in enactive/embodied views of music cognition, the discussion of aesthetics may provide insights into the nature and different dimensions of musical experience. As for those interested in aesthetics of music, the enactive framework may offer theoretical tools for considering aesthetics as grounded in the sensorimotor interaction with the environment.

**References**


Music as a Body Language: An Enactive and Dynamical View on Music Perception

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Background in Philosophy
Most often, the perception of music is attributed to a « mind » that grasps an outer auditory reality. Accordingly, the issue of music perception is generally framed by the dualistic dichotomy opposing a subject and an object. However, from the point of view of the perceptual experience itself, especially in the case of absorbed listening situations, the frontier between these poles seems to vanish, so that we can make one with the musical flow. How to account for this « re-territorialization » (Deleuze & Guattari, 1972) of our experience into the musical flow itself while still retaining in our descriptions and explanations the very individualized interpretation and reception of music that characterizes our listening experience? More simply, how do subject and object meet and form a unique phenomenal space-time?

Background in Cognitive Science
The dominant tradition in cognitive science assumes that perception consists in the internal reconstruction of an external reality (by the means of the sub-personal cognitive processing of sensory data). This view does not give room to lived experience per se (whether in its descriptions or in its explanations), and would therefore need to call on supplementary processes to account for the individualized reception of music. The enactive approach (Varela, Thompson, & Rosch, 1991), on the other hand, does not only place lived experience at the center of the descriptions of the phenomenon to be explained, but it also places it within the explanatory scheme itself. Moreover, by taking the dialectical relation between autonomy and coupling as the core element of its theoretical stance, this approach offers a unique opportunity to understand individualized music perception from a non-dualistic perspective (Himberg et al., 2018; Laroche, 2009, 2015). Finally, dynamical systems being the natural formalism for enactive proposals (Froese & Gallagher, 2012), this approach provides us with the opportunity to link first-person phenomenology with third-person scientific observation, giving the possibility to propose a non-dualistic theoretical account of non-dualistic experiences.

Aims
This paper aims at bridging the phenomenology of music perceptual experience and its scientific investigation in the light of the enactive approach, with the help of dynamical systems formalisms.

Main contribution
We will propose a non-dualistic view on the perceptual experience of music, where the experience itself is situated in the actively regulated dynamical coupling between the autonomy of the listener and the musical source. The individualized, « tasty » reception of music will not be an additional layer that is independent of the perceptual processes themselves. Rather, individuation of forms will be introduced as the very basic process that allows the perceptual experience of music. To do this, we will show that the autonomous subject is a pre-condition for a musical object to emerge, and that the body is the pre-condition for the constitution of
sensory subjectivity. This view is embodied in the radical sense of the term, giving a role both
to the physical living body and to the experiential lived body, as well as their intrications, in
the explanation of music perception.

Implications for musicological interdisciplinary
The proposition helps bridging the gap between the intimate experience of music and the
formalization of its perception by reintroducing embodiment into the descriptive and
explanatory loop. It provides a renewed network of concepts that should help various
disciplines communicate with each other, from musicology to philosophy, neurosciences, and
psychology; and this should constitute a background for new experiments as well as ways of
designing refreshed experiences, modes of listening and devices of interaction with music
materials.

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Embodying Style in Music Performance: Qualitative and Quantitative Analysis of Three Interpretations of Bach’s C Minor Partita

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Background in Performance Studies
Performing the solo keyboard music of J.S. Bach at the modern piano presents both challenges as well as opportunities for creative interpretive approaches. As a performing artist, finding one’s own voice can involve revisiting different stylistic traditions of the past. In order to gain insight into the way great performers adjust performance parameters according to their musical conception, musicologists have developed comparative research methods based on the examination of contrasting historical recordings. A notable example of one such method can be found in the work of Early Music specialist, Bruce Haynes. Through his analysis of 20th century recordings of the music of J.S. Bach, Haynes describes three stylistically contrasting performance trends: Romantic, Modern and Baroque Period style (Haynes, 2007). Protagonists in each trend use different aesthetic criteria with regard to musical parameters such as tempo, articulation, ornaments or improvisation resulting in very different performances of the same work. Yet this type of analytic work remains largely qualitative.

Background in Sound and Music Computing
In the field of music information retrieval, computational approaches have been applied to the analysis of music. Distinctive features can be computed from both scores (symbolic data) and recorded performances (acoustic data). With the development of Sonic Visualizer by Cannam, Landone and Sandler (2010), computational analysis of musical performance has become more accessible to musicologists and performers. In the works of Fabian and Timmers (2014), Burke and Osman (2017), spectral analyses of performance have shown nuance in interpretation that reflect individual understanding of the musical score. Other scholars, such as Dodson (2011), Dogantan-Dack (2016) have shown the possibility of relating quantitative analysis to the traditional analysis of cadences, harmony or musical form. However, these studies do not include the point of view of performers and their creative processes, which calls for complementary qualitative approaches and considers the body as inherent to artistic creation.

Aims
Our study aims to characterize three interpretive styles of baroque music performance as they are conceived, perceived and performed by a musician, beginning with a musician’s intentions to their perception by an external expert auditor and through a quantitative analysis of the recorded performance. We seek to (1) characterize contrasting musical interpretation styles according to pre-established performance parameters; (2) quantify these performance parameters in terms of articulation and sound; (3) relate the musical parameters of an
interpretation (defining the musician’s intentions) to the technical parameters (defining the performance); (4) and develop and apply a methodology to identify the strategies used by musicians to embody a performance style.

**Main contribution**

In our study, a classically trained pianist recorded an excerpt from one movement of Bach’s Partita in C minor BWV 826 in each of the three styles described by Haynes. The recording was made on a Yamaha Disklavier DC7X equipped with sensors at the levels of the keys and pedals. Our qualitative analysis includes the pianist’s own description of his creative process, applying the self-explicitation method (Vermersch, 2007), as well as a third party critical assessment of the recording styles. Based on criteria used by Haynes for his analysis of historical recordings, we chose to focus on tempo, articulation and the speed of key descent in our quantitative analysis. By extracting MIDI data recorded on the Yamaha Disklavier, and with the help of a Dynamic Match Toolbox, we were able to isolate these performance parameters. We used statistical and mathematical analysis in the Matlab software to produce tempo curves, figures and charts depicting speed of performance, overlap between keys (legato) and key attack velocity. Finally, we used data from three different recording takes in order to compare and validate the cohesiveness of each style across trials. This interdisciplinary approach allowed us to understand how performers embody an interpretative style, how it translates into articulation, timing and dynamic shaping, and how performance parameters can be decoded from listening to the recording.

**Implications for musicological interdisciplinarity**

Traditionally, music theorists and computer scientists tend to focus on only one aspect of musical performance. By exploring different analysis tools and by combining the work of researchers from two widely different domains we demonstrate understanding of the scope of an interdisciplinary phenomenon such as musical performance. Our study shows that traditional science-oriented methodology can be applied and adapted to the nature of the creative process as pertaining to musical interpretation. Through our work, we hope to inspire further research of musical performance based on the collaboration between performers, acousticians, engineers and musicologists.

**References**


Timbre Perception Test (TPT): A New Interactive Musical Ability Assessment to Measure Timbral Discrimination

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**Background in Timbre Perception and Memory**
While much music psychology research has focused on auditory attributes of music such as pitch, loudness and rhythm, insufficient effort has been put in to address the perception of timbre. Such lack of research in timbre arises due to its complex nature in which its multidimensional property is difficult to quantify and there being an absence of tools to measure it. Three distinctive dimensions of timbre have been proposed and agreed by many researchers - namely the spectral envelope, spectral centroid and spectral flux (Siedenburg & McAdams, 2017). However, there are no existing tools to measure these perceptual differences at a dimensional level among individuals. This largely sets constraints to understanding our perception of sound and its underlying characteristics.

**Background in Psychoacoustics**
Currently, there are two hearing assessments that sought to some extent measure individual differences in timbral discrimination. One is the subtest ‘Instrument’ from the PROMS test battery (Law & Zentner, 2012) that uses samples of orchestral instruments where the participants have to rate how similar the stimuli sound is to the target. However, the test can be biased towards classically trained musicians and is limited to 5-point scale rating. Other alternative is to use subtests from the Psychoacoustic Toolbox (Soranzo & Grassi, 2014) which measure participants’ threshold in hearing the fine-grained dissimilarities that are related to dimensions of timbre by using the adaptive testing method. While this provides an empirical measure, the test is not strictly designed for timbral perception and only applied in limited circumstances. Therefore, it calls for a new test that accounts for a more ecologically valid and unbiased approach and one that provides accurate level of thresholds.

**Aims**
Our aim was to develop a new psychoacoustics test to measure individual differences in perception of timbre, assess its validity and reliability, and compute correlation with the Gold-MSI (Mullensiefen, Gingras, Musil, & Stewart, 2014).

**Main contribution**
We developed the TPT with the aim to provide a useful tool for the music psychology community for measuring individual differences in timbral perception. In light of the existing literatures on dimensions of the timbre space, TPT examined participants’ ability to reproduce the envelope, spectral centroid, and spectral flux. Moreover, we separated each of the dimensions into matching (unlimited playback of stimuli) and memory (stimuli only heard once) tasks in order to examine the difference in accuracy when the performance is fine-tuned or recalled from memory. The test was developed using Max MSP to be performed in a standalone application environment that does not require coding, in which participants used the GUI sliders to reproduce the heard stimuli. With a sample of 103 participants, the results indicated that the reliability of the test is robust (Omega total ($\omega$) = .80) with the subtests
yielding a single factor, implying that the test is measuring the same cognitive ability. The test was also validated with the PROMS and Psychoacoustic Toolbox and revealed significant correlations. Moreover, when computing correlations with the Gold-MSI, it revealed that the TPT is strongly correlated with the general sophistication \((r=.63)\) with its subscales ‘Musical Training’ and ‘Perceptual Ability’ being the strongest predictors. Nevertheless, when examining the test scores between musician and nonmusician group, the memory tasks revealed no difference between the two groups indicating that recalling heard characteristics of timbre is not influenced by musical training.

**Implications for musicological interdisciplinarity**

The newly developed tool can be applied in a wide-spectrum of research involving timbre and can open new doors for interdisciplinary research. It can be used in investigating the associations with musical performance, musical ability, felt emotions, or begin asking novel questions such as whether ‘absolute timbre’ exists. We also plan to implement the test online and this will provide knowledge about the general populations’ perceptual thresholds and what underlies the discrepancies among them.

**References**


“Embodiment” as Generative Constraints: The Constructive Role of Constraints in Musicking

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Background in Music Studies
Musicking (Small, 1998) is part of practices that make cooperation possible through regularised behavioural and affective coordination. Coordination (entrainment) co-occurs at many nested scales of interaction: from intra-body, inter-body, to inter-group interaction (Clayton et al., 2005). Beyond immediate interaction, musicking exists as dynamical cultural phenomena at larger temporal scales (Born, 2015). In cultural discourses the “body” and “embodiment” are frequently deployed as ways of talking about “mediation” of meaning or forms of “symbolic inscription” (Loaiza, 2016). It is yet not clear how embodied music cognition fits into this wide view of musicking.

Background in Philosophy of Systems Biology
Self-organisation is a concept that brings a naturalistic view on coordination. It is a way of explaining the ordered and adaptive behaviour of any given complex system (Kelso, 1997). However, several authors associated with complex systems theory have pointed out the insufficiency of self-organisation to account for a full story of living / cognitive processes (Deacon, 2011; Kauffman, 2000). Within systems theory, self-organisation is associated with the concept of constraint (Pattee, 2012). Above the level of Newtonian mechanics constraints can be identified with forms of generative and historical divergence from randomness, equipotentiality, and independence between coupled (sub)systems (Juarrero, 1999). Constraints manifest in the limited amount of possible states that a system can visit in the course of its selforganising dynamics; and in circular fashion, self-organising dynamics entail the maintenance of such constraints. Crucially, this circularity is present only in the living world, in contrast to other “shallower” self-organising phenomena such as hurricanes or lasers (Kauffman, 2000). In short, for a philosophy of systems biology, constraints not only reduce degrees of freedom mechanically, they are crucial in explaining how living systems develop via the irreversible accumulation of historical interdependencies (Salthe, 2010).

Aims
The target of the presentation is double: to define generative constraints, and to point to the kinds of constraints that can be said to define embodiment. Moreover, the suggestion is that these definitions may lay the groundwork for a common field of musical research across disciplines. More closely:

- I propose to define embodiment as a class of constraints associated with the interdependence of bodily-bound processes.

- I clarify how the notion of bodily generative constraint used in systems biology is more encompassing than the other more common use of the term in ergonomics and biomechanics.
• I show how the notion of generative constraint, in a similar way to the notion of selforganisation, is scale-neutral and thus can be applied to many other scales of musical phenomena, from neurodynamics to social organisation. I clarify how the notion of bodily constraint is distinguishable, but not disjointed, from other constraints.

• I argue in favour of seeing such scale-neutrality as an opportunity for academic interdisciplinarity.

Main contribution
Embodied-enactive music cognition articulates a naturalistic and non-reductive understanding of embodied sense-making through the conceptual tools of dynamical systems theory (Van der Schyff et al., 2018). In this view, embodiment is related to the selforganisation of the agent-(agent)-environment unit. Yet, how to scale up this naturalistic view of embodied activity to wider cultural and historical levels remains an open question. In this presentation I address the question of how to find an explanatory framework that has continuity across scales, and by doing so, I also address the question “What does it really mean for music cognition to be embodied?”. I develop the following points: First, to claim that music cognition is necessarily embodied. I argue that the opposite claim, that music cognition can be disembodied, only seems to work if we operate with a trivial notion of embodiment as constraints. That trivial notion is approximate to the concept of mechanical constraint, whereby movements are limited by the geometrical characteristics of the human body (e.g. how the kneecap limits legs movements). I introduce the more interesting notion of generative constraints. The idea is that music cognition can only happen in the occurrence of a non-trivial interdependence between action states and sensory states. Action and sensory states become interdependent by virtue of constraints on their possible states; and this interdependence is a necessary condition for cognition. Music cognition is embodied because embodiment is a class of constraints characteristic of the irreversible interdependence of action and perception. Second, to claim that embodiment should be associated with a minimalistic form of music cognition. Embodiment (as generative constraints) cannot exhaust the myriad of constraints associated with the enaction of full-blown persons embedded in culture. I point to the existence of largely homogenised normative structures publicly available in communities of skilful practice, structures that appear as widespread distinctions of taste, convergent affects and normative attitudes across the population. The proposal is that such cognitive-niche structures correspond to an entangled multitude of constraints that severely limit the space of possibilities and thus generate bio-social interdependence.

Implications for musicological interdisciplinarity
The third point is the suggestion that some aspects that have been treated as dissimilar across the range of musical studies (from neurodynamics to sociology) can be reinterpreted through the lens of a theory of multi-level generative constraints. In this way, the suggestion also points towards an interdisciplinary and multi-scalar explanatory framework. The implication is that research projects coming from different disciplines can participate in the mapping of constraints across a wide range of spatio-temporal scales and levels of description. Systems theory, from which I take the notion of generative constraint, is concerned with non-reductive ways of observing phenomena. This will hopefully serve as a basis for a more inclusive conversation bridging the gaps between humanities, arts, and cognitive science of music.
References
Analysing Skilful Adaptivity in Musical Duos

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Background in Joint Music Performance
Performing music together requires a constant reciprocal adaptation among co-performers. Because temporal and behavioral information are continuously negotiated in real time, musicians are often understood as highly interactive systems who rely on collaborative roles and leadership within the ensemble (Timmers, Endo, Bradbury, & Wing, 2014). A large body of work exploring kinesthetic activity during performance (Palmer, 2013) increasingly conceives of bodily motion as a fundamental dimension for music production and perception, pinpointing to its key role as indicator of parameters such as force, intensity, and coherence.

Background in Movement Coordination and Dynamical Systems Theory
Recent empirical work on coordinated behavior among musicians shifted the unit of analysis from the individual agent to the emerging properties of their mutual adaptation (Walton et al., 2014; 2015; 2017). Adopting mathematical and empirical tools inspired by Dynamical Systems Theory (Kelso, 1984; 1995), this research contributed a new perspective in understanding how the continuous coupling among musicians in actions can bring forth an open horizon of possibilities and constraints relevant to their music-making.

Aims
This talk aims to employ mathematical tools of Dynamic Systems Theory to understand how the coordination of musicians’ movements change in response to disturbances in the perceptual information available during joint musical performance.

Main contribution
Nine pairs of expert string players (n = 18) participated in our study. They were asked to perform two short pieces in four main conditions, designed to test how auditory perturbations may shape coordination when partners are differently ‘present’ to each other. Conditions involved subjects being (A) naturally placed one in front each other, (B) able to see each other only partially due to the presence of a scrim, (C) unable to their partner facing away from each other, and (D) performing their part alone without the presence of a duo partner. For all conditions, two different playing modalities were investigated: (i) without disturbance and (ii) with brief, audio disturbance (white noise) delivered through headphones. To explore interactive behavior, motion-capture data has been extracted, measured, and compared within
and between groups. Principal component analysis revealed significant changes in the dimensional compression of musicians’ movements as they adapted to the audio disturbance during the joint musical performance. Further analyses will explore the time scales at which dimensional compression and the coordination dynamics of musicians’ different body movements change in response to the audio disturbance.

**Implications for musicological interdisciplinarity**

Exploring skillful adaptivity in the dynamics of joint musical activity will speak to both music performance studies and movement coordination research and may help researchers rethink standard methodologies to study musical performance. Moreover, it can help musicological research more generally, shedding new light on the role of the body in collective musical action.

**References**


The Consumers Under Control. Embodiment in Music in/as the Strategy of Audiomarketing

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**Background in Consumer Behaviour**
One of the most distinctive features of the media-dominated culture is the ubiquity of music which appears in public space often as “acoustic wallpaper” imposed on a listener. Because of the inattentive way of perception, it can become a very effective tool of social control within the strategy that can be termed as “acoustic engineering”. Its main purpose is to modify or change the recipients’ responses and behavior in a way consistent with the values and interests of the sender with the use of scientific and technical knowledge (Makomaska, 2017). A particularly intriguing problem is the role of music in a commercial environment where programmed *musicscape* (Bitner, 1992) functions not only as neutral background imposed on a listener but its main aim is to influence or even manipulate the listeners’/consumers’ behavior. This common practice known as audiomarketing (Makomaska, 2011; 2017) seems to be a perfect example of “acoustic engineering” strategy in which music becomes an effective tool of marketing communication and social control.

**Background in Musicology and Embodied Music Cognition**
Within musicology, the problem of functional background music seems to be neglected and even treated as a symptom of an incorrect attitude towards music (see Adorno, 1976; Fabbri, 2013). This approach has led to the absence of a musicological perspective in the research on contemporary practices in which programmed background music is used to influence the recipients on a mass scale. It seems that embodied music cognition approach based on the assumption that music cognition is strongly determined by corporeally mediated interactions with music (Leman, Nijs, Maes, & Van Dyck, 2018) provides an interesting perspective to understand the multilevel links between music and consumer behaviour.

**Aims**
The main objective is to find the answer to the general question what role in the contemporary strategy of audiomarketing plays the relation between music and embodiment. How and why “acoustic wallpaper” (understood as music intentionally treated as an acoustic background, not absorbing the attention of the listener) is used by the sender to induce responses which can be classified as embodied?

**Main contribution**
The problem of programmed music and embodiment will be analysed possibly multidimensional through the prism of theoretical marketing concepts of *atmospherics* (Kotler, 1973-74) and *servicescape* design (Bitner, 1992), the general assumptions of music selection on the example of audiomarketing service providers on the Polish market and the results of preliminary empirical research i. a based on “soundwalking” (Westerkamp, 1974) method conducted in selected commercial galleries in Warsaw and supplemented by survey data. Such approach gives the possibility to understand the phenomenon of embodiment in music from the perspective of the sender’s intentions taking into account the musical communication model.
consisted of the sender (brand/professional company) — (imposed, background) music — the recipient(s).

The overall analysis highlights the significant role of acoustic driving mechanism based on entrainment process (Clayton, Sager, & Will, 2005) which is intentionally used by audiomarketing service providers to manage the flow of customers (in daily, weekly and annual cycles). The possible role of entrainment mechanism in induction of more advanced cognitive and behavioral responses will be discussed through the prism of psychobiological theory of musical preference (Berlyne, 1971; North & Hargreaves, 2008; North, Hargreaves & Krause, 2018). On the other hand, the special attention will be paid to the problem of autobiographical complexity of listener responses to music (observed in the present research). It illustrates the problem of unpredictable subjectivity in reference to in-store music responses which are usually not congruent with sender’s intentions. This tendency anchored in individual recipients’ experience seems to be the significant complement existing studies.

Implications for musicological interdisciplinarity
This paper acknowledges the need to expand upon the research that examines how (background) music may be used to influence listeners’ responses in the context of music, cognition and embodiment. The proposed approach is an example of interdisciplinarity combining musicology, broadly understood consumer research, acoustic ecology and embodied music cognition, which seems particularly important in the context of research on the functioning of music in everyday life. The paper is a part of a comprehensive attempt to look at the musical culture of the 20th and 21st century through the prism of “acoustic wallpaper”.

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References
Perceived Emotion Embodiment in Music

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Background in Music Psychology and Perception
Composers and performers are capable of encoding a particular emotion in the music by combining several acoustic cues and utilising them to express that particular emotion. In turn, the listener absorbs the intended perceived emotional expression and utilises the same array of cues to decode and recognise the intended emotion (Juslin, 2000). Musical cues can loosely be divided into two categories: structural and expressive cues. Structural cues refer to the aspects of music which relate to the composed score of the music, such as tempo and mode, while expressive cues refer to the features that are controlled by performers when playing a piece of music, such as timbre and articulation (Gabrielsson, 2002; Livingstone & Brown, 2005). Both structural and expressive cues are responsible for conveying emotion and are known to operate together in an interactive fashion (Friberg & Battel, 2002; Gabrielsson, 2008), thus, cues should be studied as multiples rather than individuals. Further research on how musical cues interact with each other will assist in a better understanding of how an intended emotion is encoded and successfully decoded by the listener (Argstatter, 2016).

Background in Music Composition
Findings from an extensive review carried out by Eerola and Vuoskoski (2013) show that a staggering 76% of the musical stimuli sets used in 170 music and emotion studies were commercial recordings. The probability that the participants have already been exposed to commercial recordings may tend to be higher than using other sources of musical stimuli. Although some studies (Eerola & Vuoskoski, 2011) require participants to report if any of the stimuli sounded familiar, an unconscious bias may still exist due to prior exposure through mediums such as films and adverts and as such, cannot be controlled (Juslin & Västfjäll, 2008). A solution to eliminate both bias and the overuse of commercial recordings, would be to specifically compose music for the experiments. Only 24% of the musical stimuli sets identified in the same review had been specifically composed for music emotion research (Eerola & Vuoskoski, 2013).

Aims
The main aim of this paper is to recognise how different perceived emotions are embodied in music; in particular, identifying which properties in the structural parameters and emotional cues of a musical composition contribute to the conveying of different perceived emotional expressions.

Main contribution
This paper focusses on the relationship between music and emotions. It seeks to discover how different perceived emotions are embodied by music, specifically looking at the structure and expressive cues of a musical composition. Although research on music and emotions has been carried out for over a century, several issues have yet to be resolved. One of the main issues has been retaining ecological validity of music while it is being altered to create and communicate different emotional expressions. This study tackles this issue by using specifically
composed music examples that can be regarded as ‘real music’ and hold ecological validity even when manipulated. Additionally, this paper takes a different approach to the conventional way of studying how music structure affects emotion perception. During this study, participants are instructed to alter 6 musical parameters (tempo, mode, pitch, dynamics, brightness, and articulation) of a musical example in order to communicate different emotional expressions. This approach allows to identify which combinations of the structural parameters play a role in the listener’s perception of different emotions in music. A detailed account of the differences and similarities between the music examples conveying the same emotional expression is given, and the optimal cue combinations for each of the different perceived emotional expressions are presented and discussed within the wider context of emotion communication in music.

**Implications for musicological interdisciplinarity**
The focus of this paper has significance both to musicology and also applied fields such as music information retrieval or music therapy. Discovering the impact of structural parameters and emotional cues of a musical composition on conveying distinct perceived emotions will contribute to a better understanding of how music is perceived to embody different emotions, and will allow to expand the topic onto specific core issues such as the role of expertise and learning of these emotional cues through studies with children and participants with different cultural and musical backgrounds. Furthermore, the proposed research would be highly beneficial in rehabilitation and music therapy, where music is used as an aid for emotion regulation.

**References**
Hidden Aural Skills: Implicit Learning Through Experience

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Background in Aural Skills Pedagogy
Recent research has investigated factors contributing to the accurate recall of melodies, including melodic differences and individual differences in listeners’ working memory capacity. However, few studies have investigated the influence of listeners’ musical backgrounds on both the cognitive aspects and content knowledge necessary for musical memory tasks (a notable exception is Meinz & Hambrick, 2010), much less for specifically melodic dictation. Though sensorimotor synchronization and the role of exposure has received some attention (Colley, Keller, & Halpern, 2018; Honing & Ladinig, 2009), little is known about the embodiment and visual strategies listeners may use to encode aurally presented melodies as they are dictating the melodies, especially in relation to the instrument with which they are most experienced.

Background in Cognitive Science
Studies have suggested that musicians possess a better working memory than non-musicians (Slevc, Davey, Buschkuehl, & Jaeggi, 2016; Swaminathan, Schellenberg, & Khalil, 2017; Talamini, Altoè, Carretti, & Grassi, 2017). However, research has neglected comparisons of working memory across musicians of varying instrumentation, and especially in regards to the aural skills task of melodic dictation. Melodic dictation involves both the set of cognitive abilities necessary for perceiving, encoding, and recalling musical information as well as the knowledge required for translating what has been heard into written musical language. Musical experience builds sets of knowledge structures in the long-term memory, allowing for quicker recall and more efficient encoding processes. In the encoding stage, knowledge and recognition of basic tonal patterns help listeners to group individual notes into meaningful phrases. For example, experienced improvisors categorize chordal progressions more efficiently than unexperienced improvisors (Goldman & Sajda, 2018). Listeners may also be applying an embodiment strategy—i.e. fingering along as if playing their instrument—or a visual strategy—i.e. imagining a piano keyboard—in order to further aid their understanding of the melody. At the recall stage, knowledge of technical aspects surrounding melodic dictation, including how to correctly draw and beam notes on a staff in a given clef, impact the ability of the listener to focus on their memory of the melody. If notating music is automatic, the listener is able to devote nearly all their attention to memory; if notating music requires conscious attention, this draws away focus.

Aims
This paper aims to broaden the discussion of aural skills pedagogy to include aspects of students’ musical background and experience through an investigation of “hidden aural skills.”

Main contribution
In this paper, I consider multiple factors that impact melodic dictation success yet are not often considered in the aural skills classroom. I discuss these “hidden aural skills” and their potential influence on the strategies and struggles that students from various backgrounds often
experience when attempting to dictate a melody from the common-practice period. As an instructor for some years, I have noticed that pianists tend to be among those students who excel at melodic dictation quickly and consistently. One way in which the piano differs from other instruments and voice is that its pitches are conveniently organized in an undeviating, linear manner. Perhaps this visuospatial attribute plays a role in what might be termed a pianist advantage in melodic dictation tasks. It is also possible that musicians, depending on their instrument of expertise, employ an embodiment strategy during dictation. This strategy may be effective to some instrumentalists, while less than effective to others. I describe an ongoing study that uses MRI neuro-imaging to examine the cognitive strategies musicians may use in a melodic discrimination task that manipulates visuospatial and tonal elements, attempting to explicitly elicit an implicit advantage for pianists. I will compare serial recall accuracy and brain imaging to observe whether pianists rely on a different processing mechanism than non-pianist musicians. This study investigates whether melodic memory is enhanced by factors beyond conscious knowledge and strategy use, i.e., the unconscious application of knowledge of a keyboard layout.

**Implications for musicological interdisciplinarity**

This paper bridges the gap between experimental investigations and applications in the classroom. Further, it examines factors contributing to melodic dictation success that pertain to implicit knowledge gained through musical experience. I consider successful melodic dictation through a lens not of musical ability and intelligence, but of cognitive strategies both explicit and implicit, providing interesting and important implications for aural skills pedagogy.

**References**


Surrounding the Human Body with Sound: “Quadraphonic” Musical Performance

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Background in Philosophy
Traditionally, the philosophy of perception has predominantly focused on visual perception. In the last 10 years, the philosophy of auditory perception has gained momentum, often seeking to supplement visual models of sense perception (O’Callaghan, 2011). A key difference between vision and audition concerns spatial resolution: whereas vision presents the distance of objects in one's visual field at high resolution relative to audition, audition presents the distance of audible sounding objects at a much lower resolution than vision (Culling & Akeroyd, 2010). Apparently, humans are able to “see distance” better than they are able to “hear it”. Rethinking how auditory depth perception differs from visual depth perception offers fertile ground for thinking about spatial perception in general. Two diverging philosophical traditions, rationalism and empiricism, offer competing explanations of auditory depth perception. This paper discusses their merit in the context of surround sound, arguing that while both have merit, empiricist views offer the best explanation of auditory depth perception in such settings. Crucial to this discussion is an explanation of how recent studies in the psychology of perception figure in both rationalist and empiricist approaches to auditory perception.

Background in Musical Performance
Being surrounded by sound is sometimes thought to be a desirable quality for musical performances and film screenings to possess, creating a demand for specialized sound recording and reproduction technology (marketed in the U.S. circa 1978 as “Surround Sound”). In this period there was a surge in “quadraphonic” musical performance, concert performances with four equidistant stages typically in the “front-left, front-right, backleft, back-right” configuration. Quadraphonic musical performances bear a number of auditory and acoustic properties absent from conventional performances, something participants often describe as feeling “surrounded by sound”. This paper discusses which aspects of feeling surrounded by sound are best explained by the competing rationalist and empiricist traditions, arguing that features of quadraphonic musical performance illustrate an important reason for preferring empiricist views of auditory depth perception.

Aims
This paper aims to evaluate rationalist and empiricist perspectives for explaining the auditory perception of space (especially depth). Whereas rationalist views offer geometrical explanations of depth perception, like triangulation occurring in the visual system, empiricist views emphasize the role of cross-modal experience and embodied perceptual learning to explain the same phenomena. It is argued that empiricist views not only explain more features of auditory spatial perception, but offer a better explanation of features like depth and direction.

Main contribution
I argue that quadraphonic musical performance provides a unique case by which to compare rationalist and empiricist approaches, both of which remain at issue in the contemporary
philosophy of perception. Quadraphonic musical performances possess numerous distinctive auditory and spatial properties absent in conventional musical performances. Whereas geometrical views in the rationalist tradition have compelling explanations of a narrow range of perceived spatial properties of quadraphonic musical performance, experiential views in the empiricist tradition explain a wider range of properties by integrating features of how humans learn to perceive the location of a sound's source. In the empiricist tradition, auditory depth perception is an essentially “embodied” phenomenon. According to empiricists, auditory depth perception is to be explained with reference to certain learning experiences where subjects integrate auditory, visual, and tactile/motor sensations while moving their body toward the source of a sound. This paper answers the following three questions about empiricists' view of auditory depth perception: What features of empiricist views make them preferable to rationalist views of auditory depth perception? What commitments are necessary to adopt an empiricist view of auditory depth perception? And in what sense are empiricist views consistent with views about embodied cognition? I argue that quadraphonic musical performance offers the perfect case for answering these questions.

Implications for musicological interdisciplinarity
The interdisciplinary value of this paper lies in reflection upon (i) models of auditory spatial perception in psychology, and (ii) aesthetic experience of audience members at a musical performance, or viewing an artwork with auditory-spatial cues. Whereas rationalist views make perceptual processes in early stages of brain processing central for explaining the experience of quadraphonic musical performance, empiricist views give centrality to perceptual learning, multi-modal perception, and bodily movement, placing empiricist views closer to embodied perspectives in contemporary psychology. When it comes to the aesthetic experience of auditory depth, empiricist views bring to bear an individual's past perceptual learning experience, inviting reflection upon learned versus innate differences in auditory experience and how they may inform an individual's aesthetic experience.

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An Aesthetics of Movement in South Indian Art Music: Conceptualizing Music Through the Body

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Background in Ethnomusicology
In Karnatak music, a style of art music performed in South India, vocalists tend to gesture spontaneously while singing, thus producing continuous streams of melody and upper body movement. The same occurs during vocal lessons, where teachers gesture while demonstrating musical phrases to their students. Such gesturing is neither formally codified nor explicitly taught. Rather, performers acquire the habit implicitly in the course of the long process required to learn this complex style. Gesturing practices in North Indian art music are similar in many respects, and have previously been studied by Clayton (2007), Leante (2009) and Rahaim (2012). In my research, I focus on the Karnatak style, exploring the movement dimensions of musical meaning and experience. This work is based on several years spent learning to play Karnatak violin in South India (2007-2011) and later periods of fieldwork in the region where I made audiovisual recordings of vocal and violin lessons, and conducted interviews with approximately 40 students and teachers.

Background in Ecological Psychology and Crossmodal Perception
In ecological accounts of music perception, which typically draw on Gibson (1966) and Bregman (1994), musical qualities such as emphasis, rhythm, dynamics, and change in timbre and speed are often viewed as contributing to the experience of ‘musical movement’: the sense of motion experienced while performing, listening, and dancing to music (examples include Clarke 2001; Schlenker 2017; Windsor & de Bezenac 2012). In such accounts, movement is considered an important dimension of musical meaning. Here, I adopt this perspective and apply it to the particular case of Karnatak music performance.

In addition, I draw on existing research on crossmodal perception in order to explore the cross-domain mappings between music and movement that lie behind gesturing in the Karnatak style. Examples of such mappings found in lab-based studies include those between musical pitch and vertical position in space, and between loudness and physical force (Eitan & Granot 2006). I suggest that the spontaneous gesturing in Karnatak vocal lessons presents an excellent opportunity for exploring such mappings in a real musical context.

Aims
In this paper I apply an ecological perception perspective to my joint analyses of gesture and music in order to articulate an aesthetics of musical movement in the Karnatak style. My aim is to create an account of embodied musical meaning and experience in the style.

Main contribution
Karnatak music is structured through melodic types known as ragas. The characteristic motifs from which ragas are formed must be performed with particular patterns of rhythm, emphasis, dynamics, and articulation in order to be considered correct and pleasing (Pearson, 2016). Thus, these qualities should be considered part of the aesthetics of the style. From an ecological perception perspective (as outlined above) it follows that experiences of musical movement
will arise from such patterns, constrained by the affordances offered. It is reasonable to claim, therefore, that the Karnatak style has a dimension that can be described as an aesthetics of musical movement.

Karnatak vocalists typically gesture spontaneously while singing, and it is in these gestures that we see something of the performer’s experience and conception of ‘musical movement’. In this paper I show how such gesturing is used in vocal lessons to convey to students precisely how the music should ‘move’. My analyses of videos of vocal lessons given by three different teachers demonstrate that their gestures often enact qualities of movement and bodily sensation such as force/weakness, freedom/constraint, heaviness/lightness, rhythm, and speed, and I show how these movement qualities relate to sonic qualities of the music being taught. I argue that despite the gestures not being formalized, students understand the connection between gesturing and musical sound, partly due to long-term exposure to their teachers’ gesturing, but importantly also because they, as human beings with bodies and an ongoing history of structural coupling with the environment (van der Schyff, Schiavio, Walton, Velardo, & Chemero, 2018), associate particular movement qualities with sound qualities that correspond in their experience. I propose that both the movement aesthetics of the style and the vocalists’ embodied conceptualizations of the music are very much on display through the gestures of teacher and student.

Implications for musicological interdisciplinarity

By drawing on theoretical work, research findings, and methods across several disciplines I believe I am able to provide insights into the relationships between gesture, sound, and meaning in this context that go beyond that which would be achievable using a single disciplinary approach. Implications of this work include the observation that other musical styles also have dimensions of meaning relating to the body and movement, and that research on such dimensions is likely to similarly benefit from an interdisciplinary approach incorporating work on ecological perception and cross-domain mapping.

References


"When disgusting music penetrates into my body": Embodied, Affective Experiences of Listening to Unpleasant Music

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Background in Philosophy (of emotions), Humanistic Psychology and Sociology

It is often argued that all human experiences are embodied (e.g. Nussbaum, 2001) because we are embodied creatures. Our entire existence in the world and everything we do is “perceived through body” (Merleau-Ponty, 1945; 1962). Because of a temporal structure of our lived experience, it cannot be grasped in the moment it happens but only be reflected afterwards. The verbalisations of subjective experiences are the typical focus of qualitative research (Gibson & Brown, 2009), which aims to explore the ways of meaningmaking and analyse the quality and substance of human experience. A research paradigm usually involves constructivist assumptions of reality, which assume that our social reality is subjective, situational, culturally variable and ideologically conscious (Marvasti, 2004). Thus, also emotions can be considered not as universal affect programs, but as embodied, experiential states that exist between people in a sociocultural context, and are learned, shared and communicated via social interactions and narratives.

Background in Experimental (Music) Psychology

In music psychology, emotions relating to music have been widely studied over the past decades. Traditionally, the field has considered musical emotions as a result of cognitive appraisal or representations of one’s inner (basic) emotions – although alternative ‘enactive’ models of mind have challenged the information-processing model of cognition by emphasizing the interactivity and intersubjectivity of both cognition and emotions (e.g., Thompson, 2007; Schiavio et al., 2017). According to empirical studies, one of the most important reasons why people engage with music is to experience emotions, and the majority of music-evoked emotions are positive ones (Juslin & Sloboda, 2010), even, if the musical expression would be classified as representing negative emotions (Juslin et al., 2011; Taruffi & Koelsch, 2014). Previous research on disliked or hated music has been focusing on “bad music” as a historical and cultural phenomenon (see Washburne & Derno, 2004), or specific unpleasant musical features (Cunningham, Downie, & Bainbridge, 2005) and annoying sounds (McDermott, 2011), but empirical studies investigating subjective, embodied experiences of listening to aversive music are still close to non-existent.

Aims

The present study aims to shed light on the ways people verbalize and make sense of their experiences of listening to aversive music. Empirical textual data was collected from 95 volunteers, who described their experiences of listening to music that they found unpleasant, focusing on both the musical features and their recollections of typical bodily feelings, emotions, and thoughts evoked by this kind of music. The participants were also asked how common it is for them to experience unpleasant feelings in relation to music listening. Qualitative content analysis was conducted for identifying common themes within these descriptions of affective experiences.
Main contribution
The preliminary results of the analysis suggest that unpleasant affective experiences might be more usual than previously reported. Nearly half of the participants told that in the context of music listening, negative emotions, such as disgust or irritation, were not rare experiences to them. The unpleasantness was often reported to be associated with some level of conflict between extramusical aspects or cultural conventions of the music (e.g., styles of presenting, content of the lyrics) and the participant's personal values and attitudes towards music in a general level (e.g., what is music for, or what it should sound like). In addition, the unpleasantness of certain sound qualities, especially in the case of vocal music but also with instruments, was a typical reason to dislike music. Furthermore, the participant accounts reveal that these experiences of "musical disgust" are strong, embodied experiences involving various, unpleasant bodily feelings and physical responses, such as muscle tension or feelings of pain, nausea and headache. A strong experience of musical disgust can also feel anxiously immersive, similar to a violation of personal space, or even a physical attack, which induces strong desire to flee from the situation where the music is being heard. With some similarities to Gabrielsson's (2011) research, these descriptions challenge the still existing ideas that music-induced emotions would be mostly enjoyable or at least harmless, music-specific and thus distinct from everyday emotions, or somehow abstract results of imagination and disembodied cognitive processing, triggered by "fictional stimulus".

Implications for musicological interdisciplinarity
This kind of multi-discipline perspective on musical, embodied emotions provides means to broaden the perspective of previous studies in the field of music and emotion research. Collecting textual data from a large amount of informants rather than focusing on a smaller focus group is an atypical decision for humanistic qualitative research. Although lacking depth in case of an individual informant, this kind of data enables the explorations of people's experiences on a more general level, which can encourage dialogue with the scientific tradition that aims to produce generalizable knowledge. In addition, the results of the present study are broadening our understanding of people's negative emotional experiences in relation to music listening.

References


Signed Language: Music and Embodied Metaphor

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Background in Music and Deafness
Deaf people traditionally do not consider music listening as a part of their daily life, as music has been traditionally treated as eminently auditory. However, in recent years music for the deaf has become an incipient academic topic (Schraer-Joiner, 2014) and its role in deaf culture (Darrow, 2007; Darrow & Loomis, 1999) due to the consideration of music as being also haptic and motor (Nanayakkara, Taylor, Wyse, & Ong, 2009). There are several research projects regarding music for the deaf such as Sounding Out; Music Visualization Project; Signed Music Project; Sign & Sign; Feel the Music, that address deaf approach to music in diverse ways. When using sign language, most of the adaptations refer to vocal music and the translation of the lyrics. However, there is much less research on instrumental music and on how musical features could be translated into signed language. Amber Gallowy-Gallego and Holly Maniatty in the United States are two of the few interpreters worried about other music parameters beyond lyrics.

Background in Embodied Mind Cognitive Metaphors
Embodied mind theories allow us to understand the role of the body in music cognition and perception. Within this paradigm, embodied conceptual metaphors can become a useful tool for dealing with the problem of instrumental music translation into sign language. These kinds of metaphors are commonly used in sign language for the arts (poetry, theatre) and have been studied thoroughly (Meir & Cohen, 2018; Moriyón et al., 2010; Nilsson, 2016; Taub, 2007; Wilcox, 2005; Wilcox, Wilcox, & Jarque, 2003). Embodied cognitive metaphors are ways of conceptualization that use a known domain in order to understand a more abstract one (Lakoff & Johnson, 1980). Johnson argues that we understand abstract domains, such as music, in terms of more concrete and better-known domains. Our body feelings and experiences allow us to build up ‘image schemata’, recurring, dynamic patterns of our perceptual interactions and motor programs that give coherence and structure to our experience (Johnson, 1987). Metaphors operate by making use of patterns that we obtain in our physical experience in order to organize our more abstract understanding (Johnson, 1987), allowing us to understand the world in terms of what we already know.

Aims
The aim of this research is to understand to what extent Embodied Cognitive Metaphors can become a tool for instrumental music translation into sign language.

Main contribution
We will present a study on instrumental sign language music. The research team counts on a music teacher, also sign language interpreter, that teaches music in a bilingual primary school in Madrid, Spain (Peñalba, Moriyón, & Luque, 2018; Peñalba, Moriyón, Luque, & Cabezas, 2017). She teaches music in signed language and she uses intuitive translations of instrumental
music in order to make available the listening activities to deaf children. She also uses balloons and other resources to facilitate vibratory stimulus and complete the visual cue. We have recorded the piece ‘The Carnival of the Animals’ (Saint-Saëns) translated into signed language. We have analysed videos according to Embodied Cognitive Metaphors in order to understand the keys of music features translation into bodily gestures. Methodology includes video analysis and interviews with the teacher.

**Implications for musicological interdisciplinarity**

Results show that aspects regarding timbre, character, melody paths, rhythm, themes, phrases, among others, are represented into gestuality. We will address how these metaphors reveal cognitive considerations of an embodied mind. Sign language music is interesting not only for deaf people inclusion, but also to understand how listeners conceptualize and understand sound and music.

**References**


The Role of the Cortico-Subcortical Loops in the Perception of Musical Rhythm. Embodied Cognition or Cross-Modal Experience?

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Background in Neurobiology
The cortico-subcortical loops are the neural circuits that connect the thalamus, different cortical areas and the striatum (Gorzelańczyk, 2011). According to Alexander, the activity of these loops is crucial in the processing of sensory information that is based on prediction (Alexander, DeLong, & Strick, 1986). An increasing number of studies have indicated the activity of anatomical structures belonging to these loops (especially the putamen and the premotor and supplementary motor areas) during beat perception in music (Grahn, 2009; Grahn & Rowe, 2009; 2013) as well as during motor synchronization with music (Sameiro-Barbosa & Geiser, 2016; Schaefer, Morcom, Roberts, & Overy, 2014).

Background in Musicology
Musical rhythm is often described by the means of metaphors related to movement. It is also associated with a specific kind of musical meaning called ‘gestural meaning’ (Patel, 2008). This association does not seem to be the mere result of cultural invention, but is rather based on an intrinsic part of music perception which is strictly connected to our motor experiences (Nussbaum, 2007). In addition, these experiences are indicated as an indispensable element of music that suggests an embodied character of musical rhythm cognition.

Aims
The main aim of the proposed presentation is to analyze the role of cortico-subcortical loops in the perception of musical rhythm from the perspective of the embodied cognition paradigm.

Main contribution
Embodied cognition is a relatively new term. The most popular general meaning of ‘embodied cognition’ is that the source of mind is not restricted to the brain, but also includes the entire body and even its interactions with the environment (Jasanoff, 2018). Since rhythm perception in music is claimed to be at least partly motor in nature it is tempting to view rhythm perception in music as an embodied phenomenon. In fact, a metrical grid can be inferred from both musical structure and dance movements. Moreover, any motor activity of the body can be understood as part of a dynamic system that contains feedback loops between brain structures and other organs. It is assumed that in such a system information can be stored in the whole system rather than just in the brain (Pearsall, Schwartz, & Russek, 2000). Information from other organs is necessary to stimulate motor, emotional and cognitive representations in the striatum and the cerebral cortex which are the main parts of the cortico-subcortical loops. From this perspective, information from the body such as the heart, that reaches the cortico-subcortical loops, can influence the representations of musical rhythm. However, the activity of the cortico-subcortical loops, as well as other brain areas involved in the processing of musical rhythm, is
based on information coded in the same neural rule – the action potential. This is independent of where a particular piece of information comes from (i.e. if it is exteroception or interoception). In addition, the motor activity of the body during music listening can be inhibited without significant change of musical rhythm recognition. Apart from this, there are people who are able to recognize musical beat quite accurately, but are poor in the synchronization of their movements to a musical beat (Sowiński & Dalla Bella, 2013), which suggests that motor activity is not necessary for the recognition of musical rhythm. In other words, it seems that the sole activity of the brain structures involved in the processing of musical rhythm generates our cross-modal experience of musical rhythm composed of motor, emotional, and cognitive representations. The cross-modal character of this experience however, indicates that musical rhythm cannot be restricted solely to the cognitive arrangement of rhythm measures in time.

Implications for musicological interdisciplinarity
The full understanding of any musical structure is impossible without the knowledge of psychology, neurobiology, philosophy etc. Therefore, musicology needs to use the achievements of these disciplines to improve its theoretical claims as well as to enrich the methods of musical analysis. The presented view of the perception of musical rhythm may also contribute to a better understanding of musical structure.

References


Music and Neural Connectivity: Neuroaesthetics, Neuroplasticity and the Default Mode Network of the Brain

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**Background in Neuroscience and Neuroaesthetics**
Music has been studied for long periods of time as a structure or artefact to be analyzed outside of the time of actual unfolding. Music psychology, however, has seen recently a paradigm shift that conceives of music also as a process that unfolds in real-time, stressing the music user besides the music. Recent developments in neuroscience have been a major trigger in this context by providing new measuring tools for a moment-to-moment description of the processing by the listener. These neuroscientific contributions have been prolific, but their main approach has been cognitively oriented rather than aesthetic, conceiving of brain processes with cognitive processes being restricted to the brain (internalist approach). There is need, therefore, to establish a neuroaesthetics of music that should provide the neural underpinnings of a musical-aesthetic experience by extending the skull-skin boundary (externalist approach).

**Aims**
The aim of this contribution is to bring together insights and findings from the domains of neuroplasticity, neural connectivity, neuroaesthetics and the default mode network of the brain and to bring them in relation with the 4E approach to cognitive science (4ECS), which conceives of musical sense-making as embodied, embedded, extended and enactive. Rather than relying merely on processes which are encapsulated in the brain, it is argued that musical sense-making is shaped to a considerable extent by sensorimotor interactions with the sounds and sound-producing devices, both at a manifest or internalized level. Musical sense-making, on this view, should depend on a dynamic interplay between an externalist and internalist approach to music cognition.

**Main contribution**
Music processing can be considered as a network-based brain function. The brain, as a dynamic system, consists of highly pliable connectivity networks that are able to adapt themselves to cope with the solicitations of a challenging environment. Music processing, in this view, can be defined as coping behavior that is able to trigger brain connectivity and to change the structure and the function of these networks. Special emphasis is laid on findings from recent neuro-imaging studies, which seem to suggest a kind of convergence of aesthetic judgment, reward system, moral judgments and the default network of the brain, with functional connectivity between the auditory cortices and the mesolimbic reward system, all of them being the outcome of interactions with the sounds.

**Implications for musicological interdisciplinarity**
Music processing, as an aesthetic experience, triggers many functions of the brain. It is able to modify the structure and function of the brain, and to trigger neuroplasticity both on the short and long term. Where previous research has focused mainly on structural changes as the result of music training, there is now a whole new domain of research that investigates the functional connections between separate regions of the brain. This domain of connectomics has shown
that music processing can be studied in action, during listening, but there is also a kind of silent imprint which is still observable in the brain in its resting state. Hence the importance of the study of the resting state networks, and in particular the default network of the brain. Some tentative hypotheses have been formulated to bring this in relation with higher levels of music processing, but much work still has to be done to definitely confirm these claims.

References
Musical Improvisation Enhances Bodily and Vocal Coordination in Subsequent Conversation

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Background in Phonetics and Music Cognition
As joint dynamic interactions in which parties must coordinate their individual actions, speech and music share rhythm as an emergent property. By analysing pikes—local f0 maxima or minima (Loehr, 2007)—and musical pulse produced by dyads talking while they improvised music, Hawkins, Cross and Ogden (2013) concluded that interactants seem to entrain to one another over short periods of time, regardless of domain. Similarly, Ogden and Hawkins (2015) compared instances of Periodicity vs. Aperiodicity in Question+Answer (Q+A) pairs, concluding that rhythmicity, manifested in the emergence of periodicity of pikes or speech accent across turn-transitions. Such findings suggest common underlying mechanisms between music and speech, at least in the case of English speakers.

Background in Cognitive Science
In the last decades, interpersonal coordination has been approached at different levels and by means of different techniques (Cornejo, Cuadros, Morales, & Paredes, 2017). Motion Capture (MoCap) techniques have the advantage of tracking movements accurately while at the same time allowing a relatively ecological setting. When it comes to kinds of coordination, one established distinction is that between mirror-like (where both interacting people move as through a mirror) and complementary (or anatomical) coordination (when movements are coordinated in a complementary manner) (Pierpaoli, Ferrante, Manzoni, & Fabriet, 2014). Since coordination does not always lead to a better prosocial performance, how coordination is related with social variables such as trust and empathy remains an open question.

Aims
Working under the assumption of common underlying mechanisms between music-making and interpersonal coordination necessary for everyday interaction, an experiment was designed so as to test whether a rhythmic task such as joint musical improvisation would have a stronger effect on subsequent interpersonal coordination when compared to a non-rhythmic task. Furthermore, the experiment sought to assess both vocal and bodily coordination at the same time in order to assess potential multimodality of such an effect.

Main contribution
A total of 48 non-musician participants unknown to each other were randomly assigned to 24 same-sex dyads, and divided into two conditions. In the Musical Improvisation (MI) condition 13 couples had an initial conversation semi-structured by cue-cards (T1), then were asked to jointly improvise music, and ended with a second semi-structured conversation (T2). In the Hands-Busy (HB) condition, between T1 and T2, instead of musical interaction 11 participant
dyads (2 outlier couples were removed) were asked to jointly build a free-choice structure by means of wooden blocks. For each dyad, interpersonal bodily coordination was measured by means of a MoCap system that captured the torso movement of both interactants, whilst vocal coordination was quantified by assessing the emergence of Periodic Q+A pairs. Cross-correlation curves show that patterns of coordination changed significantly in both conditions from the initial to the final conversation interaction. Overall, lag time magnitudes around 0.5 s to 0.75 s the four curves tend to show no statistically significant difference between them (p < .001). The latter splits statistically significant correlations in two clear time ranges; a mostly immediate coordination around zero lag, and imitations that occur with a delay of +/- 1.0 s or more.

In the Hands-Busy condition, while in the initial conversation the speaker tended to coordinate with the listener in an anatomical way following her movements 1.4 s later, during the second talk both participants synchronized each other in a mirror way with various time lags. On the other hand, in the first conversation of the musical improvisation condition, the speaker coordinated with the listener in a complementary way. However, after the musical improvisation, both the speaker and listener display mirror-like coordination with each other following their respective movements with an approximate 0.5 s delay. The amplitude of the coordinative movements in the second conversation after the musical improvisation turns out to be significantly higher than the second conversation after the non-musical task condition.

Regarding vocal coordination, while pikes in Chilean Spanish are manifested primarily in the domain of intensity rather than pitch, data reveal that in the case of the MI condition, the emergence of periodicity across turn transitions in Q+A pairs rises from 23.7% in T1 to 46.2% after jointly improvising, while T1 and T2 in the HB condition display a less pronounced, opposite pattern (42.1% to 35.6%). A two-way mixed ANOVA indicates a significant interaction between condition and conversation, F(1,22) = 4.79, p = .041.

As a whole, data seems to confirm that music-making—a largely non-verbal, rhythmical task—does make a difference when it comes to the impact of such interaction on subsequent interpersonal coordination that are not normally considered as ‘musical’. Music-making not only augmented vocal alignment as represented by Periodic Q+A pairs, but also generated stronger mirror-like bodily coordination, when compared to other affiliative—but non-rhythmic—activities such as joint building. Our results thus support the existence of common, underlying mechanisms between music-making and interpersonal coordination necessary for everyday interaction. Finally, they also extend previous findings in English speakers to a Spanish-speaking sample, suggesting the universal quality of the Periodicity in Q+A pairs.

Implications for musicological interdisciplinarity
Our experiment attempts to bring together two lines of research with so far rather parallel developments: bodily coordination and speech alignment. In doing so, evidence emerges suggesting their integration into a higher-order, multimodal process of interpersonal coordination. The latter, which can be regarded as a basic human capacity, indeed seems to underlie human interaction regardless of domain, for a moment blurring the line between speech and music. Our approach aims at integration between musicology, linguistics, cognitive science, and their respective and distinct methods in the service of a holistic understanding of human interaction.

References


The Movement as a Problem: Application of Merleau-Ponty’s Phenomenology to the Percussion Technique

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**Background in Percussion Technique**
The main concern is about the symphonic percussion technique in a conservatory/university medium. Technique taken as the activity where the musician deliberately practices to develop capability in the instrument, but also as a discourse about how to play. The technique has a central role in the academic community of percussionists, from pedagogy, to study to performance, but at the same time is not a habitual topic of discussion, what makes it a low-developing theme into the percussion field.

**Background in Philosophy**
Philosophy, especially phenomenology, is an alternative to the naturalistic approach (anatomy, biomechanics) to the body, that brings and understanding from a different paradigm.

**Aims**
The aim of this paper is to rethink the main concepts and ideas used in the technical discourse of the symphonic percussion. Taking a phenomenological approach guided by *Phenomenology of Perception* (Merleau-Ponty, 1957) a theoretical framework for a phenomenological study of the instrumental percussion technique is proposed. That’s because the percussion technique, in its main discourse (percussion methods and books), has been led by a naturalistic point of view, bringing an overall thinking of the body in terms of physics, anatomy etc. which made up a way of educating and playing that does not take the experience of one’s body as something reliable. Taking the phenomenological grounding in which: body, movement, space, time, world, subject, don’t have a naturalistic but a lived sense, the main themes of the instrumental technique: position, grip, tension, relaxation, movement, body parts, can be re-signified, rooting them in the perceptual and lived experience, to finally propose that the body experience in the instrumental study is a continuous construction of meaning, where there are no real and illusory ideas or sensations, but an embodied imagination which can be a field of study-exploration in the instrumental technique.

**Main contribution**
The application of Merleau-Ponty’s phenomenology refers to the use of theoretical tools presented in *Phenomenology of Perception* (Merleau-Ponty, 1957) as an alternative to think the percussion technique and practice. I explored how its main characteristics; indeterminacy, unfinishedness, intentionality, figure-background structure, could be used to talk about the experience of playing. For that I propose a tension-relaxation structure for the experience of the body, where the imagination is a constitutive part of its intentionality, that because this tension-relaxation, as intentional, appears in a certain way, and that way is imaginary because there is not a finished or real (in the sense of unmistakable) way of asking about the experience of the body. This imagination is embodied because the purpose is to take the mentally and the bodily as a full experience, as perception, thinking about a movement and the movement itself are co-emergent and appear as the same act. This approach questions recurrent topics used in the...
technical discourse. For example, the tension that is taken as a muscular overuse, but not as an inherent part of the body operation, and the relaxation that is intuitively used to talk about a correct but unclear form of playing; when does relaxation begin and the tension end? What about the great intensity needed in some movements, is tension a magnitude or a misuse? Is relaxation a lack of muscle activity? How to move then? Could eagerness to avoid tension and reach relaxation be a barrier to explore what are those? The wrist movement as a standard model for playing, that implies the idea of body parts, movement and steadiness, and oversimplified directions, besides being a visual indication, is a clear perceptual indication? Is appropriate to categorize a movement in active and non-active parts? Do position and movement have a radical perceptual difference? How to perceptually demarcate the body parts? Does not the “up and down” movement ignore a lot of what happens in a movement? Is it really mandatory to start developing this form of playing to reach a good technique? Taking those questions with the phenomenological tools, we got a different scope of what can be done as technical study. This approach intends to overcome some difficulties in the instrumental learning as; mistrust in the own sensation, models of playing that don’t fit accurately with the experience, the restrain of the playing possibilities, the absence of interest in the body experience as central part of the instrument playing, the conflict between explanation and execution, the contradiction between the technical explanation and the professional playing, the metaphoric explanations as second hand tools. All of this to open a discussion into the percussion technique, looking for a further development.

Implications for musicological interdisciplinarity
With biomechanics, kinesiology, and other body movement related fields, the perception guide brings the opportunity to study atypical approaches to movement that demand a full body attention and also provides a point of comparison for the more orthodox ideas about body movement in playing percussion. With neurology, it could be interesting to study how is related the body experience to the explanation that the person has of it when playing. There is a gap between the bodily part of music performance and philosophy, where phenomenology opens an interesting discussion about the perception and the body experience. Finally, the phenomenological perceptual experience is an excellent tool to create different understandings and research paths.

References
How do Rhythmic Features Affect our Movement?

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Background in Embodied Rhythm Cognition
Today, cognitive science sees rhythm perception as embodied, where body movement and meter perception are mutually influential (Levitin, Grahn, & London, 2017). This interaction is reflected in activity in motor areas of the brain correlated to the perception of beats even in the absence of movement (Grahn, 2012). Besides synchronizing our movements to the beat, the way we move influences the metrical interpretation of what we hear (Phillips-Silver & Trainor, 2005). Additionally, a correlation has been found between groove and syncopation (Sioros, Miron, Davies, Gouyon, & Madison, 2014; Witek, Clarke, Wallentin, Kringelbach, & Vuust, 2014): between the sensation of wanting to move to the music and a class of violation of metrical expectations (Huron, 2006).

Background in Music Theory
Meter, pulse or beat and related concepts such as syncopation and pickups have long been part of the discourse of music theory. Recently, the notion of beat has expanded from a structural element that mainly meant a position in time to include aspects of expressiveness of the performance and music style (Danielsen, 2010; Danielsen et al., 2019). At the same time, syncopation and pickups have been formalized to allow for the systematic analysis and algorithmic generation of rhythms (Sioros, Davies, & Guedes, 2018).

Aims
Despite the development of sophisticated music theoretical models of meter and our understanding of an embodied meter perception, the details of the interaction between such theoretical phenomena and body movement are largely understudied (Witek et al., 2017). This study aims at understanding how rhythmic elements such as syncopation, pickups and expressive microtiming affect the coordination and synchronization of simple body movements to music.

Main contribution
The study consists of a motion capture experiment where participants are asked to synchronize a simple body movement that is, walking in place, to music examples. We have currently conducted and analyzed two pilot experiments and are collecting data from the main experiment.

The music examples of the study belong to the hip-hop, jazz/fusion and EDM music genres that were composed and produced specifically for the purpose of this experiment. All the music examples consist of polyphonic short loops where we algorithmically manipulated the timing of individual events. We created four variations of each example that differ only in their microtiming, syncopation and pickups. We removed first any microtiming by aligning the perceptual centers (Morton, Marcus, & Frankish, 1976) of sounds, which were obtained through a separate behavioral experiment. Then, we removed the syncopation according to the generative model of Sioros et al. (2018) and finally, the pickups to obtain the reduced version.
Our analysis of the motion capture data comprises two stages. First, we reduce the data into motion templates similar to Müller’s and Röder’s (2006) but with features derived specifically to codify the coordination and synchronization of the movement, e.g. when each foot touches the ground or when each hand moves fast.

Second, using phylogenetic classification of the motion templates, we identify clusters of participants with similar responses across the variations of the music examples. A close examination of the motion templates of each cluster reveals the effect of the rhythmic elements on the coordination and synchronization of the participants’ movements to each example.

Based on the pilot experiment and knowledge of the music styles, we have different hypotheses for each genre. We hypothesize that microtiming deviations have a greater impact for the hip-hop examples since they are associated with larger beat-bins (Danielsen, 2010), leading to variation in the synchronization of the body movements. For the Jazz and EDM genres, we hypothesize significant correlations in the coordination of the movement with syncopation and pickups. We present the details of our novel methodology as well as preliminary findings of the experiment.

Implications for musicological interdisciplinarity
This study investigates research questions that are inherently interdisciplinary. We also develop appropriate approaches to answer such questions, merging tools and practices from different disciplines into a novel methodology, which can be applied in the study of music-related movements beyond the scope of this particular project.

References


Embodied Views of Sensorimotor Interactions, Groove, and Flow in Music

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Background in Sensorimotor Interactions with Music
Music making, dancing, or foot tapping in time with a rhythm are typical examples of sensorimotor integration tasks, which demand a close coupling of perception and action. Movement-inducing music activates the motor-system even when listeners are sitting completely still (Stupacher, Hove, Novembre, Schütz-Bosbach, & Keller, 2013). During the last few decades, both sensorimotor coupling and music perception have increasingly been viewed in light of embodied cognition.

Background in the Experiences of Groove and Flow in Music
The experience of groove is most commonly described as the urge to move one’s body in time with a musical rhythm (Janata, Tomic, & Haberman, 2012). Flow is an experience characterized by the merging of action and awareness, typically during rewarding activities with matching challenge/skill levels. It is marked by a sense of control and a fusion of stimulus and response (Csikszentmihalyi, 1975).

Aims
With reference to sensorimotor interactions, experiences of groove and flow in music are discussed as embodied processes.

Main contribution
The experiences of groove and flow in musical contexts can be viewed as embodied phenomena. Danielsen (2006) describes groove as “a highly pleasurable state of being, a presence in both the music and the body at once.” In Csikszentmihalyi’s (1975) flow terminology, this “highly pleasurable state of being” might be described as the loss of the self as an intermediary between stimulus and response. Consistent with embodied approaches, groove and flow experiences transcend a strict input-output dichotomy between agent and environment; they depend upon the entire body of the living system in a real-time interplay with the environment. Two of our recent studies illustrate how embodiment approaches to music cognition and aesthetics in general can enrich the interpretation of groove and flow experiences.

The first study (Stupacher, 2019) examined the relationship between the experience of flow and sensorimotor synchronization accuracy while tapping in time with music. Higher tapping accuracy was associated with higher ratings on the flow subscale fluency of performance. This finding suggests that tighter coupling between musical rhythm and body movements induces a deeper musical and temporal understanding, which might lead to a more intense experience of flow.

In the second study (Hove, Martinez, & Stupacher, under review), participants listened to music over sound-isolating earphones with and without an additional subwoofer that stimulated the body. When participants listen to music with additional tactile stimulation from the subwoofer, they experienced more groove and showed more spontaneous body movement. Aesthetic appreciation might partly be rooted in interoceptive processing (Brown, Gao, Tisdelle,
Eickhoff, & Liotti, 2011). Thus, the bodily stimulation by bass frequencies could strengthen interoception and influence aesthetic appreciation.

Groove and flow experiences are closely related to the likability of music and feelings of pleasure (Csikszentmihalyi, 1975; Janata, Tomic, & Haberman, 2012). Without accurate sensorimotor synchronization and without an idea about what will happen next, experiences of groove and flow seem unlikely. The facilitation of pleasure and embodied responses through prediction (Salimpoor, Zald, Zatorre, Dagher, & McIntosh, 2015) can be viewed as a process on a high hierarchical level within the predictive coding framework, which depends of the forwarding of just the right amount of prediction errors to keep a rhythm engaging (Vuust & Witek, 2014).

**Implications for musicological interdisciplinarity**

From an embodied point of view, studies of sensorimotor synchronization, musical groove, and the experience of flow largely complement each other. One of the next challenges will be to relate the findings of these studies to predictive processing models, which “constitute the perfect explanatory partner […] for recent approaches that stress the embodied, environmentally embedded, dimensions of mind and reason” (Clark, 2013).

**References**


Multimodal Emotion Associations in Music and Dance

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Background in Humanities/Arts (Dance and Music)
It is a well-known fact that humans are attuned to the emotions others are experiencing, as it is important for their own well-being and survival. Historically, the study of emotion perception has resided in the ability to decipher others’ facial expressions or vocal cues (e.g., Ekman & Friesen, 1975). In the last twenty or so years, however, there has been a growing body of research that has examined how emotion can be conveyed through the arts, such as music and dance. Through processes such as emotional contagion and empathic mirroring, people are thought to decode the emotions in musical sound (e.g., Juslin, 2000) or in point-light displays of dance (e.g., Walk & Homan, 1984). For example, there is a close connection between modern dance and human emotions, as it is thought that modern dance naturally contains nonpropositional emotional cues (e.g., Camurri, Lagerlöf, & Volpe, 2003). Many theories have been proposed for how music can display emotions; popular ideas include Juslin’s interpretation of Brunswik’s Lens Model (Juslin, 2000), learned associations (Huron, 2006), and similarities with vocal prosody (Juslin & Laukka, 2003).

Background in Psychology (Emotion)
Most of the research pertaining emotion perception and evocation through music and dance has focused on a cognitive approach. Although many researchers in the field of psychology have adopted a social construction or 4E approach to emotion, the fields of music and dance have been slow to engage with these newer models of emotion. In this paper, we will utilize a 4E approach to emotion in order to examine the communication of three negatively valenced emotions in music and dance: melancholy, grief, and fear. In particular, we examine the extent to which listeners can empathize with performers of music, dance, and multimodal (music and dance) conditions. In the original translation of ‘empathy’ from the German Einfühlung, empathy meant something along the lines of identifying with another’s physical state. With the term’s popularization, empathy’s meaning changed from a purely kinesthetic sensation to a broad ability to ‘feel with’ another person’s mental (e.g., emotional) or physical state. We propose to study how physically connected performers and audience members feel during the expression of melancholy, grief, and fear. We hypothesize that all people will feel more connected during grief prompts, compared to melancholy and fear prompts, because of its unique status as an ethological signal (Huron, 2015).

Aims
H1. Observers will perceive grief expressions with more accuracy than melancholy or fear expressions.
H2. Dancers will experience more feelings of sociality while dancing to grief-like stimuli, compared to melancholy and fear conditions.
H3. Perception of sociality will be facilitated in grief conditions, but not in melancholy or fear conditions.
Main contribution
A recording session was conducted with four female members of the SYREN Modern Dance Company, a professional group of dancers based in New York City. During the session, the dancers were told that they should improvise choreography to express three specific emotions. For each emotion, dancers were asked to perform in one-minute segments. First, dancers improvised without music, then heard a previously-validated music clip, then danced again with the music. Three separate experiments are conducted using the music and dance stimuli. In the first study, participants view the stimuli and identified the expressed emotion (and its intensity), as well as two questions regarding how physically connected they believed the dancers felt to each other and how connected they felt to the dancers. In the second study, encoders examine how frequently each member of the SYREN troupe touched one or more people during each of the three emotional prompts. Finally, a content analysis is conducted on interviews of the dancers, in order to analyze which types of actions were used to communicate each of the three target emotions. These three studies will further the understanding of how music and dance relates to physical and emotional embodiment. The main contributions of these studies are to (1) expand the understanding of emotion in the arts through the analysis of both music and dance, (2) engage with the possibility that some emotions act as ethological signals and others act as ethological cues, and (3) that if emotions function as signals and cues, the embodied experience and perception of these emotions will differ in both quality and degree.

Implications for musicological interdisciplinarity
This project reinterprets traditionally-cognitive activities, such as emotional perception, with a 4E approach. Although some music scholars have already provided evidence consistent with 4E approaches in music, the current study will be the first to examine emotion from music, dance, and multimodal perspectives at the same time. Additionally, by combining quantitative and qualitative methodologies, we seek converging evidence for the fact that certain emotions are experienced and represented in different ways in the human body. Finally, this project seeks interdisciplinarity through utilizing perspectives from psychology, cognitive science, musicology, music theory, dance studies, and cross-modal associations.

References
The Mind is a DJ: Temporal Processing in Beatmatching and Embodied Neuroscience

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Background in Dance Music Research
A DJ is a musical performer who mixes together recordings of rhythmically stimulating music for dancing or head bobbing crowds in clubs, raves, bars, festivals and house parties. Perhaps the most central musical skill of a DJ is to mix records together in a way that does not disrupt the tempo of the groove. This is not a trivial task since different tracks will be recorded in different tempi. A DJ playing vinyl records on turntables will employ techniques known as slipp-cuing and beatmatching to seamlessly mix tracks together and create a long and continuous dance track. Entrainment – the process by which two or more oscillating periodicities become coupled and synchronized - is central to any rhythmically based music skill, but little is known about rhythm processing and entrainment in DJ practice.

Background in Embodied Neuroscience
Extended Mind and Enactivism are two of the 4E theories of embodied mind (Embodied, Embedded, Enacted and Extended), which state that cognition and perception do not exclusively occur in the head but fundamentally involve the rest of the body and the world. However, while strongly related, Enactivism and Extended Mind Theory have appealed to proponents of different models of brain function, with Extended Mind theorists accommodating Predictive Processing models (Clark, 2015) and Enactivists drawing on Systems Dynamics (Di Paolo, Buhrmann, & Barandiaran, 2017). While prediction theories fundamentally rely on the notion of inference in the brain, systems dynamics allows for a fully emergent understanding of cognition.

Aims
What are the temporal processes involved in mastering DJ skills and what can DJ techniques tell us about how the mind perceives and produces regular beats? In this paper, I describe the processes of phase and period correction in rhythmic entrainment and consider how such basic human cognitive capacities must be consciously and masterfully manipulated in DJ practice. The implications for our understanding of entrainment and embodiment in DJing are discussed by comparing enactivist and extended models of temporal cognition and brain function.

Main contribution
The beatmatching DJ is posited as an Extended and Enacted mind in which the temporal estimations that are often thought to occur within our own endogenous systems are instead physically enacted and distributed across the body, the brain and the turntables, highlighting the fundamentally embodied nature of entrainment.

Implications for musicological interdisciplinarity
By considering entrainment in the beatmatching DJ, I highlight how these models differ in the extent of their embodiment. I suggest that by choosing the Enactivist view, the enactive,
predictive and extended properties of temporal processing can be unified in DJing and in sensorimotor behavior more broadly.

References
Homeostatic Listening: Exploring Interoception Through Music

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Background in Psychophysiology and Consciousness Studies
Interception, defined as the sense of the body’s physiological condition, has gained increasing attention across scientific and humanistic disciplines interested in exploring human experience and conscious agency. This multidisciplinary interest relies on the fundamental role interception plays in ensuring the efficient physiological functioning of the organism, thus contributing to homeostatic control (Tsakiris, 2017). Moreover, it has been recently suggested that the awareness of our interoceptive signals might underlie our basic experiential states (Damasio, 2010), shaping the subjective experience of being ‘me’ (Tsakiris & Critchley, 2016). On this view, not only does interception contribute to the necessary stability and adaptability of the organism, but it also helps define the experience of a coherent, unified self.

Background in Enactive Music Cognition
Enactivism is a recent approach to mind and life based on the notions of ‘autopoiesis’ and ‘sense-making’ (Varela, Thompson, & Rosch, 1991). The concept of autopoiesis describes living organisms as autonomous, self-organizing systems which establish their own operational processes according to principles related to their internal coherence. These self-organizational mechanisms, in turn, contribute in developing the coupling between the organism and the environment through patterns of action necessary for the system’s auto-sufficiency and sustainability. And it is through this action-oriented coupling with the world that the organisms bring forth their own domain of meaning. The notion of sense-making, hence, refers to this exact enactment of meaningful relationships with the world. From this perspective, musical behaviors - including music-listening - are understood as affectively-motivated actions emerging from the dynamical interplay between living systems and their environment (Schiavio, van der Schyff, Cespedes-Guevara, & Reybrouck, 2016), aiming at the maintenance of the system’s organizational stability.

Aims
This presentation aims to explore the relationship between music-listening and interoception through the lens of enactive (music) cognition.

Main contribution
By integrating the enactive approach in music to the study of interception, we report on an empirical study, conducted at the Centre for Systematic Musicology during a 3-month period, starting in December 2018. The study involved a pre-post trial design investigating whether music-listening enhances interoceptive abilities. Drawing from previous studies linking interception to self-focused attention in both bodily and narrative aspects (Ainley et al., 2013), we approach music-listening behaviours as ‘activities of the self’ (DeNora, 1999) and hypothesize that listening to favourite musical pieces can facilitate interoceptive abilities. The preliminary data to be presented focus on dimensions of interception defined as interoceptive accuracy and interoceptive sensibility (see Garfinkel et al., 2014). In particular, we measured
interoceptive accuracy via a heartbeat detection task before and after subjects listened to either their favourite music (main group), or a randomly selected, unfamiliar musical excerpt (control group) for 5 minutes. Interoceptive sensibility was assessed via pre-post subjective reports on task performance judgements with the use of a continuous visual analogue scale (VAS10).

**Implications for musicological interdisciplinarity**

This study aims to build new bridges between the sciences and the humanities, and explore new ways of integrating music to clinical contexts associated with disturbances in interoception and self-awareness. Beyond its clinical applications, our research has implications not only for the understanding of music’s embodied nature and significance for a meaningful being-in-the-world, but also for wider philosophical discussions on self-consciousness.

**References**


POSTERS
Beauty and the Brain – Investigating the Neural Correlates of Musical Beauty during a Realistic Music Listening Experience

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Background in Musical Aesthetics
Music is a universally recognised source of beauty. People are usually attracted to music for the variety of emotions it generates, its ability to trigger memories, the immersive experience, the pulse to move, and for the aesthetic pleasure it evokes. As in other aesthetic domains, listening to music generates aesthetic experiences that include emotions, evaluative judgments and liking (Brattico & Pearce, 2013). Although the quest for the nature of musical beauty has a long scientific history, only recently neuroimaging techniques begun to delineate the role of the brain processes involved.

Background in Neuroaesthetics
At neurofunctional level, exposure to beautiful objects, being them faces (e.g. Kuhn & Gallinat, 2012), music (Ishizu & Zeki, 2011; Koelsch, Fritz, Müller, & Friederici, 2006), paintings or architectural spaces (Vartanian & Goel, 2004) seem to emerge from the complex interaction of multiple sensorimotor, cognitive and affective processes, involving at least three different kinds of brain activity: an enhancement of low-level sensory processing and sensory-motor engagement; high-level top-down processing and activation of cortical areas involved in evaluative judgment; an engagement of the reward circuit (Nadal, 2013).

Aims
The present work aimed at determining the neural and musical attributes of musical beauty using a naturalistic free-listening paradigm and a convergence of neural, behavioural and questionnaire measures. One group of participants (N=30) continuously rated the perceived beauty of three musical pieces with a motion sensor, while another group (N=36) had their brain activity measured with functional magnetic resonance imaging (fMRI) while listening continuously to the same three musical pieces. The continuous behavioural ratings were used to identify the music passages that would universally (commonly to all individuals) be evaluated as beautiful/ugly across participants, irrespectively of their listening background, and to set up the fMRI analysis of the universal neural responses to musical beauty. A third experiment with another group of participants (N=12 music composition experts) aimed at identifying the invariant emotional and musicological features that characterized the consistently-judged beautiful and ugly passages.
Main contribution
In the literature on the neuroaesthetics of music, many studies have investigated the neural correlates of the aesthetic appreciation of music, mostly using artificial paradigms. Often participants are exposed to short and artificially modified musical excerpts or subject-selected music inside the fMRI scanner and are required to perform aesthetic evaluations on discrete scales (e.g. Ishizu & Zeki, 2011). Here, instead, the neurometabolic brain activity was recorded while participants listened attentively to the entire pieces of music, and the aesthetic evaluations were collected with a continuous behavioural method. Moreover, the study explored the emotional and musicological features that invariantly characterized the passages evaluated as beautiful or ugly.

Evidence from fMRI analysis revealed the invariant neural mechanisms for the subjective experience of musical beauty, irrespectively of listening background, in two brain structures: the mOFC and the bilateral STG. The former being recruited while listening to the beautiful music fragments, the latter while listening to the ugly ones. However, brain activity in STG was significantly reduced when analyses pruned from the neurometabolic signal the role of the acoustic features of the stimuli, suggesting that the passages of music negatively valenced required a more elaborate perceptual auditory processing.

The identified neural mechanisms were paralleled by the musicological and emotional features that discerned the beautiful from the ugly passages, based on the music experts’ evaluations. Hence, the mOFC seemed to be associated to the invariant experience of musical beauty in relation with emotional features of sadness, tenderness and pathos, as well as with musical features of simplicity, tonality and slower tempo. In turn, the aesthetic attribution of ugliness in music was associated with larger recruitment of brain regions dedicated to auditory processing (STG), and indeed a more complex (in terms of execution, harmony and rhythm), arousing and agitation musical content. In the literature (Torst, Ethofer, Zentner, & Vuilleumier, 2011) such high-arousing aesthetic emotions in music correlated with brain activity also in sensory-motor areas. These results seem to suggest that the motoric and rhythmic complexity resonate in the mind of the listener (Godøy & Leman, 2010) resulting in excessive complexity and aesthetic unpleasantness. The aesthetic appraisal of ugliness (or beauty) seems to arise also from embodiment, resonating in the sensorimotor circuits and in the motor system.

Implications for musicological interdisciplinarity
The study identified the mOFC and STG as brain regions strongly involved in musical aesthetics in relation with specific emotional and musicological features. While being a unique neuroscientific exploration on aesthetic responses to music, the study calls for further investigations that would generalize the findings to the full variety of music from different genres and played with different instruments up to even songs and lyrics.

References
Composer’s Physical and Affective Reactions to Accuracy of Capturing Creative Ideas

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Background in Creativity and Composition Studies
The moment of sudden artistic idea’s appearance is crucial in studies of creativity and musical composition. The moment of spontaneous creativity is referred to as epiphany. Julius Bahle (1947) distinguished two types of composers: working and inspiration type. The latter is less regular in composing and relies mostly on sudden outbursts of ideas. Some inspiration type composers hear complex melodies in their heads (music imagery) and transcribe them into the physical realm.

Background in Cognitive Science
According to 4E cognition approach, extended cognition is the view that human mental processes include the environment. Capturing musical ideas can be considered as a way of offloading (Krueger, 2017) creativity from internal realm of composer’s musical imagery into external realm (notation, recording).

Aims
n/a

Main contribution
The first proposition of the current paper is to consider Involuntary Musical Imagery (InMI) as one of the possible sources of composers’ creativity – internal music can be incorporated into new compositions.
Secondly, the inner creativity of the composer can be extended beyond his mental realm. Internal music can be transcribed in the external realm – this can be seen as beyond-the-head offloading in the light of extended cognition approach.
Moreover, the idea generation may regulate composers’ emotions. The inspiration types create music spontaneously, with sudden epiphanies disrupting their mundane activities. The composers may develop mental composition prior to using external tools (notation, piano); those who do aim at transcribing it with precision and often treat the inner music as a sort of ideal form. The lack of accuracy in transcribing from mental realm causes physical reactions, negative affect, also the need for social isolation. It may suggest that capturing the inner music plays an important role for inspired-type composers in their affective (auto-) regulation.

Implications for musicological interdisciplinarity
The paper aims at merging cognitive science with composition studies. It scrutinizes the phenomenon of transcribing the InMI in composition process, as well as affective / physical reactions to accuracy of the transcription.

References


Corporal and Emotional Meaning in Music: How Much Meaning Can Be Communicated to Listeners through Improvisation, and What Kind?

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Background in Music and Emotions
Musicologists and researchers (Newcombe, 1992; Robinson & Hatten, 2012) have independently come to an understanding that in order to convey emotional expression and understanding, music needs to construct some sort of non-musical meaningful content that the listeners empathize with. This non-musical content develops and changes through time creating a sort of narrative dramatic structure.

Background in Music and Meaning
Theory by Salgar and Romero (2016) suggests that music could convey corporal meaning and Meyer (2001) proposed music can express emotional meaning, but none of these theories have been confirmed in practice.

Aims
To what extent can a musical improviser communicate the meaning of a short text to an audience? Can listeners guess the improviser’s intended emotions and implied movements? Can they guess the specific topic, subject, or story?

Main contribution
Four pianists read nine haikus, three of which focused on animals (horse, snake, bird) and their movements, three on human emotions (confident, caring, playful), and three on the natural environment (sun, lake, mountain). The pianists then improvised on each haiku, trying to express the content in music. In subsequent interviews, they described how they felt about the haiku and how they imagined associated movements and emotions. The 36 improvisations were played in different random orders to 17 school children aged 12 to 14. Each tried to guess what the music was about and describe the feelings and movements of the story’s subject. All interviews in both stages were recorded, transcribed, and assigned by three independent coders to six basic emotions (Happiness, Sadness, Anger, Fear, Surprise, Disgust) and ten movement types (Fast, Slow, Regular, Irregular, Up, Down, Big, Small, Smooth, Rough).
A Pearson’s correlation coefficient was computed to assess the relationship between the pianists expressed emotion and movement and listeners’ perceived emotion and movement. There was a significant correlation between pianists’ intentions and listeners’ perceptions for emotions Happiness, Anger, Surprise, Fear, and Disgust, but not for Sadness; and for movement types Slow, Fast, Irregular, Up, Down and Rough, but not for Regular, Big, Small, Smooth. Listeners usually could not guess the haiku theme that was represented in the title of the each haiku.

Implications for musicological interdisciplinarity
Results are consistent with the idea that music lacks the specificity of semantic content but can communicate clear and unambiguous emotions (Happiness, Fear, Anger, Surprise and Disgust) and movements that are either not context dependent or are important for immediate survival (rate of movement; Slow and Fast and direction of movement; Up and Down).
References
Embodying an Expert Pianist in Augmented Reality: Exploring the Impacts of Audiovisual Perspective Taking on Musical Learning

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Background in Sound and Music Computing and Multisensory Perception
Masterful musical performance requires not just a symbolic understanding of music, but also knowing how to move to produce certain sonic effects on an instrument. Here, we present the Augmented Design to Embody a Piano Teacher, a mixed reality system in which an expert pianist's audiovisual perspective is virtually overlaid and blended into a more novice student's performance on a real, physical piano. The goal of this project is to program effective audio feedback which will help synchronize their movements temporally with the expert, as well as visual motion feedback to facilitate proper finger, wrist, hand, and upper torso position and orientation while playing. By implementing a concept of movement fluency to characterize musical movements, we target such fluency as a skill to be pushed through training and use of the system. Movement fluency involves non-jittery, smooth motion characteristics measured in skillful musical performance across various instruments (Snchez, Dahl, Hatfield, & Gody, 2019). Through motion capture and analysis, we identify the core motion features that define this fluency on the piano, and aim to apply these features in motion feedback design to support successive approximations at various stages of the student's learning. Additionally, we are recording binaural sound to capture the sound from the perspective of the expert and enhancing various audio effects to more accurately capture the embodied and subjective perception of an expert pianist.

Aims
Our aim is to create a Mixed Reality system inspired by models in embodied music cognition that can help students to experience music in an embodied way and have more muscle memory for piano playing technique. We hope to receive feedback from this community to help inform our design decisions.

Main contribution
The main contribution of our work for the conference is to improve the community's understanding of what can be done with multisensory virtual augmentation in mixed reality to facilitate musical learning in an embodied way. We hope to add to the conversation about embodied skills acquisition by showing initial results comparing expert and novice movements on the dimension of movement fluency. This project involves simulation of the first-person, lived, and embodied sensory experience of an expert musician. We accomplish this by using various sophisticated recording devices such as stereoscopic video, volumetric video and 3D modeling, binaural microphones, and optoelectronic motion tracking to capture the embodied experience of the expert musician. This experience is then presented to a novice musician through a wearable augmented reality headset (the Magic Leap Developer 1 Kit) to augment her performance by sharing and blending her sense perception with the expert teacher. Our contribution is to show how the development of our mixed reality environment, as well as user testing and experiments can shed new light on understanding the role of the body in musical perception and learning. This is envisioned as a technological variation (Froese & Gallagher,
2010) of a phenomenological methodology by modeling and simulating musical embodiment and expertise.

**Implications for musicological interdisciplinarity**
The project combines aspects of embodied music cognition and new media technology. It also provides quantitative and qualitative indices of movement features that characterize masterful musical performance. Moreover, it offers a methodology for assessing musical learning.

**References**

The Psychosocial and Embodied Effects of South African Protest Music

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**Background in Sociology/Anthropology**

The study is based on the music which was performed during various protests against the apartheid regime before South Africa gained democratic status in 1994 and more recently in the Fees Must Fall protests which manifested on various university campuses around South Africa in 2015 and 2016. The semantic qualities of the songs echo the ideals of the two movements thus bringing to the fore elements of African Nationalism, national determination and a desire for social, political and economic reform touching on elements of decolonization and free tertiary education.

**Background in Ethnomusicology**

The origins of the liberation repertoire are significant when considering the demographic of protestors which were mainly people of colour. These songs form part and parcel of the black South African identity learned through oral transmission from caregiver to infant, as evidenced by the use of the songs, which were sung during the dark days of apartheid, being sung some 20 to 30 years later by a different generation. These songs document the events of South Africa’s history and are sacred as they are imbued with special spiritual and political powers.

**Aims**

The aim of this study is to determine why these songs were such powerful tools in fostering social cohesion through a critical analysis of their harmonic and semantic qualities. With the results of these analyses coupled with literature on music’s effect on the human brain, I aim to gain a better understanding of what elements in the songs evoke certain emotions and contribute to group solidarity and moving a group of people to action.

**Main contribution**

This qualitative study documents personal reflections on the songs and their use by key figures in the South African government who were at the forefront of the resistance against the apartheid state such as former finance minister in Nelson Mandela’s cabinet, Trevor Manuel for example. To add, the student leaders interviewed were pivotal in leading the protest at the University of Pretoria. The novelty of this study, as mentioned previously, is that it also documents selections of the struggle songs through micro analysis to discern the characteristics thereof and how these characteristics play a role in fostering group solidarity and social cohesion through a sociological and physiological trajectory. Furthermore, it provides South African scholarship on music’s effect on the human brain, with most literature relating to this topic focusing on Western Art music.

**Implications for musicology interdisciplinary**

All interviewees noted that the struggle songs afforded protestors a sense of unity and identity in the face of danger. These findings echo literature on neuromusicology which highlight music’s role in serving as a vehicle for co-pathy, affective engagement, cooperation and the generation of aesthetic emotions such as transcendence and spirituality. Furthermore, this is an
interdisciplinary study with inroads into cognitive neuroscience, ethnomusicology, music phenomenology and anthropology. For example, the struggle songs were used as a means to lead at gatherings to ensure crowd control and to keep morale intact. Existing literature draws our attention to the fact that a notable musical performance by a group of conspecifics is only achievable if it also involves cooperation. Cooperation lends itself to a shared goal or shared intention and in the context of where these songs were performed and the meaning behind them, they highlight the ideals of African nationalism, national determination and a desire for social, political and economic reform. Furthermore, taking part in cooperative behavior is a source of pleasure which is associated with the activation of the nucleus accumbens. Although more research is needed to identify the specific underlying mechanisms which drive human emotion in response to these songs, this study provides an exciting opportunity to advance our knowledge on the relationship between human emotion systems, physiology and social behavior as a result of protest music and how that has the power to alter the narrative of civilization.
The Traits of Piano Futurists of the Early 20th Century

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Background in the History of Futurism
Futurism was an artistic movement that tried to break with the instituted and the tethers of the past. Beginning in the twentieth century, in Italy, futurism spread to other European countries and to other parts of the world, being a movement that criticized many authors of that time and calling their works as the death of art and accusing a reigning academism. This movement sought for an alteration of the creative paradigm proposing the interaction between the disciplines of the arts, integrating the technological innovations of the epoch with the occultism, and enhancing the speed, technology, rebellion, noise and the machine.

Background in Futurist Piano Performance
The futurist piano repertoire considers the human being performance and its body, it is a significant feature of the movement according to many of the ideas of the futurist writings, not only the mechanizations of the epoch. So, looking for the mechanism and noise in the futurist piano writing, this paper values the work of the American composers/pianists Leo Ornstein, Henry Cowell and George Antheil comparing their futurist art with the academic and traditional manners of the epoch: the piano futurist parodies and noises, equated to the profound sound searching of pianists in the academy.

This matching is inspiring because precisely the conservatories’ quotidian life with its conventional instruments and practices need a new air and it can be based in the futurist precepts: to deform again that recurrence inside the academy by changing the meaning of pianist (who plays the keyboard), and encouraging different responses of the public, restricted in many times to a muted approbation or disapprobation. Cowell, for example, with his piano music and performance is a strong reference of one century of experimentation between body and piano, different to the common searching of automation of the academy.

Aims
1. To reveal the mechanism, underlying noise and embodiment in the futurist piano writing/performance at the beginning of the twentieth century.
2. To contribute to a better understanding of the futurist movement and its influence on the twentieth and twenty-first centuries’ academic music.

Main contribution
The transdisciplinary letter in its eleventh article argued that the abstraction is not the only method to achieve knowledge, considering the body as a valuable way to sapience. Though, an important fact to music studies nowadays is the necessity to add new artistic and interdisciplinary practices, and the concept of the piano as an extension of the body and as a precision tool are especially straight mechanic perspectives to new advances.

For that reason, the principal contribution of this proposal is the comprehension of futurism and its influence on academic music as a source of embodiment. Ornstein, Cowell and Antheil, allow me to expose in an effective way the movement because (1) the complex rhythmic and clusters in their music, combined with melodies and traditional forms, imply a performative
study as a pianist, (2) they let me establish a bridge between both sides with a fair concept about the movement and the academy, (3) with them I can expose a critical and actual perspective about futurism, because the movement’s principles continued years after - without its name - despite the movement decline. The transdisciplinary and the pluralist methodology, in which it is necessary to articulate diverse ways of thinking for achieve knowledge, recalls futurism and its multidisciplinary effort to join all human expressions. The distance that separates the conservatory and the cultural world of futurism is a good starting point for the present proposal, to go then to a description of the experimental mood and transdisciplinary that reflects the futurist piano composition and performance. Futurism proves that the coarse or bounder elements can arise artistic processes of great interest, which evidently worked to represent its precepts.

**Implications for musicological interdisciplinarity**

Being a fascist movement, the Italian futurism was not in the same line with the eugenics in which the human being must satisfy an artistic and academic puritanism. The fascist nostalgic view to the past grounded on the body sculptures of the Classical Greece, the prominence of Richard Wagner’s music, the spiritual and bucolic sense, the believing against mechanization and Enlightenment, had a problem with the diversity of the twentieth century and one of the responses to achieve the fascist human being was, for example, the Futurist Reconstruction of the Universe: a violent manifesto elaborated to educate the children about the war, using multisensorial tools. For fair reasons, the Italian movement is dead with the regime. However, my research goes to highlight the pluralistic ideals of the futurist piano expression. Within the vanguard, they worked on the convergence of the arts inspiring a profound interpretative view, interested also in the internal human body parts that were revealed by the technologies of the epoch. In fact, the futurism tried to create new art precisely with the idea of surpassing the quotidian, the visible, the humanity, the affected feelings, the artistic heritage and even the nature. The human body representation and the art of the past in uncountable times was satirized and deformed as a result of its artistic experiments.

**References**


Action in Musical Performance

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Background in Philosophy (Musical Aesthetics)
n/a

Background in Musical Analysis
n/a

Aims
The aim of this contribution is to analyze the very term “action”, connecting its historical and semantic background to its hypothetical musical meaning. The ambivalence between the term actio and the modern idea of performance can signalize the overlapping meaning of those two different practices.

Main contribution
What does the term “action” mean, when it is applied to music? What is the original semantic dimension of action, if this term is originally and etymologically related to the idea of performance? Considering the historical dimension of this term, “action” is related to the verb “to act”, as in Latin “actus” is the past participle of “agere”. Action, therefore, represents a form of doing. In this sense, a musician, or a musical performer, does something. But what kind of action this form of doing represents? What does the performer exactly do? What kind of action is this? “Agere” seems to be connected with the idea of human theatricality, i.e. with the specific action of an actor. “Ago” – in Latin – has the meaning of “going”, “advancing”, “going forward”. One makes / conducts a ritual (“ritum agere”) as one does / leads an agon (the Ancient Greek verb “ἄγω” is identical to the Latin “ago”). Being a technical term of ancient rhetorics, “actio” also means dispute, process. At the beginning of this semantic history, rituality, human theatricality and the juristic dimension of a dispute/process, i.e. the sacred, the musical-mimetic action and the Right seem to be thought together.

“Actio” has certainly to do with the idea of interpretation / translation / execution, but this meaning also seems to transgress and broaden the semantic field of these terms. The specific “actus” inscribed in this action should not be seen as a mere realization of a “performance” or as a mere “translation”, but it also seems to imply a problematic “practical” investment. Here the term “practical” (praxis) must be taken in the complexity of its philosophical meaning: it certainly has something to do with the performativity of an actio, of a “representative” and “performative” action, but it can also have a normative value: if I am an “actor” and “act” the role of Lear, I literally am Lear. In an even more problematic way, if I am a pianist, I do not simply “play” or “perform” the “Hammerklavier” Sonata, but I “act” it, and this action has all the richness of meaning of a praxis. In this sense, the pianist, playing the sonata, brings it “in action”.

So far, we can say that “bringing something into action” fills that place left empty by Aristotle, that is to say a performative realization of something that has neither the consistency of a practical action (praxis) nor the consistency of a poietic action (poiesis). In this sense, agere could be understood as the mediating term that combines praxis with poiesis: something is
“acted out”, neither in the sense of an ethical action, nor in the sense of a creative act. Seen from the point of view of ancient Rhetoric, it is therefore a matter of understanding how to act a discourse, i.e. how to perform it – in the most effective way possible. It is therefore possible to draw a comparison between, on the one hand, a score and a written text, and a musical performance and a rhetorical actio, on the other. Strictly speaking, if we want to bring together the two sides of interpretation that a theory of musical hermeneutic has probably divided – that is, the problematic relationship between music and natural language – one should think that the ancient theory of ac-tio could be understood as the model for a theory of musical performance, because the actio of a text and the actio of a score are, under this respect, two perfectly overlapping actions. If the parallel with the rhetoric works, what we need to know is how to understand the action of music, i.e. how to act music. It could be possible that understanding music somehow coincides with this idea of a musical actio, i.e. with the aenigmatic dimension of performing, or in-acting music.

Implications for musicological interdisciplinarity
Connecting the original meaning of actio/action (i.e. a term specifically related ancient rhetoric practices) with the idea of musical performance, we can possibly rethink, from the very beginning, the idea of what “understanding music” can mean. The idea of understanding music can probably be clarified through a new interpretation of what agere in music means.

References
Understanding Material Embodiments in Live Electroacoustic Music

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Background in Music Studies

Electronic music opened access to all types of sounds. The art of music is not anymore limited by the physical characteristics of acoustic instruments and voices (Smalley, 1997). For listeners, the traditional links with sound-producing objects are often ruptured. For performers, the articulation of expressive music can sometimes shift into a difficult effort. Due to the decoupled nature of electronic music instruments, sound-producing gesture is detached from sound synthesis. For musicologists, it is not easy to analyze sound practices with digital instruments (Magnusson, 2017). Musical instruments were traditionally cataloged depending on sound-producing materials. Performing digital music is understood as exploring and activating black-boxed technological systems (Kuivila, 2001). In our oral presentation we will focus on analyzing embodiment in live electroacoustic music. In this type of practice, sound passages can be controlled in real time for enveloping specific types of transformations: volume, frequency, timbre, etc. Many of the musical intentions ingrained in live electroacoustic music are usually elaborated from the concept of “sonic gesture”. Examples are the use of the “spatial gestures as compositional material” or the elaboration of “sonic textures from the combination of sound gestures”. This practice has led to an understanding of composition and improvisation as organization and transformation of sonic gestures in time.

Background in Embodied Music Cognition and Musical Instrument Design

For many decades a prior vast research has been made on developing complex technologies for capturing physical gesture for producing expressive electronic music instruments. It has resulted in the development of very accurate data acquisition systems but it has still not completely solved the problem of performing with expression. Instead, researchers in embodied music cognition (Leman & Godøy, 2010) have pointed out the need for new design models which could integrate the notion of “musical intention”. Unquestionably, playing an instrument with expression depends highly on the possibility of producing expressive physical gestures. But it also means dealing efficiently with the many expectations created by performer's mental goals and musical intentions. However, managing musical intentions is definitely a subjective task and therefore, it is quite challenging to elucidate. In the field of embodied music cognition, intentionality is conceived as an emerging effect of an act of “communicative resonance” (Leman, 2007). For these authors, people would engage with music in a similar way they engage with other people: we understand other's behaviors by mirroring them in our own subject's action-oriented ontology of behaviors. The underlying process which makes this understanding possible is called “behavioral resonance” which would be the responsible to produce corporeal responses. It is for example the case of the instinctive action of moving when listening to music: that would be our behavioral resonance in order to decode the information contained at some vibration. Thus, perceiving intention would be grounded in the coupling of a double process of action and perception. Through this coupling, our human brain would create an action-oriented ontology of the world that forms the basis of musical communication.
**Aims**

In our oral presentation we would like to present and discuss the methods and current results of our artistic research project “embodied gestures”. Our goal was the development of a new paradigm of interfaces for musical expression especially designed to emphasize a performer's gestural embodiment within an instrument. For that, “embodied gestures” explores the possibilities of shaping the physical affordances of designed digital instruments with the intention of inspiring particular forms of gesturality. Specifically, our objective was studying the implications of designing musical interfaces which can afford the same type of gesturality that a particular sound inspires. Under these perspectives of musical creation, we have developed our hypothesis is that a possible solution to the problem of disembodiment with digital instruments can be formulated from the incorporation of the notion of “sonic gesture” to nature of musical interfaces. In “embodied gestures” we propose that through the incorporation of gestural metaphors into the body of the interface, especially the ones inspired by specific sonic contents, our digital instruments will be able to afford physical reactions intimately connected to those particular sonic contents.

**Main contribution**

During the first phase of our project, our objective was understanding how people envision soundproducing gestures and materials when they listen to electroacoustic music. For that, we organized a workshop where 50 participants produced more than 180 physical mock-ups of musical interfaces directly after miming control of short electroacoustic music pieces. Participants were filmed and interviewed for the later analysis of their different personal cognitive mappings. Our results indicate that the majority of artifacts clearly showed correlated design trajectories to the sound-producing objects participants identified. At the same time, a relevant number of participants intuitively engineered alternative solutions emphasizing their personal design preferences.

**Implications for musicological interdisciplinarity**

In our presentation we would like to present and discuss our methods aimed to understand embodiment in live electroacoustic music. Instead of analyzing how people move with particular systems or instruments, we tried to understand what type of embodiments (movements and materials) are intuitively envisioned by listeners of electroacoustic music. In our opinion, emphasizing analysis of sound-producing gesture can inform musicology towards a better understanding of musical practices with digital instruments.

**References**


Sonic-affordances and Social Behavior in the Carnival of Puebla, Mexico

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Background in Ecological Psychology
The notion of affordance was first introduced by Gibson (1979) as part of his attempt to override the traditional dichotomy between perception and action. Thus, Gibson’s basic claim is that organisms do not perceive the environment in a neutral way, but rather they perceive the properties of objects as opportunities for action: in other words, organisms perceive what objects afford. We do not perceive a thing with a certain shape and then attribute to it the function of hammering, say, but rather we perceive the artefact, a hammer.

Background in Music Affordances
The notion of music affordances has been introduced in musical studies to highlight the link between hearing music and body movement (e.g. Clarke, 2005; Krueger, 2011; Reybrouck, 2005; see Menin and Schiavio (2012) for a critical review) and particularly to develop a richer understanding of what musical experience and perception entail in relation to the sonic world.

Aims
The aim of this work is to propose the notion of sonic affordances for a better understanding of the performing tasks, emotional bonding, and social normativity triggered by the sounding worlds involved in many musical practices. Importantly, these sonic affordances encompass an ample spectrum of sounds produced not only by music instruments, but also by a wide range of multiple material resources.

Main contribution
To show the relevance of ethnomusicological studies for developing new explanatory frameworks regarding music perception and action. Thus, the case study of the Carnival of Puebla City, Mexico (Loaiza, et al., 2016; Reyes et al., 2016; Villanueva, et al., 2016; Villanueva, 2018) will allow to argue for the mutual engagement between sounding worlds and social behaviors. Accordingly, it will be shown that the recognition of what are the relevant sounds to be produced during this festivity (e.g. music repertoire, screams, noise of whips, among others) is grounded in a social normativity (implicit or explicit), historically, and emotionally, constructed. It will be noted that the recognition and reproduction of this kind of sonic affordances trigger a set of habits, routines, and other social behaviors reproducible through the practice of the Carnival. In other words, this work will show that the behavioural dimension of the sonic affordances of the Carnival in Puebla constitutes a niche of behavioral expectations (of individuals and collectives) articulated in habits, routines, skills, values, and other features that guarantee the continuation of this entire cultural practice over time.

Implications for musicological interdisciplinarity
This study aims to build new bridges between ecological approaches in music cognition and ethnomusicological studies exploring the mutual influence between the acoustic environments and the multiple cognitive components of social behaviour.
References
FLASH TALKS
Have You Danced to This? – Embodied Music and Memory

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Background in Cognitive Science
Musical long-term memories appear preserved in aging and aging disorders (Cuddy et al., 2012). Characteristics of music-evoked autobiographical memories are similar in individuals with Alzheimer’s disease and healthy peers (Cuddy, Sikka, Silveira, Bai, & Vanstone, 2017). Motivated by recent embodied approaches which highlight the role of the body in driving cognitive processes, we have incorporated an embodied aspect to this line of inquiry: do facial and bodily reactions during music listening offer hints as to why musical and music-evoked memories are preserved? How can we use analyses of these reactions to enrich our understanding of music in aging?

Background in Sociomusicology
When we consider the socio-cultural dimension of music it becomes apparent that music is a communicative device (Cross, 2014). From this perspective, music experiments have a dual nature: the controlled environment of a music stimulus list, and the uncontrolled socio-cultural setting of a human experiment. Participants’ reactions in our present study can be categorized then as either musical, i.e., as engaging with the musical stimulus itself (e.g., dancing, tapping to the beat, or humming), or social, i.e., as communicating to the researcher (e.g., communicating with smiling or head nodding).

Aims
Here, we study differences between facial and bodily reactions to music in young adults (YA), older adults (OA), and older adults with Alzheimer’s disease (AD). These were categorized as one of 5 musical or one of 6 social reaction types based on a coding scheme developed during exploratory work on a subset of the present dataset (Belyea, et al., 2017). Our aim was to explore the framework of an embodied approach to the interpretation of the data.

Main contribution
Using video footage of a previous study (Cuddy, et al., 2017), two naïve raters separately coded participants’ first facial or bodily reaction. In the study, each participant had listened to 12 instrumental excerpts and reported any elicited autobiographical memories. Twenty-one YA, 19 OA, and 19 AD videos were coded. Reliability between coders was high: Of 694 coded reactions there was 95.5% agreement on category assignment among raters, and 89.3% agreement on reaction type among raters. For each participant we calculated the likelihood of social and musical reactions and the variety of social and musical reaction types for trials where a memory was reported. Likelihood was calculated by dividing the number of coded reactions (up to a maximum of 12) by the number of trials with a memory (up to a maximum of 12). Variety was calculated by dividing the number of coded different reaction types (up to a maximum of 5 for musical and 6 for social reactions) by the number of reaction types in that category (5 and 6 respectively). For a participant with memories in 7 trials who was coded as tapping to the beat in 5 trials and smiling in the other two, likelihood of a musical reaction is 71.4%, likelihood of a social reaction is 28.6%, variety of musical reaction types is 20%, and variety of social reaction types is 16.7%. To study the influence of age we compared YA to the
combined group of OA and AD. We found different effects of age on the two categories. Both YA and OA/AD showed greater likelihood and variety of social reactions than musical reactions. This difference was greater in YA. The older group (OA/AD) showed greater likelihood and variety of musical reactions than YA. The opposite pattern emerged for social reactions. To study the influence of disease we compared OA to AD participants. OA showed greater variety of social reactions compared to musical reactions. The difference was not apparent in AD, who showed greater variety of musical and less variety of social reactions compared to OA.

Implications for musicological interdisciplinarity
We postulate two mechanisms behind the reduction of social reactions in OA/AD, and specifically in AD participants. First, considering the socio-cultural setting of the experiment we note: All participants interacted with a student researcher. Thus, YA participants interacted with a peer unlike OA/AD participants. This emphasizes the communicative function for social reactions. Second, the further disease related decrease in social reactions may be related to the decline in social and nonverbal communication in older adults with Alzheimer’s disease (Fromm & Holland, 1989). Of particular interest is the observed pattern for musical reactions. Given the choice of musical stimuli, which ranged from classical to folk music, the greater likelihood and variety of musical reactions in OA/AD compared to YA participants may be due to their greater exposure and more likely past embodied engagement with that particular music. Several musical excerpts were dances. Future studies may use a wider selection of stimuli to study whether music to which one is meant to dance are more likely to elicit musical reactions. The greater variety of musical reactions in AD compared to OA participants is most interesting in light of the preservation of musical memories. Facial and bodily reactions may serve a constituent role in accessing these memories. Adding an embodied perspective to cognitive science may thus provide new ideas about mechanisms behind an effect.

References
How Music Connects: Haptic and Participatory Musical Experience

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Background in Cognitive Sciences
From a 4E perspective of cognitive sciences (embodied, enactive, extended and embedded), there are numerous reasons to assume that musical experience may be understood as an emergent property of human–musical environment interactivity, which involves biological, socio-cultural and technological dimensions. Here, musical cognition and musical experience is not grounded in internal representations, but rather in the ways embodied human agents enact dynamic patterns of actions that are relevant to be far from thermodynamic equilibrium and to their well-being. Furthermore, musical practices as listening, improvising, or coordinating musical actions with others, all require make sense in a social musical environment in active ways, that may lead to new relationships and experiences. Indeed, as music experience and musical practices are dependent on bodily involvement that goes beyond the auditory and the sense of hearing, it is easy to find the role of haptic sensation and haptic experience in the context of the agents-musical environment relationship. Thus allowing the possibility of drawing on the literature of musical haptics to illuminate a discussion to understand the role of haptic interaction in music experience.

Aims
From the context of 4E cognition and music, we aim at (a) showing that music’s vibration as a form of air pressure against the skin is relevant in music experience, and at (b) connecting the embodied haptic experience of music to wellbeing.

Main contribution
We examine human experience of music in the haptic, emotional and social dimensions. Being a vibration, music is haptically perceived through the skin, not only through the auditory system, and the subjects enter into a haptic and rhythmic entrainment with music. Inspired by the ideas proposed by Georg von Bekesy (1959) and Fahey and Birkenshaw (1972), we propose that musical haptic activation takes part in the meaningful experience that the agent lives when interacting with music. In this sense, the haptic entrainment of the agent with music is socially modulated right from the start of ontogeny, for instance in a real-time skin-to-skin interaction between a caregiver that sings a lullaby and an infant–, and through embodied coordinated experiences with others –as in the interaction playing music together in a ritual (Trevarthen, 2005; González-Grandón, 2018). Indeed, the haptic element in musical experience could explain why musical practices –embodied forms of coordination with other agents– bring about processes of emotional co-regulation that can contribute to rewarding experiences and well-being, which may be inaccessible to isolated individual agents. Furthermore, the haptic and social musical experience ground forms of participatory sense-making (Schiaviò and De Jaegher, 2017), that can be understand as different kinds of social touch. Thus, it opens up a whole world of new possibilities regarding the musical experience in the deaf, in the generation
of musical instruments, or in the creation of spaces of reflection and musical resonance to connect agents through haptic activation and to modulate their emotional experiences.

**Implications for musicological interdisciplinarity**

There are so many ways to connect the skin with music. In a concert, we feel the music beyond what is reached by airborne auditory waves but also by vibratory waves on the skin through resonances in other media such as the chair, the floor and our own rib cage. The musician and their instruments directly connect using haptic sense. In both cases a dynamical system of auditory–haptic interactions– is created (Papetti and Saitis, 2018). We believe that such haptic-music system has a crucial role in the development of better playing techniques, and design approaches to exploit haptic feedback in creating digital musical interfaces and social and musical environments that afford wellbeing. Indeed, we underline that research on the conditions that foster positive human social interaction can contribute not only to formal knowledge and conceptualizations of the causes of embodied social connectedness, but also to the creation of social and musical environments that lead to significant improvements in multiple domains of social-emotional regulation processes.

**References**


Transformations in Music Theory Pedagogy: Four Case Studies

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Background in Music Theory Pedagogy
Music education at the college level conventionally requires studies in music theory. Given the accelerating shifts in modes of music production and consumption, diversification of teaching and learning technologies, and an increasingly globalized musical landscape, the value of this core study in its present form has been called into question. Situated within these larger shifts in higher education, schools and departments of music throughout the U.S. are increasingly engaged in substantial reexamination of the foundational assumptions of what higher learning of music means. Music theory - the core curricular feature of serious music programs since the 1940’s - is a particular focus of curricular reform.

Aims
This study examined four programs engaged in the restructuring of their theory programs, gathering perspectives and insights from reform leaders through personal interviews. The aims here are to (1) identify the emergence of what can be described as embodied practice within predominant reform themes, (2) recognize shades of divergence from mainstream theory curriculum, and (3) present emerging strategies of reform design and implementation.

Main contribution
This presentation explores contemporary curricular reform in music theory at four U.S. university music programs, highlighting a pedagogical shift that foregrounds disciplinary integration, embodied cognition, and diversity. Situated within larger shifts in higher education, schools and departments of music throughout the U.S. are increasingly engaged in substantial reexamination what higher learning of music means. Music theory — the core curricular feature of serious music programs since the 1940’s — is a particular focus of reform. This study explores these shifts through ethnographic/contextual interviews with reform leaders at Harvard University, Frost School of Music, University of California Los Angeles (UCLA), and UC San Diego. An ethnographic/contextual approach invites subjects to describe their behaviors and goals in the context of their environments, avoiding a fixed set of questions, and encouraging storytelling. Common themes that emerge include: an emphasis on situated cognition (in various terms), an expanded repertoire, a reduction in music theory requirements, growth models over proficiency models of assessment, and through-line integration with other disciplines, such as music cognition.

Implications for musicological interdisciplinarity
This study provides four case studies of curricular restructuring in leading schools and departments of music in United States, each involved in the implementation of interdisciplinary imperatives. This presentation will be of interest to those interested in the current state of interdisciplinarity in the university, and those with a special interest in issues related to music curriculum and curricular change in higher education.
References
L’objet Corporel Sonore? Reconsidering the Embodied in Electroacoustic Music

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Background in Music Theory
This paper engages in relatively current discourses on the incorporation of embodiment, sentience, and mimesis into music analysis. Early writers (Ferrara, 1984) on electroacoustic music had embraced phenomenological approaches, as more traditional pitch-based approaches have not been informative for this musical genre. More recent scholars continue this lineage of focusing on phenomenology in music. This work’s author teaches music theory at his home institution, and presents talks and papers on music theory, timbre, and the intersection of music cognition and theory.

Background in Embodied Cognition
While the current paper does not report empirical findings, this paper examines how research in embodied cognition contributes to the analysis of electroacoustic music. The author periodically music perception and cognition, and music and mathematics, at his home institution, and presents talks and papers on various aspects of music cognition, especially applied to contemporary music analysis.

Aims
This paper argues for the necessity of considering embodiment in the musical analysis of electroacoustic music. The paper ties into pre-existing literature on musical gesture, embodiment, and studies on the ontology of electroacoustic music.

Main contribution
The crucial role of embodiment in perceiving music is increasingly well documented by cognitive scientists, music theorists, and musicologists. Perceiving music activates the action-perception network (Maes, Leman, Palmer, & Wanderley, 2014) in listeners. Expert pianists demonstrate greater levels of connectivity in brain regions linked to the mirror neuron system (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996) while observing other pianists (Haslinger et al., 2005). Other studies demonstrate listening subjects’ ability to match body movement to specific acoustical traits (Eitan & Granot, 2006). On the theory side, Cox (2016) proposes that mimetic motor imagery (MMI) and mimetic motor action (MMA) underlie musical experience and has developed a number of frameworks for considering sentience at the core of musical analysis. As many of these studies focus on music organized primarily around pitch, the current paper supplements this literature by considering the role of embodiment in the field of acousmatic music, where the sources of sound (of unknown provenance) heard by an audience emanate from loudspeakers. Much of the sound is synthesized or altered via signal processing, further rendering the originating sources unrecognizable.

An early thinker and composer of musique concrète, Pierre Schaeffer (1966, 2017) re-envisioned a new model of musical thinking in his Traité des Objets Musicaux. These include the implementation of his four modes of listening (to listen, to perceive aurally, to hear, to understand) and four modes of musical research (Analysis, Morphology, Typology, Synthesis), part of what he refers to as musical experimentation. Though he acknowledges the role of
instrumental agency in his first mode (to listen) of listening, his references to the body’s role is limited. His writing is couched in the post-War values of musical objectivity and dissociation, and his classificatory frameworks favor psychometric measurement of perceptual attributes of sound, where action plays a minimal role. This paper works to both challenge Schaeffer’s objective stance, and uncover avenues where Schaeffer hints at embodiment as vital to the cognition of electroacoustic structures. First, the paper argues that Schaeffer’s own sonic typology is more easily apprehensible when interpreted as gestural typology (Gritten & King, 2011), even when the originating sound sources of a given work are unknown. Second, it focuses on timbre, a key electroacoustic music attribute, the one parameter or construct through which expressive and emotive intentions of sound sources can be explained via musical embodiment (Wallmark, Iacoboni, DeBlieck, & Kendall, 2018). Finally, Schaeffer hints at the value of embodiment in his own writings. His preference for calling timbre a “character” requires its associated sound be contained by a bodily, sensorial agent; and his classification of a “natural” listening mode necessitates ecological, psychoacoustical validity (Neuhoff, 2004).

I apply these reconsiderations to three electroacoustic works, ranging from classic to more contemporary: Edgard Varèse’s Poème électronique, Morton Subotnick’s Silver Apples of the Moon, and Jonty Harrison’s Klang. This paper continues previous research done on performativity and interactive electroacoustic works (Ho, 2018).

Implications for musicological interdisciplinarity
This paper stresses the importance of utilizing research methodologies from different disciplines (here, primarily music theory, music philosophy, and embodied cognition) to enhance the study of cultural practice via empirical psychology on the one hand; and to challenge the work of psychology with a reevaluation of a particular musical practice on the other. The paper demonstrates to the musicological field possible avenues of cross-disciplinary thinking, potentially demystifying much of the work of perception and cognition to fellow scholars in the author’s home discipline (music theory). Finally, presentation of this paper can hopefully yield follow-up collaborations from interested parties, particularly experimentalists.

References
The Myths of Makunaima Songs – Embodiment and Disembodiment of Indigenous Sound Ontologies in Contemporary Brazilian Music

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**Background in Composition and Musicology**
The inclusion and appropriation of indigenous rituals, songs, and legends is used in practice by composers who aim at establishing a Brazilian musical identity. Villa-Lobos, for instance – certainly the most internationally recognized Brazilian composer in the field of art music – was also known by his nicknames “Amerindian in a tailcoat” or “a white Amerindian.” This example reveals the frequent association of the indigenous with an assumed national or “authentic” expression of the Brazilian. Furthermore, in the domain of popular music indigenous materials have been integrated: indigenous elements are often taken as a mere source of inspiration, or become associated with critical political affirmation.

**Background in Anthropology**
Indigenous sonic performances of myths, other narratives, and rituals are mainly characterized by specific ontologies as theorized in Viveiros de Castro's (1997) indigenous perspectivism, and Lewy's indigenous sonorism (2017). While the visual perception of the world is rooted in the body and not in the mind (indigenous perspectivism), sound perception and formalized sound production –like magic formulae or songs– may manipulate and/or transform the world as conceived visually (indigenous sonorism). Therefore, the visually established perspective is deeply embodied, while sound enables its transcendence, allowing for shifting embodiment of different perspectives, commonly addressed as “transformation” in anthropological discourse.

**Aims**
Starting from this premise, this paper aims to reflect upon the appropriation of various indigenous traditions by composers and how these materials are embodied and disembodied in contemporary music practices.

**Main contribution**
For these aims, we apply a combined historical, music-analytical, and anthropological approach. In a first step, indigenous sound performances are presented. Our example starts with the homonymous book written in 1928 by Mario de Andrade (2017, translated: *Macunaima: the hero without any character*). Macunaima refers to a legend collected by German linguist and anthropologist Theodor Koch-Grünberg while traveling the Roraima region on the border between Venezuela, Brasil and Guiana in 1911–1913, and published in 1916 in his book *Mitos e Lendas dos Índios Taulipang e Arekuná*. Many narratives he collected specifically reflect on the sound ontologies of “performing myth”, as well as on the performance practices of characteristically indigenous rituals and sounds.

In a second step, selected Brazilian music performances are analyzed in order to show how several elements of indigenous singing and dancing practices are appropriated and transformed. Selection criteria for the presented pieces were (i) to represent stylistic diversity and (ii) to comprehensively express this appropriation.
Therefore, the works ‘Choros 10’ and ‘Três Poemas Indígenas,’ both composed in 1926 by Villa-Lobos were chosen to represent art music. Both pieces accurately elaborate on indigenous legends and myths, and likewise attempt to recreate a sound ambience resembling a tribal context. Despite the exuberant timbre effects and orchestration accomplished by the composer, these pieces happened to create a misled idea of indigenous traditions; they unilaterally exoticize the indigenous. The realm of contemporary popular music is represented with ‘Macunaíma Ópera Tupi’ by Iara Rennó (2008). This album refers to the above mentioned Macunaíma legend collected by Koch-Grünberg. In 2018, commemorating the 90th anniversary of Andrade’s book, the album was re-created in a new live version now performed in a multimedia show involving music, dance and theater. As a further example of appropriation, the Heavy Metal album ‘Roots’ (1996) by Sepultura deserves mention, because it contains field recordings of music and sound performances among the indigenous Xavante (Xingú, Amazonas). Finally, a more “ethnically grounded” and politically critical composition style is presented in a series of albums released by Marlui Miranda, a singer and composer who is also an expert researcher in the field of indigenous music.

Implications for musicological interdisciplinary
Ontologically relevant similarities and differences are revealed by demonstrating the wide range of appropriations that occur when intending to create “typically Brazilian” genres. We can observe successful transcultural performances and compositions on the one hand, providing a new physicality to indigenous traditions by incorporating them into a concert context. Non-indigenous artists and performers embody “the indigenous” despite their distinct ancestry, ideally in consent with their indigenous source communities. On the other hand, or the other pole of a continuum of more problematic interactions of the modern and the indigenous, we encounter a factual “disembodiment” of indigenous sound practices: obtained material is transformed into “mind oriented sound performances” (van der Schyff, 2013). The sound-body relation always present in indigenous ritual and performance is ignored in order to “feed” the hunger for inspiration in western-style composition with exotic material.

References
THE BOW - Gestural Standardization of Bow Strokes for Violin

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Background in Performance Studies
As Galamian says (1962, p. 5), it is very important that violinists have a solid technique in order to achieve a good interpretation: there must be a direct relationship between these two factors. The relevance of the bow technique for the violinists is consensual, because it is responsible for the sound of the violin. There are many authors who legitimize the importance and the necessity of improvement this theme (Auer, 1925; Flesch, 1928; Galamian, 1962; Gerle, 2011; Salles, 1998).

Background in Computer Science – Gesture Analysis
In relation to the importance of bow gestures, the first relevant study in Motion Capture on the movements produced by the different bow strokes is made by Hodgson (1958), where the author proves for the first time through the capture technology of motion (Mocap), that the different movements of the bow are inevitably curved (Hodgson, 1958,). After Hodgson, several studies were conducted in this area. We highlight important authors such as Schoonderwaldt (2009); Deutsch (2011); Askenfelt (1988); Rabbath (2012).

Aims
The main aim of this study is to understand the somatic movements required for the reproduction of the different bow strokes, in order to create gestural standardizations of each stroke. Thus, this study aims not only to serve as a reflection, analysis and learning of the different movements which are necessary for the execution of different strokes of the mainstream violin repertoire, but also to help violinists and violin teachers.

Main contribution
Based on the research question of the present study: "How can we obtain standardized gestural models of the different bow strokes for teaching the mainstream violin repertoire?”, and since in this type of study the samples must be significant, a quantitative research was chosen - experimental research in the laboratory, where 30 interpretations of specific musical excerpts for each bow stroke are studied (42 strokes in total), performed by 15 professional and 15 violin students, precisely to achieve a variation in the sample: a total of 1260 recordings. Since the main objective of this research is to understand the somatic movements necessary for the reproduction of the different bow strokes in the mainstream repertoire of the violin, a survey and delineation of the most emblematic repertoire/ composers for violin of the different times of the history of music in focus has been implemented. After the realization of the survey, it was necessary to proceed with the selection of musical excerpts - the analytical corpus of this project. A total of 42 musical excerpts were selected. All the recordings were submitted to a
jury composed by three members, who selected the best interpretation of each excerpt from the
two groups under analysis, as well as the worst interpretation of each excerpt from both groups.
These selections are our gestural standardizations and we may already conclude that the
gestures selected as the best by the jury, are almost very identical, and the worst gestures are
usually very different from the others. Furthermore, when we analyzed the questionnaires
implemented to the violinists who did the experiment in the Mocap, it can be concluded that
the participants did not know about the technology (90%), and that they considered that the use
of this technology can be very useful in the teaching-learning process (100%), pointing out as
main reasons: the possibility to teach-learn the proper gestures for each bow strokes, through
the visualization of them; the possibility to isolate different gestures/ components that are
intended to improve or understand better; the possibility to improve the posture, the sound, as
well as help to prevent possible lesions.

Implications for musicological interdisciplinarity
Contrary to what happened to the nineteenth century and early twentieth century (the disciple
was going to meet the master), currently teaching music becomes decentralized. In this way,
teachers must be equipped with didactic-pedagogical strategies that meet the real needs of the
students, and that maintain the trustworthiness of the contents that are intended to teach, in
particular as regards technical (with regard to gestures inherent to the various bow strokes) -
which this study attest to the influence on the musical results of violinists. Thus, through
musicological interdisciplinarity between performance studies (violin bow strokes) and gesture
analysis through the use of computer science (Motion Capture), it is intended that the patterning
for each bow stroke created by using Mocap, prove an important strategy in teaching/learning
bow strokes, assisting students and teachers.

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Wellesley College.
Sentire as a Somatic Participatory Sense-making Experience

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**Background in Interactive Sound Performance**  
Human movement has become more and more central in nowadays music performance (Peters, Eckel, & Dorschel, 2012), in particular because of an increasing use of interactive technologies that allow the body to generate and control music (Kim, 2012). In order to better understand this kind of musical expression, we need to understand the body and her perception.

**Background in Embodied cognition and Somatics**  
Embodied contemplative practices have developed a knowledge of the body that can be helpful to understand human perception: phenomenology and embodied cognition have studied and adopted this knowledge, in order to scientifically consider first hand experiences without reductionism (Varela, Thompson, & Rosch, 1991). If the role of the body is so important for interactive music performance, this perceptual knowledge should be considered and included into interactive music practices. The combination of interactive sound art and somatics has received some attention in the last years (Candau, Françoise, Alaoui, & Schiphorst, 2017; Fogtmann, Fritsch, & Kortbek, 2008; Höök et al., 2017; Loke et al., 2013) though more work needs to be done to explore this specific field.

**Aims**  
The aim of this paper is to better understand the interaction of the participants of an artwork called *Sentire*, thanks to the theory of participatory sense-making (De Jaegher & Di Paolo, 2007) and the practice of somatics (Hanna, 1986). More specifically the goal is to demonstrate how an interactive music system such as Sentire can improve the level of participation of its participants thanks to a somatic experience.

**Main contribution**  
*Sentire* is a participative performance that uses a system which ables to measure proximity and touch between human beings, and it sonifies these events. In Sentire, the participants can interact with each other, creating and modifying the sound. The encounter of the participants usually happens in a quiet environment and the interactive sound is a strong component of the interaction, where both hearing and feeling influence each other, creating a feedback loop of physical, emotional, and intellectual experience.  
As Sentire explores how interactive sound influences human body awareness in all its complexity, a method that allows to grasp the richness of such an encounter is needed. The concept of participatory sense-making (De Jaegher & Di Paolo, 2007) can be helpful to better understand and analyze the experience of Sentire, showing how the interaction unfolds and develops, in particular how the sonification of proximity and touch affects the degree of interaction of the participants. Thus, Sentire is a very good example of participatory sense-making in the musical context:
In joint musical practices, sense-making is always participatory in a strong sense, because both the object (the musical piece) and the dynamical process shaping it (playing together) are
possible only through the systematic and recursive influence of each individual on another (Schiavio & De Jaegher, 2017). Some questions that will be addressed in this paper are:

- What is the level of participation that the design of the system offers to the users? How do the participants interact with the sound and with each other?
- How do the participants find ways to interact and how does such relationship develop and unfold?
- What are the interaffordances of the system that promote interaction and how can that be improved?

Based on the report of the participants and in line with the design of the system, Sentire seems to be able to promote body awareness and proprioception, through an embodied shared interaction. As somatics is about “the body as perceived from within” (Fogtmann, Fritsch, & Kortbek, 2008) the experience of Sentire can be understood as somatic too. If this is true, how does somatics affect participatory interaction? Does perceiving the body from within help or prevent to perceive others? And does this affect participation in relationship to the interactive sound experience in the case of Sentire?

**Implications for musicological interdisciplinarity**

Interactive music systems are more and more popular in contemporary sound art, so there is the need of appropriate methods to understand such works. As most of these devices use body movement or body related information to generate sound, an interdisciplinary method which ables to grasp the complexity of such a personal and bodily experience at a first-person level is needed. Such a goal is possible only thanks to an interdisciplinary approach.

**References**


Musical Listening and the Return to the Primacy of Experience: A Phenomenological Study

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Background in Music Education
Ideas relating to embodied cognition are increasingly recognized in musical psychological and philosophical research (Krueger, 2014; Matyja, 2016; Schiavio, 2017). Schiavio’s (2017) concept of "the phenomenological body" emphasizes the primacy of experience in musical understanding and learning. This concept aligns well with some traditional methods of pedagogical work long-used in musical education. Although embodied in essence, these methods were developed intuitively but they now have a new theoretical substantiation (Nadyrova, 2017). Forms of embodiment in music that are based on large, very visible body movements, and which reflect the rhythmic elements of music and its overall emotional tone, have received a lot of attention. Attempts have even been made to link music’s emotional impact with artists’ external expressions. Korsakova-Kreyn (2018) calls this level “superficial”, without diminishing its importance, and suggests that we pay more attention to the “primary, deep level” - which is connected by tonal relationships - the main aspects of the coding of meaning in music. In this regard, she proposes to consider embodied cognition by drawing on both basic musicology and data from modern cognitive neuropsychological studies. In classical musicology, ideas about the participation of bodily sensations (primarily vocal-motor) in the musical understanding have repeatedly been expressed; Asafiev’s (1963) well-known idea about the “vocal gravity” of musical intonation, for example. In our view, such an approach offers the promise of novel insights into hidden mechanisms that underlie the embodied cognition of the pitch components of musical expression.

Background in Biomedicine
Despite the abundance of musical-neurological research, the specific nature of hearing and music perception’s relationship with the phenomenon of motor resonance in the vocal apparatus (and associated muscular structures) is not yet fully understood. There is evidence that the motor areas of the brain are recruited during auditory perception (Chen et al., 2015; Zatorre, Chen & Penhune, 2007) and, furthermore, that this motor activity may vary depending on the musical interval (Royal, Lidji, Théoret, Russo & Peretz, 2015). It is also recognized that a number of brain areas active in hearing are also active in voice processing (Chen et al., 2015). Here, we hypothesize that, in addition to sharing the brain’s central substrates, mechanisms underlying auditory-vocal processing also share peripheral neuro-muscular substrates.

Aims
The aim of this study is to investigate the nature of bodily reactions and subtle motor sensations that occur during the imagination of musical sounds.
Main contribution
Despite the abundance of musical and psychological research, the specific nature of auditory perception, auditory imagination, and the role of bodily reactions in their underlying mechanisms, is still poorly understood. We intend to consider these issues in line with the theory of enactivism and embodied knowledge. As a first step, it is essential to characterize, as far as possible, these bodily reactions; their variability of manifestation, their exact localization in the body. Unfortunately, the little-noticed, subtle and seemingly hidden bodily reactions are difficult to investigate using established methods such as fMRI, electroencephalography, and electromyography. We therefore turned to the phenomenological research method developed by Husserl (1962); a method based on impartial contemplation of the phenomenon without participation of intellectual judgements and assuming high requirements for experts (concentration, self-reflection, audition).

We recruited twenty-one professional music students (16 Conservatoire, 5 Music College; age-range 17-22). Participants performed tasks on the internal representation of high and low sounds in different positions of the head and then recorded their observations immediately after the completion of each task. As expected, the overwhelming majority of participants noted sensations in the vocal apparatus, although any singing (including the conscious use of mute, voiceless, “mental” singing) was forbidden. However, bodily manifestations were not limited to the vocal apparatus; they were also present in various forms in most of the questionnaires. In addition, some subjects showed physiological manifestations (e.g. pulse, breathing, chills, etc.). We will describe these findings and discuss how they support the view that peripheral substrates may play a greater part in processes underlying musical cognition than traditionally thought.

Implications for musicological interdisciplinarity
If confirmed, the presence of shared peripheral substrates for musical perception, imagination and vocal production has far-reaching implications for musical pedagogy and for our understanding of the of the body’s role in music cognition.

References


The Moving and Expressive Body: A Study on the Semiotic Resources Used by Classical Orchestra Conductors in the Presentation of Musical Dynamics

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Background in Multimodal Communication and Orchestra Conducting

Bodily experience is conceived as an active participant in meaning-construction processes. The latter involves the use of cognitive mechanisms that are mostly unconscious (Johnson, 1987). In the case of orchestra conductors, every part of their body is meaningful. While musicians or singers can perform movements in order to support motor processes, conductors’ movements are communicative by definition (Mayne, 1992; Poggi, 2011). Body signals like eye gaze, head movements, facial expressions and posture become relevant expressive elements for the orchestra, which is why it is said that the conductor’s work is “multifunctional and multimodal” (Poggi & Ansani, 2016, p. 111). In this sense, conducting becomes an interesting study case to understand what types of “semiotic resources” (Streeck, Goodwin & LeBaron, 2013) directors display when expressing musical notions.

Background in Cognitive Linguistics and Metaphor Studies

By placing sensorimotor experience in the center, we are also assuming that it is the main source for our conceptual systems. Thus, mind and body, acting as a unity, contribute in the development of abstract concepts that are mostly based in our daily activities of grasping, handling, hitting, among others. A framework like Conceptual Metaphor Theory (CMT) contributes to understanding the type of relations that are established between target and source (Lakoff & Johnson, 1980). This particular study focuses on musical dynamics where certain metaphors, such as the QUANTITY IS SIZE metaphor, are constantly present.

Aims

The aim of this research was to study expressive gestures done by orchestra conductors, as well as other meaningful body movements such as facial expressions and eye gaze, in order to describe recurrent patterns in the expression of dynamics (e.g. forte, piano) in music.

Main contribution

We focused on orchestra rehearsals, since they allow more interaction between conductor and musicians and they are less structured than the actual performance. The sample includes more than 5 hours of footage from 7 male orchestra conductors: Leonard Bernstein, Nikolaus Harnoncourt, Giancarlo Guerrero, James Ross, Valery Gergiev, Gustavo Dudamel, and Riccardo Muti. The videos are publicly available on YouTube and were analyzed using ELAN with two annotators for reliability.

Dynamics, which is one expressive aspect of a musical score, influences the type of semiotic resources that conductors display. Thus, the expression of forte/fortissimo and piano/pianissimo has clear differences in the type of bodily resources that are displayed by conductors. Orchestra conductors develop a personal style over time, but many of their gestures are recurrent gestures found in daily life that acquire a new meaning in this setting. These forms cannot be taken as a nomenclature, in the sense that it is impossible to conceive a gesture with just one fixed meaning. Hence, more than assuming rigid patterns for the expression of musical
dynamics, the analyses consists in presenting forms that are more likely to occur in specific domains of expression.

Implications for musicological interdisciplinarity
Although the study is about orchestra conducting, the results add evidence to an embodied, dynamic, usage-based approach in cognitive linguistics: bodily signals and movement act together to express different qualities of meaning. The relation between form and expression that is highlighted through the study posits the question about the arbitrariness of the sign: if the fist expresses strength, but also louder sounds, it is possible to argue that these forms are highly motivated. Although the main purpose of the study came within the fields of linguistics and semiotics, music presents itself as an exciting art form to understand the connection between expression and language. In this context, interdisciplinarity with linguistics, psychology, and musicology would be highly beneficial to keep unraveling bodily mechanisms of meaning construction.

References
Music Analysis Based on Archetypes of Musical Texture: Cognitive Implementations of Cross-modal Associations/ Synaesthesia Cases

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**Background in Performance studies, Music theory**
Musical texture is a DNA of the musical composition, created by a complex of elements such as rhythm, melody, harmony structure/ accompaniment etc. Musical texture is an inducer of cross-modal associations. Our music perception and music consciousness based on a sensory feedback from different percepts, such as tactile, audio, visual, in some cases olfactory (synaesthesia types): it is embodied music cognition. This research proposing an alternative model of music analysis based on audibly and visually recognizable archetypes of musical texture to reflect on cross-modal associations and musical narrative of the composition.

**Background in Neuromusicology, Perception, Cognitive Science**
Neuromusicology looks at the processes of how the brain responds to music. The fact is that together with audio stimulus, other areas of the brain, responsible for processing visual, tactile, olfactory experiences, and get involved in music listening or music performance. Synesthesia cases show examples of how musical sounds could be perceived as a ‘landscape’ or ‘sculpture’ in the case of musical-space synesthesia, and have colour, in the case of chromesthesia. Some synesthetes report olfactory responses to musical texture. These responses are very subjective and very often neglected in musicology, and yet, offer the most interesting insights into the im bodied sensory world of music. Cytowic, Ramachandran and Hubbard call synesthesia a “window to perception”.

**Aims**
To suggest an alternative system of music analysis based on archetypes of musical texture and cross-modal associations. To bring awareness of audio and tactile visualisations of musical texture, useful for the craft of music performance.

**Main contribution**
Although various music analyses discuss harmonic structure, style of the composer, epoch or genre, there is very little discussion of cross-modal associations induced by elements of musical texture. This research offers insights into the system of alternative music analysis, first applied by S. Garcia to Scriabin’s Piano Sonata form. S. Rudenko hypothesizes that this system of music analysis is useful for mapping archetypes of musical texture for art visualisations, with reflection on cross-modal associations and narrative of musical compositions. Examples:

1. Interviews /Art works on music by artists-synaestheses: Timothy Layden, Ninghui Xiong, Geri Hahn. www.svetlana-rudenko.com Interviews in Lectures
3. 4D Visualisation of Musical texture / model of musical-space synaesthesia perception https://www.youtube.com/watch?v=LbmmwWFp1yE
Implications for musicological interdisciplinarity

Merging neuroscience methods and valuation of subjective cases and musicology analysis, are beneficial for deeper understanding of music perception and cognition. It allows to broaden the range of music analysis and include subjective experiences of cross-modal associations of the performer. Positive outcome:

1. Paintings on music from artists-synaesthetes broaden our imagery and understanding how sound could be perceived and viewed in additional sensory modalities, embodied music cognition in visual cortex.

2. Alternative model of music analysis based on archetypes of musical texture is proposed for mapping cross-modal associations and creating musical narrative of composition, giving useful insight into the emotional content.

3. 4D spatial visualisation of musical texture, based on musical-space synaesthesia model, influences perception of time, dynamics and shape of phrases. Mental visualisation can reduce hours of instrumental practice and numerous repetitions.

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Tramline 3: exit at “Herz-Jesu-Kirche”; enter the building from the back.
Bus line 63: exit at “Nibelungengasse”; enter the building from the front.
Tramline 7 and 1: exit at “Merangasse”. From there, it will be a 5-minutes-walk to the conference venue.

A helpful app to find your way around the city is **“quando Graz”**.

Printing
There is the opportunity to print in the Wall building. If you need to print a document (not more than a few pages!), please refer to a student assistant.