ESCOM 2017
BOOK OF ABSTRACTS

25th Anniversary Edition of the European Society for the Cognitive Sciences of Music (ESCOM)
Expressive Interaction with Music
31 July – 4 August 2017, Ghent, Belgium

www.escom2017.org
ESCOM 2017

31 July-4 August 2017
Ghent, Belgium

25th Anniversary Conference of the European Society for the Cognitive Sciences of Music

BOOK OF ABSTRACTS

Edited by E. Van Dyck
IPEM, Ghent University, Belgium
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Welcome to ESCOM 2017

Welcome by Marc Leman - ESCOM 2017 Conference Chair

The 25th anniversary conference of ESCOM indicates a historical landmark that calls for reflection, both on the past and the future. Are we doing well? Are we happy with the results? Should we explore new directions? How can we attract new members? Who are we, and what do we represent? What activities should we organize? And so on. Societies, such as ESCOM, therefore, are always in a sort of existential crisis. Their time for action is always limited, and their decisions have to be executed fast and efficient, in order to have impact. We know how it works, and it is fascinating. After all, our own life is one existential crisis – all the time, isn't it?

As far as ESCOM is concerned, I must confess that I was an observer of the society’s existential crisis, rather than a contributor of solutions - although Irène Deliège asked me several times, right from the start up to recently, actually, but I couldn't join. There were preoccupations with a journal (JNMR), another society (ISSSM), a large research project, and so on. Sorry for that, Irène! I always admired your enormous energy: In building up the society, in gathering excellent people around you, and in becoming increasingly professional and attractive to researchers. You were always in full action, stimulating others. Let this conference also be a tribute to you!

Nowadays, ESCOM offers a solid platform for exchanging ideas, for networking, and for building social skills on an international basis, Europe-wide, and worldwide. The upgrade of the ESCOM journal, with an international publisher, was an excellent move, and we may expect that ESCOM’s associated journal, *MUSICA SCIENTIA*, will remain a strong player in music and cognitive sciences. For both society and journal, we all want to go on for another 25 years.

However, in view of that future, it is of interest to consider ESCOM’s existence in a broader context, that of the cognitive sciences. This context may require our particular attention, as it forms both an opportunity and a challenge. Look how different the landscape is today, compared to the early 1990s when ESCOM was founded. The most important achievement, probably, is that the dominance of linguistics, as research paradigm for music, has been replaced by a music-based research paradigm. Consequently, the cognitivist approach had to stand back and make place for the study of sensorimotor processes, embodiment, and interaction. Likewise, semantic-based emotion research had to stand back and make place for research on affect and expression, including physiological and neuroscience aspects. In short, music research adopted a performance-based paradigm and by doing this it could become a core player in interaction technologies and is upcoming augmented and virtual reality applications.

However, despite these fascinating developments there are some issues that bother concern as well. Music-related neuroscience and engineering, such as research on the brain circuits of reward (cf. the dopaminergic system) and the automated music performance systems (cf. the deep learning
techniques), have become specialized research areas that we see rather seldom at ESCOM meetings, as if they neglect the performance-based research focus that characterizes ESCOM. Is performance out of the picture? Should we be concerned about this? I think we should, and very much! This drifting apart of sister-disciplines is a treat and a challenge that we, and perhaps ESCOM, should act upon. Action should be taken to promote convergence of all music sciences! Well, that’s certainly my mission, and it is the reason why we focus in this 25th anniversary conference on Expressive Interaction with Music, a topic that can be a binding factor for all music sciences. Hence our focus on interaction rather than cognition, on expression rather than emotion, and on applications and systems, together with invited keynote speakers from neuroscience, neurobiology and ethnomusicology. I would be happy if the outcome of this conference would make people aware about our existential crisis. Let us celebrate ESCOM’s 25th anniversary by asking questions about ESCOM and about our own research. Let’s question ourselves all the time. Let us go to the bottom and ask the essential thing: who are we, what do we stand for, where do we go?

While meditating about our existence, I would like to thank my staff and all the collaborators who made all this possible, in particular, co-chair Edith Van Dyck, and scientific conference assistants Dirk Moelants, Micheline Lesaffre, Luc Nijs, and Pieter-Jan Maes, with the clever logistic conference assistance of Katrien Debouck, Ivan Schepers, Joren Six, Bart Moens, and Guy Van Belle. Also thanks to all conference assistants who volunteered to help us at the time of the conference (Konstantina Orlandatou and Anemone Van Zijl) and last but not least, I wish to express my sincere thanks to the Executive Council of ESCOM for the help and support in organising this conference.

Welcome by Irène Deliège - ESCOM Founder

25th Anniversary of ESCOM: A bit of history

At the turn of the 1990s, the foundation of ESCOM was seen as an important priority. A first major event, organized by Stephen McAdams and myself, was held at IRCAM in Paris in March 1988. It was the International Symposium Music and the Cognitive Sciences, which summarized the various orientations recently developed in the field, mainly in the United States and Europe. This event resulted in the launch the following year of an analogous undertaking, the ICMPC (International Conference on Music Perception and Cognition), located alternately every two years in Asia and in the United States. The foundation of a European host for ICMPC became urgently needed.

A meeting of founding members organized at the University of Liège at the end of 1990 established the premises of the society and the official birth of ESCOM came to fruition during its first congress in Trieste in October 1991. The following year, in February 1992, an agreement was reached with the ICMPC founders. At the second ICMPC in Los Angeles, I proposed to the General Assembly of the members a junction between ICMPC and ESCOM in order to plan regular sessions on European soil in the future. This proposal was unanimously accepted and the 3rd ICMPC was thus carried out at the
University of Liège in 1994. The European sessions that followed were held in Keele (2000), Bologna (2006), and Thessaloniki (2012). Graz will host ICMPC 2018.

The official journal of ESCOM, *MUSICA ÀE SCIENTIAE* was inaugurated in 1997. I managed its editorial tasks until 2010. Reinhard Kopiez is currently responsible for its development, while Jukka Louhivuori has taken over the duties of permanent secretary. I am very grateful to them.

This quick overview has traced only a few major pillars of our history. A number of major events - congresses, symposia, etc. - as well as publications from our many activities, could not be mentioned here: details are available in the special issue of *MUSICA ÀE SCIENTIAE* which was dedicated to me in 2010 and edited by John Sloboda. For having lived it on a daily basis, I confess that the time spent at the centre of ESCOM has been particularly exciting for me. Before closing this message, I would like to express my sincere thanks to all the colleagues and friends who have agreed to join me in the committees, which operated over the two decades of my tenure. I have a wonderful memory of your generous welcome to my initiatives.

And, finally, would it be to maintain my presence among you that I got the idea of establishing the ESCOM Irène Deliège Translation Fund...? I leave the answer to you!

_____________________

Welcome by Richard Parncutt - ESCOM President

On behalf of the Executive Council of ESCOM, I welcome you to ESCOM's 25th Anniversary Conference. We wish you a productive and enjoyable few days of immersion in the best and latest research in our field. Special thanks to Marc Leman and his team for all the care, expertise, and hard work they put into preparing this event.

ESCOM was founded in 1991 by Irène Deliège, without whose constant engagement over many years ESCOM would not exist - or it would not be as strong as it is today. One of the purposes of this conference is to celebrate her achievement, along with the parallel achievements of our society's ex-Presidents. Another purpose is to celebrate the discipline of music psychology as a whole, including its ancient roots, its European (German) development in the late 19th and early 20th Centuries, its international (American) revival following the “cognitive turn” in psychology, and its continuing academic, social, cultural, educational, medical, and political relevance. We are always glad to see new faces at our conferences and extend a special welcome to colleagues who are presenting their research here for the first time.

The main aim of ESCOM is to promote research in the cognitive sciences of music - more generally, in all areas of music psychology and related disciplines. We do that in two main ways: First by organizing conferences like this one, and second by publishing a peer-reviewed journal, *MUSICA ÀE SCIENTIAE*, which in recent years has gone from strength to strength under the editorial eye of Reinhard Kopiez.
For those conference participants who are not yet members of ESCOM, we encourage you to join. ESCOM is the leading European representative of scientific and interdisciplinary approaches to music. It is a non-profit organization that is entirely funded by membership fees and journal sales. We depend on the goodwill and support of researchers in music cognition to promote the discipline and continue its activities. Researchers at all career stages are encouraged to become members. Benefits include the journal (paper and electronic), academic networking, the right to vote and hold office, society discounts, and information about coming events.

If you join ESCOM for the first time at this conference, the first year of membership is free. For further information, please ask at the registration desk.

**Welcome by Jukka Louhivuori - ESCOM General Secretary**

The first International Conference on Cognitive Musicology was organized in Jyväskylä, Finland, in 1993. Many of the participants of that conference are today well known by ESCOM members and have a key position in our society, such as Richard Parncutt, the present president of ESCOM. The background of the conference was strongly inspired by the writings of Otto Laske, who suggested a paradigm change for musicology and introduced a new concept: cognitive musicology.

During those times a group of people, whose background was not so much in musicology, but in psychology, had established a new society called ESCOM (European Society for the Cognitive Sciences of Music). Thus, two groups of people, whose scientific background was a bit different, had a very similar goal: to look at music research from the point of view of human cognition.

In 2008, during my period as the president of ESCOM, I was sitting in Irène Deliège’s living room with two of my Finnish colleagues discussing about the future of ESCOM. Irène asked about our possibilities and willingness to take over the society and move it from Belgium to Finland. The society was founded by Irène in Brussels, but according to her it was now the time to think about the future location of ESCOM. It was a great honour that Irène had such a trust in our abilities to continue her incredible efficient work. At the same time we understood the challenges of this kind of move: constitutions and by-laws should be re-written according to Finnish law and the archive should be moved physically from Belgium to Finland. On the other hand, the department of music at the University of Jyväskylä had focused on cognitive musicology for a few decades, and thus, it was quite obvious for us to reply positively. In 2010 the society was re-established in Finland, and the office was moved to the Department of Music in Jyväskylä.

It took some time to move the ESCOM archive; hundreds of back issues of MUSICÆ SCIENTIÆ and other official material were transported from the cellar of the University of Brussels to the Musica building in Jyväskylä. The ESCOM activities Irène had managed for years by herself were soon
shared by several people: a new general secretary, a new editor and a new publisher (SAGE). I still can’t understand how Irène was able to take care of all these duties just by herself.

Today, ESCOM is the home for researchers whose background can be diverse; (systematic) musicology, psychology, ethnomusicology, education, music theory, computer science, etc. ESCOM has grown rapidly, and today, the position of our society in the field is strong. Key activities of ESCOM are still those that Irène Deliège originated in the first years of the society: triennial conferences, symposia, and MUSICÆ SCIENTIÆ. Irène her ideas, on which the society was build, have proven to stand the test of time.

I wish all ESCOM anniversary conference delegates most inspiring days. This event is at the same time the celebration of the founder of the society, Irène Deliège, and honours the great success of the society. Special thanks go to Marc Leman and his team for giving a positive answer to our suggestion to organize this event. The role of Marc has been huge in the paradigm change of systematic musicology, one of the key scientific pillars of the cognitive sciences of music.

Welcome by Reinhard Kopiez - Editor-in-Chief of MUSICÆ SCIENTIÆ

Conference contributions are the journal publications of tomorrow. This is a promising perspective for a journal editor. I therefore would like to encourage you to consider MUSICÆ SCIENTIÆ, the peer-reviewed journal of ESCOM, as a potential outlet for your research. The journal offers different publication formats, such as “Research Notes,” full papers or even an entire special issue. The latter option could be of interest for symposium organizers, and a Call for Papers will be circulated in autumn 2017 to all members of ESCOM. Please take a look at the journal homepage (http://msx.sagepub.com) to get an impression of its broad thematic scope and of those papers that have been currently accepted. We welcome high quality music-related empirical research from fields, such as psychology, sociology, cognitive science, music education, artificial intelligence, and music theory, that might contribute to our understanding of how music is perceived, represented, and generated. The journal is also open to replication studies and meta-analyses.

Convincing reasons for a submission to MUSICÆ SCIENTIÆ are its impact factor of 1.4 (for 2016), the fast turn-around times (first decision within less than 40 days, and final decision within 10 days), the high quality reviews, immediate online first publication of accepted papers, the option of providing supplemental online material for the readers, and the journal’s excellent international visibility (guaranteed by SAGE Publishing and a more than 200 institutional subscriptions worldwide). MUSICÆ SCIENTIÆ is present in all relevant citation indices and listed in the databases PsycINFO, ERIC, and RILM.

I wish you a productive and inspiring conference, and I am looking forward to receiving your submissions!
Welcome by Jane Ginsborg - Past-President of ESCOM, 2012-2015

When the European Society for the Cognitive Sciences of Music was founded in 1991, I had barely begun to study psychology, let alone develop an interest in music psychology, perception, and cognition. When I became a PhD student, I gave my first international conference presentation at the Third Triennial ESCOM Conference in 1997, in Uppsala, and I remember well the excitement of opening my copy of the first volume ever published of MUSICÆ SCIENTIÆ. Since its very earliest years, then, ESCOM has been integral to my learning, research, and teaching. ESCOM has provided me with the opportunity not only to read the work of many distinguished researchers but also to hear them present it and to meet them at conferences. It was a huge honour to follow Michel Imberty, John Sloboda, Alf Gabrielsson, Andrzej Rakowski, Mario Baroni, Jukka Louhivuori, and Reinhard Kopiez in the role of President from 2012 to 2015, and to organize, with Alexandra Lamont, the Ninth Triennial Conference at the Royal Northern College of Music in Manchester. I know how much work is needed to plan a successful conference and am confident that Marc Leman and his team have done a superb job in preparing not only for a stimulating scientific meeting that foregrounds interactive performance but also a celebration of ESCOM’s achievements over the past quarter-century. As I write – on the day our countries’ representatives begin to negotiate the departure of the UK from the European Union – it is all the more vital that we continue to support each other in the interests of our discipline: through meeting, talking, sharing, discussing, carrying out, and disseminating research, reaching out to future generations of European researchers, and across our boundaries, throughout and beyond Europe.

Welcome by John Sloboda - Past-President of ESCOM, 1995-1997

As a founding member of ESCOM’s Executive Committee and a past President I am looking forward to this celebratory conference, and the opportunity - with Jane Ginsborg, current Past President - to share some reflections on ESCOM, its history, its achievements, and its prospects. For now I would just recall that the idea of a Pan-European Society for the Cognitive Sciences of Music first emerged at the time of the collapse of the Soviet Union and the re-integration of Europe as a region committed to the practice and spread of democracy. The most hopeful sign of those early years for me was the appearance of colleagues from countries of the former Eastern bloc at our events, and their active and enthusiastic participation alongside members from Western Europe and the surrounding regions. Today, new political forces threaten to undermine European collectivity and solidarity. Organisations such as ESCOM, which bring Europeans together across cultural, geographical, and political divides, have never been more important, and I hope ESCOM members will strive to ensure that the forces which divide Europeans from one another will not be allowed to take root in music sciences.
ESCOM 2017 Committees

Organizing Committee

Conference Chair and Co-Chair
Marc Leman and Edith Van Dyck

Scientific Assistants
Dirk Moelants, Micheline Lesaffre, Luc Nijs, and Pieter-Jan Maes

Conference Assistants
Katrien Debouck, Ivan Schepers, Joren Six, Bart Moens, and Guy Van Belle

Advisory Board (ESCOM Executive Council)

President
Richard Parncutt

Vice-President
Renee Timmers

Past-President
Jane Ginsborg

Editor-in-chief of MUSICÆ SCIENTIÆ
Reinhard Kopiez

General Secretary
Jukka Louhivuori

Treasurer
Jaan Ross

Members
Anna Rita Addessi
Emilios Cambouropoulos
Alexandra Lamont
Barbara Tillmann
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Adam Ockelford, University of Roehampton, UK
Alexander Demos, University of Illinois, Chicago, USA
Alexander Refsum Jensenius, University of Oslo, Norway
Alinka Greasley, University of Leeds, UK
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Andrea Schiavio, Bogazici University, İstanbul , Turkey
Andreas Lehmann-Wermser, Hannover University, Germany
Andrew King, University of Hull, UK
Anna Rita Addessi, University of Bologna, Italy
Antonia Ivaldi, Aber Aberystwyth University, UK
Baptiste Caramiaux, Goldsmiths, University of London, UK
Bénédicte Poulin-Charronnat, University of Burgundy, France
Birgitta Burger, University of Jyväskylä, Finland
Clemens Wöllner, University of Hamburg, Germany
Daniel Müllensiefen, Goldsmiths, University of London, UK
David Hargreaves, University of Roehampton, UK
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Eduardo Coutinho, University of Liverpool, UK
Elena Longhi, University College, London, UK
Eleni Lapidaki, Aristotle University of Thessaloniki, Greece
Elvira Brattico, Aarhus University, Denmark
Emilios Cambouropoulos, Aristotle University of Thessaloniki, Greece
Erkki Huovinen, University of Jyväskylä, Finland
Frank Desmet, Ghent University, Belgium
Freya Bailes, University of Leeds, UK
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Glenn Schellenberg, University of Toronto at Mississauga, USA
Graça Mota, College of Education of the Polytechnic Institute, Porto, Portugal
Gunther Kreutz, Carl von Ossietzky University, Oldenburg, Germany
Hauke Egermann, University of York, UK
Henkjan Honing, University of Amsterdam, Netherlands
Jaan Ross, Estonian Academy of Music and Theatre, Estonia
Jane Ginsborg, Royal Northern College of Music, UK
Jessica Grahn, Western University, Canada
Jin Hyun Kim, University of Berglin, Germany
Joel Krueger, University of Exeter, UK
Johan Sundberg, KTH and University College of Music Education, Stockholm, Sweden
John Iversen, University of California San Diego, USA
John Sloboda, Guildhall School of Music and Drama, UK
Jonathan Berger, Stanford University, USA
Jonna Vuoskoski, University of Oxford, UK
Jukka Louhivuori, University of Jyväskylä, Finland
Kai Lehikoinen, University of the Arts Helsinki, Finland
Kai Lothwesen, University of Bremen, Germany
Karen Burland, University of Leeds, UK
Katie Overy, University of Edinburgh, Scotland
Konstantina Orlandatou, Hochschule für Musik und Theater Hamburg, Germany
Luiz Naveda, Escola de Música da UEMG, Brazil
Maarten Grachten, Austrian Research Institute for Artificial Intelligence, Vienna, Austria
Makiko Sadakata, Universiteit van Amsterdam, NL
Marc Thompson, University of Jyväskylä, Finland
Marco Lehmann, University Medical Center Hamburg-Eppendorf, Germany
Mark Reybrouck, University of Leuven, Belgium
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Martin Cle Antonyton, Durham University, UK
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Mowraread Farbood, New York University, USA
Naomi Ziv, College of Management Academic Studies, Israel
Neta Spiro, Nordoff Robbins, UK
Nikki Moran, University of Edinburgh, UK
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Petr Janata, University of California Davis, USA
Petri Toivainen, University of Jyväskylä, Finland
Petri Laukka, Stockholm University, Sweden
Pirkko Paananen-Vitikka, University of Oulu, Finland
Rebecca Sheifer, Leiden University
Reinhard Kopiez, Hanover University of Music, Drama and Media, Germany
Renee Timmers, University of Sheffield, UK
Richard Ashley, Northwestern University, Evanston, IL, USA
Richard Parncutt, University of Graz, Austria
Rita Aiello, New York University, USA
Rolf Inge Godøy, University of Oslo, Norway
Scott Lipscomb, University of Minnesota, USA
Simone Dalla Bella, University of Montpellier, France
Susan Hallam, UCL Institute of Education, University College London, UK
Thomas Schäfer, Chemnitz University of Technology, Germany
Uwe Seifert, University of Cologne, Germany
Victoria Williamson, University of Sheffield, UK
Werner Goebl, University of Music and Performing Arts, Vienna, Austria
Zohar Eitan, Tel Aviv University, Israel
Awards

SEMPRE Conference Award

SEMPRE has offered Conference Awards to presenting delegates. They were awarded to students and unwaged delegates, on the basis of merit, financial need, and geographic representation, to assist with the cost of attending the event. A total of 32 participants were given varying levels of support based on their needs for a total grant of £9500 or €10740.

Awards have been distributed to:


ESCOM Young Researcher Award

ESCOM awards a Young Researcher Award to a PhD (or Master) student who submits a high quality proceedings paper in the field of music perception and cognition. Firstly, overall quality and originality of all submitted abstracts were assessed and afterwards, a shortlist was drawn based on the review ratings of the submitted abstracts. After submission of the proceedings papers, another round of reviews was organised starting from this shortlist and finally, the members of the Award Selection Committee selected the award winner. The committee consisted of Marc Leman (chair of ESCOM 2017), Richard Parncutt (president of ESCOM), and Renee Timmers (vice-president of ESCOM).

The Award Selection Committee has decided to grant the ESCOM Young Researcher Award to:

Jan Stupacher: Go with the flow: Subjective fluency of performance is associated with sensorimotor synchronization accuracy and stability
Ghent University Award

Ghent University awards a Researcher Award to a second researcher who submits a high quality proceedings paper in the field of music perception and cognition. For this award, all researchers (also senior researchers) who submitted a proceedings paper were taken into account. The selection procedure was identical to that of the ESCOM Young Researcher Award. The committee consisted of Marc Leman (chair of ESCOM 2017), Richard Parncutt (president of ESCOM), and Renee Timmers (vice-president of ESCOM).

The Award Selection Committee has decided to grant the Ghent University Award to:

Kathryn Emerson: Seeing the music in their hands: How conductors’ depictions shape the music

During the conference, the winners of the ESCOM Young Researcher Award and Ghent University Award will receive a money prize (€ 200) and a selection of books on Systematic Musicology, and will present their research during a special plenary session of ESCOM 2017.
CONCERTS

CONCERT TUESDAY 1ST AUGUST
De Krook, 20:00-21:00

Prototype - Marc Vanrunxt

Prototype is a dance performance centred around the loner Lucien Goethals (1931-2006), a pioneer of Flemish electronic music. Sound designer Daniel Vanverre, with whom Vanrunxt collaborated with for Discografie (2013), will manipulate these recordings live on stage. The performance will act as a journey through time, towards what used to sound like the music of the future back in the 70s and perhaps still does today. Koenraad Dedobbeleer has developed a set inspired by the American artist Ellsworth Kelly (1923-2015). His work has always played a crucial role in the development of Marc Vanrunxt’s work. Kelly’s pursuit for abstraction can be translated into dance as an impossible challenge; dance can never be abstract because there are always live bodies on stage. For exactly this reason, abstraction is always a fascinating challenge within dance.

CONCERT THURSDAY 3RD AUGUST
Aula, 18:00-18:30

Shout at Cancer

Shout at Cancer is the only charity in the world that combines the implementation of singing, acting and beatboxing techniques in speech rehabilitation for patients following the surgical removal of the voice box (laryngectomy).
We are a team of singers, actors, speech therapists, doctors and trained laryngectomy participants that support the patient and family through different psychosocial mediums.

We use concerts and other social activities to engage the public and educate on the layered impact of this invasive surgery, indicated by throat cancer.

The hole in the neck and the change in voice is just the tip of the iceberg.

The charity - only two years young - has won; ‘The Lancet Prize’ for best pitch at the Global Health Film Festival (London 2016) and received the ‘Points of Light Award’, a personal recognition from the British Prime Minister, Theresa May (London 2017).

Highlights so far include performances in: The Belgian Embassy in London, The Royal College of Surgeons in London and The Wellcome Collection. This October we are collaborating with Garsington Opera House in the Victoria and Albert Museum (V&A) and in November we are opening the Global Health Film Festival in the Barbican, London.

Our aim is for the laryngectomy voice to be heard, hence our slogan: “Together, we shout louder!”

Twitter: ShoutaCancerUK

Facebook Shout at Cancer

www.shoutatcancer.org

info@shoutatcancer.org

(Picture: Thomas S.G. Farnetti, Wellcome Collection, Thinking out of the Voice Box, 8 June 2017, Wellcome Collection.)
Presentation Guidelines

Poster Presentations

We recommend that the maximum metric paper size is DIN A0 (84 cm × 119 cm, or, 33.1 × 46.8 inches). We expect posters to be displayed in portrait orientation (height greater than width). You may print your poster in other (small) page sizes and assemble your poster as you wish on the poster boards that we will provide. Please take into account the size of your fonts and the level of magnification. All poster presenters are required to bring their own poster(s) and we recommend to print them in advance. There are a number of copy shops close to the conference venue where the posters can be printed, however, many of them will be closed due to the holidays during ESCOM 2017.

Presenters will be responsible for mounting and removing their own posters. Posters can be set at lunchtime the day of your poster session and have to be removed – at the latest – by lunchtime the day after. The Organising Committee will not be responsible for posters that are not removed by this time. At least one author of each poster must be available during the timetabled poster sessions. To maximise the opportunities to talk to delegates about your work, we advise to be present at your designated poster board during tea and coffee breaks on the day of your poster presentation.

Spoken Presentations

Spoken presentations should be maximum 20 minutes in length and will be followed by 7 minutes for discussion and a 3-minute break for switching between presenters and/or conference rooms. As a presenter, you are required to carry out a technical check in the auditorium/room where you are presenting. The technical check should be performed 15 minutes before your session starts OR on Monday July 31th between 17h and 20h (during the registration time on Monday). We recommend you to bring your personal laptop and VGA connector for your presentation, but in case that is not possible, a basic Windows 7 computer will be available in every auditorium/room as well with PowerPoint 2013 installed. If it is necessary for you to use the computer provided in the auditorium/room, please bring a copy of your presentation on a USB/flash drive (presenters with their own laptop are advised to bring such a copy as well as back-up). Meet your chair and technical assistant 10-15 minutes before the start of the session in which you are presenting to let them know that you are present. If you have handouts, please distribute them before your talk. If something goes wrong with the equipment during your talk, please ask the technical assistant to fix it. For audio playback a standard mini-jack connected to an amplifier and speakers will be available.

WiFi is available but the connection might become rather unreliable when a large number of surfers are connecting to the same access point. Please avoid depending on an Internet connection for your presentation. While the YouTube video loading indicator can be mesmerizing, watching the indicator is not the main focus of ESCOM. Try to avoid it.
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Tuesday 1st August

CONFERENCE OPENING BY MARC LEMAN
Blandijn - Auditorium C, 10:00-10:30

KEYNOTE
Blandijn - Auditorium C, 10:30-11:30

Interaction, entrainment and music performance
Martin Clayton
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Human beings have a remarkable capacity to coordinate their actions, and ability that is exploited in rich and diverse ways in music making. The importance of the meaningful interactions of musical activity, including this mutual synchronisation of sound and movement, have fascinated observers for many years and have been described from many perspectives. These observations point to their importance in phenomena as profoundly important to the human condition as the sharing and transmission of affect and the creation and reinforcement of social bonds. Nonetheless, the ways in which groups of human beings interact with one another in musical contexts – including the ways in which they mutually entrain – remain poorly understood, as do their effects on the people involved. In this paper I will discuss some important aspects of these questions, including the contributions ethnomusicology can make to answering them.

EMOTION 1
Blandijn - Auditorium A, 11:30-12:30

11:30-12:00

'Playing on autopilot'. New insights on emotion regulation in music students
Michaela Korte*1, Deniz CerciH2, Victoria J. Williamson*3
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Keywords: Depersonalization, anxiety, depression, music students
Background: Emotional regulation plays a central part in every musician's life. Music students are thought to be at increased risk to experience anxiety and depression symptoms relating to emotion regulation ability. In line with this theory, they often report high scores of anxiety, however, their experiences of depression have only been investigated to a lesser extent. An investigation of both symptoms in music students will shed new light on the complex nature of these symptoms, and their possible links to the kind of emotion regulation difficulties that have the potential to impact musicians' work and life experiences. One particular area of interest is depersonalization, a disorder marked by emotional regulation difficulties. Clinical observations, such as the activation of prefrontal attentional brain systems, present compelling evidence that links depersonalization and anxiety as co-morbid disorders. However, due to its complex nature, this area is yet to be fully explored and no research exists in relation to music students, despite the fact that they are an ‘at-risk’ population. Depersonalization can occur in transient episodes, and has been reported in healthy individuals under situational conditions, especially stress. In some cases, it can go on to manifest as a chronic psychiatric disorder causing considerable distress. Studies have shown that depersonalization scales can differentiate patients with pathological depersonalization from other patient groups, such as those with anxiety disorders; hence the use of depersonalization scales has the potential to identify links to anxiety within a population of music students, or, in the absence of any links, to identify experiences of emotion regulation difficulty that are linked to depersonalization. Aims: The present study's aims were; 1) To investigate the prevalence of both depression and anxiety symptoms in the same population of music students, 2) To compare anxiety and depression levels between music students and non-music students, and 3) To examine the occurrence of depersonalization in both groups. Method: 67 students from the University of Sheffield, including both music (31) and non-music students (36), completed an online questionnaire with relevant scales, including the Hospital Anxiety and Depression Questionnaire (HADS), Cambridge Depersonalization Scale (CDS-9), and a sub-scale of the GOLD-MSI. The groups were evenly distributed in age (mean: 22.7 years, SD: 6.30), education level, and relationship status. Results: Both groups showed a relatively high propensity towards anxiety (A) and depression (D). Whilst these mean raw scores were within a similar range across the groups, prevalence – the number of participants significantly affected by anxiety / depression symptoms – ranged for HADS_A from 40.6% (music students) to 55.5% (non-music students), and for HADS_D from 9.3% (music students) to 19.4% (non-music students). There were no differences between the two groups on depersonalization. However, overall prevalence on the CDS-9 was 43% (music students) compared to 40% (non-music students). There was a significant correlation between anxiety symptoms and the frequency of depersonalization symptoms ($r_s(8) = .21, p < .05$) for both groups. For music students, a trend was observed between increased depersonalization and the amount of daily practice reported, but not for years of practice. Conclusions: This study found evidence of anxiety and depression symptoms amongst participants. However, it was not unique to music students. The main group difference was a higher depression score in non-music students. Depersonalization scores helped to interpret these main findings, as they support the presence of transient anxiety-based problems as opposed to a trend towards pathological depersonalization. The pattern of depersonalization scores in the music students increasing with hours of reported daily practice, but not with longer term training; this new finding is indicative of a risk towards increased or enhanced transient depersonalization episodes that aligns with certain training practices, and requires further investigation. The experience of depersonalization episodes can gradually impair emotion regulation processing, hence this result calls for closer investigation into how long students practice and the importance of education and awareness surrounding the possible impacts of their practice schedules on their emotional regulation experiences and abilities.
12:00-12:30

Musical chills as experiential correlates of adaptive vigilance: An ecological-evolutionary stimulus-response theory

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Keywords: Chills, freeze, emotion, fear, awe, lust, vigilance

Background: Intense emotional responses to music, both positive and negative, often involve chills (thrills, frissons, goose bumps, shivers down the spine, piloerection). What is their origin? Feeling cold is characteristic of sadness and fear across cultures (Breugelmans et al., 2005). “Because feelings of sadness typically arise from the severance of established social bonds, there may exist basic neurochemical similarities between the chilling emotions evoked by music and those engendered by social loss” (Panksepp, 1995). Musical chills are associated with positive emotion [Benedek and Kaernbach (2011) linked piloerection to feeling moved] and the personality factor “openness to experience” (McCrae, 2007): fantasy, aesthetic sensitivity, inner awareness, diversity preference, and intellectual curiosity. But music-evoked emotions also differ everyday emotions. They are aesthetic and reactive rather than utilitarian and proactive (Scherer & Zentner, 2008). “Being moved and aesthetic awe, often accompanied by thrills, may be the most genuine and profound music-related emotional states” (Konečni, 2008). Awe is linked to “perceived vastness … [assimilation of] an experience … threat, beauty, exceptional ability, virtue, and the supernatural” (Keltner & Haidt, 2003). Aims: To develop a plausible, testable theory of the origin of musical chills, based on their non-musical functions. Main contribution: Chills may be experiential correlates of adaptive vigilance: “Goosetingles and coldshivers are posited to serve the function of signaling that an event in the environment is pertinent to one’s most deeply seated hopes or fears” (Maruskin et al., 2012). Pertinent examples include freezing (not moving) to hide from mortal danger, and flirting (romantic love; cf. Sternberg, 1986). An ecological-evolutionary approach considers aspects of social and physical interactions between humans and environments that were stable for many generations, allowing for biologically based behaviour evolution. Infants and children play an important role due to their high mortality rate in ancient hunter-gatherer societies (Pexnington, 2001, Fig. 7.2). The autonomic fight-flight-freeze response is fundamental to animal survival. Human infants can only freeze (dissociate, observe, prepare). In many animals (primates, humans), healthy, adaptive responses to danger include freezing, vigilance (startle), and changes in breathing and circulation (Buss et al., 2004; Kalin et al., 1998; Rosen & Schulkin, 1998). Infants have always stayed near their mothers or carers (Ainsworth, 1979); their crying promotes parental caregiving (Zeifman, 2001). But when danger looms, silence (freezing) may be safer than crying (cf. maternal silencing; Falk, 2004). Panksepp's theory of separation anxiety is context-dependent. When an infant and/or its mother is attacked (rape, infanticide; Hausfater, 1984), or when an animal stalks or arches its back, an infant might recognize typical sound and movement patterns, and freeze. Physiological correlates “experienced” by the infant include chills. Later in life, music with similar sound and movement patterns might evoke similar autonomic responses including pupil dilation (Gingras et al., 2015; Laeng et al, 2016). This theory can account for the sound patterns and emotions that typically precede and accompany chills (Sattmann, 2016). Those patterns include sudden or surprising change, crescendo, voice entry, melodic peak, expansion of pitch range, uncertainty or ambiguity, monotony (repetitiveness), and slow tempo. Associated emotions include awe, wonder, and power - what an infant might perceive in the presence of its mother or carer, or a dangerous man or animal. The musical “lump in the throat” may combine stress-induced autonomic glottal expansion and stifled crying. In summary, infant survival depends on the ability and motivation to attend to, admire, and imitate the carer, and to recognize and fear dangerous situations. Reproduction and partner selection may also play a role (Darwin). Thus, chills and strong emotions
accompany fear, awe, and romantic love, both in real life and in music, religious rituals, and Hollywood movies. **Implications:** If musical emotion is based on unconscious infant subjective “experience” (Dissanayake, 2000; Parn cott, 2009), empirical studies of infant behaviour, combined with assumptions about ancient hunter-gatherer societies, can contribute to understanding musical experience. Empirical studies of musical chills are also relevant for developmental psychology.

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**AUDIO-VISUAL STIMULATION**

Blandijn - Auditorium B, 11:30-12:30

**11:30-12:00**

The sound motion controller: A distributed system for interactive music performance

Enrico Cupellini*1, Jeremy R. Cooperstock*2, Marta Olivetti Belardinelli#3

*Centre for Interdisciplinary Research in Music, Media and Technology, McGill University, Canada, #Interuniversity Centre for Research on Cognitive Processing in Natural and Artificial Systems (ECONA), Sapienza University, Italy

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**Keywords:** Music interaction, expressive music content, collaborative music, adaptive algorithms

**Background:** There is a large body of research in computer music that discusses the performer's need for direct contact with the physical sound production mechanism. This contact is necessary both for control of the digital instrument and to support intimate artistic expression. In response, many interaction designers have developed interactive systems, some with motion sensors and effectors as key features of their design. In this sensor-based paradigm, movement must be processed and mapped to sound. The literature describes the need for parallel mappings, employing different physical traits, to create both symbolic contents and expressive intentions. While some authors suggest that micro-level movements should be mapped to expressive qualities, and larger gestures to sound event creation, there is no consensus to this question. Likewise, there is considerable debate over the choice of algorithms for real-time beat extraction and adaptation to the dynamic changes of the music, as needed to produce coherent sound expressions. Furthermore, especially when traditional instruments are combined with sensor-based interfaces, one must consider the constraints on social behaviours, and how these may impact the musical expression. **Aims:** With these challenges in mind, we describe our design of a music interface that supports the mapping of musical intentions of one or more users, as conveyed by their motion, to sound control parameters. Our approach differs from that of related systems, in that it allows natural and flexible interaction among musicians, addresses different use cases, and functions with commodity devices. We imagine a framework in which performers play their instruments and the music can be influenced at some level by the response of the equipment. The interface should enhance performance, being sensitive to the musician's expressive intentions. Furthermore, since performance is often a group activity, we aim to support collaborative interaction and shared musical expressions between musicians. This objective requires multiple connections to handle interpersonal expressions and interactions. **Method:** In order to build our first prototype, we conducted a number of tests on a series of use cases in which the musical instrument played, the sensors employed, and their arrangement on the user were varied. The music parameters manipulated are chosen by the musician. They are treated by an algorithm based on beat error histogram classes to handle the musician's expression of timing, and a clustering algorithm which detects levels of dynamic variations. Through these algorithms we tried to outline ranges of significant actions and therefore to facilitate an awareness of physiologic structures. **Results:** The resulting distributed interface, running as an iOS mobile application, receives motion data from the mobile device itself or
from a number of external devices, connected via Bluetooth. To extend the target area, we integrated the use of commercial wearables to the system. Moreover, we developed an effector unit, acting as a control output to the music equipment by sending analogue modulations and digital messages. The effector employs a microcontroller equipped with a Bluetooth antenna to receive data, it is connected via Bluetooth to the mobile device and electrically to the music equipment. The software, called "Sound Motion", is able to process timing and dynamic expressive movements. It can be used with our effector unit, or connected via Bluetooth to a computer and send MIDI messages to other devices. Sound Motion is available as a free download from the App Store. It has been used in several music performances and it received positive feedback, both from musicians and musical instruments manufacturers. **Conclusions:** This work presents the initial design of a system for musical expression that promotes collaborative music creation. Our interaction design evolved toward the realization of a distributed interface, to be used in different conditions according to the number of units involved, music equipment, sensors and different music instruments played. Some preliminary results of the use of the interface are presented. Our next tasks will focus on interplay and collaborative aspects of music performance, exploiting our interface within a multi-user scenario.

**12:00-12:30**

The influence of audio-visual information and motor simulation on synchronization with a prerecorded co-performer

Renee Timmers*1, Jennifer Macritchie#2, Siobhan Schabrun*3, Tribikram Thapa*4, Manuel Varlet*5, Peter Keller*6

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**Keywords:** Synchronization, TMS, motor simulation, audio-visual information, ensemble performance

**Background:** When musicians perform together in synchrony, visual as well as audio information can be used to support synchronization. Moreover, it has been shown that motor simulation of the actions of the co-performer may facilitate synchronization. This prompts the question of whether visual information should be conceptualized as "motor-information" or whether it forms a source of perceptual cueing through audio-visual integration mechanisms. **Aims:** This project aimed to distinguish between the influence of visual cuing and motor cuing on the ability of a performer to synchronize with a (virtual) co-performer. It examined this question by varying the visual information provided to participants and by stimulating brain areas related to motor simulation (premotor cortex) and to audio-visual integration (right intraparietal cortex). **Method:** 26 musically trained volunteers participated in the experiment, who differed in level of pianistic expertise (7 professional, 8 semiprofessional, 6 serious amateur pianists and 5 non-pianists). Before participating, participants received video instructions to practice four simple melodies to be played with the left hand. During the experiment, participants tapped along with pre-recorded performances varying in timing and dynamics of the four melodies under nine conditions: 3 TMS conditions x 3 Audio-Video (AV) conditions. Participants tapped on a single key of a Clavinova keyboard that was silenced. MIDI recordings were made of the participant's tapping. The TMS conditions consisted of double-pulse stimulation of the right premotor cortex, the right intraparietal cortex (located under P4 according to 10-20 EEG positioning), and sham stimulation (TMS coil tilted away from the head). TMS stimulation happened either once or twice within a performed melody at a specified location. The AV conditions consisted of audio only, audio & video, and audio & animation. The video recording was a close-up of the left hand of the pianist. The animation
showed the movement of the hand in an abstract manner (moving colored blob). **Results:** Data analysis focused on the timing and velocity of the note that followed TMS stimulation. Differences were measured in onset timing (TIMING), inter-onset-interval (IOI), duration (DUR), and velocity (VEL) between the presented performance and the participant's tapping. Data outliers were removed (mean ± 2.5 stdev). The standard deviations (stdev) of these differences within a condition were used as dependent measures. A mixed model ANOVA with multiple measures was run with stdev in TIMING, IOI, DUR and VEL as dependent variables, and TMS, AV, note duration (NDUR), and piano expertise (PE) as independent variables. Results showed a main effect of TMS on IOI and DUR – the stdev of the differences in these measures was lower after stimulation of the intraparietal cortex than in the other TMS conditions. The stdev was relatively large in the Premotor stimulation condition, but this difference was not statistically significant compared to the Sham condition. Main effects were found for the effect of NDUR on all measures, and of PE: stdev were smaller for shorter note durations than for longer, and stdevs were smaller for more experienced pianists. An interaction between NDUR and PE for IOI indicated that the difference in stdev between the two note durations was smaller for experienced pianists. An interaction between AV and NDUR for VEL showed that the stdev was lower in the audio & video condition than the audio condition for short notes, but not for longer notes. **Conclusions:** Stimulation of premotor cortex and right intraparietal cortex showed contrasting effects, where the latter improved performance, the former showed a trend towards decreasing performance. The improvement of performance when stimulating the right intraparietal cortex may be due to a lack of interference between audio-visual information. Depending on note duration, among others, visual information may disadvantage or improve synchronization (analyzes not reported here). These results suggest a differential role for action priming and visual cuing.

**ENSEMBLE PERFORMANCE 1**
Blandijn - Room 100.072, 11:30-12:30

**Rehearsal processes and stage of performance preparation in chamber ensembles**
Nicola Pennill¹, Renee Timmers²
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**Keywords:** Music ensemble performance, rehearsal, team adaptiveness

**Background:** Membership of chamber ensembles in the Western classical tradition is a popular form of music participation, involving both musical and social interaction. The process of preparing for performance through collaborative rehearsal provides a framework for ensemble members to refine cognitive processes and team coordination dynamics. Social and musical dynamics of rehearsal processes have been studied through observational and case study research, showing that while there are commonly-occurring elements, there is also wide variation in practices across ensembles. One aspect that might account for some of this variation is the rehearsal phase or stage. Research on well-functioning groups has shown that they can flexibly adapt to changing situations whilst maintaining a high level of coordination and performance. Such teams pass through episodic phases as they work towards goals, with periods of task engagement (action) and downtime (transition) (Marks, Mathieu & Zaccaro, 2001). **Aims:** As part of a wider survey investigating rehearsal strategies, we aimed to explore adaptation of rehearsal activities and group interaction with stage of performance preparation (i.e. early stages vs. close to performance). The elements considered included rehearsal activities and objectives, verbal and
nonverbal communication behaviour, and social relationships. **Method:** A survey study was undertaken of UK-based chamber musicians comprising professional, student and amateur players and singers, in ensembles of 2-15 members. It included questions on size, membership and purpose of the group, general rehearsal strategy, and stage of preparation. A list of commonly-reported rehearsal tasks (drawn from the literature and refined with feedback from musicians) was used to prompt detailed descriptions of the content and order of tasks performed in a recent rehearsal. Details of leadership, roles, conflict, amount and topics of rehearsal talk, and modes of nonverbal communication were also captured. For analysis, respondents were assigned to one of three groups; those with no immediate performance goal (Group 0, n=39), in early stages of preparation (Group 1, n=32), and where the rehearsal was just before a performance (Group 2, n=37). **Results:** Comparisons of rehearsal tasks showed consistent differences between the three groups of ensembles. Group 2 reported inclusion of more tasks related to work on expression, performance cues, blending, and isolation of several voices. Group 0 reported less use of score study, isolation of single voice or instrument, work on tuning, and reflection and planning tasks. Ways of ordering tasks and planning were also compared by stage. Whilst there were no differences in advance planning of task order, Group 0 reported more pre-rehearsal planning than other groups. No differences were found in the incidence of shared or single leadership in the three groups. No differences were found in total amount of talking, or amount of conflict or the severity thereof. However, reasons for conflict varied according to rehearsal stage; Group 2 reported more conflict arising from time constraints, or from disagreements about concert planning. Differences were also found in amount of social talk, in amount of talk on topics of interpretation and ensemble performance, and in importance of talk on matters of interpretation; Group 2 reported more negative facial expressions, and mutually-agreed gestures, whilst Group 0 reported more use of eye contact and spoken cues. **Conclusions:** Chamber ensembles are subject to a dynamic environment, with cycles of transition and action as performance goals are achieved and new ones identified. This study showed that stage of preparation is associated with differences in rehearsal processes across a mixed sample of chamber ensembles. Differences were found in rehearsal activities and objectives, and in communication style and interpersonal interactions, which changed as performance approached. The presence of episodic phases in the performance preparation process supports the characterization of music ensembles as adaptive teams, engaged in interactive processes which change with task demands. The results complement earlier work on the temporal dynamics of ensemble interactions over a cycle of performance preparation. Given that these results were obtained as part of a survey including a mixture of ensembles, they need further corroboration using longitudinal investigations of specific ensembles, which is indeed the next phase of our ongoing research.

**References**

**12:00-12:30**

**How do musicians manage melody transfers when rehearsing chamber music? A study of their gaze behaviour**
Sarah Vandemoortele,*, Kurt Feyaerts,† Mark Reybrouck,‡ Geert De Bièvre,§ Geert Brône,¶ Thomas De Baets,*

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Keywords: Ensemble performance, gaze behaviour, mobile eye-tracking, multimodal analysis

Background: Researchers studying non-verbal behaviour in musical ensemble playing often focus on body movement. Moreover, they can rely on Motion Capture Systems and corresponding automatic quantitative analysis methods (Volpe et al., 2016). The study of eye gaze as a communication channel would connect well with this research: eye gaze is important for both information pick-up and sending out signals (Kawase, 2014). Our recently concluded pilot study and current research are partly motivated by this claim, and are partly encouraged by the new technique of mobile eye-tracking that allows for a fine-grained measurement and analysis of musicians’ eye movements while allowing musicians to play in relatively natural conditions. As a pioneering study on musicians' gaze behaviour the current ongoing research project hopes to shed a new light on existing research interests such as musical coordination, synchronisation, and leader-followership roles in ensemble playing. Aims: During our pilot study we explored a method for analysing the non-verbal behaviour of musicians playing in duos via several modalities (eye gaze, bodily movement and sounding music). The ongoing research aims to adopt such multimodal analysis method in order to describe the interactional dynamics in trios. However, our initial focus lies on the relation between gaze behaviour and a type of interaction that is predefined by the musical score, namely 'melody transfers' (passing-on of a melody from one musician to another). This focus of analysis is motivated by one of the outcomes of our pilot study, where it was hypothesized that gaze behaviour might be in part related to melody transfers. In the present paper we hope to demonstrate the potential of a multimodal analysis by referring to the pilot study, and to share some preliminary results regarding the relation between musicians’ gaze behaviour and melody transfers. Method: The research method involves recording and analysing a multimodal dataset. This means that five duos (in the pilot study) and four trios (in the current study) were recorded by using mobile eye-trackers, external cameras (to maintain an overview on the musicians’ gestural behaviour), and an audio recorder. For the current study the musicians were asked to rehearse an excerpt from Milhaud’s Suite for violin, clarinet and piano during a single session according to a predetermined schedule that encompassed individual practice, rehearsal time, run-through, rehearsal time, run-through and run-through again. The musicians were selected on the basis of their musical abilities as judged by the chamber music coordinator at LUCA School of Arts. They hadn’t played the piece before and never played any chamber music together. The analysis will explore whether different types of melody transfers relate to different gaze strategies, and how these strategies differ across run-throughs and across trios. Results: Some preliminary results in answer to the current research question will be shared, as well as some results (mostly of a hypothetical nature) from the pilot study. Conclusions: This paper reflects on ongoing research, especially at a methodological level. However, we believe the preliminary results will open up already many questions regarding what constitutes successful musical interaction and the role of eye gaze therein.

References

AMUSIA
Blandijn - Room 110.079, 11:30-12:30
Long-term plasticity for pitch and melody discrimination in congenital amusia

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Keywords: Amusia, melody

**Background:** Congenital amusia is a developmental disorder in music perception, related in part to an underlying deficit in fine-grained pitch perception. Until recently, poor pitch and melody discrimination in amusics was believed to be a life-long condition that was impervious to training. However, we recently demonstrated robust learning for pure-tone pitch and melody discrimination in a group of 20 amusics and 20 matched controls (Whiteford & Oxenham, 2016). Participants trained on either pitch discrimination of a 500-Hz pure tone or a localization control task for bandpass white noise over 4 separate sessions. Surprisingly, over half of the amusics no longer met the standard diagnostic criterion for amusia post training, as measured via the Montreal Battery of Evaluation of Amusia (MBEA). **Aims:** The primary aim of this study was to examine whether the learning effects observed in amusics and controls post training is maintained long-term (one year later), or whether performance reverts to that observed before training. A secondary aim was to see if impairments in the discrimination of harmonicity, but not acoustic beats, previously found in a separate group of amusics (Cousineu et al., 2012) is also present in our group of subjects one year after training. **Method:** Thirty-one participants (13 amusics) from Whiteford and Oxenham (2016) have returned one year after initial training to complete the follow-up study. The follow-up tests were identical to the pre- and post-training tests from Whiteford and Oxenham (2016) and consisted of pitch discrimination at three frequencies (500, 2000, and 8000 Hz) and melody discrimination, assessed via the MBEA. A subset of 20 participants (8 amusics) completed harmonicity and acoustic beats discrimination, which was not previously assessed pre or post training. **Results:** Results demonstrate that average pitch discrimination thresholds are nearly identical between post training and one-year follow-up for both amusics and controls, with no significant main effects or interactions with time (p > .4 in all cases). Amusics, however, continue to exhibit significantly poorer pitch discrimination abilities than controls [F(1,29) = 13.7, p = .001, η² = .32], despite their improved performance. The same average trends were observed for melody discrimination, with no change between post training and one-year follow-up [F(1,29) = .19, p = .667, η² = .006], no interaction between time and group [F(1,29) = .304, p = .585, η² = .01], but poorer overall performance in the amusic group [F(1,29) = 42.9, p < .001, η² = .597]. Individual results of post-training vs. follow-up melody discrimination demonstrate between-subject differences, with some participants improving even more relative to post-training, while others have the same performance or decreased performance relative to post-training. The variability in post- vs. follow-up melody discrimination difference scores is larger in the amusics compared to the controls, perhaps indicating greater variability in long-term maintenance of melody discrimination in amusics. Nine of 13 participants who were amusic prior to training no longer met the diagnostic criterion for amusia one year after training. Perhaps because the majority of our amusics were no longer amusic, there was no significant difference in harmonicity discrimination between amusics and controls (amusics mean: 63.9% correct; control mean 68.8% correct; p = .2, one-tailed), whereas large differences were previously found in a separate group of subjects who did not undergo our training paradigm (Cousineu et al., 2012). **Conclusions:** On average, previous learning observed in pitch and melody discrimination was maintained one year after the completion of laboratory training in both amusics and controls. Contrary to previous findings, amusics are not only capable of learning pitch and melody related tasks, but this learning appears to be retained over a period of at least a year for the majority of subjects. [Supported by NIH grant R01 DC005216.]
References

12:00-12:30
Congenital amusia in dizygotic twins: A case study
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Keywords: Congenital amusia, twin study, spatial processing, pitch processing, hereditariness

Background: Congenital amusia is a little-known, neuro-developmental disorder that has a negative influence on pitch and rhythm perception (Foxton et al., 2004; Peretz et al., 2002; Stewart, 2008). People with congenital amusia (in the following called amusics) face lifelong impairments in the musical domain (Stewart, 2008). The disorder is neither caused by a hearing deficiency, nor brain damage or intellectual impairment (Ayotte et al., 2002). Recent studies (Hamann, et al., 2012; Liu et al., 2010; Patel et al., 2008) have also shown that amusics have deficits in the perception of linguistic pitch (intonation) as well and that the disorder can no longer be seen as domain-specific to music. In addition, Douglas & Bilkey (2007) reported deficits in spatial processing, which, however, failed to be replicated by Tillmann et al. (2010) and Williamson et al. (2011). The disorder is said to affect 4% of the general population (Kalmus & Fry 1980) and to have a hereditary component (Peretz et al. 2007), while its exact genetic underpinnings are still unknown. Aims: Here we report the first documented case of congenital amusia in dizygotic twins. The female twin pair was 27 years old at the time of testing. The twins have no history of psychiatric or hearing disorders. They grew up together in the same household with one younger sibling and attended primary as well as secondary school as well as their undergraduate program in linguistics together. They had formal music lesson from the age of 8 to 12 and were exposed to music in their childhood. One twin, NN, was diagnosed as amusic using the Montreal Battery of Evaluation of Amusia (MBEA) (Peretz et al. 2003) (pitch composite score: 20.5) and a detailed questionnaire (MBEA, while the other, JN, was diagnosed as non-amusic (pitch composite score: 27). NN has a pitch perception as well as a rhythm perception deficit, while JN has normal pitch and rhythm perception. While exposure to music has always been claimed to have no influence on the development of congenital amusia, this twin case study proves this for the first time. We conducted a large battery of tests to assess the behavioral differences of the twins that emerged despite the same environment. Method: We conducted a pure tone audiometry at 250 - 8000 Hz, the Hamburger Wechsler Adult Intelligence Scale including verbal intelligence and spatial rotation tasks. Besides the MBEA and a questionnaire about educational, musical and demographic background, we also conducted the Gold-MSI (Müllensiefen et al. 2014) to assess musical abilities. To assess auditory memory and processing abilities, we conducted a pitch detection and direction discrimination task (Williamson & Stewart 2010) and also a pitch memory task (Schaal et al 2015). To assess language perception, we conducted an intonation perception task (Hamann et al. 2012) and a vowel perception task. And lastly to assess spatial processing, we conducted a perspective taking/spatial orientation task (Hegarty & Waller 2004) and a cross section task (Cohen & Hegarty 2012). Results: Both twins had normal hearing and above average intellectual abilities, the latter also reflecting their higher than average education. Both twins had an identical pitch detection threshold of 0.135 semitones, while their pitch direction threshold differed significantly. Surprisingly, they also had an identical, low pitch memory span of 3.5 tones. While their
performance on the intonation and vowel task differed significantly with the amusic twin performing worse. The twins also performed significantly different on both visual tasks, with the non-amusic twin (83 % correct on both tasks) outperforming the amusic twin (58 and 20 % correct). **Conclusions:** The finding that both twins have a comparable pitch detection threshold, while their pitch direction threshold differs is in line with previous findings (Williamson & Stewart 2010). It is surprising however that both exhibit a comparably low (amusia) pitch memory span in comparison to normal controls (Schaal et al. 2015), which might be interpreted as a indication for a certain hereditariness of pitch memory, as has been proposed for pitch processing (Drayna et al. 2001). While the everyday communication of the amusic twin seems to be unimpaired, her intonation and vowel perception are impaired in comparison to her twin, as was to be expected based on previous studies (e.g., Liu et al. 2010; Hamann et al. 2012). Lastly and most surprisingly, the spatial processing abilities of the amusic twin were significantly impaired, replicating a finding by Douglas & Bilkey (2007), which failed to be replicated by Tillmann et al. (2010) and Williamson et al. (2011). This twin case study highlights that congenital amusia is not due to insufficient exposure to music in childhood. The exposure to music of the twin pair was as comparable as it can be for two individuals. Yet, one twin has amusia, while the other does not but both seem to have poor pitch memory. This study also shows that the question of a spatial processing deficit in amusia needs to be revisited and more research is needed in that area.

**GESTURE & EMBODIMENT 1**

Blandijn - Auditorium A, 14:00-15:30

**14:00-14:30**

**Mapping physical effort to gesture and sound during interactions with imaginary objects in Hindustani vocal music**

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**Keywords:** Hindustani, singing, effort, interaction, embodiment, gesture-sound links, imaginary objects, motor imagery

**Background:** Physical effort has often been regarded as a key factor of expressivity in music performance; nevertheless systematic explorations of this have been rare. In North Indian classical (Hindustani) vocal music singers often engage with melodic ideas during improvisation by manipulating intangible, imaginary objects and materials with their hands, such as through stretching, pulling, and pushing. **Aims:** The engagement with imaginary objects suggests that some patterns of change in the acoustic features relate to basic sensorimotor activities, which are defined by the effortful interactions that these objects may afford through their physical properties. The present work seeks to identify relationships and describe mappings between the voice, the interaction possibilities of malleable (elasticity) vs. rigid (weight/friction) objects and the physical effort they require, as perceived by an observer. Manual interactions with imaginary objects offer a unique opportunity to study gesture-sound links in an ecologically valid setting of a real performance; on the one hand the lack of a real mediator leaves the performer free to move in relation to the voice and on the other hand the engagement with an (imagined) interaction makes it easier to identify the underlying action-based metaphors that we wouldn’t else be able to see directly. **Method:** The work uses a mixed methodological approach, combining qualitative and quantitative methods using original recordings of interviews, audio-visual material and 3D-movement data of
vocal improvisations for two different Dhrupad vocalists of the same music lineage. First, action-based metaphors were identified through a thematic analysis on the interview material. We then relied on third-person observations in order to develop a coding scheme and annotate the audio-visual material in terms of visually identified recurrent gesture classes (interactions with elastic versus rigid objects) and perceived effort levels, and visually detect systematic associations between gesture classes and characteristics of the melody. Finally, in the quantitative part of the study, we developed formalized descriptions of gesture-sound mappings by fitting linear models on measured movement and audio features for (a) estimating bodily effort levels and (b) classifying gestures. Results: 1) Effort-voice: Different idiosyncratic schemes of associating the perceived physical effort with the voice were identified among the 2 vocalists through linear regression ($R^2_{\text{adj}}=0.6$ and $0.44$ respectively). These are based on the pitch space organisation of the raga (melodic mode), the mechanical strain of voice production, the macro-structure of the alap improvisation (progressively rising mean pitch and maximum pitch reached through the ascending part of a melodic movement) and cross-modal analogy (asymmetry between intensification (ascent) vs. abatement (descent)). Nevertheless, a more generic cross-performer estimation of effort was achieved ($R^2_{\text{adj}}=0.53$ and $0.42$ respectively) by the combined use of acoustic and movement features: minimum and maximum pitch of melodic movement, mean and standard deviation of the hands’ absolute velocity (and mean of hand distance for 2nd singer). 2) Gesture classification: Similarly, different modes of gesture class association to sound were identified through logistic regression (AUC=0.95 and 0.8 respectively), based on regions of particular interest in the raga pitch space and analogous cross-domain contours. A more generic cross-performer gesture classification was achieved (AUC=0.86 and 0.78 respectively) by the combined use of acoustic and movement features: mean and standard deviation of pitch, mean of absolute velocity (and mean of hand distance for 2nd singer). Conclusions: Overall, we rejected the null-hypothesis that gesture and effort are unrelated to the melody and found statistically significant movement and sound features that (a) best fit each individual performer and (b) describe the phenomena in the most generic way across performers. Findings indicate that despite the flexibility in the way a dhrupad vocalist might use his hands while singing, the high degree of association between classes of virtual interactions and their exerted effort levels with melody provides good evidence for non-arbitrariness; this may reflect the dual nature of mapping in being associated with both the mental organization of the melodic context and the mechanical strain of vocalisation. By taking an embodied approach and mapping effort to a combination of features from both domains (auditory and movement), this work can contribute to the enhancement of mapping strategies in empty-handed artificial interactions on the grounds of physical plausibility and effort in sound control; novel interaction paradigms can be developed which are inspired by our interaction with the real world.

14:30-15:00

**Impulse-driven sound-motion objects**

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**Keywords:** Sound-motion objects, motor control, intermittency

**Background:** Our own and other research seems to suggest that perception and cognition of musical sound is closely linked with images of sound-producing body motion, and that chunks of sound are perceived as linked with chunks of sound-producing body motion, leading us to the concept of *sound-motion objects* in music (Godøy et al., 2016). One challenge in our research is trying to understand how such sound-motion objects actually emerge in music. Taking into account findings in motor control research as well as in our own research, we hypothesize that there is a so-called *intermittent motor control* scheme (Sakaguchi et al., 2015) at work in sound-
producing body motion, meaning a discontinuous, point-by-point control scheme, resulting in a series of holistically conceived chunks of sound-producing motion, in turn resulting in the perception of music as concatenations of coherent sound-motion objects. **Aims:** The main aim here is to present a comprehensive theory of how such sound-motion objects are *impulse driven*, i.e. are produced by (and later also perceived as the result of) intermittent control impulses, and that so-called *continuous control* (also called *closed loop control*) is not feasible because it will not be fast enough for many cases of sound-producing body motion. A corollary of this is that also effort in sound-producing motion probably is unequally distributed, as we may typically see in cases of so-called *ballistic motion* (hitting, stroking) as well as in the initial phases of more continuous motion (bowing, sliding). Our aim also entails documenting how sound-producing body motion is constraint-based (i.e. that there are limits to speed, that there is a need for anticipation, for pre-programming, that there are emergent fusions by so-called *phase-transition* and *coarticulation*, etc.), and that all these constraints converge in impulse-driven sound-motion objects, something that in turn contributes to chunking and other perceptually salient features of musical sound. **Method:** Our approach to studying impulse-driven sound-motion objects is fourfold: (i) Motion capture data of sound-producing body motion, and in addition to the motion trajectories of the involved effectors, their derivatives such as velocity, acceleration, and jerk, as well as their amplitude, frequency, and quantity of motion, and data on the mentioned phenomena of phase-transition and coarticulation. (ii) Extensive studies of motor control literature, in particular concerning more recent theories of intermittent motor control and the associated constraints of attention, of reaction times, of the so-called *psychological refractory period*, and of anticipatory cognition, as well as the organization of skilled motion by *key-postures* at the intermittent impulse points in time. (iii) Feature analysis of sound, in particular of perceptually salient dynamic, pitch-related, and timbral envelopes, and various rhythmic, articulatory, and expressive shapes. (ix) Systematic studies of sound-motion correlations based on our collected data, mapping out similarities between perceived shapes of sound and of motion features. A common task in all these areas is a close scrutiny of the timescales involved, i.e. differentiating what features are found at the very small timescale of a few milliseconds, what are found at the typical sound-motion object timescale in the approximately 0.5 to 2 seconds duration range, and of what are found at still larger timescales. Additionally, we are working on a general model of how such impulse-driven sound-motion objects may be simulated and applied (in reverse) to existing sound-motion data. **Results:** Our motion capture data seems to suggest that there is an uneven distribution of effort in musical performance, based on what can be seen in the acceleration shapes, assuming there are links between acceleration and effort. Also, our motion capture data seems to clearly document the mentioned phenomena of coarticulation and of phase-transition, hence of subsumptions of smaller motion units to larger-scale units as a function of duration and event density. From other studies on ballistic motion we have reports of unequal distributions of effort, including a "pre-motion silent period" of little or no effort that immediately precedes ballistic motion. Additionally, several studies document motor control constraints such as the psychological refractory period and the need for anticipatory control (feedforward control) and the difficulties with any continuous feedback, or closed loop, control scheme. **Conclusions:** Needless to say, we have a long way to go in developing our understanding of sound-producing body motion and the associated issues of motor control and sound perception. However, there seems to be converging evidence that various human biomechanical and motor control constraints contribute to the emergence of impulse-driven sound-motion objects in music, and that these constraints also shape our perceptual schemas in music. Such body motion based schemas of chunking could be seen as generic and as potentially applicable to musical features across different genres and styles.

**References**

15:00-15:30

**Expression and interaction in real-time listening: A dynamical and experiential approach to musical meaning**

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**Keywords:** Sense-making, interaction, experience, ecology, systems theory, cybernetics

**Background:** Music has been studied traditionally in logocentric terms, using a propositional and disembodied approach to musical sense-making. This holds a discrete-symbolic stance on musical sense-making that proceeds outside of the time of unfolding. Recently there has been a paradigm shift in musicology that argues for a dynamic and experiential approach to musical meaning, taking account also of the richness of full perception. This entails a transition from a structural approach of music to a process-like description of the music as it unfolds through time. Music, in this view, is not merely an artefact, but a vibrational phenomenon that impinges upon the body and the mind. **Aims:** The aim of this contribution is to provide an operational approach to the concept of interaction and its relation to expression in a real-time listening situation. Starting from the cybernetic concepts of control system and adaptive device, it brings together insights from ecology and systems theory in defining music users as open systems that interact with their environment. These interactions can take place either at a physical or epistemic level, but it is argued that both levels can conflate to some extent with expressivity being located at the interface of physical and epistemic interactions. The former are continuous in their unfolding, the latter are discrete to the extent that they reduce the continuous unfolding to successive assignments in a time-series. It is a major aim to bypass this dichotomy by defining expressive interaction as a combination of the continuous and discrete approach. **Method and results:** The main contribution is the introduction of a descriptive and explanatory framework for musical sense-making with a major focus on the analog-continuous decoding of the sounds and the circularity between perception and action. It argues for new methodological tools to assess the process of sense-making in a real-time listening situation and aims at providing theoretical grounding that is rooted in the adaptive-evolutionary approach to musical sense-making. Elaborating on the distinction between a bottom-up and top-down approach to auditory processing, it explores the background of phylogenetic and ontogenetic claims, with a focus on the innate auditory capabilities of the fetus and neonate and the gradual evolution from mere sensory perception of sound to sense-making and musical meaning. Crucial in this development is the role of affective speech and emotive vocalizations, which can be considered as the playground for the development of expressivity at all levels of dealing with music. Theoretical background and empirical findings are collected to support these claims with a special focus on early communicative musicality and the enactive approach to musical emotions, which challenges to some extent the assumptions about the nature of emotional experience which remain committed to appraisal, representations, and a rule-based or information-processing model of cognition. To do this we develop a range of cross-disciplinary support, most notably drawing on developmental perspectives and related research in affective science and dynamic systems theory by emphasizing the self-organizing aspects of meaning-making, often described as an ongoing process of dynamic interactivity between an organism and its environment. **Conclusion:** Rather than locating expressivity at the performance level of dealing with music, it is stated that expressivity can be studied also at the perceptual level of fine-grained listening. It is an approach, which stresses experience over mere recognition, and which favors the
processing of non-propositional contents over symbolic knowledge. As such, much is to be expected from the domain of affective semantics as opposed to the lexico-semantic approach to musical meaning.

References

ENSEMBLE PERFORMANCE 2
Blandijn - Auditorium B, 14:00-15:30

**14:00-14:30**

**Situated aspects of joint music performance in a longitudinal field study**
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**Keywords:** Situated cognition, musical experience, joint music performance

**Background:** In the last decades several approaches have become increasingly popular that question the traditional cognitivist stance that cognition is solely based on processes located in the head. Consequently, cognition has been conceptualized as **embodied**, as **embedded** in a relevant environment, as **extended** beyond the borders of the body, and even as **enacted** on the basis of a relational process comprising brain, body, and environment. It has also been suggested that cognitive processes may be **distributed** among several agents. In order to investigate how these various ‘situated’ approaches may be discriminated and appropriately applied to music, I proposed a systematic framework for the exploration of situated aspects of musical practice and musical experience (Seibert, forthcoming). Providing four dimensions (**topic**, **location**, **relation**, **perspective**) for the differentiation of situated approaches, this framework is also applicable as a research tool for the investigation of situated aspects in complex musical practices. Indeed, more recently, research on joint music performance has adopted a situated perspective and challenged traditional cognitivist approaches (e.g., Schiavio & Høffding, 2015). Hereby, the importance of pre-reflective, dynamic, and enacted processes as opposed to higher-order processes involving mental representations has been emphasized. **Aims:** Using my framework I aimed at investigating situated aspects in joint music performance. Assuming that accounts referring to lower order, pre-reflective,
dynamic processes ('situated') or to higher order, representation-involving processes ('cognitivist') are not oppositional, but rather build the extremities of a continuum, I addressed three aspects: (1) performance fluency: it is hypothesized that flow-like experiences during an ensemble performance are rather 'situated', whereas precarious experiences are rather 'cognitivist'; (2) ensemble cohesion: it is hypothesized that in the course of the development of a common performance practice, individual experiences of joint performances are rather 'cognitivist' at the initial phase and rather 'situated' at the end of one year of shared musical practice within an ensemble; (3) musical identity: it is hypothesized that individual experiential and verbal access to situated aspects of musical practice are dependent on personality traits, musical biographies, and musical self-conception.

Method: A newly composed contemporary music ensemble comprising eight musicians is continuously investigated for one year. During this period, three similar programmed concerts were performed by the ensemble (the third concert will take place in 9/2017). Rehearsals and concerts were observed via ethnographical methods. The musicians filled out a questionnaire addressing individual experience during performance after every rehearsal and concert-performance. In addition, focused and phenomenological interviews were conducted focusing the individual musical experience during previous performances.

Results: Data collection runs from 10/2016 to 9/2017. In the course of the analysis of the qualitative data, qualitative content analysis will be complemented by phenomenological analysis in order to get access to pre-reflective levels of musical experience. This analysis is contextualized with ethnographic data and supplemented by individual descriptive time series of quantitative data from the questionnaires. Preliminary results will be presented to exemplify the usability of this approach. Conclusions: The application of the systematic framework in the course of the investigation of situated aspects in joint music performance offers a possibility to examine situated approaches to music cognition and musical experience in vivo. The results of this study will complement and substantiate the theoretical debate mainly rooted in philosophy. Discussing my approach, this paper describes a process of mutual enrichment between abstract theoretical considerations and the observation of concrete musical practice.

References

14:30-15:00
Call and response: Musical and bodily interactions in jam sessions
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Keywords: Emotional expression, free jazz improvisation, nonverbal interaction, duo performance, bodily motion

Background: Jazz musicians often encounter situations in which they interact with other musicians for the first time. These sessions offer insights into the multimodal communicative processes between musicians for reaching a coherent performance in terms of synchronization, expressiveness and further musical parameters (Wöllner & Keller, 2017). "First encounters" in performances make it necessary to negotiate a common musical goal by means of nonverbal bodily and musical gestures (cf. Ginsborg, Prior, & Gaunt, 2013). This is especially the case for genres such as Free Jazz improvisation, in which only a limited set of musical rules and corresponding mental representations exist. Studying patterns of call and response (CGR) in Jazz improvisations allows analyzing which parameters of a “performance call” a further musician picks up and transforms musically into a response. Aims:
The goal of this study is to investigate the expressive processes of Free Jazz improvisations in several duos by means of motion capture, musical and acoustical analyses. We assume that even in first encounters, Jazz musicians pick up crucial expressive information in the “call musician's” communicative intentions and transform these ideas, showing some similarities in musical expressions and bodily behavior. **Method:** A total of twelve male Jazz musicians took part in this study. They were invited as duos of an e-guitar and a saxophone under the condition that they had not performed together in the same musical ensemble prior to the study. After a warm-up session, one of the musicians (guitar or sax, balanced across duos) was asked to improvise according to one emotional expression (happy, sad, neutral) for approximately 20 seconds. The second musician responded to this expressive improvisation without knowing which emotional intention the first musician had in mind, followed by the other emotions. Subsequently, call and response roles of musicians were exchanged. While musicians improvised or listened to their duo partner, they were both recorded with a 12-camera optical motion capture system. Participants also filled in the Affective Communication Test (Friedman et al., 1980). **Results:** The motional and musical quality of the performers' expressive interactions in both roles was analyzed for 15-second excerpts. Responders frequently picked up musical motives from the call musician's play. In addition, the mean intensity was significantly correlated across C&R for both happy and sad emotions. Analyses of the head markers across all duos show positive correlations in the cumulative distance travelled, indicating that the overall magnitude of the call musician's head movements was mirrored in the responder. While cumulative distance did not differ between happy and sad emotions, variance in velocity profiles was higher in happy emotion conditions. In some duos, the responder synchronized (e.g., by foot) with the call musician's performance. There were differences in the success to encode and decipher the expressive intentions. Retrospective verbal decoding of the call musicians' emotional intentions was correct in 76.5% of all C&R situations. Those musicians who clearly communicated their emotional intentions showed a tendency for higher scores in affective communication. **Conclusions:** These results and in-depth analyses of differences between duos may elucidate some key parameters in expressive interactions, which shape a musical genre that depends to a high extent on interpersonal communication.

**References**


15:00-15:30

**Measuring visual aspects of interpersonal interactions in jazz duos: A comparison of computational vs. manual annotation methods**

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**Keywords:** Interpersonal entrainment, interaction, music ensemble coordination, movement, improvisation
Background: Music performance is a highly relevant case for studying expressive interpersonal interactions. Much progress has been made in the study of the types and purposes of gestures used for communication between performers, the measurement of leader/follower relationships, etc. However, large-scale cross-cultural evidence on interpersonal interactions in music is still sparse. One feature of ethnomusicological research that has imposed constraints on developments in this area is that state-of-the-art technologies (e.g., motion capture, EEG) are often not available or feasible to field researchers. As such, it is important to develop methods for studying interpersonal interaction that can be applied to audio and video recordings collected in field research, which can provide highly ecological and rich data sources yet pose various challenges in terms of control of the data collection parameters. Aims: Our study aimed to evaluate the efficacy of computational techniques for measuring interpersonal interaction in music performances in comparison to manual annotations of interaction from expert raters. We extracted movement trajectories from duo performances using an automated computer vision technique known as optical flow and quantified the degree of performer interaction using wavelet analysis. The output of these models was then compared to expert annotations of interaction.

Method: The study made use of an existing set of 30 videos of jazz duos with diverse instrumentation; 15 videos featured performances of a jazz standard (‘Autumn Leaves’) and 15 videos featured free jazz improvisations. Manual annotation of interactions between performers was completed in ELAN by three independent raters. Raters watched all videos with the audio muted, as the task was to code ostensible bouts of interaction between performers without being influenced by audio cues. Raters followed a procedure to familiarise themselves with each duo’s typical movement qualities before coding ‘bouts of interaction’. Bouts of interaction were defined as gaze patterns and body movements that indicated—to the coder—an intention to facilitate co-performer communication. Optical flow data for each performer were obtained using EyesWeb XMI 5.7.0.0. The extracted coordinates for both performers in each duo were subjected to wavelet-based analysis ranging from 0.25 to 2.0 seconds. The cross-wavelet power spectrum of the wavelet reconstructed time series was used as a measure of interaction.

Results: Manual annotations were largely similar across the three raters (72.3% overlap, Fleiss’s Kappa \( z = 18.7, p < .0001 \)). To obtain a maximal amount of agreed bouts of interaction, the annotations were aggregated at the level of two raters. In a logistic regression analysis with cross-validation, these agreed bouts of interaction were correctly classified in 70.3% of cases using the cross-wavelet power of both performers’ movements as a predictor. However, the results indicate that the computational techniques identified considerably more bouts than the manual coders.

Conclusions: Our results suggest that computational measures of musical interaction from video data show a high degree of correspondence to manual annotations. However, a number of factors should be borne in mind in interpreting these results. As the wavelet analysis primarily picks up on shared periodic movement, certain coded interactions (e.g., mutual eye contact) were not reliably recognized by the computational methods. Conversely, various shared periodic movements identified by the automated analysis were not revealed in the manual annotations. All such bouts, then, cannot necessarily be taken to indicate intentional or purposeful communication between performers as the current method stands. However, the results indicate that large-scale comparative video corpus studies may be possible using largely unsupervised computational techniques, but should be supplemented with manual coding by experts. Our future work aims to continue the combined use of automated video analysis techniques, manual annotations, and ethnographic reports to explore interactions across a variety of musical styles, including Indian, African, and Afrogenic music.

CHILDREN
Blandijn - Room 100.072, 14:00-15:30
Children play with music: Results from a consonance and dissonance perception study
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Keywords: Consonance and dissonance perception, infants and children, musical toy, embodiment

Background: Recent literature on auditory-motor integration in music (Zatorre, Chen, & Penhune, 2007) and on the role of the human motor system in music perception (Leman & Maes, 2014) encourage the development of novel behavioural protocols based on auditory stimuli that are intrinsically related to participants' motor activity. Here we present a new method based on participants' free interaction with a musical toy that emitted consonant/dissonant intervals according to its rotating degree (Di Stefano et al., in press).

Aims: Main objectives of the study are: i) to promote new behavioural methods based on the role of children' motor activity and embodiment in music perception; ii) to address a less investigated age range in consonance and dissonance studies with children; iii) to investigate children' sound discrimination through a simple motor action.

Method: The study involved 22 participants aged between 19 and 40 months (30±6 months, mean±SD; F=13, M=9). The musical toy produces harmonic intervals, according to its orientation (+/- 90° rotations in terms of the resting position, i.e. vertical, 0°). Children can rotate the handle around the hinge at its base. Rotations exceeding the [-40°/+40°] interval produce dissonant and consonant sounds, respectively. Between -40° and +40°, the device is silent. The consonant intervals were A3-E4, C4-G4, C4-C5, E4-E5; the dissonant intervals were Bb3-E4, F4-B4, A#3-B4, E4-F5. During the procedure children freely interacted with the toy for 7 minutes, producing sounds as they like. The experimental session was divided into three phases: two sounding phases (1 and 3) and a mute phase (2).

Results: A one-way ANOVA showed that the manipulation time significantly varied across the phases (F[2,63]=9.58, p=.001), and that in Phase 2 was significantly lower than that in Phase 1 (p=.005) and Phase 3 (p=.004), while no significant differences were observed in the manipulation time between the sounding phases 1 and 3 (p=1). Thus indicated that sound actually stimulated the children's use of the toy. Then, we investigated the effect of sound on the use of the toy across the three phases using repeated measures ANOVA, with phase (3 levels) and type of sound (consonant, dissonant, 2 levels) as the within-subjects factors and consonant and dissonant stimuli durations as the dependent variables. We found a significant effect of phase (F[2,20]=9.39, p=.001) and a significant interaction between phase and type of sound (F[2,20]=8.26, p=.002). No significant effect of sound was found when it was separated from phase (F[1,21]=.55, p=.47). Conclusions: Results show that participants preferred to emit consonant stimuli rather than dissonant ones, and are therefore consistent with the preference for consonance that has been largely reported in the literature on infants and children. While previous literature has primarily focused on newborns, infants, and children older than 4 years of age, the present procedure was tested with toddlers ranging in age from 19 to 40 months, thus addressing a gap in literature on sound perception and children.

References

25th Anniversary Conference of the European Society for the Cognitive Sciences of Music, 31 July-4 August 2017, Ghent, Belgium


**14:30-15:00**

**Musical mode, intelligence, and emotional-visual-spatial dimensions: A comparison between children and adults**

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**Keywords:** Musical mode, cross-modal association, intelligence, spatial perception, colors

**Background:** Previous literature widely showed that adults are able to associate major musical mode with happiness, and minor mode with sadness (Parncutt, 2014). This association has also been tested in adults at the implicit and pre-attentive level in priming, speeded classification, and ERP studies (Costa, 2012; Marks, 2004). Children evolve this ability quite late in their development, such as at 5-6 years old. Cross-modal associations between the auditory and the visual-spatial domain have extensively been studied in the past decades, through both behavioral and neuroscientific paradigms, with a strong emphasis on pitch. (Marks, Hammeal, & Bornstein, 1987). As regard to intelligence previous literature showed a positive connection between the preference for the minor musical mode and the level of fluid intelligence (Bonetti & Costa, 2016).

**Aims:** We aimed to study the difference between children and adults in cross-modal associations between major and minor musical stimuli and visual-spatial features (arrows pointing up-down, light-dark grey rectangles, warm-cold colors, happy-sad faces). A pleasantness preference evaluation for each major or minor stimulus was also included. Moreover, we investigated the relation between fluid intelligence and the ability of making cross-modal associations, in both children and adults.

**Method:** We conducted two studies: the first involved a sample of 51 children ranging in age from 4 to 6 years, while the second focused on a sample of 168 university students. Both children and university students were not musical experts. Firstly, we asked participants to make cross-modal associations between musical stimuli presented either in major or minor mode and visuo-spatial stimuli. Secondly, we assessed the level of participants' fluid intelligence.

**Results:** The association major-happy face and minor-sad face evolved from a proportion of .58 at the age of four, to .61 at the age of five, .72 at the age of six, and .92 in adults. The major-up, minor-down associations had a proportion of .62 in both five and six-year-olds, and evolved to .84 in adults. The major-light, minor-dark associations evolved from .59 at the age of five, to .72 in six-year-olds and .92 in adults. The ability to associate major and minor stimuli with happy and sad faces was strongly related to the intelligence level in children from the age of five, particularly to the *WISC Block Design* score ($r = .64$).

**Conclusions:** Our results represent an additional confirmation that the human mind integrates information coming from different sensorial channels to build a general and coherent meaning of the surrounding environment. The strong positive correlation between fluid intelligence and the ability of making the associations ‘major-happy face’ and ‘minor-sad face’ found in children from the age of five suggests that this ability is strongly influenced by the cognitive maturation level.

**References**


**15:00-15:30**

**The pro-social impacts of embodied rhythmic movement in joint music interactions**

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**Keywords:** Musical interaction, children, cooperation, sharing, synchrony, emotional valence, rhythm

**Background:** Music is a powerful medium for social interaction that can create strong bonds between individuals and in particular, may enhance the development of social skills in children. Engagement in musical interaction is a highly embodied experience of joint rhythmic movement. Participants enjoying music together perform repetitive rhythmic movements either synchronously or asynchronously, depending on the type of music and the individual roles that they play. Synchronous rhythmic movement emphasizes coordination and similarity, whereas asynchronous movement highlights individual differences and how they synergistically assemble into a whole. How does rhythmic movement influence children’s social interaction and what are the differences in impact between synchrony and asynchrony? These are fundamental questions that will help understand the interplay between music and the foundations of social behaviour. **Aims:** In a series of studies, we aimed to examine how children perceive joint rhythmic movement, how it affects their social interaction and what are the differences between synchronous and asynchronous rhythmic movement. **Method:** In order to engage children in rhythmic movement we employed either guided tapping or passive swinging on a specially designed apparatus. The tapping addressed certain aspects of performance, whereas the swinging consisted of perception alone in a completely music-free context. Following these treatments we used a variety of tests to measure the impact of the rhythmic interaction on emotional valence, social attitudes, cooperation and sharing behaviour. **Results:** Children without a musical background associated synchronous tapping with positive emotions and asynchronous tapping with negative emotions. Strikingly, musically trained children showed the opposite preference, possibly due to the increased interest evoked by asynchrony. In a separate study, children who tapped in synchrony with each other perceived their partner as more similar and closer than children tapping asynchronously. Children swinging synchronously performed better in joint cooperative tasks than children swinging asynchronously. However, both forms of swinging, synchronous and asynchronous enhanced sharing behavior compared to no treatment. **Conclusions:** These results demonstrate that rhythmic movement, which is foundational for music, has a strong effect on children at various stages of development and can influence their emotions, their perception of each other and their social interactions. Together, these studies reveal that in addition to synchrony, which has repeatedly been shown to positively affect various aspects of social interaction, asynchrony may also contribute to certain forms of social bonding.
EXPRESSIVE PERFORMANCE
Blandijn - Room 110.079, 14:00-15:30

14:00-14:30
Exploring pianists' concepts of piano timbre in expressive music performance
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Keywords: Piano timbre, embodiment, cross-modality, expressive performance

Background: The notion of timbre as a basis of discriminating sounds having the same pitch and loudness is widely used. Psychoacoustic studies on timbre investigate the relationship between differences in acoustic parameters of tones such as spectral energy distribution and timbre perceptions (Rasch & Plomp, 1982). Recent interest has turned towards the investigation of the perception and production of different timbres on a single instrument such as the clarinet (Barthet, Depalle, Kronland-Martinet, & Ystad, 2010) and guitar (Traube, 2004). With respect to the production of piano timbre, few acousticians have demonstrated a measurable impact of touching techniques (struck or pressed, key-pressing depth) on audio characteristics (Goebl, Bresin, & Fujinaga, 2014). Nevertheless, piano timbre is a concept used by performers, possibly relating to the combined effect of several expressive parameters (i.e. the overall sound produced by all musical attributes). Studies of piano timbre verbalization have been conducted to identify the semantic structure of timbre descriptors, indicating dependencies on familiarity, frequency of occurrence, and semantic proximity (Bernays & Traube, 2011). Additionally, precise piano actions (e.g., acceleration of key/hammer, attach depth/duration, and dynamic levels) have been examined in the production of particular timbral intentions or touching qualities, with the aid of sensors embedded within computer-controlled pianos (Goebl et al., 2014). These studies have focused on associating timbral intentions with piano action, emphasizing a disembodied notion of timbre production. In our view, to better understand how pianists employ and produce piano timbre, a more holistic approach is needed that considers pianists' embodied concepts of timbre. Aims: This research aims to: (1) explore pianists concepts' of piano timbre in their expressive performance; (2) identify the role of the body, emotion and different sense modalities such as touch in these timbre conceptualizations. Method: Nine advanced pianists are interviewed and asked to give a performance demonstration. In the semi-structured interview, pianists are asked about their understanding of piano timbre – what it means to them and how they employ the term, and the ways in which they produce different timbres on the piano. In the performance demonstration, pianists are asked to play an excerpt from a self-selected piece of music and to explain their employment and production of piano timbre(s). Results: Thematic coding is used to interpret pianists' responses. The analysis focuses on characterising emerging themes related to pianists' ways of understanding timbre and the methods and conceptualisations they use to produce timbral intentions. The results identified several factors that influenced pianists' subjective experience of piano timbre: (1) various qualities of touch applied to the keyboard (attack speed/depth, finger percussiveness,
and finger shapes); (2) the involvement of other bodily parts, including the body scope, weight, relaxation/tension, and direction; (3) and the simultaneous perception from other musical attributes (pitch, dynamics, articulation etc.). The results also showed that pianists relate the piano timbre concepts closely with the musical interpretation and are affected by the composer's intention; pianists regard timbre as a desired outcome of performed tones and relate it closely to their expressive intentions including emotional communication with listeners. **Conclusions:** Despite limitations in the control over piano timbre, sound quality is highly relevant to pianistic performance. Pianists' descriptions indicate the multimodality of their timbre concepts and the role of embodied representations of timbre production.

**References**

**14:30-15:00**

**What score markings can say of the synergy between expressive timing and loudness**

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**Keywords:** Performance modeling, tempo, loudness, idiosyncrasy

**Background:** Performance gestures are often realized along different expressive dimensions (e.g., a change in the dynamics might be emphasized by a change of tempo) and they may also be affected by constraints imposed by a score. Elucidating how such interactions and score dependencies can be better modeled is a key element to further understanding the characterization of both individual and shared performance approaches. **Aims:** We examine possible interactions between tempo, loudness and specific score markings over a set of performances. We hypothesize that tempo and loudness can be better predicted at score markings when including contextual information from two bars before the score markings and when combining them as complementary expressive features, instead of when considering them as isolated. In particular, we examine how tempo may contribute to the prediction of loudness at dynamic score markings (e.g., *pp, f*), and how loudness may contribute to the prediction of tempo at tempo score markings (e.g., *lento, moderato*). **Method:** We conduct two experiments. In our first experiment (E1) we model collective approaches to the use of tempo and loudness. In our second experiment (E2) we model individual approaches. In both experiments our goal is predicting tempo or loudness for a specific piece based on how a group of performers (E1), or each individual performer (E2), played the rest of pieces in the corpus. We use a dataset of recordings of 26 different Chopin Mazurkas played by 11 pianists containing tempo, loudness and score markings annotations (Kosta et al., 2016). We collect a total of 317 dynamic markings and 109 tempo markings. Following Kosta et al. (2016), the score features proposed are: - Marking at which either
loudness or tempo is predicted, - Previous marking, - Next Marking, - Possible additional marking, - Distance in beats to previous marking, - Distance in beats to next marking. In addition to the score based features, we propose the following performance features corresponding to two bars previous to each marking: - Normalized Inter Beat Intervals (IBI), measured in seconds, - Normalized Inter Beat Loudness (IBL), measured in sones. We train our models to predict the mean of the IBIs and IBLs of the bar at which tempo or dynamic markings are annotated. We experiment with Multi-Layer Perceptron, Random Forests and K-Nearest Neighbors and tune their hyper-parameters with exhaustive grid-search after applying the jack-knifing technique. We consider the following versions of the feature set: #S (only score based features), #L (#S + previous two bars IBL), #T (#S + previous two bars IBI), #A (#S + previous two bars IBI + IBL). We evaluate these models by measuring the mean squared error between the predicted values and the true values. Finally, we choose the best performing models and calculate significance using the Wilcoxon test. Results: E1 shows significant improvements at tempo markings (p=0.015) when adding tempo features (#T) to score features (#S) but no improvements between #A and #T features models (p=0.771). In the case of dynamic markings, we observe improvements (p=0.017) when adding loudness features (#L) to score features (#S) and marginal improvements when adding tempo (#A) to loudness (#L) features (p=0.049). E2, at tempo markings, shows no improvements between #T and #S predictions and, in most models, no improvements when combining tempo and loudness features (#A). At dynamic markings, we observe that #L improves the predictions of #S (p=0.004) but no improvements when combining loudness and tempo features (#A). Our results also show that the predictions obtained on E1 are better than the predictions on E2. Conclusions: Our results indicate that loudness is, in most cases, better predicted when including performance features preceding dynamic markings and that individual tempo predictions at tempo markings are sensitive to IBIs variance across performances. We found no evidence for an interaction between tempo and loudness at dynamic or tempo markings. These appear not to be dependent on shared or individual stylistic approaches. These results could be confirmed by studying alternative features and methods as well as by examining larger datasets. Future work will address such potential interactions by studying them across entire performances using sequential data models.

References

15:00-15:30
Expressive performance and interaction with the music as agent: Dynamic contours of the self-sensed experience

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Keywords: Performance, music agency, human-music interaction, moving sonic forms

Background: According to the classic theory of music performance, musicians communicate the meaning of a musical score employing a multiplicity of body actions through musical technique, as to exerting technical control over the notational information of the musical piece. However, expression in performance is for sure more than that. Music ‘moves’ us due to its intrinsic dynamic qualities, and in so doing, it prompts in our experience the unfolding of a vital resonance. Therefore, music might be thought as a moving sonic form (Leman, 2008) to which it can be attributed intrinsic agency; in so doing, music prompts the interpreter to interact -by means of his
perception-action cycle— with its ongoing dynamics. When music performance unfolds in time, the action-oriented ontology that the performer displays appears as a non-linguistic description. It contains sonic and morphological cues that might inform about an emergent vitality of the performer-music interaction. The emergent meaning of the dynamic profile of the sonic form generated in such interactional context can be captured by linguistic descriptors that account for the evolving arousal activated during the experience of the sonic form (Stern, 2010). In this paper we use those linguistic descriptors to prime in the musician’s experience the communication of the self-sensed expressive meaning of a musical piece. **Aims:** To identify dynamic and temporal cues in the action-oriented ontology of the performer that account for the self-sensed expressive meaning as an emergent feature of the ongoing sound-kinetic interaction with the moving sonic form of music.  

**Method:** Participants: A professional pianist (32 years old; 23 years of piano performance). Stimulus: Prelude Op. 28, 7 by F. Chopin. Apparatus: HD video camera 60fps; a Roland electric piano; Kinovea software; MatLab platform with MOCAP Toolbox (Toiviainen & Burger, 2013). Design and Procedure: the pianist was required (i) to perform his own expressive version of the prelude; and (ii) to produce five further expressive renditions of the same piece, that were primed using five linguistic descriptors of vitality forms: floating, precipitate, hesitant, explosive, and gentle (Stern, 2010). It was assumed that the self-sensed emergent vitality should exhibit sound-kinetic cues activated by the linguistic descriptors. Performance was registered in audiovisual format with a video camera placed in front of the pianist’s body. Sound data were MIDI recorded. Data processing: (i) the sound signal (total duration, tempo, expressive timing, dynamics and articulation), and (ii) the kinetic information (trajectory of movement of the right hand in two dimensions (x and y) plus time, instant velocity, and quantity of motion of the whole body) were analysed. Results: An ANOVA Repeated Measures found significant differences between the six rendered versions, for factors Timing (F=8,703; p<0,001), and Dynamics (F=105,6; p<0,001) (sound), and Instant Velocity (F=355,145; p<0,001) (right hand movement). Results show, for example, that (i) the timing pattern changes according to the conveyed vitality: last notes of motives are played rall. in hesitant; and accel. in precipitate; and (ii) dynamics between explosive and floating appears as opposite (floating mean=0,21; explosive mean=0,60). (iii) instant velocity between explosive and hesitant also appears as opposite (hesitant mean=1,54; explosive mean=5,9). As to movement analysis, the emergent gesture of the horizontal-vertical morphology shows in each rendition a dynamic trajectory that conveys an idea of continuity of hand motion that goes beyond the effector movements needed for sound production. Results inform of an action-oriented ontology based on ongoing human-music interaction. Conclusions: The performer rearranges consistently the dynamic micro-organization of time, sound, and movement, in order to communicate his sensed vitality. The morpho-kinetic-sonic descriptions of such vital profiles constitute ‘3rd person readings’ of the interactional dynamics that the musician elaborates throughout performance. Given that vitality is a shared human experiential basic dimension, vitality forms allow both performers and listeners to understand each other when experiencing the joint activation of such energetic vital profiles that are, together with other embodied forms, at the foundation of the empathic communication between performers and audiences. Thus, sound-kinetic expressive forms become non-linguistics descriptions of the action-oriented ontology of the performer (Leman, 2008), highlighting the ways musicians elaborate the interaction between music as agent and the self-sensed expressive experience.

POSTER SESSION 1
Blandijn - Floor +1, 15:30-16:30
Is music absorption a distinct state of mind? A taxometric investigation
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Keywords: Taxometrics, latent structure, classification, continuity

Background: Of the variety of psychological states that music can evoke, perhaps one of the most highly prized is the notion of *absorption*: moments of being ‘carried away’ by the musical sounds, association, or reverie. It can be defined as “an intense focal concentration and cognitive involvement in one (or more) aspect(s) of conscious awareness, resulting in the exclusion of other content from the phenomenal field and, often, the context in which it is experienced (for example, the loss of self-awareness and self-reflection)” (Butler, 2004). Based on a subjectively perceived shift away from everyday life experience, absorbed listening is sometimes being described as a qualitatively different state of mind and conceptualized as a *specific class* of music experiences. Although being fundamental to any psychological construct, its latent structure is rarely discussed and has never been directly tested, though. Aims: Correspondingly, a basic question that has yet to be resolved is whether the phenomenon of music absorption refers to a distinct state of mind, or not. In other words: Is being absorbed by music a ‘matter of degree’ or a ‘matter of kind’? Clarifying this has important implications for measurement as well as for theoretical views on how absorption is different from other, non-absorptive states of mind induced by music (i.e., etiology). Method: To answer this question, the current study conducts a taxometric analysis on a heterogeneous, admixed sample of music listening experiences (N=845) collected in two identical online studies. One study (n₁=223) was based on self-selected, highly involving music with a previously demonstrated high degree of absorption cases (i.e., taxon members); the other study (n₂=622) was based on a list of generally well-known musical pieces preselected by the researcher (i.e., providing complement members). Taxometric analysis enables to determine whether the latent construct of state absorption is better understood as being categorical or continuous (Ruscio, Haslam and Ruscio, 2006). It tests whether two groups explain the observed correlation among a set of indicators (H₁) against the hypothesis that one (or more) continuous underlying dimension(s) explain all of the observed correlation among the indicators (H₀). Absorption was measured using 13 items based on Pekala’s (1991) Phenomenology of Consciousness Inventory. Results: First, a principal-axis factor analysis on the state scale yielded clear evidence of a 3-factor structure underlying state absorption. This led to a set of 3 composite construct indicators: ‘attentional focus’, ‘altered awareness’, and ‘visual imagery’. These indicators demonstrated good distributional and validity characteristics needed for taxometric analyses. Second, visual inspection of output graphs and comparison curve fit indices (CCFI) of three, non-redundant taxometric techniques (MAMBAC – *Mean Above Minus Below A sliding Cut*, L-MODE – *Latent mode*, and MAXEIG – *Maximum eigenvalue*) were used to determine the latent structure of the data. All graphs indicated a continuous structure. The CCFI results similarly suggested that being absorbed in music, at least in these data, is continuous in nature. CCFI values below 0.40 indicate a continuous structure, and CCFI values at or above 0.60 indicate a categorical structure. CCFIs were: MAMBAC = 0.27, MAXEIG = 0.31, and LMode = 0.27. Conclusions: Instead of being a qualitatively distinct state of mind—a view that is occasionally being expressed in the literature — the results are consistent with absorption being a gradual, quantitative phenomenon. Feeling absorbed by music thus is a matter of imprecise estimation rather than being marked by a clear observable onset. The present results highlight the necessity for cautioning against subtyping absorption experiences as being qualitatively distinct. Also, it is likely to arise from multiple causal influences rather than a single present/absent factor that determines ‘category membership’. Future research should include behavioral/physiological data in order to account for the mono-method bias which is inherent to self-report measurement.
Poster 2

Product placements in popular music
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Keywords: Advertising, content analysis, music industry, framing, lyrics

Background: “Pass the Courvoisier” sings Busta Rhymes while Fergie promotes the fashion label Candie’s. These are only two examples for product placements in popular songs, interpreted by famous singers. It seems like there are many reasons for musicians to place names of brands and products in their songs: Placements are an additional source of income, part of endorsement deals or should lead to a certain image transfer. The representation and effects of product placements in popular songs are not well researched so far. But we know a lot about the effectiveness of product placements in general (e.g., Karrh, 1998) and little about the effects of placements in songs (Delattre & Colovic, 2009; Ferguson, & Burkhalter, 2014). Still, we do not know how many placements there are in popular songs. Songs that reach millions of people every day through radio, music streaming and personal music collections. We do not know how musicians incorporate and frame placements. But these are central aspects that could influence the reception and the effects of the product placements. Aims: Therefore, we wanted to know how many product placements are present in popular songs and how they are incorporated and framed in the songs. More precisely, we were going to investigate how many songs in the German single charts featured product placements in the course of the last 25 years and if the placements were framed in a positive, neutral or negative way. Additionally, we wanted to examine, if product placements were more present in prominent parts (i.e. chorus) of the songs and which types of products were actually placed in the lyrics.

Method: For this purpose, we conducted a quantitative content analysis. All songs from the German Top 20 Year End Charts from the years 1990 until 2014 were analyzed line per line. Every commercial product or brand name that was mentioned was considered a product placement, disregarding whether we could tell if it was paid or not (most of the time we could not), and therefore coded. A standardized code book was compiled and pre-tested to secure an inter-subjective reliable measurement for this study. Formal categories that were coded were for example: publishing year, language, sex of the singer and part of the song (title, chorus, verse, and interlude). The type of product that was mentioned was coded and categorized (12 types total, e.g., fashion, electronics, food, Holstí’s R = .89) and the valence of the placement framing was rated (Holstí’s R = .85). Over all the 480 analyzed songs resulted in 29,030 coding units. 74.8% of the songs were in English, 14.6% in German and 6.2% in other languages. 51.2% of the songs were performed by a male, 28.2% by a female singer and the rest had groups of female and male singers or could not be identified.

Results: Overall 178 product placements were found overall. No obvious increase or decrease was identified over the years. There were no placements in the Top 20 of the years 1994 and 1995, a maximum of 31 placements in 1999 and an average amount of 7.12 mentioned products per year. Most of the coded products were framed in a neutral way (78%), while 16.9% were positively and 5.1% negatively framed. Most of the placements were found in verses (57.9%), while only 24.2% were coded in choruses and 15.2% in interludes. Interestingly, also 5 song titles (2.8%) featured a placement. The product type that was coded the most was alcoholic drinks (20.2%), followed by media (18%) and vehicles (17%). Least coded were
Conclusions: Due to the sinking sales and struggles of the music industry, one could expect that musicians would welcome income opportunities like endorsement deals and therefore would incorporate more product placements in their songs in recent years. But we cannot find an increase in the Top 20s, which should be representative for successful popular music, over the 25 years we examined. Most of the product placements are neutrally framed and incorporated in verses. This indicates that products are more likely to be coincidentally than strategically placed by musicians, labels or publishers. Maybe the singers have a certain affiliation to the brand and felt like mentioning it as a part of personal story rather than cooperating with a company. Like many content analyses point out: alcohol is a predominant topic in popular music, which is sometimes considered as problematic. This becomes especially true when pop stars are endorsed by alcohol brands and therefore incorporate the respective products in their lyrics. We cannot say what the intended effects are that musicians, music industry or companies would like to achieve, but we can tell that product placements are neither as prominent in pop songs as assumed, nor are they framed in a positive way too often.

References

Effect of melodic representation on the Speech-to-Song (STS) illusion
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Keywords: Speech-to-Song illusion, repetition, melodic representation, robustness

Background and Aim: Hearing the difference between song and speech is usually considered an easy task. When listening to the same sentence over and over again however, speech can sometimes appear to be song instead (Speech-to-Song illusion, STS, Deutsch et al., 2011). Interestingly, listeners undergoing this phenomenon usually report that they cannot 'unhear' the singing, even though they are aware that it is a speech segment. Looking into such robustness of the STS illusion is a promising way to gain insights into how mental representation interacts with our perception of speech and song. In this study, we aim at demonstrating the effect of melodic representation on the strength of the STS illusion. Method: 15 speech fragments, spoken in English, French, German, Spanish and Dutch, were used as base stimuli (mean duration 1843 ms). A pilot study confirmed that these samples did not transform from speech to song after being repeatedly presented 7 times. For all base stimuli, the F0 contours within each syllable were morphed towards a flat F0 contour of a diatonic scale closest to the average F0 of each syllable with smoothing. This manipulation made each syllable sound as auto-tuned to the closest musical pitch. We created four variations of each stimulus, namely 0% (base, non-transforming), 30%, 60% and 90%, where 100% refers to the stimuli with F0 syllable pitch contours completely flattened and matched with the closest musical pitch. 42 subjects (18 male, 24 female) aged between 17 and 49 were asked to classify stimuli as speech or song after listening to them once, as well as after 7 repetitions with 170 ms ISI. Base and manipulated stimuli were presented consecutively in three orders: 1) Increasing F0 manipulation (0, 30, 60, 90%), 2) Decreasing F0 manipulation (90, 60, 30, 0%) and 3) Random manipulation order. This allowed us to study the
effect of repetition, F0 manipulation, exposure and melodic representation on perceived song-like rating. **Results:** The perceived song-like rating was significantly greater for all repeated conditions than for corresponding single listening conditions. This confirms the classic finding that repetition facilitates the STS transformation effect. In proportion to previous studies, we found that when a stimulus includes syllables with a stable pitch contour close to musical frequencies resembling a Western diatonic scale, it is more likely to be perceived as a song: perceived song-like rating of base stimuli in Increasing condition was significantly lower than that of 90% stimuli in Decreasing condition. Also the results of Random condition indicated that the degree of our manipulation strongly correlated with the perceived song-like rating as stronger effects were observed for stimuli with greater manipulations. In fact, the perceived song-like ratings of 90% stimuli were all quite high and did not differ among three conditions, indicating that the exposure to the stimulus does not play a role here. A presentation order with decreasing manipulation degrees resulted in participants continuously giving higher overall song-like ratings than the other two conditions. In particular, it is interesting to note that the perceived song-like rating of the 60% stimuli in Decreasing condition was significantly higher than that in Increasing condition. Here, the degree of exposure to a melodic rendition was stronger in Decreasing than Increasing condition, while exposure to a particular stimulus was greater for Increasing than Decreasing condition. The result thus indicates that having heard a more melody-like version of the same stimuli greatly facilitates the STS illusion, much more so than having heard more examples of less melody-like version of the same stimuli. **Conclusions:** Our results showed that exposure to repetitive presentation of a melodic rendition of speech materials enhanced the perceived song-like rating of speech segments, even for the base stimuli with unmodified pitch information. This may relate to the common observations that it is hard to unhear the singing once the STS illusion had occurred. Future research should look into the mechanisms underlying this effect.

**References**

**Poster 4**
**Does the fluency of artists and songs’ names matter? The effect of linguistic fluency on evaluations of music**
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**Keywords:** Processing fluency, linguistic fluency, song titles, musical judgments and preferences

**Background:** Processing fluency refers to the subjective experience of ease with which people process information. Research shows that processing fluency consistently influences people’s judgements in a wide range of social dimensions (Alter & Oppenheimer, 2009). For instance, studies manipulating linguistic fluency reveal that easy to process stimuli (e.g., statements or words) are believed to be more frequent, true, familiar and likeable than similar but less-fluent stimuli. However, to date, no one has attempted to study the effect of linguistic fluency on evaluative and judgement processes involving music. **Aims:** The aim of the present research was to investigate whether the linguistic fluency of artists and songs’ names influences preferences and judgements for music. **Method:** 48 monolingual English speakers were told that the purpose of the study was to investigate how people evaluate music from amateur Turkish artists. Participants listened to and evaluated songs presented with different names. To avoid confounding variables such as meaning and familiarity, we used Turkish
names that were shown in a previous study to be fluent or non-fluent (Shah & Oppenheimer, 2007). While in the fluent condition songs and artists’ names were easy to pronounce (e.g., *Dermod* by Artan), in the non-fluent condition names were difficult to pronounce (e.g., *Taahhut* by Aklale). **Results:** A linear mixed-effects model revealed a significant main effect of linguistic fluency. The same songs were rated more positively when presented with fluent names that when presented with disfluent names. Interestingly, when participants were asked whether they thought that they were affected by the artists and songs’ names presented with the music, on a scale from 1 (not at all) to 5 (always), the mean score was 1.29 (SD = .72). **Conclusions:** This study shows that the linguistic fluency of artists and songs’ names has an impact on subsequent judgements of music. Linguistic fluency is one of several mechanisms within the bias of perceptual fluency and has been widely shown to influence human judgements and decision-making in many areas (Reber, Schwarz, & Winkielman, 2004). This finding indicates that like many other human judgements, evaluations of music can rely on cognitive biases and heuristics that do not depend on the stimuli themselves, which is in line with models of decision-making and the research framework developed by Tversky and Kahneman (2011).

**References**


**Poster 5**

The special case of music-induced visual imagery and its correlates with musical skills: Findings from an online survey

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**Keywords:** Visual imagery, music listening, emotion, Gold-MSI, VVIQ

**Background:** Visual imagery—the experience of seeing images before one's mind's eye—is often associated with music listening and has been proposed as one important mechanism of how music induces emotions in the listener (Juslin & Västfjäll, 2008). Although evidence suggests that people identify visual imagery as an emotion-eliciting factor when listening to music (Juslin, Liljeström, Västfjäll, Barradas, & Silva, 2008), the literature on this topic is scant. **Aims:** Therefore, our initial aim was to investigate the prevalence and nature of visual imagery during music listening. **Method:** To that end, we conducted an online survey, consisting of standardized measures such as the Vividness of Visual Imagery Questionnaire (VVIQ) and the self-report inventory of the Goldsmiths Musical Sophistication Index (Gold-MSI) as well as 24 new items on music-related visual imagery (MVI) and items concerned with active and passive engagement with various forms of art. There were also demographic items such as gender and education and open-ended questions to describe visual imagery during music listening and its associated emotional experience in detail. **Results:** Of 339 respondents of a convenience sample, 146 (82 females, M = 36.62 years, SD = 15.13, range 18–79 years) completed the survey and were used for statistical analysis. Results of a factor analysis of the 24 MVI items revealed that they load onto the three factors ‘Realistic Imagery’,
'Abstract Imagery' and 'Absorbing Imagery', together explaining 62% of the variance. 'Realistic Imagery' showed significant differences between individuals with high and low VVIQ scores and a negative correlation with age. 'Abstract Imagery' was negatively correlated with education. Correlation analyses showed that the Emotions subscale of the Gold-MSI correlates with VVIQ (r = .282), but only two out of 24 MVI items correlate with the VVIQ measure. **Conclusions:** Our findings provide evidence that visual imagery in response to music correlates with one's vividness of visual imagery in general, and is mediated by several inter-individual differences. Implications for music-induced emotions will be discussed.

**References**

**Poster 6**

**Modeling timbre similarity of short music clips**

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**Keywords:** Short audio clips, music similarity, timbre, audio features, genre

**Background:** There is evidence from a number of studies that most listeners are able to extract information related to song identity, emotion, or genre from music excerpts with durations in the range of tenths of seconds (e.g., Krumhansl, 2010; Mace, Wagoner, Hodges, & Teachout, 2011; Schellenberg, Iverson, & McKinnon, 1999). Because of the very short length of these excerpts, timbre as a multifaceted auditory attribute appears as a very plausible candidate for the type of features that listeners make use of when processing short music excerpts. However, it yet remains unclear exactly which timbral features serve as the basis for performing listening tasks involving short excerpts. **Aims:** Hence, the goal of this study was to explore to what degree similarity judgements of short music clips can be modelled robustly with low-level acoustic features related to timbre. **Method:** We utilized the similarity data from two large samples of participants: Sample I was obtained via an online survey, used 16 clips of 400 ms length, and contained responses of 137,339 participants. The sample is identical to the one reported in Müllensiefen, Gingras, Musil & Stewart (2014, Study 4), but its sound similarity data has not been previously examined. Sample II was collected in a lab environment, used 16 clips of 800 ms length, and contained responses from 648 participants. Our model departed from the basic structure of a timbre dissimilarity model presented by Siedenburg, Jones-Mollerup, & McAdams (2016). Here, we used two sets of audio features, which included commonly used timbre descriptors from the Timbre Toolbox (Peeters, Giordano, Susini, Misdariis, & McAdams 2011) and the well-known Mel-frequency cepstral coefficients (MFCCs) as well as their temporal derivatives. In order to predict pairwise similarities, the resulting distances between clips in terms of their audio features were used as predictor variables with partial least-squares regression. Sparse models were obtained by selecting the predictors identified as significant via a bootstrapping procedure. **Results:** We observed that the best performance was achieved by the union of the two feature sets with coefficients of determination ranging around R²=0.3 and 0.4 for Samples I and II, respectively. However, models failed to generalize towards the respective other set. Sparse variable selection reduced the number of predictor variables by around a factor of five. This yielded models that provided much better predictions in the respective other sample at the cost of a
reduced fit on the training data. The best performing sparse model achieves an R2 of up to 0.34 when evaluated on the dataset it was trained on and an R2 of up to 0.23 when evaluated on a new dataset. Finally, the inclusion of a binary predictor that encoded whether two clips shared the same genre (jazz, rock, pop, hip-hop) or not improved the model fits by 15-20 percentage points, explaining up to 50% of shared variance (R2) between observations and model predictions. The most predictive descriptors turned out to be related to the coarse spectral shape of the audio signals (MFCC #1, Centroid, Kurtosis) and of the variability of spectral structure (Spectral decrease inter-quartile range, ΔMFCC #12).

Conclusions: The results of this study provide empirical evidence that both acoustic features of the signal related to timbre as well as higher-level categorical features such as musical genre play a major role in the perception of short music clips. Whereas this study represents the first attempt to build rigorous models describing the perception of short audio excerpts based on audio feature extraction and has achieved an encouraging model performance level, future research needs to assess the robustness of this modelling approach using clips of the same length and overall larger sets of audio clips.

References

Poster 7

Expert pianists' stylistic assessment of musical notation from brief glances

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Keywords: Music reading, silent reading, musicianship, musical style

Background: Research in music reading has emphasized sight reading performance, while silent sight reading has received much less attention. Musical expertise may be reflected in both visual processes and the conceptual integration of the extracted information (Penttinen et al., 2013), but there is a lack of research that shows how musical information is extracted from brief exposures to notated scores. Extracting technical and stylistic information with quick glances is crucial for the planning and coordination of *prima vista* performance and for the effective use music notation as a source of information, e.g., in browsing music libraries. Aims: The aim of this study was to find out whether a brief exposure to notated musical excerpts would allow competent musicians to make reliable stylistic assessments concerning the music. Supposing this to be the case, we also wanted to inquire into the thought processes involved in such quick decisions by investigating whether correct stylistic judgments are made faster or through different inferential processes than incorrect judgments. Method: The participants of the study were 25 pianists professionally educated in the common practice classical tradition, with
a mean age of 29.6 years (SD = 8.8). The visual stimuli used in the experiment were score extracts selected from the keyboard works of J. S. Bach, Beethoven, and Chopin—representing the stylistic categories of baroque, classical, and romantic music. From each composer, we selected 3 extracts from Urtext publications by Henle Verlag, each of them covering 3 consecutive staff systems. Each pianist participated in an individual session with an experimenter, seated at an electric piano and a computer screen that functioned as a music stand. Using a PowerPoint presentation, each score extract was shown on the screen in the exact size of the physical score, preceded by a white rectangle marking the location and size of the upcoming stimulus; by clicking the mouse the participant would trigger the appearance of the stimuli, each of them appearing for 500 ms. Upon seeing the stimulus, the participant was asked to “describe in your own words everything that you had time to perceive in the notated example,” and to assess the stylistic period that the example represented. The keyboard could be used at any time. The spoken responses and use of the keyboard were transcribed from video recordings, and coded for right/wrong recognitions of: stylistic period, composer, and specific composition. In addition, five categories of content (pitch organization, temporal organization, musical texture, compositional type, aesthetic experience) were used to code any other statements or keyboard demonstrations. Results: Overall, the 500 ms stimuli were well recognized in terms of musical style. Supposing that recognition of composition and/or composer implies recognition of style period, correct attributions of style period (e.g., “baroque”) were found to occur significantly more often in the appropriate set of score extracts (e.g., pieces by Bach) than in the whole set of responses. Khi²-tests showed this to be the case for each of the three stylistic categories (all ps < .001). Correct attributions of style period (when there were no misattributions) were given 26.5 s after the beginning of the stimulus, on average (SD = 31.1). When there was no correct attribution, the first incorrect attributions of style period were given in 59.6 s (SD = 49.4). The difference is significant (t(165) = 5.233, p < .001), suggesting that correct responses might be given more intuitively. An analysis of the spoken contents further revealed differences between sequences of codes leading up to correct and incorrect attributions. In particular, correct recognition of style period was more often preceded by statements concerning musical texture. Conclusions: The research suggests that expert musicians can reliably assess the stylistic character of a notated score based on a half-second glance. It also suggests that successful visual assessment of musical style may be preceded by different inferential processes.

References

Poster 8
Re-performing everyday life through music
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Keywords: Performance, mobile music listening, interviews, shadowing

Background: Performance can be understood in many different ways. The immediate association is with something that happens on a stage, but there are other definitions of performance, too. Goffman (1956) sees performance as conveying an impression, as self-presentation. But performance is also performance to self and as such it can involve self-regulation and self-management. When taking into account the chronology of a performance, the preparation, actual performance and outcome of it, performance can be understood as having a history and can be analysed as a Musical Event (DeNora, 2003). Mobile music listening has been looked at from a
variety of perspectives, but performance has not often been one of them. **Aims:** This poster will demonstrate how all of these different interpretations of performance can be found in participant’s own descriptions of their mobile music listening experiences. Music gives support in everyday life, thereby re-performing it. **Method:** In interviews 11 mobile music listeners were given the opportunity to explain their behaviours and choices. Later on they were shadowed (DeNora, 2000), i.e. observed while displaying this behaviour in their natural environment, to validate what they had said before and to check for anything that was not mentioned earlier. Immediately after the shadowing there was another interview to enable the participant to explain what happened during the shadowing. **Results:** A person wearing headphones automatically conveys an impression to other people that needs to be adjusted occasionally in order to achieve a required, socially acceptable effect, e.g., not shutting others out when in their presence. On the other hand it can also be used to avoid being overtly rude by indicating prior engagement. It will be shown through the example of one participant how the scheme of The Musical Event facilitates deeper understanding of the mobile music listener and his behaviour. He prepares his devices and the music on it meticulously, has reasons for listening to particular pieces of music, and knows exactly how to fulfill his needs through mobile music listening. This is so successful that it leads him to display this behaviour repeatedly. Performance as self-regulation has been the topic of studies before. Here it will be demonstrated that some participants are very aware of the emotional effects music has on them, and that others utilise music in specific ways during exercising. **Conclusions:** Mobile music listening can be used to re-perform everyday life in several different ways, using multiple definitions of the word “performance”. It is a complex behaviour that reveals new perspectives depending on the angle from which it is observed.

**References**

### Poster 9

**Psychological predictors of engagement in music piracy**

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**Keywords:** Music piracy, music engagement, everyday listening, uses and gratifications

**Background:** Designed to appease the desire to listen to music freely and conveniently, music-streaming services such as Spotify are exceptionally popular nowadays. Yet, music piracy remains prevalent. Assuming a psychological perspective, the present study considers why people might choose to engage in music piracy (the practice of illegally sourcing music) when so many popular and varied legal services now exist. **Aims:** The present study considered the relationship between music piracy and broader musical engagement practices. In particular it addressed two research questions: (RQ1) beyond demographics, can psychological concepts (i.e., personality and identity) as well as music engagement (i.e., listening engagement and format use) explain piracy attitudes; and (RQ2) are the uses and gratifications associated with one’s preferred format related to piracy attitudes? **Method:** Three hundred and ninety six USA, UK, and Australian residents (38.60% USA, 26.50% UK, 34.80% Australia) completed an online questionnaire. Ages ranged from 16-71 years (M = 34.53, Mdn = 20, SD = 8.98); 71.00% of the sample was female, 28.00% was male, and 1.00% of participants identified as ‘custom’.
Participants completed Brown and MacDonald’s (2014) Attitudes Towards Music Piracy (AMP-12) scale, Langford’s (2003) short five-item personality questionnaire, Brown and Krause’s (2016) 49 Format Uses and Gratifications Item measure, and Krause and North’s (2016) music-technology identity measure. Additionally, participants indicated the format they used most often to listen to music (of six formats: physical (i.e., CD, vinyl, cassette), digital files (i.e., mp3), free digital streaming, paid-for digital streaming, radio, and live music); indicated how important they consider music in their lives; and estimated how many hours they listen to music daily. Individuals also reported their age, gender, whether they held a University qualification, and their country of residence. 

**Results:** RQ1: The Generalized Linear Mixed Method analysis that considered whether psychological constructs and music engagement variables accounted for music piracy attitudes was statistically significant, $F(15, 366) = 4.391, p < .001, \eta^2_p = .050$. In particular, conscientiousness was negatively associated with the AMP score, such that those individuals favouring music piracy were easy-going and disorderly. Post-hoc pairwise comparisons revealed that males demonstrated more favorable piracy attitudes than females ($\beta = 0.234 [0.069, 0.399], t(366) = 2.785, p = .006, \eta^2_p = .021$). Moreover, individuals using digital files and paid-for streaming services were significantly more likely to endorse positive piracy attitudes than those using physical formats; and users of free streaming services were significantly more likely to endorse more favorable piracy attitudes than users of physical formats, digital files, and the radio. RQ2: The generalized linear mixed method analysis that considered how the eight format uses and gratification dimensions related to piracy attitudes was statistically significant, $F(8, 283) = 5.715, p < .001, \eta^2_p = .079$. In particular, the value for money dimension was positively associated with more favorable piracy attitudes, while the connection uses and gratification dimension (characterized by emotionally connecting with music) was negatively associated with favorable piracy attitudes.

**Conclusions:** The associations between positive piracy attitudes and being male and expressing low levels of conscientiousness replicate findings reported elsewhere (Brown & MacDonald, 2014). The preference for accessing music digitally was also associated with engagement in music piracy, suggesting that even the seemingly-infinite catalogues of on-demand music are not enough to deter music piracy. Furthermore, with regard to uses and gratifications, results suggest that music piracy is driven by a perception that buying music is poor value for money, rather than a reluctance to pay altogether. From a policy perspective, future research could seek to establish what it is that drives perceptions of value for money in relation to music consumption practices.

**References**

**Poster 10**

»I don’t like that!« Disliked music and its rationales

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**Keywords:** Musical taste, disliked music, self-concept
Background: In Western cultures, musical taste – i.e. a particular attitude towards music (Farnsworth, 1969) – is an important aspect of one's self-concept. As an affective and expressive medium, music not only serves to satisfy emotional and social needs, rather, it can be used to create and affirm one's own identity. Until now, research mainly focuses on explaining and understanding preferred music and its respective functions. Only few studies investigate the reasons and functions of disliking music. Aims: Therefore, the aims of this study were to explore the breadth of people's disliked music as well as their rationales for disliking specific music. Method: Qualitative semi-structured interviews were conducted (stratified sample with five age groups, N = 21 with 52 % female). In preparation to the interview participants were asked to bring a list of their disliked music with them. Based on this list, they were asked for the reasons why they disliked each item on the list, what aspects exactly they disliked and what they would do when exposed to their disliked music. All interviews were fully transcribed and analyzed using structured content analysis. Results: Various musical as well as nonmusical aspects were identified as being important in order to explain participant's reported disliking, e.g., rhythm, lyrics, artists / performers, fans or performance settings. Reasons for musical dislikes were divided into three categories: personal, social and material reasons. Participants reported using musical dislikes explicitly to express their identity and to establish and reinforce a negative self-image, which they perceived and presented as highly incongruent with their self. The social category of reasons contained all rationales associated with peer groups or family, either by means of social affiliation or distinction. Material reasons comprised of rationales based on musical knowledge and music-related quality standards of the participants. In addition, participants discriminated between several intensities of musical dislikes ranging from mild dislikes to very strong rejections of specific pieces, artists or entire musical styles. They also reported that their dislikes were stable over long periods of time and rarely changed. Conclusions: The study provides further insights into the extent of people's musical dislikes and the rationales behind those dislikes. Results from this study are in line with Behne's model for the rationales of musical taste (Behne, 1986) and the psychological theory about possible selves (McCall, 2003). Participants reported using their disliked music to create, affirm and present their self. While they were able to talk about how their musical dislikes were associated to their self, they could not say in which way their preferred music related to their self-concept. This indicates that disliked music might be an easier way for the participants to verbalize and present their self-concept compared to speaking about their preferred music (see also Berli, 2014). Therefore, future research should take into account both – likes and dislikes – when investigating musical taste.

References

Poster 11
The influence of meter on harmonic syntactic processing in music. An ERP study
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25th Anniversary Conference of the European Society for the Cognitive Sciences of Music, 31 July-4 August 2017, Ghent, Belgium
Keywords: Syntax, structure building, rhythm, harmony, EEG, ERAN

Background: Musical syntax includes tonal-harmonic structures, but also rhythm. Although several theoretical investigations stressed the importance of the interplay between tonal-harmonic and rhythmic (and specifically metrical) aspects for musical syntax, neuroscientific evidence is lacking. Aims: Thus, the aim of the current experiment is to investigate the influence of meter on harmonic syntactic processing in music using event-related potentials, in particular the early right anterior negativity (ERAN). Method: Twenty-one participants (musicology students; 8 females; mean age: 23.3 years, range: 18–37 years) listened to musical sequences consisting of five chords of equal loudness, the final chord function being either tonally regular or irregular. The metrical importance of chords was manipulated by presenting the sequences in two blocks: each chord sequence was preceded by a one-bar percussion sequence either in a 4/4 or in a 3/4 meter. Thus, the final chord occurred either on a metrically strong (first) or weak (second) beat. To further induce a specific meter, participants had to detect rarely occurring chords with deviant timbre (p = .1) and judge as fast as possible whether they were on a strong or weak beat (e.g., by pressing the left button if the deviant was ‘on 1’ and the right button if it was ‘not on 1’). To accomplish the task, participants had thus to keep the induced metrical structure over a whole chord sequence. The electroencephalogram was recorded with 24 scalp electrodes with a sampling rate of 500 Hz (SMARTING system). Data were offline rereferenced (linked mastoids) and filtered (0.25–25 Hz, FIR). Eye artefacts were corrected by performing an Independent Component Analysis and removing independent components contaminated with eye artefacts (EEGLAB). Other artefacts were automatically rejected. Event-related potentials (ERPs) for regular and irregular chords were averaged (-200 – 1000 msec) and statistically evaluated by repeated measures ANOVA. Moreover, behavioral data (d’ and reaction time) were analyzed. We hypothesize that if the metrical structure influences tonal syntactic processing, the ERAN shows larger amplitudes when chord sequences are presented in a 4/4 meter than in a 3/4 meter: in the former case, an irregular final chord is on the metrically strong beat and is considered to cause a much stronger syntactic expectancy violation, compared to when an irregular final chord is on a metrically weak beat.

Results: The analysis of d’ values showed that participants detected the timbre deviants and judged their metrical positions above chance level (d’ (SD) = 4.66 (0.87) for 4/4 meter and d’ (SD) = 4.15 (0.98) for 3/4 meter). However, participants detected deviants faster in 4/4 than in 3/4 meter (t(20) = -3.9, p < .001). Compared to tonally regular chord sequence endings, tonally irregular endings elicited an ERAN which was maximal at around 200 msec in both 4/4 and 3/4 meter. An ANOVA with factor chord type (regular, irregular) and meter (4/4, 3/4) showed a main effect of chord type only (F(1, 20) = 69.4, p < .001), but no interaction between chord type and meter (F < 1). Conclusions: In the current study, the amplitude of the ERAN was not modulated by metrical importance. However, there are several aspects that need further consideration. For example, the meter induced by the timbre detection task was possibly not strong enough to influence ERAN. An analysis of the Beta band activity might help us to investigate whether different meters were induced in participants, as has previously been shown. Moreover, the current experimental stimuli did not include metrical expectancy violations, and the ERAN might be influenced only by simultaneous syntactic expectancy violations. It is also possible that meter processing may influence cognitive processes reflected in later ERP components (e.g., N5). Alternatively, metrical structure building might be a lower-level process and differ fundamentally from harmonic structure building.

Poster 12

Polish adaptation of GEMS - factor structure and reliability

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25th Anniversary Conference of the European Society for the Cognitive Sciences of Music, 31 July-4 August 2017, Ghent, Belgium
Keywords: GEMS, music emotion, scale adaptation, Polish sample

Background: Original GEMS constructed by Zentner, Grandjean, and Scherer (2008) consists of 9 scales and is available in three versions: full 45 items, short 25 items and a brief version with 9 items. The Scale is popular in studies where the subjective emotional reaction to music is measured. In order to use GEMS in Polish studies on affective reactions to music, we have begun work on Polish adaptation of this scale. In the previous study, we used a 72-item version of GEMS (Chełkowska-Zacharewicz & Janowski, 2016). The EFA results allowed us to shorten the scale to 52 items on 9- or 10-factor solution. The 9-factor solution consisted of scales: Joyful Activation, Wonder, Transcendence, Nostalgia, Sadness, Power, Tension which were comparable to the original scales, Tearfulness - which separated from Sadness scale, and merged scale which consisted of items from original Peacefulness and Tenderness scales. In the 10-factor solution, Peacefulness and Tenderness scales were separated like it occurred in the original GEMS. We have found that both 9- and 10-factor solution have strong factor loadings, although 10-factor solution explains better the affective reactions to music. We have decided to analyse both solutions in the present study. Aims: The aim of the study was to reduce number of items from the first study, to confirm the factor structure of the Polish adaptation of GEMS and to verify the reliability of obtained scales. Method: We used the tentative, 52-item version of Polish GEMS prepared on the grounds of EFA performed in the previous study. The study was conducted via the Internet on the online Concerto platform. Respondents filled the scale twice, using five-point Likert scale, while a random piece of music was played. We used 8 affectively different pieces of music. Two hundred and forty-two respondents took part in the study, full responses were obtained from 210 participants (161 women), and 177 participants filled the scale twice. The final number of responses was 398. For CFA we defined 9- and 10-factor solutions, according to our findings in the previous study. In both models we reduced the number of items to three, basing on responses of five raters who had to choose for every factor the words that were linguistically the most proper for the Polish language. All of the chosen items had high factor loadings in EFA in the previous study (from 0,624 to 0,843). Results: For the 9-factor model, the CFA measures were satisfactory: RMSEA=0.071, SRMR=.059, NFI=.95, CFI=.97, GFI=.85. For the 10-factor model, the CFA measures were satisfactory as well: RMSEA=.072, SRMR=.064, NFI=.95, CFI=.97, GFI=.84. These measures are comparable, although models differ significantly (p=0.00). However, the 10-factor solution enables to explain the factor structure better compared to original GEMS scale. The reliability (internal consistency) of the 10 scales measured with Cronbach’s alpha was satisfactory and ranged from 0.786 in Joyful Activation to 0.929 in Tearfulness. Conclusions: Polish adaptation of GEMS has a different factor structure than the original one. In Polish sample, Tearfulness occurred to be a separate factor from Sadness. Authors of the original version did not conduct the CFA after adding ‘tearful’ to the Sadness scale, therefore we cannot compare these results. It is possible to maintain the 9-factor solution, however, in this instance, two original factors Tenderness and Peacefulness merge in one scale. The psychometric values are similar for 9- and 10-factor solutions, so for the future research we decided to use the 10-factor solution, as it is closer in structure to the original version and it will be easier to compare obtained results with outcomes of studies that use English version of GEMS.

References
Poster 13

Young musicians' views on their learning of expressive performance within an action research project

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Keywords: Action research, dialogic teaching, expression, instrumental teaching & learning, performance pedagogy

Background: To date little is known about effective approaches for developing and improving young musician's expression in performance. Instrumental tutors in an exploratory study used various instructional strategies for teaching children expressive performance, including teacher's enquiry, discussion, aural modelling and gestures & movements (Meissner, 2017). Results of this study suggested that especially teacher's enquiry and discussion might be helpful for improving pupils' expressiveness. This teaching strategy was confirmed to be effective in a one-off experimental lesson, comparing the outcome of an experimental lesson using dialogic teaching of expressive performance with a control lesson focusing on accuracy and technique. For a longer-term approach the question arises: Would a dialogic teaching approach be sufficient or do learners need supplementary methods to support this teaching of expressive music performance? Aims: A longitudinal study was organized to explore the development of young musicians' expressive performance through weekly individual instrumental lessons with teachers employing enquiry & discussion as well as other instructional strategies. Part of the study was to investigate young musicians' views on, and experiences of, their learning of expressive performance. How do pupils respond to their teacher's enquiries and what is their view on a dialogic teaching approach in their music lessons? Do pupils think that they benefit from the use of various instructional methods for learning expressiveness? Which methods work well for the young musicians? Method: An action research study consisting of two cycles was organized with five instrumental tutors and eleven pupils (aged 8-14) during one school term. The teachers used enquiry and discussion and explored how various instructional strategies can support dialogic teaching of expressive performance. Pupils' performances at the start, middle and end of the project were video-recorded and evaluated by the tutors and three independent adjudicators. Questionnaires and video-stimulated recall interviews were used to gather information about pupils' views and experiences. Qualitative data was coded in NVIVO and analyzed with thematic analysis. Results: Participating pupils thought that they had learned more about playing with expression during the action research project. Teacher's enquiry and discussion had been useful, given that pupils thought that reflecting on the musical character and how to convey this in their playing had been helpful for their learning. Additionally pupils had found it helpful to listen to teacher modeling, and some had also found it useful when their teacher had played with them. Pupils seemed to enjoy thinking about the interpretation of works they were studying and came up with perceptive ideas. Pupils indicated that their confidence had grown during the project. Data analysis is still in progress. Conclusions: Preliminary findings from this study support the idea that it is possible to facilitate young musicians' learning of expressive performance. Participating pupils had found enquiry and discussion supported by teacher modelling helpful for their reflection on, and understanding of, the musical character and structure of their pieces. Findings of this study will contribute to the development of a systematic pedagogy for facilitating young musicians' learning of expressive performance.
Poster 14
Glottal adduction and spectral envelope variation at singing diatonic scales with different dynamic shapings
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Keywords: Singing, glottal adduction, electroglottography, inverse filtering, dynamic shaping, closed quotient, spectral envelope, phonation mode

Background: Voice quality depends (1) on the vibrational characteristics of the vocal folds and (2) on the shape of the vocal tract. In the classical school of singing, the timbral integrity over the wide pitch and dynamic range is pursued. The flow phonation mode of glottal adduction, which corresponds to the value of closed quotient (CQ) between about 0.4 and 0.5, allows producing maximum sound power (Titze & Sundberg, 1992). However, the efficiency of airflow conversion into sound energy increases at higher CQ values. Vocalizing with CQ values higher than about 0.6 (pressed phonation) is considered detrimental to the voice health. The phonation at CQ lower than about 0.3 tends to be perceived as breathy. Björkner et al. (2006) have found that vocally untrained persons increase glottal adduction with pitch and loudness, but professional singers tend to avoid such automatism. Aims: The goal was to discover (1) whether the assumption of Björkner et al. (2006) holds when classically trained male vocalists sing ascending scales with various dynamic shapings, and (2) how the dynamic changes are expressed in the voice spectrum. Method: Eleven professional male singers and voice students were asked to sing ascending D major one-octave scales on vowel /a/ three times: (1) with the most comfort and habitual dynamics, (2) with *sempre cresendo* from *p* to *f*, and (3) with *sempre diminuendo* from *f* to *p*. The performances were recorded. Simultaneously the electroglottographic (EGG) signal was captured, and absolute sound pressure levels (SPL) were registered. Then the acoustical recordings were inverse filtered with the help of *Sopran* software (*Tolvan Data*, Svante Granqvist) and the closed quotient (CQ) was determined for each note. From voice recordings, the power spectrum was calculated for each note and the spectral peak levels at the fundamental component (LH1), at the first formant (LF1) and at singer’s formant (LF3) were determined. From EGG signal we determined the quasi-contact quotient (QxEGG) values. Results: In the task without intentional dynamic shaping, the singers actually increased the SPL by 10 dB in the average. The increase was by 20 dB in the *p* to *f* task, and SPL decreased by 3 dB in the *f* to *p* task. There was a statistically significant tendency that the parameters CQ and QxEGG had low values in the case of the tones that were sung *piano*, and high values in the case of *forte* tones. The correlation between CQ and QxEGG was strong (*r* = 0.75). The correlation between QxEGG and SPL was also quite strong (*r* = 0.6), but weaker between CQ and SPL (*r* = 0.5). The correlation between QxEGG and pitch was weak (*r* = 0.2), and between CQ and pitch insignificant. The average values of CQ over all investigated singers stayed inside the conditional borders of flow phonation mode. However, the individual performance sometimes entered even into the conditional zones of breathy or pressed phonation. From spectral parameters, the strongest correlation was between LF1-LH1 and CQ (or QxEGG), on both cases *r* = 0.7. Correlation between the level of the singers' formant (LF1-LF3) and CQ (or QxEGG) was negative and weak (*r* = -0.2). Conclusions: Glottal adduction tends to vary systematically also in the case of classically trained professional singers when they change the dynamics of
their voice. At the same time, quite large idiosyncratic differences are possible. The strength of the glottal adduction is mainly mirrored in the level of the fundamental spectral component.

References

Poster 15
**Involuntary vs. voluntary musical imagery: A comparison of temporal precision and emotional responses**

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**Keywords**: Musical imagery, earworms, tempo, memory

**Background**: Research on involuntary memories for autobiographical events has revealed that these types of memories tend to be more specific and emotional than voluntarily recalled autobiographical memories. However, such research has primarily compared involuntary versus voluntary memories for different sets of events. Research on musical memory affords an opportunity to test such claims more directly for memory of the same stimulus. This can be achieved by comparing musical memories that enter the mind as involuntary musical imagery (INMI, or ‘earworms’) — the spontaneous recall and repetition of a tune in the ‘mind’s ear’ — to deliberate recall of the same tune as voluntary musical imagery (VMI). Such research also adds to the growing body of literature on INMI, by helping to further our understanding of the strong emotional responses that can be elicited by INMI and descriptions from previous research that INMI often represents a vivid and veridical re-experiencing of a previously heard tune. **Aims**: The present study compared involuntarily and voluntarily recalled imagery for the same pieces of music. Specifically, we aimed to compare temporal precision and emotional responses between these two types of imagery. **Method**: Twenty participants completed two 3-day data collection tasks: an INMI task and a VMI task. In the INMI task, participants were asked to tap to the beat of INMI episodes during their daily life while wearing an accelerometer that recorded their tapping. They also recorded information about each tune experienced as INMI and their emotional response to it in a diary. During the VMI task, participants received text messages from the experimenter at the same time of day that they had experienced a tune as INMI, which asked them to voluntarily imagine the same section of the same tune they had previously reported as INMI. They were asked to tap to the beat of this VMI with the accelerometer and to record information about the tune and their emotional response in their diary. **Results**: The tempi of INMI and VMI for the same song were highly correlated, $r(153) = .92, p < .001$. Original tempi of the imagined sections from all tunes that exist in canonical versions were calculated from the original recordings. Both forms of imagery were quite temporally precise; the median deviation of INMI tempo from the original, recorded tempo of a tune was 7.7% and the median VMI tempo deviation was 7.3%. A linear mixed effects model with ‘participant’ as a random effect and task (INMI vs. VMI) as a predictor of deviation from the original tempo revealed no significant effect of task ($t(33.5) = -0.13, p = .899$), indicating a generally equivalent level of accuracy in tempo recall for INMI and VMI. Positive correlations between valence ($r(224) = .31, p < .001$) and arousal ratings ($r(224) = .33, p < .001$) for the same tune within the INMI and
VMI tasks indicate a moderate level of mood congruence during the two types of imagery. Although mood during INMI episodes was rated higher on average in both arousal and valence than during VMI episodes, task was not a significant predictor of arousal ratings in a mixed effects model ($t(18.51) = -0.19, p = .852$). However, task was a marginally significant predictor of valence ratings ($t(38.98) = -1.80, p = .079$). Finally, the tempo of INMI episodes was a positive predictor of concurrent arousal ratings ($t(132) = 2.70, p = .008$), whereas VMI tempo did not significantly predict arousal ($t(129) = 1.38, p = .171$). **Conclusions:** INMI for canonical tunes was recalled very close to the original, recorded tempo, at a similar level to deliberate imagery of the same tune. In addition, some evidence for mood congruence during INMI and VMI for the same tune was found. However, arousal ratings were affected by musical features (specifically, tempo) of the INMI tunes, but not the VMI tunes. INMI tunes also tended to be accompanied by higher (more positive) ratings of valence than VMI tunes, which conflicts with the stereotype of INMI as an annoying or necessarily negative experience but aligns with several previous studies on INMI that have revealed that most INMI episodes (around 66%) are rated as positive or neutral in valence.

### Poster 16

**Pianists' mental practice strategies: A mixed-method approach**

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**Keywords:** Aural models, eye-tracking, mental practice, mental strategies, mixed methods, music reading, silent reading

**Background:** Learning new pieces from musical scores is a common and time-consuming task for musicians. Mental practice (i.e., practice without an instrument) can be seen as an important complementary addition to regular practice activities, and as a valuable tool in situations when an instrument is not at hand. Some pianists are known to prefer using recordings as practice aids, while others prefer to study the score in silence. What is less well understood are the actual strategies of mental practice applied in these conditions, and how such strategies might be reflected in the readers’ visual processes and in the ensuing performances. **Aims:** This study explores pianists' strategies in two mental practice situations: while silently reading the score and while reading the score with an aural model of the music. Our first aim is to find out what kinds of strategies pianists are using in both conditions, and in what ways these strategies may be reflected in the visual processing of the score and in the performances that follow. For this purpose, we apply a mixed-methods approach, in which interview data is complemented with eye-movement recordings and analyses of musical performances. Our second aim is to explore how eye-movement data could complement the information gained from pianists’ own descriptions of their practice strategies. **Method:** The participants were 23 professionally trained pianists with a mean age of 25.17 years ($SD = 3.59$). Each participant was tested individually in a laboratory in the presence of one experimenter (MP). The participant was instructed to play two piano pieces with an electric piano. The notated music was presented from a computer screen placed behind the keyboard. The pieces (by the Lithuanian composer Jürgis Kaizauskas) were comparable in length and style. Between *prima* and *seconida vista* performances of each piece, the participant was allowed 2 min 55 s to prepare for a second performance without touching the instrument. Both performances were recorded using Logic Pro X 10.2 software. For one of the pieces, the mental practice phase was carried out in a *silent condition*, and for the other piece, in *listening condition*—i.e., while listening to a MIDI performance of the music (played 3 times). During both mental practice periods, the eye movements of the participants were recorded using a Tobii T60XL Eye Tracker. Finally, a semi-structured interview was conducted (by NL) to elucidate the pianists' practice strategies. The performances were analysed by
subjecting them to evaluations by a panel of four experts in piano performance as well as by separately counting frequencies of errors in pitch and rhythm. Based on the performance scores, mental practice strategies were collated and four cases were selected for more detailed scrutiny of the interview and eye-movement data.

**Results:** Qualitative analysis of the interview data on group level resulted in the identification of four main types of strategies during mental practice: 1) aural strategies, 2) practical strategies, 3) analytical strategies and 4) expressive strategies. Qualitative analysis of four participants’ eye-movement videos distinguished between four silent music-reading activities: 1) linear reading, 2) linear scanning, 3) non-linear scanning and 4) selective stopping. Based on the interview data, it seems that strategic choices in mental practice of newly encountered music were moderated by skills and preferences in analytical and imaginary processing of music, experience in mental practice, sight-reading skills, motivation and in some cases by the practice condition. Using qualitative eye-movement videos to supplement qualitative self-descriptions was found to be a useful and promising method. **Conclusions:** Identifying diverse ways to read and practice music without an instrument will help musicians use more versatile and appropriate learning strategies in different musical situations. Acknowledging individuals’ skills and preferences in silent processing of music should be considered when mental practice is taught. However detailed and enlightening the pianists’ subjective descriptions of applied mental practice might be, a more profound understanding of the strategies is gained by supplementing these descriptions with evidence concerning the visual reading processes.

**Poster 17**

**Towards a model predicting music selection behavior by functional, situational, and person-related factors**

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**Keywords:** Music listening in everyday life, situation, situational influences on music listening behavior, engagement with music, music listening behavior

**Background:** Explaining why people listen to music is a central part of research in music psychology. On the one hand, a vast amount of research investigates individual differences of music listening behavior – that is trying to explain why people use music differently or listen to different kinds of music. On the other hand, a growing amount of research highlights the importance of situational influences – showing that people actively use music to fulfill specific functions in certain situations. Recent research revealed that the goals and effects of listening to music are predominantly determined by situational influences. The question which people listen to music to fulfill these time-varying functions of music listening is not sufficiently answered yet. Moreover, we still do not know how much of people’s daily engagement with music (i.e. listening to different styles and musical qualities) is attributable to individual differences (e.g., musical taste) and how much is due to situational influences (e.g., the presence of others). Thus, we argue that research trying to explain music listening behavior should incorporate personal, situational and functional factors. **Aims:** We aimed at statistically predicting music selection behavior (i.e. listening to specific musical characteristics) using person-related, situational, and functional variables. In addition, we wanted to identify the most important factors predicting music selection behavior. Lastly, we wanted to investigate how stable (i.e. attributable to individual differences) music listening behavior is and how strongly it is governed by situational (i.e. time-varying) factors. **Method:** Five hundred eighty-seven participants completed an online study where they sequentially described three self-selected music listening situations which typically appear in their daily lives. Each participant reported on situational aspects (e.g., presence of others,
momentary mood), the functions of music listening, and the music they usually listen to in the specific situation. The functions were measured using an inventory comprising 22 functions of music listening representing 5 dimensions (Steffens, Greb, & Schlotz, 2016). The music was measured via seven musical characteristics on seven-step bipolar rating scales (in detail: slow - fast, simple - complex, sad - happy, peaceful - aggressive, less rhythmic - very rhythmic, less melodic - very melodic). After describing the listening situations, participants reported on sociodemographics, musical taste, musical training, and Big 5 personality traits. For each outcome variable (i.e. musical characteristic), all measured variables were entered into a hierarchical linear regression model and we used a percentile-Lasso to reveal sparse models which only include the most important predictors. The percentile-Lasso is a machine learning technique which is used for variable selection and furthermore generates models which are optimized to make predictions for unseen persons. Thus, results are highly reliable especially when compared to common model fitting procedures (e.g., forward or backward selection). Results: The inspection of intra-class correlation coefficients of the null-models showed that, on average, 23 % of the variance of the musical characteristics was attributable to differences between persons, while 77 % of the variance was due to within person differences between situations. This ratio varied across the different musical characteristics (between-person: 9-32 %). The final models contained a varying amount of predictor variables for each outcome variable (number of included predictors: 1-13). The functions of music listening were the only predictors that were included in every model. Person-related variables were included in three of the six models. Furthermore, our study revealed a set of key variables involved when people select music in a certain situation. Conclusions: Our results showed that the perceived musical characteristics of music people listen to considerably varied across situations (i.e. within persons). Hence, the qualities of music people select to listen to in their daily life seem to be predominantly determined by time-varying factors associated with the situation and the function of music listening at a specific moment. Lastly, our study revealed several important findings that might guide future research on music listening behavior.

References

Poster 18
Expressivity, embodiment, control: Exploring the motivations for building new digital musical instruments
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Keywords: Digital musical instruments, motivation, expressivity, embodiment

Background: Over the past four decades, the number, diversity and complexity of digital musical instruments (DMIs) has increased rapidly. Most DMIs, in contrast to traditional acoustic instruments, have a separation of sound control and sound generation elements, which means they in turn can have any number of different input-output relationships, as determined by the mapping design (Wessel, Wright, & Schott, 2002). This possibility for endless reconfiguration grants instrument designers and performers of DMIs practically limitless flexibility for music-making. Given that there are very few constraints on DMI design and that it is historically the limitations of particular technologies that have pushed the creation and introduction of new musical instruments (e.g., the
limited dynamic range of the harpsichord encouraged the invention of the modern pianoforte), what motivates the development of new DMIs? **Aims:** We conducted an interview study with designers of new DMIs, in order to explore 1) the motivations electronic musicians may have for wanting to build their own instruments; and 2) the extent to which these motivations relate to the context in which the artist works and performs (university vs. club setting). On the basis of existing research, we predicted the emergence of three categories of motivation: M1: wanting to bring greater embodiment to the activity of performing and producing electronic music/wanting to develop new physical setups for this; M2: wanting to make the activity of performing and producing electronic music more interesting to audiences; and M3: wanting to develop new sounds or timbres. No predictions were made regarding the second aim of linking motivation to performance context, this was approached in a purely explorative manner. **Method:** We carried out semi-structured interviews with ten artists, all of whom are prominent performers in the field of electronic music and who build their own digital musical instruments. The mean interview length was 59.2 minutes (range: 35-90 minutes). The transcribed interviews were analysed using Atlas.ti (Version 1.0.48). **Results:** In total, the interviewees mentioned their motivations for building DMIs on 51 occasions. Almost all of these 51 quotations could be grouped into the three proposed motivation categories. However, one new category emerged, the motivation of using technology (e.g., machine learning methods) to lessen the amount of control that the performer has (M4), with the aim of making a device that surprises and challenges them, particularly when improvising. We then grouped these four categories under two larger themes or intentions. Quotations for the two most frequently mentioned motivation categories, M1 (n=23 quotations) and M2 (n=15), often identified general shortcomings with music technology that the artists felt motivated to rectify through instrument development, most commonly the lack of expressivity or enjoyability when playing existing, typically laptop-based, systems. In contrast, quotations from the categories M3 (n=7) and M4 (n=6) mention the motivation of using technology to achieve more specific artistic aims. There were also some detectable trends in motivation according to the context in which the artists work and perform. Those working in the club (C2) and mixed contexts (C3) mostly only cited M1 and M2, whereas the artists from the academic setting displayed a broader set of motivations. **Conclusions:** Our results offer the first systematically gathered insights into the motivations for new DMI design. It appears that it is the challenges of controlling digital sound synthesis itself that drives the development of new DMIs, rather than the shortcomings of any one particular design.

**References**

**Poster 19**

**Music influence on visual and motor cortex: A synesthetic activity explored with evoked potentials**

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**Keywords:** Music, neuroplasticity, connectivity, visual and motor cortex, synesthesia, visual evoked potentials, transcranial magnetic stimulation.
Background: Evoked potentials provide a direct assessment to explore the functioning of nervous system and neuroplasticity. Recent studies reported interesting changes in musicians, showing neuroplasticity, particularly with reference to hearing function tested by means of Brainstem Auditory Evoked Potentials (BAEPs). The results showing enhanced auditory evoked potentials in musicians along with enhanced attentive and preattentive skills in musicians compared to non-musicians, open up wider perspective about the effects of music on neural plasticity and its role in integrating multiple brain structures to develop new circuitries and networks. Aims: To explore the influence of music on visual and motor areas by recording Visual Evoked Potentials (VEPs) and Motor Evoked Potentials (MEPs) to Transcranial Magnetic Stimulation (TMS). Method: Eighteen subjects without ocular pathology were enrolled in the study. They were divided in two groups depending on the type of music indicated as mostly preferred: Narrative (melodic) and Music Releasing Movement (MRM, energetic and rhythmic). The examined subjects were asked to listen to a piece of their favourite music for about 45', while seated comfortably; both evoked potentials were recorded immediately before and after the listening session according to the following sequence: Silent VEPs, Silent MEPs, Music listening (This stage was filmed in order to document the appearance of motor activity accompanying the music listening), Music post MEPs, Music post VEPs. VEP recordings to checkerboard pattern reversal performed at 15' and 60' were analysed for changes in the P100 amplitudes (Aminoff & Michael, 1994). MEPs obtained in response to the technique of paired TMS were analysed for changes in the threshold and amplitudes in order to evaluate differences in the intracortical inhibitory profile of 1msec to 10 msec (Caramia, 1996) possibly induced by music. Results: VEPs changes to checkerboard pattern reversal at 60' after music listening, resulted in a significant increase of P100 amplitude with respect to the pre-listening values, in the Narrative music subjects. No significant P100 amplitude differences were recorded in the MRM group that instead demonstrated remarkable changes in motor excitability. After music listening, MEPs in response to paired stimulation were totally disinhibited for interstimulus intervals of 2 msec-3 msec and 4 msec in all MRM subjects, therefore indicating a loss of the physiologic intracortical inhibition. On the contrary, no significant MEP changes were measured in the Narrative group between recordings obtained before and after music exposure. Subjects belonging to the MRM group showed to accompany the process of music listening with motor activity consisting in typical rhythmic gestures that goes along with the sound; in these subjects, the normal profile of intracortical inhibition was totally lost after the session of music exposure, with the presence of MEPs at those intervals known to best suppress the motor output (Caramia, 1996). Conclusions: The present study provides neurophysiologic evidence for a central role of music in inducing short-term synaptic plasticity in non-hearing areas probably mediated by a change in cortical excitability of visual and motor areas. These findings further support the perspective that music induced neuroplasticity can be used for education, to improve psychomotricity and for the treatment of various clinical disorders.

References
Musical abilities and academic achievement – what’s the difference?

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Keywords: Musicality development, musical sophistication, academic achievement

Background: Positive associations between musical skills and academic performance in school have frequently been reported in the literature. Both kinds of achievements may be linked through third factors such as intelligence and general cognitive capabilities, genetics or personality. Alternatively, there are claims in the research literature proposing that musical activities have a causal effect on academic achievement. Müllensiefen et al. (2015) found associations connecting musical training and musical listening skills as well as musical listening skills with academic performance in a cross-sectional sample. However, from the network model it was not possible to confirm whether there was indeed a direct effect from musical training to academic achievement.

Aims: The aims of this study are to assess the causal hypothesis that increases in the amount of musical training lead to increases in musical listening skills and academic achievement. This study uses a sample that provides the opportunity to model the musical and academic development of the same individuals across two consecutive years while also assessing the impact of musical training on their development.

Method: Participants were 179 secondary school children from Queen Anne’s School, Reading, that participated in the same longitudinal study on musical, cognitive, academic, and social development in 2015 and 2016. There was no music intervention and all data was observational. Participants were assessed on a battery of 20 tests and self-report measures of which we only use as primary variables the self-report measures of musical training and concurrent musical activities, the tests of melodic memory, beat perception taken from the Goldsmiths Musical Sophistication Index as well as their school grades to index academic achievement. In addition, we also controlled for participants’ age and intelligence. Measures of concurrent musical activities and musical training were highly correlated (r = .77, p < .001) and therefore combined into a single variable ‘musical activity’ using principal component analysis. Participants’ development on academic achievement and beat perception ability was then modeled with two linear mixed effects models with ‘year’ and ‘musical activity’ as the primary predictors of interest and ‘IQ’ as additional variable to be controlled for. In addition, an ordinary regression model was run using difference scores (2016 scores minus 2015 scores) of the beat perception, academic achievement and musical activities variables.

Results: Results from beat perception model indicate a small overall increase in beat perception ability form 2015 to 2016 by 0.1 standard deviations. The only significant predictor affecting beat perception (positively) was musical activity (p = .005). Academic achievement was also affected positively by musical activity (p < .001) in addition to a positive effect of intelligence (p < .001). For the model using difference scores, the increase in musical activity from 2015 to 2016 had a positive and significant effect on academic achievement (p = .014). However, the increase of musical activity from 2015 to 2016 did not lead to significantly greater beat perception ability (p = .427). Conclusions: The results of this study suggest that increasing musical activity over the course of a school year has subsequent effects on academic achievement. Interestingly, increasing musical activity over the same time period does not have an immediate significant effect on beat perception ability. This could imply that musical listening abilities develop on a time scale longer than one year. In contrast, the immediate effects of musical activities on academic achievement seem to be detectable on a shorter time scale which is suggestive of the influence of attitudinal changes.
References

Poster 21
Sedative sound and music computing
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Keywords: Sedative music, non-pharmaceutical sleeping pill, mutual influence of respiration and heart beat, heart rate variability

Background: Recent sound and music research has concentrated on supporting human physical action with motivational music. There is, however, also a huge demand for relaxing music. Most apps for motivational music concentrate on the synchronisation of music to the human locomotion system. As relaxation is generally associated with none or slow movement sedative music should avoid stimulating the locomotion system. Systems that are relevant for relaxation are breathing and heart rate. The present consortium of Colombian and European investigators in biophysics, experimental physiology, musicology and music composition want to investigate the influence of sound or music on these processes. In addition the understanding of breathing and heartbeat is important in music performance. Aims: Collecting basic knowledge for the development of an app for relaxation purposes for the general public, and for people with special working conditions that disturb their daily rhythm, like pilots, top-athletes and musicians. Method: In the pilot experiment 30 subjects participated in relaxation sessions of 90 minutes during which they were in supine position on a bed with normal head support. Half of them received silence with noise suppressing headphones and the other half received “The Greatest Relaxing Pieces” of London Philharmonic Orchestra with the same type of headphones. During this session breathing and heartbeat was captured with iPod Touch acceleration sensors, which facilitated the determination of synchronisation. In addition, their ECG was captured. In the mean time also the second phase work was started on the development of the app to synthesise in real time music that can be adapted in tempo and complexity to the relaxation state of the subject. This is done by using real time breathing and heartbeat measurements: the music will adapt its tempo to these rhythms and progressively guide the subject toward a slower pace, inducing relaxation. Results: The analysis of the pilot experiment make it clear that in early stages of relaxation the frequency of heart beat and respiration diminish and that in advanced stages of relaxation synchronisation of the respiration to a multiple of the heart beat becomes more and more important. Our observations are in line with these of McGuinness et al. (2004). Synchronisation happened more than we expected. Subjects differ in the number of heart beats in a respiration cycle and switch quite often between the number of heart beats in the respiration cycle. The analysis of the influence of the music on the relaxation process is in progress. The Pure Data biofeedback circuit is ready for the next stage. Conclusions: The influence of breathing on heart rhythm is
generally known as sinus arrhythmia. The influence of the heartbeat on the respiration cycle is much less known. This effect may possibly be used as a basis for a biofeedback system. The measurable progress of the state of relaxation makes it feasible to continue with the biofeedback system.

References

Poster 22
Can mastery of musical grammars partially predict perception of musical expression? A cross-cultural study between western and Indian classical music
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Keywords: Cross-cultural study, music perception, music expression, music induced affects, musical grammar

Background: That there is such a thing as musical grammar and that it plays a fundamental role in music cognition is a well-established claim if one defines musical grammar in terms of mental representations of discrete elements in norm-governed hierarchical structures. Debated questions rather are: (1) How best describe it? (e.g., Are these norms rules, schemata, optimality constraints, constructions?), (2) What is universal about musical grammar? (e.g., Are there syntactic norms in all known musical cultures?), or (3) What is the role of musical grammar? (e.g., How much does musical expression rely on the mastery of musical syntax?). Aims: The aim of this study is to tackle some questions pertaining to points (2) and (3), while assuming some hypotheses from (1). Assuming that subjects who are more familiar to Western classical music (WCM) than South Indian classical music (SICM) master the grammar of WCM better than that of SICM (and vice versa) and assuming that Vijayakrishnan (2007)’s and Lerdhal (2001)’s grammatical theories are accurate, we ask: (a) How would judgments of musical expression differ in subjects more familiar with one of the two musical idioms? (b) How would feelings induced by music differ in these two groups?, and (c) Would differences found in (a) and (b) be predictable by differences in the mastery of musical grammar? Question (c) is tantamount to asking: as Westerners, do we understand our classical music better because we lack grammatical knowledge of foreign music? Method: Around 80 participants are selected: around 20 SICM practitioners, 20 South Indian non-musicians, 20 WCM practitioners, 20 Western non-musicians. The experiment comes in three tasks, apart from a questionnaire on general background information. Task 1 uses the framework of PROMS (Law & Zentner, 2012), which is, to the best of our knowledge, the most reliable test for skills in perception of musical elements. Subjects are asked to judge whether two small musical extracts played one after the other are the same or not, a few notes of the second melodies being altered in some cases. We used (i) culturally neutral rhythmic stimuli as well as melodic stimuli which follow either (ii) only WICM grammatical norms, (iii) only SICM grammatical norms, or culturally neutral i.e. (iv) acceptable and (v) unacceptable for both WEM and SICM grammatical norms. The stimuli were designed by specialists of both musical grammars. The expectation is that WCM practitioners will score higher for (ii) and SICM practitioners for (iii), but that they will have similar results for (i), (iii) and (iv). This is based on the known fact that, for Westerners, the less a melody respects Western grammatical norms (e.g., the less tonal it is), the harder it is to reidentify it. In task 2, participants are presented with 18 1-minute extracts of pieces for solo violin, 9 from SICM and 9 from WCM (played by professional musicians of both cultures). Their task is to rate the intensity with which they feel the 9 components of the Geneva Emotional Music Scale (GEMS-9). The
expectation is that subjects familiarized with SICM (WCM) will have more homogenous ratings with respect to SICM (WCM respectively) extracts. (This corresponds to question (b) above.) In task 3, participants rate how much they think the 18 musical extracts express a given affect every 5 seconds while listening to the extracts. The expectation is similar to the second task: more in-group homogeneity. This would allow spotting quite precisely where in the music subjects differ in their judgments of musical expression. **Results:** The tests are being conducted between Chennai (India) and Geneva (Switzerland). Apart from the 3 expectations already mentioned, the main point of interest is the following: We expect that differences in task 2 and 3 to be partially predictable by differences in task 1. In other words, differences in felt affects and in expression judgments would be partially predicted by different levels of grammatical mastery (this corresponds to question (c) above). **Conclusions:** Whatever the results turn out, this study will shed light on cross-cultural musical perception, focusing on culture-specific aspects of two well-studied musical systems, a domain of music cognition where empirical data is crucially lacking.

**References**

**Poster 23**
**Evaluation of associations between gender and dance/music movements**

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**Keywords:** Dance, samba, gender, movement, embodiment

**Background:** Dance movements, stereotypes, music forms or gender roles influence and overlap each other in a complex process that cannot by easily isolated. A simple joke about a song or the way we think one should dance to music can reflect these processes and are not only a result of our formal knowledge of dance or music. How do stereotypes of gender are attached to our musical lives so imperceptibly? Part of the literature argues that music carries codes associated with gender. Authors such as Susan McClary claim that “(...) music does not just passively reflect society; it also serves as a public forum within which various models of gender organization (...) are asserted, adopted, contested, and negotiated” (McClary, 2002, p. 8). Such a network of gender models would be characterized by a complex of cultural attributions and practices are associated with, for example, the masculine or feminine (Butler, 1988, p. 519). We will focus on how dance movements associate with gender roles. Naveda and Leman (2013) recorded the body movements of a group of 30 professional dancers. The computer analysis of the similarity between the movements lead to a “choreography map” that was able to discriminate gender associations using the morphology of the dancers’ gestures. The result suggested that the morphology of repetitive dance gestures could encode cues of gender associations. In the present study, we evaluate the same dataset of dance recordings by means of tests with subjects. **Aims:** The aim of the study is to identify how gender is perceived in the patterns of dance movements. **Method:** The experiment was conducted with 28 Brazilian university students, musicians, aged from 18 to 50 years. The subjects responded to a socio-cultural questionnaire and a subjective test on a web browser. Each trial of the subjective test consisted of stimuli in the form of video sequences displaying music and a moving stick of the body (extracted from the dataset of motion capture
recordings, used in Naveda and Leman, 2013). The subjects were asked to evaluate if they perceive gender associations from the movement of the stick figure (thus, isolated from other gender signalizations) by means of a rule containing 5 levels ranging from 1 (masculine) to 5 (feminine). We also asked if the subjects could identify what parts of the body influenced the evaluation. We presented 14 different sequences of dances. The dataset used in our study comprises a subset of the original dataset (only dances at 120 BPM), containing excerpts of 10 female and 4 male dancers. The dancers danced the samba-no-pé style, which is a paradigmatic “step” in the samba culture, danced by either men or women. Results: The results show (a) the gender evaluations (1 to 5) and (b) the most influential body part for each dance performance. The results show that the subjects identify strong gender associations for the dance performances and few neutral evaluations (2, 3 or 4 ratings). When we consider the most feminine or masculine dances (according to the evaluations), the evaluations of feminine dances seem to be influenced by inferior parts of the body. The evaluation of masculine dances seems to be influenced by head and shoulder movements. In general, hips, feet, and shoulder were the body parts more present in the overall evaluation. Conclusions: The results suggest that the traditional gender model is strongly represented in the evaluations. Even in the case where other gender cues are not presented (e.g., clothes, hair, faces) the dance and the music still force the binary gender model. This indicates that the dance movement does carry gender associations in itself and should be considered in further studies in the area. This study could help to evaluate the use of dance in musical pedagogy and support new studies involving gender in musical contexts.

References

Poster 24
Investigating grouping behaviour of dancers in a silent disco using overhead video capture
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Keywords: Silent disco, musical preferences, earworms, prosocial behaviour

Background: Making music and moving to music is very much a social experience. Evolutionarily, one theory suggests that this experience fosters group cohesion and social bonding, through joint synchronised movement (Freeman, 2000). The influence of music on social interaction has mostly been studied in laboratory settings (Kirschner, 2009). These experiments are fairly limited in the number of participants and primarily sought for evidence of socialisation. Additionally, knowledge of the experiment may lead to participants subconsciously changing their behaviour. There has been a particular lack of work on music and social interaction in ecologically valid environments. This study presents a method for conducting ecologically valid research on this interaction, through the use of silent discos, where music is streamed to wireless headphones allowing participants to switch between channels. The headphones include coloured lights indicating the channel a participant is listening to. Together with synchronised movement, this presents a kind of social coordination game for participants.
Additionally, we investigate the role of music selection and the effects of (meta-) musical features. For example, earworms are a type of involuntary auditory cognition where (part of) a song runs continually through a person’s mind. **Aims:** The first aim of this study is to develop a method for the processing and analysis of overhead video data of dancers in a silent disco. This allows for a type of ecologically valid research on larger groups of participants compared to a laboratory setting. Additionally this comes with a financial benefit compared to having to setup an entire motion capture laboratory. The second aim is to use this method in investigating the influence of (meta-) musical features on grouping behaviour. **Method:** Two silent disco events were organised and analysed. The first event featured two channels (earworms and matched controls) where participants were unable to switch. The second event featured three themed channels (1940s-1960s [blue], 1980s-1990s [red], post-2000 [green]) where participants were able to switch between channels. Using the first dataset, we developed a pipeline using Python’s OpenCV image processing toolbox. Video frames were thresholded and binarised based on the colours of the headphone lights. Next, these contours were modelled and their centres were extracted. Using these centres, undirected graphs were created, yielding an overview of the dance floor at a given moment. For these graphs, local and global clustering coefficients were determined and these were analysed by fitting a linear model with factors for channels and time segments. This process was followed for both datasets, using the second dataset for validation of the processing toolbox. **Results:** The toolbox yields consistent measures for both datasets, however the measures are sensitive to the number of people on the dance floor. When fewer than 10 participants are present the data becomes more unreliable. **Event one.** For local clustering there is a main effect of group (SS = 263.75, DF = 1, F = 6667.95, $\eta^2 = 0.0830$) and a main effect of time (SS = 1103.24, DF = 29, F = 961.73, $\eta^2 = 0.2747$). There is also a group $\times$ time interaction effect (SS = 155.24, DF = 29, F = 135.32, $\eta^2 = 0.0506$). Global clustering shows a similar pattern: group (SS = 11.49, DF = 1, F = 366.416, $\eta^2 = 0.0056$), time (SS = 192.81, DF = 29, F = 212.122, $\eta^2 = 0.0863$), group $\times$ time interaction (SS = 61.76, DF = 29, F = 67.948, $\eta^2 = 0.0294$). **Event two.** For local clustering there is a main effect of group (SS = 249.85, DF = 2, F = 4093.11, $\eta^2 = 0.1644$) and a main effect of time (SS = 51.94, DF = 14, F = 121.55, $\eta^2 = 0.0393$). There is also a group $\times$ time interaction effect (SS = 62.91, DF = 28, F = 190.64, $\eta^2 = 0.1137$). **Conclusions:** The toolbox developed so far allows us to investigate grouping dynamics of dancers in a silent disco, and how these dynamics change over time. Both datasets yield consistent data, however it is necessary to control for number of participants. Further development will allow more detailed investigation of individual movement and switching behaviour.

**References**

**Poster 25**

**Genre movement characteristics and preference in music-induced movement**

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**Keywords:** Motion capture, dance, genre, preference, dyadic analysis

**Background:** Research into how music affects movement has focused mainly on music features such as tempo, flux and groove, or on expressed emotion in music (e.g., Burger et al., 2013). However, genre is an important means of categorizing music at a higher level that has not yet been thoroughly studied in relation to music-
induced movement. Individual preference for certain genres over others may also affect music-induced movement, both alone and in social contexts. Aims: The current study aims to identify differences in movement characteristics between genres, and how and how these movements are related to preference and exert influence within dyads. Method: Participants (n = 73) were presented with 16 stimuli of 35 seconds, representative of 8 genres (Blues, Country, Dance, Jazz, Metal, Pop, Rap, Reggae), and instructed to move or dance as felt natural to them. Each participant danced alone and with a partner. Optical 3D motion capture data were collected from their whole-body movements. For each genre, acceleration data from each of 20 joints were extracted to quantify mean amounts of movement per stimulus and genre. Covariance matrices were extracted for each participant including key markers (hands, head, feet) and compared across genres for differences. Results: Preliminary results indicate positive correlations for participants’ preference for certain genres and overall amount of movement to those genres in the case of Metal and Jazz music. Additionally, analysis of actor-partner effects in dyadic dancing indicated significant actor effects correlated to preference for Metal, Country and Reggae and a significant partner effect for Metal, suggesting individual genre preference can influence movement in dyadic contexts. Covariance matrices, however, failed to be reliably identified in relation to genre, showing stronger relationships to individual dancer than to stimulus. Conclusions: Genre and genre preference seem to exert an influence on music-induced movement, but further research is needed to explain the nature and extent of this influence.

References

Poster 26
Chunking and co-articulation in performance analysis
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Keywords: Performance analysis, music performance, gesture

Background: The relation between analysis and performance has been subject to much debate in music research. In previous research, it has been proposed that a ‘performer’s analysis’ may put a distinct focus on music’s temporal nature, and hence a focus on shape rather than structure. More recent developments along similar lines emphasized that ‘the physical actions of the performer not only inform but also shape the analytical awareness’ and, that ‘the potential elements of a performance’ should be identified (Rink, 2015). Also, the notion of ‘performance cues’ has been proposed. These cues can relate to expressive qualities, interpretative decisions, but also basic performance elements such as intonation and playing techniques. The concepts of ‘performance elements’ or ‘performance cues’ gain further significance through the notion of ‘chunking’, understood as a fundamental feature of musical perception through which the perceived is divided into ‘action chunks’ (Godøy et al., 2010). Although chunking is certainly related to the auditory stimuli, it should not be understood as equivalent to phrasing or articulation; it is instead inherently related to movement, starting at one point and stopping at another. But, rather than aiming at identifying the smallest denominators in musical perception, chunking emerges also through its combination with the concept of co-articulation, as separate movement chunks may be combined in larger units. This defines a hierarchical framework of interacting action patterns in the performance, which can be the constituent of musical expression (Leman, 2016). Aims: The present study is built on the assumption that a substantial layer in a performer’s analysis can be carried out as an identification of chunks and
supra-chunks, and of the co-articulation of musical gesture in these materials, hereby situating the analysis in the physicality of musical performance. Here, we want to constitute further method development of the performance analysis framework established in Coorevits et al. (2016), by focusing on the embodied aspects of chunking and co-articulation in music performance. **Method:** For this study, the performance of Rolf Riehm’s Toccata Orpheus for classical guitar by Stefan Östersjö at the Humanities Lab in Lund was selected. The performance was recorded on video and motion capture recordings of the performer’s body were made as well. The analysis combined both qualitative and quantitative methods. A detailed mapping of perceived performance cues (1st person-perspective, for details on this method, see Coorevits et al., 2016), was combined with the extraction of chunks and patterns of co-articulation from the motion capture data (3rd person-perspective). The movements of the hands and head as well as detailed movements of fingers were taken into account. **Results:** Preliminary results show that perceived performance cues and the structures and shapes emerging from this analysis are closely related to the chunks and patterns of co-articulation extracted from the motion capture data. How the musician shapes the music in order to convey expressive intentions and overcome technical difficulties is reflected in the way the different types of performance cues are organized in larger and smaller chunks in head, hands and fingers. The co-articulation of these performance elements results in a ‘gestural map’, which is a strong tool for understanding how musical expression is perceived in terms of chunking and co-articulation. **Conclusions:** The aim of this study was to elaborate on the embodied aspects of co-articulation and chunking in music performance in order to strengthen an earlier developed performance analysis framework. Direct connections between musical perception and the physical movements in performance were established through the analysis. Moreover, our results strengthen the evidence that a focus on bodily aspects of chunking and co-articulation may reveal underlying performance strategies of musicians, which provides a powerful tool for music performance analysis that can be applied in other performance studies as well.

**References**


**Poster 27**
**Musical sophistication and health. Findings from an online survey**
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Keywords: Musical sophistication and activity, health and well-being, epidemiology

Background: A growing body of research suggests health implications of musical activities. However, appropriate inventories are needed to explore these associations at epidemiological levels further. Here we present first data from an extended measure of music sophistication (Müllensiefen et al., 2014) in combination with batteries addressing demographics and health. Aims: The study aims at piloting an online survey to explore associations between musical activities and health-related variables. It is of primary interest here to assess general compliance, time needed to fill out the survey as well as to elicit any issues concerning the acceptance and handling of the new inventory as perceived by a university campus population. Method: The composed online questionnaire consists of socio-demographic information, personal valuation of mental and physical health, personality aspects, individual musical sophistication (Gold-MSI, Müllensiefen et al., 2014), as well as current and past music practice. Ethical review commission of the University of Oldenburg granted its consent to the study. Students and university staff served as sample and were reached via intern mailing lists and social networks. The online-survey was provided via hyperlink. Data collection was conducted in April 2017. Results: A total of N=1,018 persons responded to the study invitation. Of these N=758 participants finalised the 31 core questions of the Gold-MSI and thus will be included in the analyses for this paper. This sample mainly consists of students (94.5%) with a mean age of 26.8 years (SD 8.2 years) and the following sex distribution: 68.6% female, 31.4% male. Initial data analyses will concentrate on exploratory correlations between musical sophistication and general aspects of mental and physical health as well as musical sophistication and personality aspects. Results will be available in time to be presented at the ESCOM conference. Conclusions: Preliminary results suggest a high degree of compliance as well as low-levels of issues or difficulties with respect to handling this novel research instrument on music sophistication and health. Analyses are expected to provide first insight into associations between the target domains.

References

Poster 28
Perception of beat accuracy in music: Relative to the tempo?
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Keywords: Beat, time accuracy, IOI, music perception, correctness

Background: Beat and time are two important dimensions in music. Lay listeners are reliable and precise judges when evaluating the pitch accuracy of melodic performances. Their perception of “correctness” relies on “fixed” higher order categories (Larrouy-Maestri et al., 2016). Regarding the time dimension, listeners show high sensitivity to beat regularity. For instance, Dalla Bella et al. (2016) observed that a deviation from isochrony in music is detected at about 8% of an initial Inter-Onset Interval (IOI) of 600 ms (i.e., 60-ms beat deviation). Akin to
melody perception, listeners might develop a “correctness” category with regard to the time dimension. The nature of such category needs to be clarified to further understand similarity/differences across music dimensions. **Aims:** The present study focuses on listener's perception of beat accuracy in music. We aim at defining listeners' tolerance with regard to beat regularity and at examining the nature of such “correctness” category. For these purposes, we asked listeners to rate manipulated music sequences presented at different tempi. **Method:** Thirty-six participants (26 women) from 18 to 29 years old ($M = 22.5, \text{SD} = 3.31$) and without formal musical training participated in two experimental sessions. We used three musical sequences based on a computer-generated 2-bar except of Bach’s “Badinerie” BWV 1067, with a piano timbre, taken from the BAASTA battery (Dalla Bella et al., 2016). Three different tempi were chosen: Slow: 66.6 beats per minute (IOI = 900 ms); Medium: 100 bpm (IOI = 600 ms); Fast: 133.3 bpm (IOI = 450 ms). Each sequence was either isochronous (i.e., with regular beat) or manipulated (i.e., shift forward of the 1st beat of the 2nd bar). The manipulation was gradual, from 0 to 45% of the IOI, in 5% steps. The 10 versions of the slow, medium, and fast sequences were presented 16 times to the participants in a random order. Participants were asked to judge whether each sequence was on- or off-beat, and rated the confidence of their rating on a 4-point scale (0: not confident, 3: very confident). **Results:** A repeated measures ANOVA performed on the percentage of on-beat answers, with tempi (i.e., slow, medium, and fast) and manipulation (i.e., from 0 to 45% of the IOI, in 5% step) as within-subject factors, showed that listeners were sensitive to beat manipulations ($p < .001$). This sensitivity was mediated by the tempo of the sequence (i.e., interaction manipulation*tempi: $p = .006$). The examination of the fitted confidence curves revealed that listeners' tolerance to time deviations was larger than their discrimination thresholds and was affected by the tempo ($p < .001$). Indeed, the boundary between on- and off-beat sequences ranged from 125 ms (i.e., 28% of the IOI for fast sequences) to 208 ms (i.e., 23% of the IOI for slow sequences). Interestingly, the categorization process itself varied as a function of the tempo of the presented sequence. Indeed, the slopes of the fitted identification curves cover ~10% of the IOI, regardless of the tempo of the sequence ($p = .474$). Finally, we observed contrasting patterns of categorization slopes (flat or sharp), which reflect individual differences in beat perception. **Conclusions:** Listeners develop higher order categories relative to “correctness” in both pitch and time dimensions. Unlike for pitch accuracy, the perception of beat accuracy is influenced by the music material. The categorization process depends on the tempo of the music sequence. Further investigation of individual differences and a direct comparison with the pitch dimension seems promising avenues to gain a better understanding of the mechanisms underlying “correctness” perception in music.

**References**


**Poster 29**

His master's voice: In search of individual approaches to tempo modulation of contemporary pianists through the study of recorded performance of Chopin and Liszt

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**Keywords:** Individuality, performance analysis, performance style, tempo, piano performance
Background: The bulk of past empirical research into musical performance has focused on establishing trends and expressive variations from the norm. Most of these studies map features of performances to structural properties of the music established by score-based analysis. The few studies that focused on individual musicians tend not to be comparative, at least not in a systematic manner. As a result, the performance styles of individual performers are either posited within a generally assumed historical norm without specific context data or remain relatively unexplored. More importantly, there has been little attempt at establishing individual differences in overall interpretative approaches using tempo modulation data. Critical reviews would tell us that some performers have a lyrical-melodic approach; others are more flamboyant and dramatic, while some may focus on the expression of musical structure, for instance. Can such claims be supported by evidence? Can measured tempo variations be indicative of such interpretative differences? **Aims:** To investigate individual approaches to tempo modulations in recorded performances by mid-career contemporary pianists and to analyse the results of these tempo variations with a view to establishing individual style of performance. **Method:** Two large-scale pieces - Liszt's B minor Sonata and Chopin's First Ballade - and two short pieces - Liszt's *Liebestraum* and Chopin's Nocturne in D-flat major - were selected for study. For each piece recordings by 10 different pianists born between in the 1970s and 1980s were selected (40 recordings in total). Tempo modulation in each recording was measured by marking up the beats of each bar. The normal tempo modulation was calculated by using the statistical average tempo value for each beat. The data was normalized so as to eliminate differences in basic tempos. Moments with at least 10% deviation from the norm and/or lies outside the ‘conventional range’ of tempo were selected for further investigation. In this paper I report the results of Valentina Lisitsa. The paper describes the moments where she deviates from the norm with reference to the score to identify and explain her individual approach to tempo modulation. **Results:** Results show that unlike the other 9 pianists in the sample, Lisitsa tends to play with dramatized expression both in large-scale shaping and in refined nuances. She plays with extreme tempos in both virtuosic and lyrical passages, i.e. playing virtuosic passages with exceptionally fast tempo and lyrical passages with exceptionally slow tempo. Her use of tempo rubato also tends to highlight the dramatic elements of the music: agogic accents are placed at moments where new melodic and rhythmic elements are introduced in the music. **Conclusions:** This paper shows that different pianists may embrace different approaches to tempo modulations in both large-scale and local levels. Some tend to highlight long-range phrases and sections while others tend to dwell on moment-to-moment variations, either at harmonic melodic cruxes or at metric accents. At large-scale level, some pianists use highly contrasting tempos across sections to accentuate structural divisions while others play with a more through-performed manner which undermines structural sense and, as a result, diverts our attention to local nuances.

**MEMORY**
Blandijn - Auditorium A, 16:30-18:00

**16:30-17:00**

*If you wanna be my lover...* A Hook discovery game to uncover individual differences in long-term musical memory

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**Keywords:** Long-term musical memory, individual differences, multivariate item response theory
Background: Hooked on Music (Burgoyne, Bountouridis, van Balen, & Honing, 2013) is a citizen science project, developed to uncover what makes music memorable. The game consists of two stages: first recognizing a song fragment, and then verifying that one actually knows that song well, by correctly singing along to it. After stating you recognize a song, the sound mutes for four seconds during which the player is supposed to continue singing (out loud or in their head). When the sound is unmuted, the music will continue either in the correct spot or not (50/50 chance). To verify, the player is to say whether the continuation was correct or not. Aims: Firstly, this study aims to uncover individual differences in long-term musical memory, by analyzing the data of Hooked on Music. Secondly, we aim to illustrate the relevance of a technique that has not yet been used in musical memory research before. Method: We used multivariate item–response theory to analyze the data from Hooked on Music (Hambleton, Swaminathan, & Rogers, 1991). Item–response theory (IRT) takes into account both the difficulty of an item and the ability of the participant, which can correct for important confounds. It differs from most other methods because characteristics from the items (difficulty, discriminability) are regarded as valuable information, instead of something that needs to be averaged out. In its multivariate version, IRT enables us to find factors that represent individual differences in performance on Hooked on Music recognition and verification, similar to an exploratory factor analysis. As a framework for the interpretation of our multivariate IRT results, we reviewed existing literature on music memory. We also considered participants’ answers to demographic questions and an audio-based corpus analysis to help interpret the factors, including a multiple-regression analysis of different musical features (e.g., intensity, melodic complexity, or rhythmic conventionality) against IRT measures. Results: The factor analysis resulted in a four-factor model for recognition ($R^2 = .47$), and single-factor models for verifications with correct ($R^2 = .09$) and incorrect ($R^2 = .14$) continuations. The Gender factor featured songs with a high female vocal prominence, showed a small correlation with being female ($r = .14$), and was predicted by tonal conventionality ($b = -0.15$, $SE = 0.06$, $p < .05$). The Age factor represented songs all with a similar release date (1990s) and showed a moderate correlation with age ($r = .41$). The Rhythm factor reflected songs all from a similar genre (rap) or with similar musical characteristics, with melodic complexity ($b = -0.21$, $SE = 0.06$, $p < .05$) and rhythmic conventionality ($b = -0.13$, $SE = 0.06$, $p < .05$) as predictors. The Residual factor remained ambiguous and requires further testing. Thus, the first three recognition factors represent better recognition for music with female vocals, music released in the 1990s, and rap music/attention to rhythm, respectively. The verification models both seemed to relate directly to the participants’ task. For correct continuations, the items represented a Sing-Along factor. It was correlated with being a singer ($r = .12$). For incorrect continuations, the Change factor appeared to represent a playing strategy based on whether the overall tone color sounded very different post-compared to pre-mute, which also correlated with being a singer ($r = .13$). Conclusions: Based on the recognition model, it seems clear that two factors play a role in determining long-term musical memory: age and musical preference/attention to music characteristics. These factors were also predicted by musical features. This shows that these sources of individual differences are important for, and could possibly confound, studies on long-term musical memory. In addition, the results illustrate that an MIRT-based analysis is able to uncover sources of individual differences in long-term musical memory, urging its use in future studies. By taking into account not only the ability of a participant, but also the difficulty of an item, and the way they interact, it corrects for important confounds that other techniques may not.

References
Melody recall in folk song transmission

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Keywords: Music information retrieval, recall, long-term memory, stability, folk songs

Background: Songs and instrumental pieces in a musical tradition are subject to change: as they are adopted by a new generation of listeners and musicians, they evolve into something new while retaining some of their original characteristics. We approach this phenomenon through the analysis of an existing folk song collection, providing evidence on variation as a result of real-life musical transmission. Aims: The current study investigates to what extent the variation of melodic phrases as a result of musical transmission can be predicted by their memorability. We draw our hypotheses on the memorability of melodic phrases from research in serial recall and music cognition, investigating the influence of phrase length, position and rehearsal, as well as expectancy and motif repetivity. Method: We investigate a corpus of 1695 Dutch folk songs collected in the second half of the 20th century, which domain experts have categorized into 147 groups of variants, or tune families. The corpus is publicly available as part of the Meertens Tune Collections. We quantify the variation of phrases within the folk songs through a pattern matching method (Janssen, van Kranenburg, & Volk, 2017), which determines occurrences of these phrases within tune families. The more frequent a given phrase occurs within its tune family, the more stable (i.e., resistant to change) we consider it to be. Prediction is performed through logistic regression, taking into account that the errors produced by the pattern-matching method depend on tune family. Therefore we use a generalized linear mixed model (GLMM) with a tune family-dependent intercept term. We compare all combinations of predictors and select the model that predicts phrase stability best. Results: The best-performing model includes all predictors from the proposed hypotheses, and explains 5% of the variation in the data if all other effects are fixed, or 22% of the variation if the effect of tune family is also taken into account, constituting a medium-sized effect. The prediction coefficients indicate that phrase length and expectancy possess most predictive power. With increase of a given query phrase’s length, the odds that it occurs in a given melody are decreased. Higher expectancy leads to an increase in stability. The coefficients also indicate that phrases occurring early in a melody are easier to remember. Moreover, an increase in pitch proximity leads to increased chance of occurrence. More repetitions of a phrase also result in the increased odds of occurrence. The coefficients which contribute least to prediction state that if a phrase adheres to the gap-fill principle, its odds of occurrence are increased. Conclusions: Folk song collections are a valuable resource for studying music cognition, as they allow us to study variation as a result of musical transmission (Jassen, Burgoyne, & Honing, 2017; Olthof, Janssen, & Honing, 2015). We show that the memorability of melodic phrases contributes to their stability, or resistance to change, confirming hypotheses from serial recall and music cognition. It would be interesting to investigate whether the factors increasing stability in the present study would hold in other musical genres, or to see whether memorability of melodies can be predicted in a participatory experiment of artificial transmission chains.

References

17:30-18:00

**Unconscious plagiarism in music: Exposure increases plagiarism in music composition**

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*Keywords:* Unconscious plagiarism, music plagiarism, exposure, idea elaboration, source monitoring, expertise, implicit memory

**Background:** Unconscious plagiarism occurs when another person’s idea is retrieved from memory, but is remembered as one’s own. In verbal creative tasks, the role of idea elaboration in plagiarism has been extensively tested (Stark, Perfect, & Newstead, 2005; Stark & Perfect 2008) with the finding that plagiarism is increased after improving others’ ideas. **Aims:** We tested whether these findings explained unconscious plagiarism in musical tasks. Using the three-stage paradigm of Brown and Murphy (1989), we investigated whether improving others’ ideas also increases plagiarism in music. Further, we investigated the effects of domain-relevant expertise on plagiarism. **Method:** We conducted two experiments; the first with a sample of 36 participants, (18 expert, 18 non-expert); the second was a replication study in a larger sample of 65 participants (31 expert, 34 non-expert). Expert musicians had undertaken a minimum of 10 years’ intensive study on any instrument/voice, or as a composer (Ericsson, Krampe, & Tesch-Romer, 1993). We used a computer-based simulation of the Brown and Murphy (1989) paradigm created in Max/MSP. Participants composed one melody for every three generated by the computer. A proportion of both the computer-generated and participant melodies were then elaborated by improvement and imagery. A control group of melodies were not re-presented following generation. Participants returned after a retention interval of up to one week to generate new melodies and complete a recognition test, working alone in both tasks. When generating new melodies, plagiarism was defined as creating a melody similar to one of the computer-generated melodies at a level above chance (measured using SIMILE; Müllensiefen & Frieler, 2006). In the Recognition test, plagiarism occurred when participants claimed one of the computer-generated melodies was their own. **Results:** Contrary to expectations, all forms of elaboration increased plagiarism in comparison to control melodies. No differences were observed between the effects of elaboration type. Participants also indicated significantly greater familiarity with melodies following all forms of elaboration. Expert musicians were as likely as non-experts to plagiarise. Taken together, these results suggest that re-exposure to music, regardless of task, leads to unconscious plagiarism in music. **Conclusions:** In contrast to verbal tasks, unconscious plagiarism in music does not occur exclusively through improvement of others’ ideas. Instead, exposure to music, including simply listening to and evaluating others’ ideas, is sufficient to increase the likelihood of plagiarism. This finding suggests that musicians are at greater risk of plagiarism than earlier thought. Of particular concern for musicians is the finding that expert memory does not reduce plagiarism. The result is considered in context of the literature of implicit and explicit memory. Explicit memory is improved through elaborative processing, but implicit memory is improved through exposure and repetition priming (Schacter & Church, 1992). Musical knowledge is predominantly acquired implicitly through exposure (Rohrmeier & Rebuschat, 2012). According to the source-monitoring framework of Johnson, Hashtroudi, and Lindsay (1993), where implicit memory is employed, source-monitoring processes may not necessarily be engaged. Thus, the
findings in music, in contrast to verbal tasks, are consistent with a dissociation between implicit and explicit memory systems in unconscious plagiarism.

References

PERFORMANCE
Blandijn - Auditorium B, 16:30-18:00

16:30-17:00
The effect of handedness on spatial and motor representation of pitch patterns in pianists
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Keywords: Handedness, pianists, lateralization, spatial representation of pitch height, transfer of learning, reversed keyboard

Background: The left-handed population is known to show less hemispheric asymmetry when performing various tasks. The current study investigates whether handedness has systematic effects on musical skills, more specifically in performance skills of pianists. Jäncke (2002) described an interesting case of a left handed pianist playing on a reversed piano – on which high pitch is on the left and low pitch on the right – who showed quick adaptation to the reversed mapping. Interestingly, this was interpreted to be related to his left-handedness.
Aims: The aim of this study is to find out whether there are indeed differences between left and right-handed pianists in the way they adjust to play melodies in various situations. To this end, we studied the effect of handedness, spatial and motor representation of pitch patterns in pianists using the transfer of learning paradigm. Method: Twenty-five pianists (12 right-handed and 13 left-handed) participated in a four-part experiment. Two questionnaires were used to determine participants' level of handedness and their level of musical sophistication. The transfer of learning task is a speeded task measuring performance duration of short
melodies (Meyer & Palmer, 2003) consisting of a practice and a test phase. In the practice phase, pianists were asked to repeat a 13-note melody for 10 times, followed by the test phase that repeats modifications of the practiced melody for 4 times. The difference between the duration of the last trial of the practice and the average duration of test melodies is used as a measure to assess processing differences between the practiced and tested melodies. In this study, we included three test conditions with a change in: spatial mapping of the keyboard (normal or reversed keyboard), hand (the same or different hand from the practice phase), and contour (the same or reversed melodic contour causing a change of fingering), resulted in eight test conditions per melody. **Results:** Musical sophistication and level of handedness were found to be similar among both participants groups. The results from the transfer of learning task showed that left and right handed pianists performed similarly on the reversed keyboard, suggesting no difference in adjusting to altered spatial representation of pitch height for left and right handed pianists. It was however found that transfer of learning performance was affected most significantly by hand condition, specifically when melodies were played with the left hand and regardless of participant’s handedness. A second significant effect was found for the contour condition in which the fingering was reversed: the left-handed pianists showed better transfer performance than the right-handed pianists. Analysis of errors indicated that right-handed pianists made significantly more mistakes in the hand and contour conditions, i.e. when fingering was reversed and when playing with their left hand. This suggests that left-handed pianists were more accurate in adapting to the conditions of using a different hand and different fingering. **Conclusions:** In summary, different from Jäncke's observation (2002), handedness did not have a significant effect on how quickly pianists adopt their performance of short melodies on a reversed keyboard. However, we did observe that left-handed pianists were quicker in playing melodies when reversing their fingering of trained ones. The analysis of errors indicates that left-handed pianists were also more accurate in this process. The results will be further discussed in the light of the advantages, disadvantages and problems that left handed pianists may encounter.

**References**

**17:00-17:30**
**Music performance skills: Facilitating flow and reducing performance anxiety**
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**Keywords:** Flow, music performance anxiety, music performance

**Background:** Classical performing musicians make use of a wide range of cognitive, physiological and musical skills in performing music. Despite this command of a varied skill set, most of the literature devoted to performing optimally is focussed on the pathological aspects of performance: on treating the debilitating effects of music performance anxiety (MPA, Kenny, 2011). It has been suggested that working within a positive psychology paradigm, where the emphasis is placed on enhancing positive functioning, may be helpful in facilitating optimal music performance (Patston & Waters, 2015). Optimal performance is often associated with being in a state of flow (Csikszentmihalyi, 1990). Research into flow amongst classical musicians is still in its early stages, yet a recent study by the present authors found evidence of a strong, significant negative association between flow
and MPA amongst 200 professional orchestral musicians. Music students have been pinpointed in the MPA literature as a population in need of music performance skills. Based on the strong negative association between flow and MPA, this paper investigates whether a clinical intervention focusing on facilitating flow as well as reducing MPA may be helpful in encouraging optimal musical performance. **Aims:** (1) To carry out a performance skills intervention in which students are introduced to tools for facilitating flow and reducing MPA. (2) To provide an opportunity for newly learned tools to be implemented in simulated performance situations. (3) To obtain quantitative and qualitative data to measure changes in students’ performing experiences. **Method:** Participants were 24 university post-graduate music students: 12 in both the experimental group and the wait-list control group. The experimental group received an 11-week music performance skills intervention comprising: (1) mental skills training, (2) physiological awareness, and (3) music communication skills. In weeks 2 and 10 participants in the experimental group took part in simulated performances. Pre/post-test measures were taken of the short Dispositional Flow Scale (Martin & Jackson, 2008); the Music Performance Anxiety Inventory (Nagel, Himle & Papsdorf, 1981); Positive and Negative Affect Schedule (Watson, Clark & Tellegen, 1988) and Spielberger’s State Anxiety Inventory (Spielberger 1983). **Results:** Mixed-repeated ANOVAs showed a significant reduction in pre/post-test MPA between the wait-list control and experimental groups \(F(1,20) = 6.96, p = .016\). Participants in the experimental group showed significantly lower state anxiety \(F(1,11) = 6.22, p = .030\) and lower negative affect \(F(1,11) = 6.50, p = .027\) before the second simulated performance, compared to levels before the first performance, and significantly lower negative affect \(F(1,11) = 9.92, p = .009\) and higher positive affect \(F(1,11) = 4.86, p = .050\) after the second simulated performance compared to levels after the first simulated performance. Qualitative data indicated that experimental students felt more positive and confident about performing at the end of the course. There were no significant changes in measures of flow during the intervention, and flow measures were generally low. **Conclusions:** This preliminary study provides evidence that the performance skills course was successful in reducing levels of MPA and helping participants feel more positive about performing. However, the intervention did not appear to facilitate flow. This could be due to the absence of a skills/challenge balance amongst the students (one of the pre-conditions of flow) and the resulting low levels of flow. The present study is limited by its small sample size. A larger investigation would help provide a greater understanding of the clinical potential of the relationship between MPA and flow.

References

**17:30-18:00**

**Validation of the Kenny Music Performance Anxiety Inventory (K-MPAI)**

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**Keywords:** Music performance anxiety, K-MPAI, high order exploratory factor analysis, cross-cultural analysis

**Background:** Music performance anxiety (MPA) is a complex phenomenon that includes the somatic and cognitive symptoms that characterize anxiety disorders. Other features such as attachment insecurity, depression, and panic are present in those severely affected. The revised K-MPAI (Kenny, 2009) was developed to assess this underlying psychopathology as well as specific MPA symptoms. Chang (2015b) estimated the psychometric
properties of the K-MPAI in a Peruvian sample of undergraduate musicians using a certified translation of the K-MPAI into Spanish. In line with the theoretical approach used in that study, a higher order exploratory factor analysis (HOEFA) revealed a higher order unidimensional structure named “negative affectivity in relation to music performance anxiety” (G) with two first order factors named “music performance anxiety” (F1), and “depression” (F2) (Clark & Watson, 1991) that required cross-cultural validation. **Aims:** This research assessed whether MPA can be theoretically conceptualized as a unidimensional construct and whether this structure is consistent across Australian and Peruvian populations of musicians with varying levels of musical expertise. **Method:** Two groups of participants were included in this study. A Peruvian sample of music undergraduate students (n = 455, mean age = 21.19, SD = 3.13) majoring in an instrumental specialty; and an Australian sample of professional orchestral musicians (n = 368, mean age = 42.1, SD = 10.3) who were members of one of the eight major Australian orchestras. A HOEFA with Schmid-Leiman solution was performed on both samples. The extraction method was unweighted least squares (ULS) and the number of dimensions to retain was defined by the optimal implementation of parallel analysis (PA). Cronbach and ordinal alpha, as well as SEM were calculated for both samples. The degree of comparison between populations was assessed with a measure of invariance. **Results:** For the Australian sample the ULS-PA indicated that two first order factors be retained. Together these explained 47.89% of shared variance. The first order factors’ correlation levels with G were: F1 = .80, and F2 = .93. Items with factorial loadings on G equal or higher than .30 were retained. Ordinal alphas were: G = .96 (SEM = 7.50), F1 = .95 (SEM = 6.03), and F2 = .93 (SEM = 3.58). For the Peruvian sample the ULS-PA indicated retention of the two first order factors which explained 41.17% of shared variance. First order factors’ correlation levels with G were: F1 = .76, and F2 = .92. Items with factorial loadings on G equal or higher than .30 were retained. Ordinal alphas were: G = .94 (SEM = 7.43), F1 = .92 (SEM = 6.23), and F2 = .91 (SEM = 2.89). The invariance of the bifactorial model was tested with the Peruvian sample. The fit of the model was good, \( \chi^2(375) = 731.92, p < .001, CFI = .989, TLI = .987, RMSEA = .034, SRMR = .045 \). **Conclusions:** The similar factorial structure of the K-MPAI and the invariance analysis added empirical support to the structure and conceptual interpretation of the high-order structure of the Peruvian and Australian samples (Clark & Watson, 1991; Kenny, 2011; Kenny & Ackerman, 2015). Besides its unidimensional interpretation, a bidimensional way of using the inventory is possible due to its clear content and high reliability. Future studies will assess the degree to which the K-MPAI can be validly cross-culturally interpreted.

**References**
SIGHT READING
Blandijn - Room 100.072, 16:30-18:00

16:30-17:00
Sight-reading by cellists: The role of positional knowledge
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Keywords: Sight-reading, pitch error, skills, fluency, music instruments

Background: Most western music practices use music notation for documentation and communication of compositions. Music production is often mediated through such notations, which makes sight-reading an essential skill for amateur and professional musicians. Two strategies can be discerned for string players: tonal strategies (how a tone sounds within its tonal framework), and positional strategies (how the pitch is technically produced). These strategies are also fundamental to different teaching methods. Previous research on sight-reading mainly took place from a tonal perspective where intervals and harmonic functions form basic premises, showing that a tonal approach for measuring sight-reading ability is adequate, especially for singers. It is however reasonable to expect that different kinds of music instruments yield different difficulties in these two domains. For instance, wind instruments, keyboard-based instruments and the human voice differ on important aspects in comparison with string instruments. The question is therefore if a mere tonal approach is the most appropriate method to measure proficiency in sight-reading with string instruments. Aims: The goal of this project is to measure sight-reading levels of cellists. Furthermore, the research examines the effect of position knowledge and the use of tonal and positional strategies on sight-reading errors, which manifest themselves as pitch errors (playing wrong notes) and fluency errors (unintended short and long pauses) during sight-reading. The purpose is to answer the following question: Does position knowledge lead to better sight-reading by cellists, and how is technical level related to the use of strategies? Method: In this study 79 amateur cello students participated, varying in age (7 to 70), technical level (low, moderate, high), defined by the number of positions on the neck of the instruments the player masters, and experience – measured in years of having followed cello lessons (between 1 and 20). The research design is partly correlational and partly experimental. The following measurement instruments are developed for this research: (a) Questionnaire on Background Variables of Sight-Reading with open and closed questions, (b) Survey on Sight-Reading Strategies, consisting of 24 questions on a 5-point Likert scale, questioning both the use of participants’ tonal and positional strategies while reading music, (c) Position Knowledge Test consisting of 40 multiple choice questions, and (d) Transposed Sight-Reading Melodies Inventory, based on melody 1, 3, 4, and 5 of Henry’s (1999) scale. Each melody was transposed to three different keys with increasing numbers of accidentals, representing three different levels of complexity. For each melody the number of pitch errors, long and short pauses, and the use of position changes were recorded. Results: The research findings suggest that use of tonal and positional strategies in sight-reading by cellists are not mutually exclusive. Use of positional strategies during sight-reading shows no significant stronger correlation with the number of pitch errors than the use of tonal strategies. However, better position knowledge has a very strong negative correlation with the number of pitch errors, and a weak negative correlation with long and short pauses. An increase in complexity of melodies leads to more pitch errors and more pauses. Furthermore, the present project shows that both tonal and positional strategies play a role in music production through sight-
reading by cellists with different technical levels and varying experience. However, pitch errors and fluency are likely mediated by different mechanisms. Pitch in cello playing is mediated by position knowledge and skill (shown by choosing the right fingering and extension in playing the selected melodies and the number of positions mastered in general). Paradoxically, pitch appears to be mainly affected by strategies and knowledge about how the right notes are produced, not by their tonal function. Conversely, fluency in music production is mainly affected by experience and the use of tonal strategies. **Conclusions:** The concluding advice is that music education for string players should place more emphasis on practice and acquisition of a cognitive position network, embedded in a musical theory background wherein both tonal and positional strategies are provided.

**References**


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**17:00-17:30**

**The relationship between sight reading music performance and updating in working memory: Differences associated to development and instrument knowledge**

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**Keywords:** Sight reading, instrument knowledge, updating in working memory

**Background:** Sight reading (SR) involves the simultaneous processing of visual, motor and auditory information (Finney & Palmer, 2003). Although SR performance requires at least certain amount of instrument knowledge to carry out, and its efficiency is highly related to general performance level during skill acquisition (Lehmann & Ericsson, 1996), we suggest that the ability to rapidly update information in working memory (WM) could be associated to SR performance. **Aims:** Our main goal was to analyse the relationship between different indexes of SR performance, and updating in WM sub-processes (retrieval, transformation and substitution) in groups of players of different ages and levels of instrument knowledge. **Method:** 131 string and wind students were organized in three age/instrument knowledge groups: elementary level (68 children and pre-adolescents; at least 2 years of music training); intermediate level (32 adolescents; at least 6 years of music training); superior level (31 young adults; at least 12 years of music training). We selected two different SR tests (binary and a ternary) by instrument level for each participant group from *Sound at sight* series (Trinity College London, 2003-2009). Performance was measured from zero to ten by two expert musicians, according to the following indexes: global performance at sight (α = .98), proportion of errors (α = .86), continuity (α = .98), indicated tempo adjustment (α = .98), tempo maintenance (α = .98), rhythmic accuracy (α = .99), pitch accuracy (α = .97), and articulation accuracy (α = .98). We also obtained an index of expressiveness (α = .98), measured as general phrasing previously established by experts, and accuracy in dynamics, or either expressive indications. We used an updating task (Carriedo et al., 2016), adapted from De Beni and Palladino, (2004). A total of 24 lists of 12 words that were names of objects, animals, or body parts of different sizes, and abstract common nouns were auditory presented. Each list included words to be recalled (relevant words), words to be discarded (irrelevant words), and filler words. Participants were asked to remember the smallest items of each list. We obtained an index of the retrieval and transformation process (recall) and two different indexes of the substitution process: (1) inhibition in WM (same list intrusion errors), and (2) proactive interference (previous list intrusion errors). We registered the amount of current individual/group practice in hours per week. **Results:** Pearson’s partial correlations controlling
for current practice were computed within each participants group for all the dependent variables. The results showed a significantly relationship between the processes of retrieval and transformation and SR performance in only elementary and intermediate groups. The results also showed that the substitution process was significantly related to SR performance in all participant groups regarding both, inhibition in WM and proactive interference indexes. However, the results showed a significantly but negatively relationship between proactive interference and SR performance in superior group that could reflect an ability to consciously ignore the inadequate responses in benefit of fluency. **Conclusions:** The relationship among the processes of retrieval, transformation, substitution and SR performance could be distinguished among participant groups as a function of instrument knowledge, the difficulty of the SR test and the specific indexes of performance. A possible limitation is that the effect sizes were weak. However, executive function tasks tend to show low correlations due to the fact that any executive task involves other cognitive processes (Miyake et al., 2000).

**References**


**17:30-18:00**

**The eye-time span: Stimulus-driven effects on looking ahead in sight-reading**

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**Keywords:** Eye-hand span, eye-tracking, generalized estimating equations, musical notation, music reading

**Background:** A competent sight reader has to be able to “look ahead” from the notes currently played in order to achieve a fluent performance. This phenomenon has been known as the Eye-Hand Span, and measured in a number of ways that are here divided in two classes. In the forward projective approach, the “back end” of the span is fixed at a chosen point in the musical performance (e.g., a key press) to find out how far ahead the reader’s gaze extends at that point in time. The single-item lag approach pairs a fixation on a score element with the later performance of the very same element. Neither approach is well suited for studying stimulus-driven effects. In the forward projective approach, long measured spans do not reflect the salience or difficulty of the score information at the point of measurement, but they rather reflect how the reader has reacted to some other upcoming symbols. A problem for the single-item lag approach is that it also reflects the interpretive, agogic decisions by the performer. **Aims:** Our aim is to study how changes in the local complexity and/or visual salience of notated musical stimuli influence “looking ahead” in sight-reading. In order to study such stimulus effects, we introduce a backward projective approach: here, we take our starting point in a fixation targeting a given symbol, and work backwards to measure the distance (in units of musical meter) to “where the musical time was going” at fixation onset. This measure will be called the Eye-Time Span (ETS). We present two alternative hypotheses concerning stimulus effects on the ETS. First, the salient target elements themselves might catch the reader's attention from a longer distance, provoking oculomotor responses that result in long ETS measurements for the elements in question (salient target effect). Second, the salient targets might already be decoded when they fall
within the perceptual span, extending somewhat to the right from each fixation. Thus the targets might be decoded from fixations falling on elements before the target, yielding longer spans for these prior elements (approximate precaution effect). **Method:** We examined the above-mentioned hypotheses by having musicians read and perform simple melodic stimuli *prima vista*, in controlled tempi of 60 bpm and 100 bpm. In Experiment 1, 14 piano performance majors and 23 education majors sight-read diatonic quarter-note melodies in which larger intervals of fourths and fifths had been embedded in otherwise stepwise contexts. In Experiment 2, 14 piano performance majors sight-read diatonic melodies with added melodic sixths whereby the note following the skip involved an accidental. In both cases, Skipped conditions were compared to Stepwise conditions, supposing that in the former, the note after the larger interval would represent a point of heightened structural salience. For all and only correct performances of the notated stimuli, we analyzed the ETS data by using generalized estimating equations (GEE). **Results:** In Experiment 1, there were significant main effects of Tempo and Expertise, the latter being due to performance majors operating with larger spans than education majors. Also, there was a significant interaction between Condition (placement of the melodic skip) and Metrical location, showing that the insertion of intervalic skips affected the ETS. Here, the largest spans were observed at the salient targets, as suggested by the salient target effect hypothesis. In Experiment 2, we observed highly significant main effects of Condition and Metrical location, and, again, an interaction between the latter two variables. This time, however, the comparison between the Stepwise and the Skipped condition showed the latter to have larger ETS measurements on notes prior to the target note, suggesting an approximate precaution effect—an oculomotor reaction with a more unspecific target. **Conclusions:** Using a backward projective measure called the Eye-Time Span, we have shown that musicians’ visual processing may be sensitive to small local changes in music-structural complexity (and/or visual salience). In our experiments, larger melodic intervals inserted in a stepwise context led to greater spans targeting the area of the score where the interval appeared. Moreover, as shown by Experiment 2, competent sight readers may handle such “more difficult” elements by early glances to other elements preceding the difficult targets. Studying the local, stimulus-driven effects on “looking ahead” thus requires taking into account fixations falling on a broader visual area—not just the salient target elements themselves.

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**SEMIOTICS & POLITICS**
Blandijn - Room 110.079, 16:30-18:00

16:30-17:00

**Expressing archetypes through music: A musical semiotics approach to the encoding and decoding of archetypal figures**

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**Keywords:** MIR, semantics, similarity, semiotics, archetypes

**Background:** Archetypes, from a Jungian perspective, are symbols or motifs that appear to be universally present in individual psyches. Archetypal frameworks (e.g., Hero, Rebel, Lover) are used frequently to connect to an audience through visual and written content (Mark & Pearson, 2001). Considerably less attention has been given to the expression of archetypes through auditory content, with little to no empirical evidence available to establish a link between music and archetypal figures. We consider musical properties as a form of semiotic code
learned through cultural experience, in relation to communicating archetypal figures. **Aims:** Establish whether there is evidence of a semiotic coding system for archetypal figures within Western musical culture, from the perspective of the encoder (‘Composer Study’). Use this evidence to create an instance of a musical coding system, informing a listening experiment whereby participants are required to ‘decode’ the intended archetypal associations (‘Listener Study’). **Method:** Composer Study: 22 composers were asked to imagine composing a piece of music for each of 5 archetypal figures (Hero, Rebel, Jester, Lover, Sage), and rate 13 psychoacoustic properties (e.g., tempo, timbral brightness) on a Likert-based scale. Listener Study: Composer analysis was used to identify 9 configurations of 5 psychoacoustic properties (tempo, dynamic loudness, dynamic changes, pitch range, brightness), that would intend to convey Jester, Lover and Sage archetypes. 138 instrumental clips (19 seconds long) were derived from 600 tracks sourced from a commercial music library, distributed across the 9 configurations. Properties were measured using MIR Toolbox (v1.6) in Matlab. Participants were asked to listen to each clip once only and rate suitability for the clip for 6 different archetypal figures. 48 participants completed the experiment in a lab-based environment (each rating 69 clips); a further 145 participants completed a shorter online replication (23 clips). **Results:** Composer Study: Intra-Class Correlation Coefficient (ICC) analysis demonstrated general variability amongst composers in how different properties were used, though some fair agreement on use of tempo (ICC = .45) and dynamic loudness (ICC = .58). Latent Class Analysis revealed some limited evidence for variants of composition for two of the archetypes. Percentile-based criteria identified areas of high and low agreement between composers for properties. Listener Study: Results were nearly identical in both lab-based and online implementations. Multilevel linear models for 7 of the 9 configurations demonstrated a significant effect (6 configurations at p < .01, 1 at p < .05) of Archetype to determine average suitability scores. Contrasts indicated significant differences between suitability ratings for Jester versus Lover/Sage in 7 configurations (3 at p < .001, 3 at p < .01, 1 at p < .05), but only one configuration with a significant difference between Lover and Sage (p < .01). Multiple linear regression models yielded significant predictors (p < .001) that matched some of the properties with high agreement amongst composers for Jester (tempo, brightness), and Sage (tempo, pitch range), and one with low agreement for Sage (brightness). Good model fits were found for Jester (adjusted $R^2 = .491$, p < .001) and Sage (adjusted $R^2 = .732$, p < .001). **Conclusions:** The results demonstrate some agreement between composer and listener, indicating that a semiotic coding system is used both to encode and decode archetypes. The near-identical replication of patterns of results suggests this system is generalizable across culturally similar populations. Properties with strong predictive power for archetypes have consistent correlates in studies of mood, affect and emotion, including parallels with kinaesthetics (e.g., expressive movement, expressive vocal theory, emotional interpretation of footsteps), and Hevner’s mood/affect adjective circle.

**References**

17:00-17:30

**Gender and pop music lyrics**

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**Keywords:** Popular music, lyrics, gender, United Kingdom, corpus analysis
Background: The majority of content analyses of pop music lyrics and music videos have addressed levels of sexuality and misogyny in relatively small samples of music, establishing that depiction of these is prevalent. Given this, it seems appropriate that further consideration of (a wider range of) music lyrics should focus on how the prevalence of various themes varies as a function of the gender of the musicians in question. Aims: The present research considered whether the prevalence of lyrical themes differs depending on whether the performing musicians are male or female. Method: A dataset containing all 4534 sets of song lyrics from the top 5 songs in the United Kingdom sales charts for each week from March 1960 through December 2015 was created. In this particular dataset, each song only appears once, regardless of the number of weeks the song was in the charts. Computerized analysis of the song lyrics was performed using Diction 7.0 software, a text analysis program designed to analyse content of a wide variety of social discourse. Diction calculates the frequency with which particular words occur within a given text, producing 35 different variables, known as dictionaries. Two variables concerning the musician(s) associated with each song were also coded. The number of musicians and their gender was recorded. This information was used to calculate the proportion of musicians who were female. Results: A Generalized Linear Mixed Model analysis considered whether lyrical content was associated with the proportion of the musicians who were female. The overall model was statistically significant, $F(32, 4338) = 7.723$, $p < .001$. Results indicate that while a single dictionary (inspiration) was positively associated with the percentage of female musicians, eight dictionaries (the number of different words, aggression, passivity, cooperation, diversity, insistence, embellishment, and activity) were negatively associated with the percentage of female musicians. Conclusions: Several aspects of these results are surprising. First, there were only a limited number of instances in which the proportion of band members who were female was related to the prevalence of lyrical themes concerning interpersonal relationships. The pattern of findings indicated that the proportion of female band members was associated with less prevalence of descriptions of behavioural interaction (cooperation), individuals or groups differing from the norm, and human competition and forceful action (aggression). However, there were also non-significant findings in the cases of self-reference, collectives, blame, communication, human interest, and exclusion. This raises a second interesting aspect of the findings, namely that although there were a number of variables that were associated with the proportion of band members who were female, there was little evidence to suggest that these followed broader sex-typing. The result concerning aggression was consistent with sex-typing but the results for cooperation and diversity arguably were not. Moreover, the remaining significant variables do indicate relationships involving gender but appear irrelevant to sex-types and instead point to a much more sophisticated pattern of relationships between lyrics and gender.

References

17:30-18:00

Music and national identity: The effect of patriotic and protest songs
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Keywords: Political orientation, identification, patriotism, protest

Background: Patriotism, a sense of attachment and love to one’s country, is often related to outgroup derogation, outgroup hostility and exclusion (Butz, 2009). National identity is constructed and maintained by cultural
symbols and traditions, among which music plays a significant role. Modern nationalism has always been supported by the use of music, the primary example of which is the national anthem. We are all taught to love and feel attachment to our country, and national songs, such as the anthem, are supposed to evoke and enhance our sense of attachment to our country. Through its power to evoke emotions and identification, music can bring people together, creating a sense of cohesion within a group, and differentiation between groups (Brown, 2006). In political contexts, music is often used to strengthen national identity and a sense of patriotism. At the same time, music may also express dissent and criticism of national policies. In reaction to events such as wars, or to other political affairs, popular music may contest national values, criticize and protest against policies or events, and function as an agent of resistance and opposition (Street, 2012). At a time when many countries are witnessing increased political polarization and a rise in extremist rhetoric, understanding the effect of music on national sentiment and attitudes towards outgroups is of particular relevance. The study was conducted in Israel, where similar processes of polarization are taking place.

Aims: The aim of the present study was to examine the effect of identifying with “patriotic” or “protest” songs on patriotism, national attachment, and sectarianism.

Method: The study was conducted on-line. Ninety-nine participants took part in the study in two groups. Participants listened to three “patriotic” (N = 50) or three “protest” (N = 49) songs. They rated their political orientation from extreme left (1) to extreme right (7) and filled out a patriotism questionnaire (Cronbach’s alpha = .945), containing two sub-scales measuring national attachment (alpha = .929) and sectarianism (alpha = .883). Scores for each of the three scales were calculated for each participant. Finally, they rated their degree of identification with the songs. Results: Univariate analysis of variance with political orientation and type of songs on identification with songs showed a main effect of music. Identification with patriotic songs was significantly higher than with protest songs. An interaction between political orientation and type of songs was found, with right-wing participants identifying more with patriotic songs. Within left-wing participants, no significant differences were found. Regression analysis was run with political orientation and identification with songs as predictors on all three measures of patriotism. Political orientation and identification with songs contributed significantly to explained variance on all measures of patriotism (general score, national attachment, and sectarianism). Likewise, an interaction between music type and identification with songs was found. In order to interpret the interaction, separate regression analyses were conducted for patriotic and protest songs. Results show that identification with national songs had a significant positive contribution to explained variance on all three measures of patriotism. For protest songs, identification had a weaker, negative contribution to explained variance on patriotism and national attachment, and no significant effect on sectarianism. Conclusions: The findings regarding differences between left and right-wing participants on identification with songs is in line with previous studies showing right-wing individuals to be more patriotic, and more susceptible to priming. Results suggest that music in itself does not affect patriotism. Rather, what determines its effect is the degree to which it evokes identification. Identifying with patriotic music, while increasing patriotism and the positive feelings towards the nation, also increases sectarianism and rejection of outgroups. Identifying with protest music, on the other hand, has a weaker effect, decreasing patriotism and national attachment. However, it has no effect on sectarianism. This study is the first to empirically test the effect of music on aspects of patriotism, and contributes to our understanding of how national sentiment may be manipulated through music for political aims.

References
Music-enhanced experience: Perception, learning, memory
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Psychological experiments from our laboratory provide evidence for a role of music as a prominent human social technology that is likely to have played an important role in the consolidation of human societies. Investigating human readiness to engage in music throughout the life span, I report and discuss musical effects, which increase levels of motivation to immerse in strenuous activities, facilitate courting behavior, improve learning, and, as a medical tool aid rehabilitation and prevention. This evidence-based scenario of music-evoked short and long-term brain plasticity creates the ground for the argument that systematic use of music is highly effective at addressing prospects and challenges faced by present society.

Go with the flow: Subjective fluency of performance is associated with sensorimotor synchronization accuracy and stability
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**Keywords:** Flow experience, music, rhythm, action-perception coupling, finger tapping

**Background:** Sensorimotor integration tasks, such as body movements in time with music, can foster the experience of flow – a pleasurable state of full engagement and concentration, occurring during a seemingly effortless and automatic activity. As it can be argued that both music and flow are embodied phenomena, action-perception coupling might be the core of the intimate relationship between flow and music. Aims: Although a variety of studies have investigated links between flow and musical activities, such as music listening, or musical performance (for review, see Chirico et al., 2015), empirical evidence on the relationship between sensorimotor coupling and flow is scarce. Here, we examined whether a direct relationship exists between the subjective experience of flow and sensorimotor synchronization accuracy and stability in a finger tapping task with music. **Method:** Sixty-nine participants (34 female, 35 male, $M = 24.5$ years, $SD = 4.1$) were divided into three groups (between subject design). Participants tapped in time with music clips with low ($N = 21$), medium ($N = 24$), and high ($N = 24$) rhythmic complexity. For each rhythmic complexity group, four different clips with tempi between 100 and 130 BPM were recorded by a drummer and a pianist and edited by author JS. Participants were instructed
to tap their right index finger as synchronously as possible with the beat. Taps were recorded with MAX/MSP 5 software and a circuit board connected to a 3×3 cm aluminum pad. Four to eight practice trials were monitored by the experimenter. There were two tapping blocks with eight trials each. Depending on the tempo of the clips, trials lasted between 31 and 40 seconds. The flow state was measured with the Flow Short Scale (Rheinberg et al., 2003). Participants completed the scale two times directly after each of the two tapping blocks. For the analysis of the two flow factors fluency of performance (6 items) and absorption by activity (4 items), we used the mean values of each of the two factors from both blocks. Tapping accuracy and stability was assessed by the circular variance and the SD of inter-tap-intervals (ITIs), respectively. 

**Results:** The circular variance was significantly negatively correlated with fluency of performance in the high rhythmic complexity group ($r = -0.46, p = 0.022$). Additionally, a trend was found in the medium complexity group ($r = -0.38, p = 0.067$). No significant correlation was found in the low complexity group ($r = -0.10, p = 0.657$). The SD of ITIs was significantly negatively correlated with fluency of performance in medium ($r = -0.42, p = 0.040$) and high rhythmic complexity groups ($r = -0.49, p = 0.016$). No significant correlation was found in the low complexity group ($r = 0.15, p = 0.518$). No significant correlations between circular variance or SD of ITIs and the flow dimension absorption by activity were found ($ps > 0.2$). Neither fluency of performance nor absorption by activity differed between the rhythmic complexity groups ($F(2,66) = 0.77, p = 0.467$, and $F(2,66) = 2.68, p = 0.076$, respectively). 

**Conclusions:** Our findings add to the evidence that action-perception coupling plays a key role in explaining the relationship between flow experience and musical activities. This was shown by significant correlations between sensorimotor synchronization accuracy and stability and the flow factor fluency of performance. Higher tapping accuracy and stability in music clips with medium and high rhythmic complexity were associated with higher fluency of performance. In line with previous research (for review, see Chirico et al., 2015), our results suggest that the factor absorption by activity with items such as “I don't notice time passing” is not as relevant to the experience of flow during musical activities as one might naively assume.

**References**


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**GESTURE & EMBODIMENT IN PERFORMANCE**
Blandijn - Auditorium A, 11:00-12:00

**11:00-11:30**

**Conscious and subconscious body movement: An exploratory study into expressive and technical gestures in piano playing**

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**Keywords:** Embodiment, gestures, music performance, consciousness, expressivity
Background: The embodied cognition theory in music suggests that the body is a vehicle for understanding and representing musical meaning. Previous studies into pianists' gestures have demonstrated an embodiment of expressive intentions. However, to our knowledge, the consciousness of this musical embodiment has not been explored in depth. Aims: The purpose of this study was to conjointly engage musical embodiment and consciousness in the observation of piano playing. The aims of the study were to see if musical expression is embodied through gestures and to what extent this was conscious or subconscious for the performer. A further aim was to explore whether prior experiences that simultaneously engage both mind and body, influence consciousness of certain gestures. In this study, these experiences were defined as musical-bodily experiences (MBEs) and were categorized as follows: Technical (e.g., amount and type of practice), Focusing Techniques (e.g., Alexander Technique), Mimetics (e.g., observing other pianists) and Extra-Musical (e.g., dancing). Method: Nineteen pianists took part in this study. They each completed an online questionnaire about his/her own MBEs. Pianists were then filmed playing a piece of their own choice, followed immediately by a second questionnaire to report their thoughts, as well as gestures they thought they had made, at specific points in the music that were previously identified by the researcher as relevant and outstanding. These specific points were chosen based on their emotional content and/or their technical difficulty. From the film recordings, gestures the pianists had actually made at these specific points were thoroughly analysed by the researcher. Using a ‘Gestures Checklist’ (created for this study to provide consistency), gestures were categorized into either technical (sound-producing, e.g. preparing hands on keyboard, pressing piano keys slowly) or expressive (ancillary gestures, e.g. circular body movements, jerky shoulder movements). At each specific point in the music, gestures made by the head, trunk, arms, and hands were each coded in the following pattern: E0 (no expressive gesture), E1 (one expressive gesture), T1 (one technical gesture), or E1T1 (a combination of an expressive and technical gesture). ‘Consciousness scores’ (CS) were calculated by subtracting the number of gestures observed by the researcher from the number of gestures the pianists thought they had made. To see if MBEs influenced consciousness, CS were correlated with MBE scores. The pianists' responses (from the second questionnaire) were also qualitatively investigated using content analysis to see if any concepts or themes emerged. Results: Pianists seemed to be conscious of general body movements, but less aware of more detailed gestures, such as wrist and shoulder movements. Although written prose from the second questionnaire indicated that the pianists were conscious of the emotional content of the music, they were not always conscious of the fact they were portraying their expressive intentions through their own gestures. In other words, their thoughts at specific points in the piece would consider expressivity of the music, whereas their thoughts of their movement would concern their technical (i.e. sound-producing) gestures. Some significant correlations were obtained for CS and MBEs. The more practical MBEs correlated consciousness of technical gestures, for example Alexander Technique positively correlated with technical CS ($r_s = .50, p < .05$). Prior engagement with more creative MBEs correlated with expressive CS, for example dancing ($r_s = .46, p < .05$). Conclusions: This study provides an insight into cognitions of pianists whilst performing. The findings suggest that expressivity is subconsciously embodied regarding more detailed gestures. Results also suggest that prior engagement of the body in varying musical contexts can shape the consciousness of gestures when performing music. The findings have practical implications as they promote engagement in musical experiences that can positively affect musical development. This information can also be helpful for those who struggle with performance anxiety. Individuals may find that incorporating MBEs highlighted in this study could help regulate self-consciousness and awareness, allowing them to immerse themselves in the pleasure of music making.
Gesture in the communication and control of musical timing

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Keywords: Timing, gesture, music performance, synchronization

Background: Musical gestures are an integral part of music performance and can play an important role in communicating and controlling musical expressions and intentions. These expressive intentions are also communicated to co-performers when playing in a musical ensemble. An important mechanism in music performance is the prediction and control of, and the adaption to the expected and perceived musical timing. When performing, musicians are involved in a complex dynamical system of mutual adaptation which is not completely understood so far. In this study, we want to investigate the role of sound-producing gestures of musicians in the mediation process of (interpersonal) musical timing in a duet performance. We expect that gestures will help to convey musical time and predict the expressive timing patterns of a co-performer, leading to smaller asynchronies. Moreover, we expect that adding expressive gestures will lead to a better control of timing and a more stable performance, especially in slower tempi. Therefore, we designed a study where musicians had to tap a simple melody on a pad using three different movement strategies, with and without visual contact and in two different tempi. Method: 14 duos (28 participants) of musically trained people were tested. Two duos were occluded from analysis due to technical problems during the recordings. The musical excerpt we used were the first eight bars of the Pachelbels Canon in D with a final note added to end the sequence. Successive taps triggered the successive notes of the melody which were heard by the participants through headphones. All bars contained four quarter notes, meaning that for each trial, all the participants produced 33 tones (with the final tone included). Participants were asked to tap the Pachelbels canon using three different performance styles: (a) in a normal way (baseline), (b) with an additional expressive gesture in between the taps, or (c) using the least movement possibly by pushing on the pad without lifting the finger. These strategies were combined in 5 conditions (P₁(a)-P₂(a), P₁(b)-P₂(b), P₁(b)-P₂(c), P₁(c)-P₂(b), P₁(c)-P₂(c)). The second factor was modality: in one part of the experiment, individuals could see each other’s arms and hands, while in the other part they could only rely on auditory communication. Also, a metronome always initiated the tempo, which could be fast (100 bpm, IOI = 600ms) or slow (50 bpm, IOI = 1200ms). In total, this sums up to 2x2x5 conditions. For each condition, participants performed 3 trials. Circular statistics were applied to calculate the mean phase angles and resulting vector length for each performance, estimating the asynchronies and stability of the phase relationship between participants. Variability of IOIs was used to express the stability of the tempo, and Lag-1 correlations to test for adaptive behaviour between participants. To test the effect on these dependent variables, a 2x2x3 repeated measures ANOVA was applied on these conditions were participants used the same performance strategy (P₁(a)-P₂(b), P₁(b)-P₂(a), P₁(c)-P₂(b), P₁(c)-P₂(a), P₁(b)-P₂(c), P₁(c)-P₂(c)), while a 2x2x2 repeated measures ANOVA was applied on the other two conditions (P₁(a)-P₂(a), P₁(b)-P₂(b)). Results: In summary, the 2x2x3 ANOVA showed that, when comparing the absolute (unsigned) phase angle, the smallest phase angles occurred when there was visual contact between participants and when using expressive gestures. The largest resultant vector length (or most stable phase angle) was observed when having visual contact between participants, using expressive gestures and while performing in the fast tempo. The ‘expressive gesture’ strategy yielded significantly more stable phase relationship between participants than the other strategies in the slow tempo. Also, it was only the ‘expressive gesture’ strategy that made a significant difference when comparing visual and no visual contact. When comparing the variability of IOI’s, again, the most stable performance was observed when expressive gestures were used. The 2x2x2 ANOVA on the signed phase angle showed that the participants using an expressive gesture lagged behind the participants applying the ‘least
movement-strategy', but the effect was significantly stronger when there was visual contact between participants and in the slower tempo. Strength of Lag-1 and +1 correlations between the series of IOI of participants in the mixed movement conditions did not reveal significant differences, suggesting that both participants adapted to one another equally across both lags, even when they applied different performance strategies. **Conclusions:** Our results show that adding expressive gesture improves the control and communication of expressive timing in performance. Adding movement while performing establishes different timing relationships between musicians. Also, the differences in resulting vector length and variability of IOIs between the two modalities in the ‘expressive gesture’ strategy suggest that timing in music performance is being monitored by different modalities and that using the body as a controller, together with a strong coupling between visual and auditory cues, leads to a better performance.

**MUSIC THERAPY**
Blandijn - Auditorium B, 11:00-12:00

**11:00-11:30**
Temporal interpersonal synchronization in accompanied musical improvisations with people with borderline personality disorder
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**Keywords:** Clinical improvisation, borderline personality disorder, temporal interpersonal synchronization, music therapy

**Background:** Borderline Personality Disorder (BPD) is a serious and complex mental disorder characterized by pervasive difficulties with emotion regulation, impulse control, and instability in interpersonal relationships and self-image. Interpersonal dysfunction has always been a prominent characteristic of BPD, indicating a need for research to identify the specific interpersonal processes that are problematic for individuals diagnosed with BPD. Most previous research in this area has concentrated on self-report measurements and interviews to study interpersonal dysfunction. We propose accompanied musical improvisation as an alternative method to investigate interpersonal processes within an embodied context of the interaction itself. Musical interaction hinges on the phenomenon of temporal interpersonal synchronization, which entails the capacity to plan and execute specific actions at precise times, in relation to an accompanying therapist. **Aims:** This study aimed to investigate the phenomenon of temporal interpersonal synchronization, using a novel, carefully planned ABA’ accompanied piano improvisation paradigm, taking into account the possible influences of mood, psychotropic medication, general attachment, impulsivity, personality and musicality. **Method:** 25 BPD patients and 25 matched normal controls participated in the improvisation paradigm. The improvisations were recorded using a MIDI enabled piano, and the accompanist’s part was then beat-tracked, and several variables from the field of Music Information Retrieval (MIR) were calculated in an attempt to quantify how a participant’s temporal interpersonal synchronization varied over the course of the improvisation. For example, one quantification of temporal interpersonal synchronization, called metrical deviation, measured the mean absolute deviation between the participants’ notes and the nearest 8th note beats. **Results:** Results indicated that over the course of the improvisation B section, controls’ metrical deviations decreased (temporal interpersonal synchrony became more
precise) whereas that of the patients did not. We will illustrate this with video examples. In addition, a binary regression model built on a linear combination of metrical deviation in the first and second halves of section B performed significantly better than chance at distinguishing patients and controls. Conclusions: In this presentation the outcome of a case-control study with patients with borderline personality disorder will be presented. A quantification of temporal interpersonal synchronization emerged as the most significant musical phenomenon in a predictive/diagnostic model of BPD. Implicit social learning processes within the musical interaction of clinical improvisation will be presented as new insight in music therapy.

11:30-12:00
Assessing the quality of relationship in music therapy sessions with the focus on language
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Keywords: Music therapy, interaction, autism, video analysis, language, scale, relationship

Background: Music therapy is often suggested if the main symptoms are difficulties with the interpersonal relationships. Even without eye or body contact music can help to create an interpersonal relationship as well as to express own and foreign feelings respectively (Stern, 2007). In order to assess the quality of this relationship in a music therapy session the AQR-instrument (Assessment of the Quality of Relationship, Schumacher, Calvet, & Reimer, 2013) has been developed. The AQR-instrument consists of three scales focusing on the patient, namely an instrumental, a vocal-pre-speech, and a physical-emotional scale, and one scale focusing on the therapist. Every scale differentiates between six qualities of relationship that are characterized by specific features. These scales can be applied for diagnostic, documentation, and finally for the evaluation of intervention techniques.

Aims: The current paper deals with the further development of the AQR-instrument focusing on the not yet elaborated aspects of vocal expressions using words in contrast to vocal-pre-speech. With this language scale the quality of relationship in music therapy sessions in which language is used can be evaluated, and therefore intervention techniques adjusted accordingly.

Method: Extensive audio- and video material of ten years of music therapy course with of a boy with Autism Spectrum Disorder serves as the data set. After selecting relevant sequences using qualitative sampling techniques, the sequences are analysed with the software Interact. The methodological procedure combines deductive and inductive approaches that is categories are developed based on the one hand on the theoretical background (developmental psychology, language development), and on the other hand on the material leading to supplemented categories during the coding process.

Results: The analysis points out different qualities of relationship (so called modi) focusing on language that can be described with the help of specific characteristics. Singing (when using words) is one important aspect of the scale. Categories and descriptions as well as video samples for the detected modi will be introduced.

Conclusions: The analysis serves as a first draft of a language scale assessing the quality of relationship in music therapy sessions. The scale should now be applied to further video sequences, especially further clinical pictures apart from autism. Furthermore, quality criteria such as objectivity, validity and reliability should be investigated assessing the video scenario for example by at least two persons.

References
Not so scary anymore: Screaming voices embedded in harmonic contexts are more positive and less arousing

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**Keywords:** Emotional evaluation, human voice, auditory scene analysis, anger, arousal

**Background:** Vocal arousal is an essential feature of human and animal communication, conveying a wide range of emotions including fear, anger, as well as conditions of danger, excitation, and challenge (Blumstein et al., 2012). Here, special attention is given to recent psychophysical and imaging studies describing how the human brain extracts low-level acoustical features from the voice to infer socio-emotional traits of the speaker. In particular, relationships have been documented between amplitude modulations in a specific range of frequencies, usually labeled as *roughness*, and the activity of subcortical structures critical to the rapid appraisal of danger (Arnal et al., 2015). Yet, it is not clear how higher-level factors - such as the acoustic context these voices are presented in - guide their processing, perception and evaluation. It is reasonable to believe that such context effects may be particularly important for music (Belin and Zatorre, 2015).

**Aims:** We investigated the influence of the type of background context (none / musical / non-musical) on the emotional evaluation (arousal and valence) of pitched vocal sounds.

**Method:** Two professional singers were asked to produce different pitched vowels (/a/) at different levels of anger, in order to obtain a set of naturally-produced voices with a coarse quantification of roughness. Recorded voices were embedded in two musical contexts (clean guitar, distorted guitar) and one non-musical control context (noise modulated by acoustic features of the distorted guitar). These stimuli were then normalized in loudness. We then let N = 23 participants evaluate the emotion (arousal and valence, on a Likert scale) conveyed by the voices, while intentionally ignoring the background. Participants first practiced the task with voices presented alone, for which they received fake performance feedback (in fact a random score controlled by the experimenter). Participants were then instructed to aim for the same performance, now with voices embedded in different contexts, and keep coherent with their former judgements. From an observer's point of view, the auditory stimuli were thus composed of both signal (voices) and noise (guitar or modulated noise), and they had to evaluate the signal while ignoring the noise.

**Results:** We expected a context effect specifically related to the musicality of the background: as compared to the voices presented alone, angry voices in a congruent musical context (distorted guitar) would be judged more positive and less arousing, but not in the other incongruent contexts (clean guitar, distorted noise). Results suggested a more general effect: valence and arousal ratings were significantly affected by both musical and non-musical contexts, with contexts containing roughness indices (distorted guitar and noise) leading to lower valence and higher perceived arousal of the target voices.

**Conclusions:** These results suggest that high-level (e.g., emotional) & local (i.e. on one object of the auditory scene) judgments in the task are in fact computed on the basis of low-level indices (e.g., harmonic to noise ratio) of the *global* (signal + background) auditory scene.
References


11:30-12:00
Features of vocal expression in song and speech: Examination of ‘speechsong’
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Keywords: Classification, speech, song, Pierrot lunaire

Background: Although it is usually easy to classify vocal performances as being sung or spoken, the perceptual impressions leading to such a choice remain unclear. For decades, speech and song have been described with respect to pitch changes. However, vocal expression is not limited to pitch and other characteristics might influence our perception of vocalizations as being sung or spoken. A precise description of what constitutes a listener’s impression of a performer speaking or singing is challenging. Indeed, we implicitly develop categories when listening to vocal expression. As shown by the speech-to-song illusion (Deutsch et al., 2011), once a vocalization is categorized as song (after several repetitions of the same phrase), listeners interpret actual speech as a sung phrase. Such top-down processes make it difficult to examine a listener’s perception of vocalizations as being spoken or sung. One way to overcome such difficulty is to examine the perception of performances which are not initially categorized as speech or song. The present study focuses on the musical phenomenon called ‘speech-song’, described as an expressionist vocal technique resembling an intermediate state between speaking and singing. Aims: This study aims to clarify the vocal features associated with speaking and singing on an impressionistic level by investigating speechsong performances of a musical piece by Arnold Schoenberg (1914): ‘Pierrot lunaire’ (op. 21). Method: 25 students of speech science (all reported 4–18 years of musical training, M = 6.76 years) participated in the study and were familiar with the evaluation tool but not with the musical piece examined. As musical material, twenty recordings of the first stanza of piece No. 7 ‘The Sick Moon’ were chosen, ranging from 1940 to 2010, representing a wide variety of interpretations. The questionnaire, adapted from Bose (2010), focused on the vocal-articulatory expression. Items were grouped in categories: pitch, sound of voice, articulation and complex phenomena such as mode of phonation (i.e., song or speech) and rhythm. With few exceptions, the scales allowed for rating each vocal feature as being ‘Just About Right’ (JAR) or, for example in the case of average pitch, as ‘too/much too high’ or ‘too/much too low’. After providing information about the composer and the piece under study, excerpts were played in a random order (three times) and participants filled in the questionnaire. Results: Spearman coefficients were computed to estimate the pairwise correlations between the 25 participants (rating 20 items for each of the 20 interpretations). The median correlation coefficient ($r = .339, SD = 0.072$) supports high inter-rater agreement despite the atypical character of the piece under study. The following features are associated with the item ‘mode of phonation’ (according to Spearman correlations and chi-square tests), i.e., perception of the performances as song (or speech). Note that the association with ‘speech’ is represented by the antonyms (e.g., low average pitch, sudden pitch changes, etc.): ‘High’ average pitch ($r = .51, p < .001$), ‘continuous’ pitch changes ($\chi^2 = 22.24, p < .001$), ‘inflected’ pitch contour ($r = -21, p = .009$), ‘wide’ pitch range ($r = -.19, p = .036$), ‘bright’ timbre ($r = .34, p < .001$), ‘wide’ faucal distance ($r = -.20, p = .019$), ‘head voice’ register ($\chi^2 = 76.38$, WED 2
By examining the relation between the features and singing/speaking mode of phonation, our results confirm the importance of pitch (average pitch, changes, contour, range), but also point out the relevance of timbre, faucal distance, register, and tension among the 19 items proposed to the listeners. **Conclusions:** Besides highlighting the vocal features associated with speech and song, this study supports the relevance of the present approach (i.e., focusing on a theoretical middle category) to better understand vocal expression in song and speech.

**References**

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**JAZZ EXPERTISE**
Blandijn - Room 110.079, 11:00-12:00

**11:00-11:30**
**Jazz musicians’ tune identification from harmony**
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**Keywords:** Memory for harmony, tune identification, jazz, musical training

**Background:** Research has shown that listeners with extensive musical training are much better at identifying music from chord progressions than other listeners (Jimenez & Kuusi, 2016). The present study investigates what specific aspects of jazz musicians’ training contribute to their ability to identify music from chord progressions. Jazz musicians were chosen for this study because memorization of chord progressions and attention to harmonic elements during improvisation is central to the performance of most styles of jazz music and because the practice of identifying songs from chord progressions is sometimes used by jazz musicians as a method to cultivate their listening skills (Berliner, 1994). We expected activities associated with the development of jazz musicians’ awareness of chord progressions to be connected to a greater ability to identify music form chord progressions. **Aims:** The aim of this study is to clarify which aspects of musical training in jazz are associated with a greater ability to identify music from harmony. **Method:** Participants (*N*=71, 16 female, 55 male, mean age = 32.9, *SD* = 13.03) were either professional jazz students (*N*=42) or professional jazz musicians (*N*=29). The pieces for the experiment were chosen according to their popularity on the music website LastFM.com, their harmonic uniqueness, rhythmic density, and harmonic rhythm, as well as on pilot results regarding jazz musicians’ familiarity with the pieces. Roots and main chord qualities for the chord progressions consisting of seven, eight, or nine chords from the beginning of the main theme of the standard were chosen according to chord information from Hal Leonard’s *Real Books*. The top voice of the chord progressions was composed to represent the most important notes of the original melody of the jazz standard. In the main experiment, participants were first asked to listen to each chord progression played with a digital piano sound and to identify the piece from which the chord progression was taken. The tunes were then presented as commercial recordings; participants were asked...
to name the tunes and to provide information about whether or not they had ever played their chords. After finishing the experiment, the participants responded to a questionnaire about their musical training (e.g., amount of time playing; imitating and transcribing chord progressions, bass lines, and melodic lines) and asking them to write out (with chord symbols/labels) the most typical first four chords of each piece used in the experiment. **Results:** A factor analysis of participant variables revealed four main factors: (1) years of experience playing jazz, (2) amount of experience imitating and transcribing jazz pieces, (3) years of jazz theory and jazz aural skills classes, and (4) specialized familiarity with the material (i.e. having played the chords of the target pieces and being able to write down their chord labels). A regression analysis revealed that familiarity was the only statistically significant participant factor influencing music identification from chords. We also analysed the effect of specialized familiarity at the case level, that is, whether or not the participant had played and/or written the chords of the individual target piece. ANOVA analysis confirmed that the influence of specific specialized familiarity was more important than participants' global specialized familiarity with the material. **Conclusions:** Results from this experiment show that when Jazz musicians are familiar enough with the target pieces to name them from commercial recordings, specialized experiences with the chords progressions of the target pieces have a considerably greater effect on music identification from chords than activities believed to increase listeners' general awareness of harmony (e.g., playing a harmonic instrument, taking theory classes, playing chords by ear, etc.).

**References**

11:30-12:00

**Diversity in conceptualizing improvisational expertise**

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**Keywords:** Improvisation, cognitive style, expertise, jazz

**Background:** Improvisational expertise in jazz entails a mixture of musical knowledge, skills, and attitudes that are needed to improvise consistently and superiorly on a set of representative improvisational tasks. The composition of this mixture is not static, but subject to change due to the continuous evolution of jazz music. Since there is a persistent debate in the jazz field between those who want to operate within existing ‘improvisational’ frameworks and those who prefer to restructure these frameworks (cf. the ‘jazz/not jazz-discussion’), we expect jazz experts to have different opinion on improvisational expertise as well. **Aims:** We explored this issue and specifically addressed differences and similarities between more adaptive and more innovative jazz experts (see also Stoyanov, Jablokow, Rosas, Wopereis, & Kirschner, 2017). We used Kirton's Adaption-Innovation theory (2006) to distinguish adaptive and innovative jazz experts. According to Kirton, adaptive experts prefer to ‘do things better’ when solving (creative) problems, while innovative experts favor to ‘do things differently’ in similar situations. The aim of our study was to reveal and compare conceptions of improvisational expertise between the two expert groups. We consider such conceptions important for those who design improvisation instruction for (future) professional musicians. **Method:** Twenty-four renowned jazz musicians, teachers, and critics participated in this study. They were categorized as ‘adaptor’ or ‘innovator’ using Kirton’s Adaption-Innovation Inventory (Kirton, 2006). Both adaptors and innovators completed Trochim’s Group
Concept Mapping (GCM) procedure to generate, sort, and rate constituents of improvisational expertise (Kane & Trochim, 2007; Wopereis, Stoyanov, Kirschner, & Van Merriënboer, 2013). Multivariate data analyses including multidimensional scaling and a hierarchical cluster analysis resulted in a two-dimensional concept map for each group (two so-called ‘cluster maps’). Results: The experts generated a total of 169 statements related to improvisational expertise. The adaptors categorized these statements into five clusters; the innovators sorted them into 14. Both adaptors and innovators acknowledged the importance of basic musical skills and regulation skills for jazz improvisation. These clusters were manifest in both cluster maps. Beside this similarity we also identified differences between the two expert groups. The cluster map of the innovators for instance underlined their interest in artistic boundary crossing, risk-taking, and the creation of a personal voice. Interestingly, we could not discern such clusters in the adaptors’ cluster map. Their map emphasized the need to build and strengthen (a variety of) existing musical idioms. The ratings of statements of both groups were comparable. Non-parametric tests revealed only three statements to be significantly different. Conclusions: The results of this study indicate that innovative jazz experts fixate on more aspects of improvisational expertise than adaptive jazz experts. They also seem to focus more on ‘improvising differently’ (e.g., by means of risk taking and artistic boundary crossing) than on ‘improvising better within prevailing musical frameworks or idioms’. This is in line with Kirton’s Adaption-Innovation theory. For jazz educators it is important to realize that jazz experts have different views on improvisational expertise. To address diverse views on expertise in (early) improvisation instruction, jazz educators should have the ability to differentiate instruction. This study provides conceptual input for such instruction. Future research should aim at revealing strategies to design effective differential instruction for (continuing) improvisational expertise development in jazz musicians.

References

PERCEPTION
Blandijn - Auditorium A, 13:30-15:30

13:30-14:00

Is musical consonance a signal of social affiliation?
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Keywords: Consonance, coordination, social cognition, musical interaction

Background: Our capacity to express and recognize emotional content in music has been the subject of fervent empirical research in the past two decades. Musical expression is often thought to rely much on the same
acoustical characteristics as speech emotional prosody: music may e.g. exult like joyful speech with fast pace and high intensity, or sorrow like sad voice with monotonous pitches and dark timbres. The picture is less clear however when music is considered a medium not only for basic emotions, but also for interpersonal emotions. Group music making and choir singing have been linked to social effects such as increased trustworthiness (Anshel & Kipper, 1988) and empathy (Rabinowitch, Cross, & Burnard, 2013), but it is unclear whether these effects are mediated by acoustic aspects of the interactions or rather the simple fact that these are all satisfying group activities. **Aims:** In recent work (Aucouturier & Canonne, 2017), we asked duets of musical improvisers to communicate 5 types of non-musical social intentions, such as being domineering, disdainful or conciliatory, to one another using their sole musical interaction, and found that vertical/harmonic coordination covaried with the affiliatory nature of the social relations encoded in the interactions: consonant/mirrored for high-affiliation attitudes and dissonant/opposed for low affiliation. It remains an open question, however, whether observers actually make use of these cues, i.e., if musical consonance functions for listeners as a signal of social affiliation. Here, we manipulate the consonance between interacting musicians to give causal evidence that it is indeed the case. **Method:** We selected 5 high-affiliation, high-consonance interactions from the corpus of Aucouturier & Canonne (2017), and manipulated their degree of harmonic coordination by de-tuning one of the two musicians by one semitone. We then asked N=24 non-musicians (female: 17, M=21.2yo, SD=2.7) to rate the attitude of musicians in both original and manipulated extracts along the two dimensions of social affiliation (from affiliatory to non-affiliatory) and control (from dominant to submissive). **Results:** Musicians involved in interactions with decreased harmonic coordination (de-tuned extracts) were judged significantly less affiliatory to their partner (M=5.5) than in the original, non-manipulated interactions (M=6.0, t(21)=−2.50, p =.02), while the manipulation did not affect their perceived level of control (t(21)=0.72, p=.48). **Conclusions:** By manipulating cues of consonance between musicians in musical interaction and testing the effect on perception, this study establishes a direct causal relationship between spectral/harmonic coordination in music and non-musicians' judgments of the level of affiliation in the underlying social relations. That harmonic complementarity should be a cue for social observation in musical situations is particularly interesting in a context where preference for musical consonance was long believed to be very strongly biologically determined, until recent findings have shown that it is in fact more culturally-driven (McDermott et al, 2016). More generally, these results provide empirical support to the recent view that music is not only social and participatory in its production, but also in its perception: music can be perceived as the sonic trace of social relations between a group of real or virtual agents, and the social properties of these relations can be computed from the musical properties of the interaction.

**References**


Perceptual processing of a complex musical context: Testing a more realistic mismatch negativity paradigm

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**Keywords:** Auditory perception, music perception, magnetoencephalography, multifeature, MMN, ERP

**Background:** One striking property of the human auditory system is its capacity to transform a simple acoustic wave into a complex percept such as music. While the exact mechanisms of this process are unknown, the evidence suggests that the formulation, violation and update of auditory predictions play a fundamental role in music perception. The mismatch negativity (MMN) is a brain response that offers a unique insight into these processes. The MMN is elicited by deviants in a series of repetitive sounds and reflects the perception of change in physical and abstract sound regularities. Therefore, it is regarded as a prediction error signal and a neural correlate of the updating of predictive perceptual models. In music, the MMN has been particularly valuable for the assessment of musical expectations, learning and expertise. However, the MMN paradigm has an important limitation: its ecological validity. Most studies use single tones or simple pitch patterns as stimuli failing to represent the complexity of everyday music. This is important since music perception is highly dependent on the statistical regularities of often hugely varying sound contexts. Furthermore, different types of listeners (e.g., jazz vs. classical musicians) might perceive different aspects and types of music in different ways. These nuances are very difficult to capture with current paradigms.

**Aims:** Our main goal is to determine if it is possible to record MMNs in a more ecologically valid and complex musical context. To this aim we will develop a new paradigm using more real-sounding stimuli. Our stimuli will be two-part music excerpts made by adding a melody to a previous design based on the Alberti bass (Vuust et al., 2011). Our second goal is to determine how the complexity of this context affects the predictive processes indexed by the MMN. We will achieve this in two stages. First, we want to establish how the pitch complexity of the melody affects predictions for different features. Thus, we will compare the melody and the bass when presented separately. Second, we want to determine how presenting the melody and the bass together affects MMN responses. To this purpose we will compare the two-part excerpts with the melody and the bass presented individually.

**Method:** We will measure non-musicians responses to deviants (tuning, intensity, timbre and slide) embedded in two-part music while they watch a silent movie. Stimuli will consist of several melodies placed on top of the Alberti bass used previously. The musical excerpts will be randomly transposed to several keys. There will be four different blocks: melody alone, bass alone, melody and bass together and bass in the pitch range of the melody. This last block will be added to control for pitch height confounds. We will use Magnetoencephalography to record MMNs, and magnetic resonance imaging (MRI) to aid source localization.

**Results:** We expect MMNs for all features in all blocks. For the comparison between the melody and the bass, we hypothesize reduced—but still present—MMNs in the melody for pitch related features (tuning, slide). This is because the melody’s pitch complexity is higher and its pitch predictability is lower, which makes pitch related deviants less surprising. Regarding the two-part excerpts, previous studies suggested a reduction of MMN when several streams are heard simultaneously. This might be due to competition for neural resources. In consequence, we expect reduced MMNs in this condition compared to the bass and the melody presented separately.

**Conclusions:** Our study can open the door for testing auditory perception in more real-sounding and complex musical contexts. It may lay the ground for the research of more fine-grained questions with different types of listeners such as particular kinds of musicians and cochlear implant users. We hope our efforts promote the interest in the use of more realistic stimuli in music research.
Perception of tone clusters

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Keywords: Pitch perception, clusters, contemporary keyboard music

Background: During the 20th century, tone clusters (‘chords’ consisting of consecutive pitches separated by small intervals) have become a common feature in the compositional language, especially in keyboard pieces. Composers are using it as a means to create pitch aggregates with varying weights without having a clear tonal reference. Yet, hardly any research has been done about the perceptual functioning of these clusters. Aims: We investigate how the size, density and content of the tone clusters influence their perception by the (expert) listener. Method: Three experiments were conducted, presenting manipulated piano-clusters to groups of expert listeners (N = 64-100). In the first experiment combinations of two small (3 semitones), medium (6 semitones) or large (12 semitones) chromatic clusters were presented, varying the gap between the two clusters from one semitone to two octaves. Listeners were asked if they heard one single cluster or a combination of two tone clusters. In the second experiment chromatic clusters varying in size between 3 semitones and one octave were presented. Listeners had to judge the distance between the lowest and highest pitch in the cluster. In the third experiment an interval of a fifth (c-g) was filled with all possible combinations of pitches, creating every possible ‘chord’ between a triad and a full chromatic cluster. Participants were asked to indicate the number of tones perceived and to identify the sounding pitches using a keyboard representation. Results: The results of the first experiment show that clusters largely mask the presence of gaps up to a full octave. The second experiment shows that adding pitches to a cluster is highly effective only up to a fourth (6 semitones) but loses its effect when the cluster reaches the range of one octave. The results of the third experiment are more difficult to summarize. It shows large differences in ability to distinguish pitch between participants. A detailed analysis shows which pitch aggregates are perceived to be more dense and which as more transparent, which pitch combinations are preferably perceived and which are the most common sources of confusion between different pitch aggregates. Conclusions: We found that a size of around one octave is crucial in the perception of clusters: it needs about an interval of an octave to detect a gap between two clusters and adding more pitches to a chromatic cluster over the size of an octave does not contribute to the perception of the cluster size. The results of the third experiment give us a detailed view on how specific intervals and pitch combinations contribute to the perceived complexity and how some pitch combinations are preferred in perception.
Perceiving emotion from music performance cues: Studies with normal-hearing listeners and cochlear implant users

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Keywords: Cochlear implants, music, emotion, perception, auditory features, simulation

Background: Because of both sensorineural hearing loss and limitations of the cochlear implant (CI), users typically perform poorly in pitch discrimination tasks and hear with reduced dynamic range, relative to normal-hearing listeners. However, CI users can perceive emotion in music with accuracy significantly exceeding chance performance. Since emotion perception depends upon sensitivity to subtle variations in acoustic features, it is unclear how this level of performance is attained.

Aims: The following studies aimed to elucidate the underlying mechanisms by which CI users perceive emotion auditorily during musical performance, investigating differences in listening strategies for stimuli processed to attenuate particular auditory features. It was hypothesized that participants would focus preferentially on auditory features better preserved by the CI (\textit{i.e.} tempo and intensity, as opposed to frequency).

Method: Study 1. Twenty normal-hearing listeners were recruited. Participants listened to short musical excerpts, derived from a previous study, and judged the emotions conveyed (Anger, Fear, Happiness, Neutral or Sadness). There were four different stimuli conditions, with processing applied to attenuate either: frequency variation (frequency contour flattened to median), intensity variation (dynamic range compression) or temporal variation (dynamic time-warping with neutral stimulus). All stimuli were additionally processed with noise-band vocoder-based cochlear implant simulation. In each of the stimuli conditions, participants were pre-tested, then underwent a training phase, during which feedback was given after each emotion judgment, and stimuli were presented a second time, to facilitate learning. Lastly there was a post-test, in which participants made emotion judgments relating to previously unheard stimuli.

Study 2. Approximately ten CI users are being recruited, for an experiment following the same procedure as outlined above, except that stimuli will not be processed with the CI simulation.

Results: Study 1: Analyses were concerned with the extent that participants "learned" how to judge the stimuli, and whether this varied as a function of the stimuli processing condition or the emotion being judged. Across the different experimental phases, some learning did occur, but most strongly where duration cues were preserved. However, this learning did not generalize well to unseen stimuli. Sadness was well identified (perhaps due to strong durational cues), in addition to Anger and Neutral. Three-way loglinear analysis indicated that the Processing $\times$ Emotion $\times$ Response interaction was significant, and follow-up chi-square analysis revealed a significant effect of Emotion upon judgment accuracy in only the 'Original' stimuli.

Conclusions: With CI simulation, duration information appears to be the most helpful auditory cue. Therefore, there is preliminary evidence that better-preserved features may be prioritized – in turn promoting better performance – but this strategy must be learned through practice, and is more successful for some emotions than others (\textit{e.g.}, Sadness). Since performance did not always generalize to novel stimuli, it is possible that, to some extent, participants learned acoustic features for specific stimuli, as opposed to more general associations between acoustic feature configurations and emotions. To follow up this, a currently ongoing project will attempt to replicate the aforementioned results with real CI users. Additionally, future work will utilize logistic regression modeling to examine which auditory features lead to optimal emotion judgment accuracy – and whether these correspond with the strategies used by participants.
Comparative analysis of brain activation in trained musicians during attentive motionless listening of regular and irregular rhythmic patterns

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Keywords: Irregular rhythms, motor-related areas, rhythm processing, fMRI

Background: Neuroimaging of motionless subjects has shown that listening to music activates auditory, linguistic, and less expectedly motor-related cortical and subcortical areas. Motor-structures such as the Basal Ganglia (BG) and the Supplementary Motor Cortex are activated in trained musicians when attending to rhythm (Grahn & Brett, 2007). It has been suggested that BG activation is not only coincident, but necessary for keeping up with regular rhythms as well as internal generation of beat (Grahn, 2009). In spite of consistent data correlating the activation of motor-related structures and rhythm perception, further conclusive evidence is needed to clarify the role of BG. Furthermore, anatomical and functional differences have been found in musicians with respect to non-musicians (Jongsma et al, 2004; Ohnishi et al, 2001).

Aims: To investigate whether the areas recruited for irregular rhythm processing differ from the ones required for regular rhythm processing, particularly the motor-related areas, and whether instrument specialization affect rhythm processing in the brain.

Method: 13 irregular rhythmic patterns were selected among 113 sound samples of Balkan, Indian, African and Flemish music. Test subjects were classified as harmonic or harmonic-melodic according to their instruments. The sample was composed of 14 musicians: 5 women and 9 men. 13 regular and 13 irregular rhythms were presented randomly to the musicians and they were instructed to mentally decipher the time signature of each rhythm without moving while subjecting them to EPI-based fMRI.

Results: Despite every stimulus across experimental groups lead to activation of motor-related structures, the areas recruited were not always the same. For example, in the cohort of melodic instrumentalists, BG were noticeably activated while listening to regular rhythms; on the other hand, the cerebellum was more active while listening to irregular rhythms. This study gives evidence of differential neural activation between regular and irregular rhythm processing.

Conclusions: Results obtained in this study corroborate previous data of motor-related areas activation during music attentive motionless listening; however, the circuits activated differed among conditions and instrument specialization, suggesting a special function of BG for regular rhythm processing (in accordance to Grahn’s results). This study raises new questions about the differential contribution of other motor-related areas in the processing of diverse rhythmic patterns.

References


Periodicity detection by neural transformation

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Keywords: Harmony perception, response frequency spectra, periodicity detection, neural networks, spiking, non-linear activation

Background: It is well-known that during the hearing process in the ear and the brain an acoustic stimulus, e.g. a musical harmony, is transformed in a highly non-linear way. The input signal, which may be a superposition of periodic signals of certain frequencies and their overtones, undergoes a neural transformation in the brain. This can be studied by comparing the frequency spectrum of the input stimulus and its response spectrum in the auditory brainstem. The latter shows additional frequencies which are not present in the input spectrum, in particular the periodicity pitch frequency (also known as missing fundamental). Recent results from neuroscience demonstrate that periodicities of complex chords can be detected in the human brain (Langner, 2015).

Aims: The aim of this paper is to find out relevant factors that lead to the occurrence of the periodicity pitch in the response spectrum of a signal. Reasons may be (among others): 1) phase-locking induced by neurons with intrinsic oscillation frequency, different from the frequencies in the input; 2) autocorrelation which may be realized by superposition of the input signal and a delayed version of it; 3) the transformation of the input signal into pulse trains (spikes) whose maximal amplitude is limited by a fixed uniform value.

Method: The stimuli from other studies are used as input to a theoretical model and compared with the corresponding response spectra in the brain (see e.g. Lee et al., 2015). In the brain, spikes are created when the action potential crosses some threshold, namely if the net excitation, received by a neuron over a short period of time, is large enough. Therefore, in the theoretical model proposed here, the input signal is transformed as in artificial neural networks: A non-linear, strictly increasing sigmoidal activation function, e.g. the logistic function, the hyperbolic or arc tangent, or simply the sign function, can be applied to the input which in this case is a signal over time. By this, the input signal is transformed into a rectangular pulse train with uniform maximal amplitude.

Results: Both the response frequency spectra and those computed by the theoretical model (by means of a MatLab/Octave implementation written by the author) show: 1) The spectra contain the periodicity pitch frequency, not arbitrary difference tones. 2) The peaks in the response spectrum are sharper the more pulse-like the transformed input is. 3) The peaks at the periodicity pitch frequencies are more salient for more consonant harmonies. The good correlation between relative periodicity and consonance is well known (see e.g., Stolzenburg, 2015).

Conclusions: In summary, the most important factor during the neural transformation for periodicity detection seems to be the spiking with uniform, limited amplitude (i.e. reason #3). Even for random phase difference or slightly mistuned intervals the results do not change. Autocorrelation, intrinsic oscillation, phase-locking, or similar mechanisms (see e.g., Lerud et al., 2014) are not needed to explain the response spectra but nevertheless correlate well with the empirical findings. The result that the periodicity pitch appears in the response spectrum and not arbitrary difference tones can be reproduced by Fourier analysis of amplitude-limited pulse trains. Nonetheless, it remains an interesting research question whether a similar effect can be noted also in the response spectrum when the harmonic tones are not presented simultaneously, but in succession. This will be the subject of future work.
Simulation in musical interaction: Causal involvement of dorsal premotor cortex in turn-taking accuracy

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Keywords
Motor simulation, performance, music interaction, TMS

Background: Coupling between sensory and motor representations has been well documented for familiar actions, and is strongest when the series of actions has been previously practiced (Lahav et al., 2007). One explanation for such coupling is the use of internal motor simulations to predict the outcome of both observed and produced acts. In this study we investigated the causal role of simulation in joint musical action, specifically its role in turn-taking. Two forms of motor simulation are motor resonance and motor imagery (Phillips-Silver & Keller, 2012). Motor resonance involves automatic (involuntary) activation of the motor system during passive observation of an action and is linked to the dorsal premotor cortex (dPMC - Caspers et al., 2010); motor imagery involves active (voluntary) imagination of oneself performing the observed action and is linked to the supplementary motor area (SMA - Lotze and Halsband, 2006). We hypothesized that if motor resonance is used for temporally accurate turn-taking, stimulation of the dPMC would impair entry accuracy when the partner’s part had been rehearsed to a greater degree than when the partner’s part had not been rehearsed; if motor imagery is used for temporally accurate turn-taking, then stimulation of the SMA would impair entry accuracy when the partner’s part had been rehearsed to a greater degree than when it had not been rehearsed. Aims: In this study we aimed to investigate the causal involvement of motor simulation in musical turn-taking. We further aimed to investigate whether use of simulation involved use of automatic motor resonance or active motor imagery. Method: We constructed piano duets in which each pianist used only one of their hands in a series of alternating solos. 16 expert piano participants were given the duets to rehearse and memorize (using specified fingerings) one week before the lab session. Two of the right-hand duets showed both left- and right-hand parts, and two showed only their own right-hand part (counterbalanced across participants). Participants memorised the duets, half of which included their co-performer’s part. In the experiment pianists played the right hand of these duets with a videoed partner, during which we temporarily disrupted the right dPMC or the SMA using double-pulse transcranial magnetic stimulation (110% of resting motor threshold) around the turn-switch. The accuracy of pianists’ entries were analysed in terms of the timing of their first keystroke in relation to the unheard metronome underlying their duet partner’s performance. Differences between their entry and this metronome (in ms) were converted into absolute values. Results: When pianists had previously practiced their co-performer’s part, stimulation of the dPMC significantly reduced their entry accuracy. Stimulation of the SMA caused no performance decrement. When pianists had not previously practiced their co-performer’s part, entry accuracy was
not affected by stimulation of either region. **Conclusions:** By combining a musical duet task with a real-time repetitive TMS protocol, we provide evidence indicating that the dorsal premotor cortex plays a causal role in accurate turn-taking coordination between a pianist and their observed interaction partner. Given the reported involvement of the dorsal premotor cortex in the simulation of observed actions, our findings suggest that and when observed actions are represented within one’s own motor system resonance-based motor simulation is used to determine the timing of turn-taking. Since turn-taking behavior is a fundamental feature of human communication, we suggest that such simulation is a foundational mechanism underlying the temporal dynamics of communicative joint action.

**References**


**15:00-15:30**

**Do vocal and instrumental primes affect word processing differently? An fMRI study on the influence of melodic primes on word processing in Chinese musicians and non-musicians**

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**Keywords:** Pitch contour prime, vocal versus instrumental, functional ROI, speech syllable processing

**Background:** In various societies, especially in tone language areas, speech surrogates serve a variety of purposes including long-distance communication, conveyance of message between close encounters, etc. Some of these speech surrogates map speech onto instrumental or whistling sounds by preserving only fundamental pitch or formant contours. How speech surrogates work is not yet well understood, but there is a suggestion that tonal information may assist tone-language speakers to access their mental lexicons. A behavioral study reported that pitch contour primes facilitate response times in a word repetition task, and that vocal primes lead to a stronger facilitation than instrumental ones in Mandarin-speaking non-musicians. Chinese musicians, however, showed no significant effect for instrumental primes, indicating that they are less influenced by melodic primes in the same task. **Aims:** This study investigates whether brain activity in Chinese musicians and non-musicians during a word repetition task is differently affected by vocal and instrumental pitch contour primes. **Method:** 24 native Mandarin speakers took part in the study (14 non-musicians and 10 musicians). While their brain activities were scanned, the participants performed 1) a passive task: passively listening to blocked presentation of vocal and instrumental pitch contour primes, and 2) an active task: listening to spoken target Chinese syllables and repeating them silently. Each syllable was preceded (250ms SOA) by one of three prime types: white noise (control), instrumental (Chinese flute, Xiao), and vocal sounds with mean duration and intensity of the target syllables. The pitch contours of the primes match the 4 Mandarin speech tones. Imaging data were acquired on a
3T MRI scanner. A cluster analysis of the BOLD signal was followed by a fROI analysis of % activation changes. The fROIs that covers the temporal cortices, parts of Broca's, premotor, parietal areas, and several sub-cortical components. T-tests were performed and FDR controlled using the Benjamini-Hochberg procedure. **Results:** The analysis demonstrated that differences in effects of vocal and instrumental primes in musicians and non-musicians largely correspond to differential activation changes in the right superior temporal gyrus. The largest differences are found in the Heschl's gyri. Musicians showed greater % BOLD changes in left hemisphere than in right (difference = .04pp) while non-musicians did not show a significant hemispheric difference. Musicians showed the highest activation changes for instrumental primes in both hemispheres (% diff to controls= .06pp) whereas non-musicians showed the largest % BOLD changes for vocal primes (% diff to controls= .04pp).

**Conclusions:** For tone language speakers, vocal and instrumental primes affect syllable processing in musicians and non-musicians differently. The strongest activation is produced by instrumental primes in musicians but by vocal primes in non-musicians. Differential effects of vocal and instrumental pitch contour primes on syllable processing are significant in temporal areas (Heschl's gyrus, planum polare, planum tempolare, anterior and posterior superior temporal gyrus). The results contribute to an improved understanding of the different behavioural effects of pitch contour primes in musicians and non-musicians.

**References**

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**SYNCHRONY**

Blandijn - Room 100.072, 13:30-15:30

**13:30-14:00**

**Shifting the musical beat to influence running cadence**

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**Keywords:** Synchronous music, running, cadence, phase shifting

**Background:** The use of music in the fields of sport and rehabilitation has been explored in several ways. Mostly, these studies have dealt with the effect of different types or genres of music and the difference between using synchronous or asynchronous music. Within the studies on synchronous music there is some discrepancy as to what is considered to be synchronous. This varies from music with a tempo in the range of the tempo belonging to a certain task, to music that is exactly matched in tempo to the task's tempo. The use of tempo-matching music allows us to even do more fine-grained music alterations: shifting the beat to try to spontaneously manipulate a runner's cadence. **Aims:** Musical tempo has been shown to have an effect on running cadence. Instead of influencing running cadence by manipulating the musical tempo, we explored the possibility of spontaneously affecting cadence by shifting the phase of the musical beat. **Method:** Twenty-six recreational runners ran four minutes, nine times. The first minute of each 4-min sequence consisted of running without musical accompaniment. Running cadence was measured and the average cadence of the final 15 sec was used to select a musical track with matching tempo. In the following three minutes we tried to increase or decrease the runner's tempo up to 5%. Three different coupling strengths, meaning a small, medium or big timing difference between
the beat and the footfall, were tested. Results: The study revealed a significant main effect of the phase angle adjustment strategies on runners’ cadence and velocity. Furthermore, a significant gender interaction effect was found for runners’ cadence adaptation. Women spontaneously increased or decreased their running tempo with the +5% and -5% target tempo conditions respectively. Men, however, could be sped-up, but not slowed-down more than the decrease in cadence that was already observed when the musical beats were perfectly synchronized with the footfalls. In addition to effects on kinematics, the results showed higher enjoyment levels with music than with metronome, and a decrease in enjoyment with the -5% tempo conditions. Conclusions: Being able to influence runners’ cadence, velocity, and enjoyment through phase-shifted music is an interesting finding in the light of preventing and treating common running-related injuries.

Regularity and asynchrony when tapping to tactile, auditory and combined pulses

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Keywords: Tapping, cross modal perception, perceptual processing delay, tactile feedback

Background: This research is carried out with the aim to develop assistive technology that facilitates finding the beat in music. This is of interest to cochlear implant users and beat deaf people that want to partake in dance. The envisioned technology is to use tactile feedback on each musical beat. However, this raises a couple of fundamental questions about uni- and cross-modal perception, which are not addressed in similar context in the literature. Questions like: is it possible to follow a tactile pulse? If so, how well? Are there differences in the perceptual processing time between auditory and tactile queues? Does mean negative asynchrony (MNA) manifest itself in both modalities? Does it help if both tactile and auditory queues are present at the same time or does detract from the performance? Aims: The aim of this research is to answer the questions posed above in a controlled environment: dance was reduced to tapping. More specifically it aims to provide insights into both regularity and synchronization when a participant is requested to tap along with a) an auditory pulse b) a tactile pulse and c) a simultaneous auditory and tactile pulse in different tempi. Method: Subjects: 27 subjects were recruited, 16 female and 11 male. The group contained two professional musicians and three participants with cochlear implants (CI) implanted after language development. All subject had normal motor skills. The three CI users serve as case studies. Experimental set-up and procedure: the subjects were placed in a soundproof room with dimmed lightning. They were placed at a table with a drum equipped with strain gauges placed below the dominant hand and a vibrating device in the other. Headphones were used to deliver the auditory stimuli. Participants were requested to tap along with: a) an auditory pulse b) a tactile pulse and c) a simultaneous auditory and tactile pulse at three tempi (90, 120 and 150BPM). Auditory pulses where either discrete (a metronome) or continuous (music). The intervals between tactile pulses where either rigid (originating from the metronome) or contained small micro timing perturbations (originating from the music). Which makes a total of 18 conditions. Stimuli and equipment, analysis and data: A linear resonant actuator (LRA) was used to provide tactile feedback. To ensure the timing of stimuli and the precision of the measured taps a micro-controller was used. The micro-controller is responsible for all time-critical tasks and is capable of low latency feedback (replaying audio and tactile feedback) and input (registering taps). The music fragments were chosen to have a clear beat with an unambiguous tempo. The resulting experimental data consists of lists of timestamps in milliseconds. A list for the reference (beats or tactile feedback pulses) and a list for the received taps. The regularity of the taps (inter tap intervals) and asynchrony between taps and beats (pulses) can be analyzed subsequently. For the asynchrony circular statistics is used. Results: Subjects performed significantly better in
terms of regularity for the auditory and auditory/tactile condition with respect to the tactile only condition. As shown by an ANOVA on the standard deviation of the inter tap intervals and a post-hoc Tuckey test. There was a main effect for factors Tempo (90, 120 and 150BPM), Sound (music or metronome) and Stimulus (tactile or auditory). Changes in synchronization performance were also induced mainly by a change in from auditory to tactile feedback. A circular statistics anova showed significant effects for Stimulus and Tempo but the model only explained 18% of the variance. The data showed a similar performance for the auditory and tactile-auditory condition and worse performance for the tactile only condition in terms of synchronization. **Conclusions:** It is possible to follow a tactile pulse however regularity and synchronization both suffer. It is hard to attribute changes in synchronization between tactile or auditory conditions to perceptual processing delays. In the current experimental design it is not possible to attribute delays to feedback processing time, anticipatory behavior, motor control delay/problems or reaction times. Mean negative asynchrony (MNA) for auditory and combined (auditory and tactile) conditions were in the range of previous studies. The MNA's for the tactile conditions showed a remarkable dependence on tempo. In the 90BPM condition a clear anticipation (~20ms) was reported, for the 120BPM condition the mean was around zero, the 150BPM condition showed a positive MNA (a reaction vs anticipation). If both tactile and auditory queues are present at the same time our data suggest that tapping performance increases slightly (in terms of both regularity and synchronization).

### 14:30-15:00

**Timing of cued movement: Effects of cue complexity and cognitive function**

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**Keywords:** Cued movement, rehabilitation, cognitive function

**Background:** Auditory cueing is increasingly used in rehabilitation in order to (re)train movement. However, research on the efficacy of cued movement for motor skill acquisition, and specific contributing factors is scarce. The type or content of the cue may be influential; research suggests that the use of metronomes or music cues may have different consequences for the movement being cued, with metronomes thought to be more efficient, but music to be more engaging (cf. Bood et al., 2013), and more effective in older populations (Wittwer et al., 2013). Cognitive functioning level may also be important, as music is clearly more complex, and moving to an auditory cue is thought to also require attentional resources (Peper et al., 2012). Additionally, feelings of fatigue may interfere with cognitive function and consequently the performance of moving to a rhythmic cue. Hence, auditory cueing may not be suitable for neurological patients with reduced cognitive functioning, or complaints of fatigue. **Aims:** The current study assesses the effect of rhythmic cue complexity on the timing precision of a complex cued movement. Therefore, a comparison is made between the timing precision of metronome-cued movement and movement cued by music. Moreover, as cognitive factors may contribute to the precision of cued movement, working memory and attention were also assessed, alongside ratings of perceived fatigue and liking of the current task. A clarification of the influences of different kinds of rhythmic auditory cues, as well as the impact of working memory, attention and fatigue, will offer opportunities for fine-grained tailoring of cued movement paradigms to specific patient groups that may benefit from these interventions. **Method:** Thirty-four healthy non-musician volunteers (21 female, mean age 21.6 years, SD=1.8) completed three conditions where button press sequences were produced with four fingers on a button box, along with a visual cue. A silent condition functioned as a baseline, followed by two auditory conditions; where either metronome ticks, or music created to fit the button sequence were added to the visual cue. After each movement trial, participants rated their liking and their perceived fatigue. Additionally, a simple finger tapping task was conducted, and two
cognitive tasks to assess working memory and attention, namely the CDT (or Cijfer-Doorstreep Test, in which attention and processing speed are assessed), and the WAIS IV Digit Span Backwards. The precision of the movement timing was analysed using circular statistics, taking the standard deviation of the mean phase of the taps within the rhythmic periodicity. We compared the silent, metronome-cued and music-cued movement with a repeated-measures ANOVA, and the influence of cognitive factors added as covariates. The predictive effects of fatigue and preference on motor timing were assessed using a multiple linear regression. **Results:** The precision of the cued movement was affected by cueing condition; post hoc tests showed that for both the metronome and music, the timing variability was reduced in comparison to the silent condition ($p<.001$ for both). However, there were no differences in the variability of movement timing between metronome and music cueing ($p>0.05$). Neither cognitive measure had an effect on timing precision, nor did fatigue have predictive value. However, the liking of the task predicted the movement variability in both auditory cued conditions, with an auditory cue, but is not affected by cue complexity. Liking of the task predicts movement precision, in both cued movement conditions. Since working memory, attention or perceived fatigue did not affect movement precision, auditory cueing may be suitable for patients with reduced cognitive function, and liking may be a more relevant variable to take into account. However, more clinical research is needed to address this further.

**References**

**15:00-15:30**

**Interpersonal entrainment in Seoul shaman songs and its implication for musical timing structure**

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**Keywords:** Interpersonal entrainment, Korean *jangdan*, timing structure, structurally important timing events

**Background:** Even in metered music, musicians across cultures do not play exactly in time, beat by beat. Rather, they tend to move between more or less tightly entrained moments, within an entrained state. Interrogating how tightly entrained moments occur have focused on interpersonal entrainment in metered music (Alborno et al., 2015; Clayton et al., 2005; Doffman, 2008; Yoshida et al., 2012); others point to the relationship between deviation/entrainment and the beginning and closing of musical units/their climax (Yoshida et al.), and likewise between deviation/entrainment and preparation/conclusion of a rhythmic cycle (Alborno et al.). However, as musical structure is determined by our mind while listening to music (Lerdahl et al., 1983), and actualized while playing music, it can be assumed that structurally important timing events in ensemble performance are influenced by the ways of entrainment between players. **Aims:** Our case study based on four songs (ca.15'40),
taken from audio recordings of Seoul gut (a shaman ritual performance in the Seoul area) aims to identify structurally important timing events through the empirical studies on interpersonal entrainment. The rhythmic foundation of Korean shaman music is a cycle, called jangdan whose period ranges from one to ten minutes. We hypothesize that 1) there is a structurally important timing event, which serves as a focal point to control timing within that rhythmic cycle and 2) change in interpersonal entrainment may be related to that event. **Method:** We use audio data, extracting the interonset interval according to the jangdan's sub-beat and calculating the relative phase relationship (RPR) within two performance pairings: 1) between the drummer's (timekeeper) first beats and other beats; 2) between the drummer and shaman (leadvocals); 3) between the drummer and piri player (main accompanying instrument). **Results:** Based on the mean value of RPR of drum itself, the sub-beat (sb) 3, 9, and 12 were revealed as significant. Multiple players tended to synchronize with each other at specific time-points: between the vocals and drum, on the sbs 1 and 7, the starting points of phrase; between the piri and drum, on sub-beats acting as focal points organizing the time span of jangdan, i.e. onset (sb1), tempo confirming (sb3), and the climax of rhythmic energy flowing (sb9). **Conclusions:** We found that change in the degree of interpersonal entrainment is related to structurally important timing events; these serve as a focal point for performers to control and coordinate timing within the jangdan. This indicates that empirical research on musical interaction—in our case: interpersonal entrainment during musical performance—could allow eliciting embodied timing structure in music whose theory has not been established yet such as that of Korean traditional music.

**References**


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**EDUCATION & TRAINING**

Blandijn - Room 110.079, 13:30-15:30

**13:30-14:00**

Prevalence and predictors of music-related neuromyths among teachers and students

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**Keywords:** Educational neuroscience, music education, music students, music teachers, neuromyths, neuroscience in education

**Background:** Research on music cognition has produced impressive results relating to neuroplastic adaptations in musicians, cortical differences between active musicians and mere listeners of music, and distinct qualities in music processing among musically divergent participants. Such scientific results as well as results from other
school subjects and general education have found their way into classrooms and led to the emergence of educational neuroscience as the intersection between neuroscience, psychology and music education (Dekker et al., 2012). Many teachers show interest in the application of neuroscientific findings in school; however, communication between scientists and teachers is not always without problems. So-called neuromyths can appear due to simplification, misunderstanding, and, in some cases, the deliberate warping of neuroscientific results (OECD, 2002). The prevalence of unsubstantiated neuromyths among teachers can be detrimental for educational achievements. Aims: The aim of the present study (Düvel, Wolf, & Kopiez, 2017) was to investigate the prevalence and predictors of music-specific neuromyths among music teachers and students pursuing a teaching career in the subject of music. Method: Twenty-six theses were collected through literature research and subsequently evaluated by four experts with respect to the theses’ scientific substantiation and educational relevance. On this basis, 14 theses were selected, only seven of which are scientifically substantiated, the remaining seven were myths. In an online survey, music teachers ($n = 89$) and music students ($n = 125$) aiming at a teaching career evaluated the theses with regard to their scientific substantiation. Furthermore, related variables were gathered to determine possible predictors for a high performance in discriminating the theses as scientifically substantiated or not scientifically substantiated. Results: Teachers and students detected 77% and 78%, respectively, of the scientifically substantiated theses correctly. Of the seven myths, they correctly rejected 59% as scientifically unsubstantiated. Further analyses along the lines of signal detection theory (Macmillan & Creelman, 2005) revealed a sensitivity of $d' = 1.26$ ($SD = 1.12$) for the teachers and $d' = 1.48$ ($SD = 1.22$) for the music students (difference is not significant). Both groups showed a general tendency to evaluate the 14 theses as scientifically substantiated (bias $c = -0.36$ and $c = -0.41$, respectively). Multiple regression revealed predictors for a high discrimination performance. For the teachers these included having received a PhD degree, having studied to become a teacher and having read many media about educational neuroscience and related topics. For the students the predictors included the number of read media and the hitherto completed number of semesters. All predictor variables can be associated with a good level of scientific education. Conclusions: Both teachers and students are far from being experts on topics related to educational neuroscience in music. Especially those unsubstantiated myths using neuroscientific language, such as “brain hemisphere” or “cognitive abilities”, were often assumed to be correct (Weisberg et al., 2008). To foster a better ability in future music teachers to discriminate myths from genuine findings, a better education in music psychology and neuroscience may prove useful. Principally, a better communication between scientists, teachers and music educators would also help refute the belief in neuromyths.

References
14:00-14:30
Musical analysis and emotions: A case study of a teaching and learning strategy designed to promote optimal experiences
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Keywords: Musical analysis, teaching and learning, music performance, emotions, optimal experiences

Background: Musical analysis assessment should be a strategy to promote learning. Conversely, diverse factors might hinder student motivation, e.g., focusing only on technically difficult passages. Karlsson and Juslin (2008) suggest that the main issue of performance lessons is technique. On the other hand, Woody and McPherson (2010) argue that both children and adults learn music performance better if they concentrate on expression and emotions rather than only on technical skills. Should university lectures encourage emotion communication for motivating and helping students to achieve better learning outcomes as performers? Could this be done out of the practice classroom? Previous findings suggest that a musical analysis approach focused on the affective content of music might improve students’ expression, confidence and satisfaction during performance. Aims: The aim of this paper is to explore how such approach, implemented in a music analysis course, affects students’ experiences in solo performance assessments. Expected outcomes of this approach are that students overcome technical challenges and set learning goals in a more meaningful way; and improve their concentration, avoid thinking on negative extra-musical events and have positive experiences during their performance assessments. The author chose six of the nine flow dimensions (Jackson, Eklund, & Martin, 2010) to measure these outcomes: challenge-skill balance, clear goals, concentration on task, sense of control, loss of self-consciousness and autotelic experience. Action-awareness merging and time transformation were not considered necessary to the measurement; and unambiguous feedback presented a translation inaccuracy, in the Spanish version of the Flow State Scale (FSS) used (Calvo, Castuera, Ruano, Vaillo, & Gimeno, 2008). Method: Eight university students, in an advanced music analysis course, were trained on analysing the affective content of music. Additionally, they kept a journal of the learning process of a piece they had to play in the end-of-semester assessment, in which they applied the analytical approach to their performance. Four students fulfilled the requirements for the study: they kept the journal and analysed a piece of their final solo performance assessment. Data was collected from learning journals, semi-structured interviews and a questionnaire drawn from the Spanish long FSS. Questionnaires and interviews were applied to each participant after performance assessments, in three occasions: two before the journal strategy and the third after completing it. Categories from the interviews and journals were mapped against the chosen scale dimensions. Results: The questionnaires’ scores showed a particular increase in the last measurement. Although there might be multiple factors intervening in such increase, the analysis of interviews and journals confirmed that keeping a learning diary allowed a deeper learning and the setting of clearer performance goals. Three students stated they used musical analysis as a central strategy for preparing performance, for the first time, and obtained desired results. Additionally, all students recognized that focusing on emotion and expression, through analysis, contributed to novel positive experiences during both preparation and performance. Conclusions: Keeping the learning journal promoted self-regulated learning during the planning of performance. This, in addition to the novel analytical approach, transformed the musical analysis course into an appropriate environment to promote performance optimal experiences, which might contribute to further personal and professional development.
Does practise make perfect? An investigation on the effect of the presence of other people on eliciting the dominant response in musical performance

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Keywords: Social influence, performance accuracy, audience effect

Background: The theory of social influence states that the presence of others affects the performance of an individual (Brehm et al., 1999). There are two main ways this can manifest itself, the first is social facilitation in which the presence of other people improves the performance of the individual, the second is social inhibition, which has the opposite effect. The type of influence elicited (facilitation or inhibition) is thought to depend on an individual's dominant response to the task conducted (Cottrell et al., 1968). The most-likely dominant response for a well-practiced piece could be an improvement of performance, whereas for a poorly practiced piece this could be a decrease in performance accuracy. While these effects have been frequently studied through research in various performance areas, there is a general lack of research of social influence on musical performance. However, as the presence of other people is almost always indicated in music performance this study was designed to test the phenomenon. Aims: The aim of this study was to test the effect of the presence of other people on the accuracy and experience of musical performance. We hypothesized, 1) that the presence of other people during performance will change the performers' subjective experience of the performance; that 2) there is a difference in accuracy of performance between the well-practiced and poorly-practiced participants groups of participants, and 3) that when participants are performing in a room where others are present, this difference in accuracy of performance between well-practiced and poorly-practiced groups will be larger due to the dominant response being elicited. Method: These hypotheses were tested in a study in which 23 music students (aged between 18 and 22 years, 15 female) repeatedly performed Christmas carols in three different social influence conditions (mere presence of other people, evaluated by others and playing in co-action) and a control condition (alone). Before the experiment, participants were divided into two groups: one well-practiced and poorly-practiced group. Therefore, before performances, participants could practice the carols either six times (well-practiced) or two times (poorly-practiced). The accuracy of the performance was measured by listening to the recording of the participant and computing the percentage of how many notes from one verse and chorus of the randomly allocated piece was played correctly, both rhythmically and melodically. Results: The analysis of results shows that the evaluation co-presence condition significantly decreased the positivity of experience in both participant groups. However, while poorly-practiced performances generally lead to an increase in performance errors, this difference did not significantly change in the social influence conditions. This finding was indicated by
several non-significant interaction terms between the ANOVA factors presence of person and practice condition.

Conclusions: While experiments with higher test power might lead to different test outcomes, we conclude that the results of this study suggest that the accuracy of music performance is not affected in the same way as other behaviors that do show a significant response to social influence.

References

15:00-15:30
An electrophysiological investigation on the role of musical training on speech prosody processing and segmentation.
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Keywords: Musical training, speech, ERPs, neuroplasticity

Background: During the last decades researchers have highlighted the numerous attributes that music and language share. More recent studies suggest that musical training impacts on language processing and, that it influences the perception of pitch contour in speech (Schön, Magne & Besson, 2004) leading to enhanced perception of vocally expressed emotion (Lima & Castro, 2011) such as emotional prosody. The literature also suggests training to modify the detection of acoustic regularities in linguistic input, which is crucial for speech segmentation. Nevertheless, there is no consistent data clarifying whether musicians have enhanced speech segmentation abilities and which neural mechanisms musical training modifies. Thus, it is still unclear whether musical training affects the temporal course of emotional prosody processing and speech segmentation. Aims: The goals of this project were twofold. Firstly (Study 1), we investigated the effect of musical training on the electrophysiological correlates of emotional prosody processing by presenting participants with emotional and neutral prosodic sentences with intelligible and unintelligible semantic content. Secondly (Study 2), we examined the impact of musical training on auditory statistical learning abilities that are crucial for speech segmentation, by examining behavioral and electrophysiological data resulting from an Artificial Language Learning task (ALL).

Method: Musicians and healthy controls with no musical training participated in the studies. In Study 1, 228 sentences were presented in two conditions: i) semantic content condition (SCC) - 114 sentences with neutral semantic content (38 with happy, 38 with angry and 38 with neutral intonation); ii) ‘pure prosody’ condition (PPC) – the same sentences without semantic content. Subjects had to answer whether the sentences were spoken with neutral, happy or angry intonation, via a button press. In Study 2, subjects were presented with an ALL task in which they hear a continuous speech stream composed of prosodic pseudo-words with no perceivable boundaries. Segmentation was only possible if transitional probabilities between syllables were calculated. Afterwards, subjects heard previously presented pseudo-words from the stream intermixed with new ones and had to judge the familiarity of each one. Event-related potentials (ERPs) were recorded during both studies. Results: Study 1 revealed reduced P50 amplitude in musicians. A difference between SCC and PPC conditions was found in P50 and N100 amplitude in non-musicians only, and in P200 amplitude in musicians only. Furthermore, musicians were more accurate in recognizing angry prosody in PPC sentences. In Study 2, the preliminary behavioral findings were
not clear-cut in showing an effect of training. The electrophysiological results reveal that a negative ERP component peaking between 250–400 ms (N400-like), after words’ onset in the stream, emerged for both groups with musicians showing increased N400 amplitude. **Conclusions:** Together, ERP and behavioral findings suggest that the auditory expertise underlying long-term musical training may impact both early and late stages of vocal emotional processing, particularly the extraction of sensory information from an acoustic signal (P50, N100). They also suggest that musical expertise leads to facilitated recognition of angry prosody in sentences carrying no intelligible semantic information. Additionally, results suggest musical training to modify implicit auditory sequencing skills that can contribute to an increased capacity to process speech. These results provide partial support for the hypothesis that music and language share neural resources and for the transfer of training between music and language.

**References**

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**POSTER SESSION 2**
Blandijn - Floor +1, 15:30-16:30

**Poster 30**
Effects of vocals in advertising songs
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**Keywords:** Advertising, vocals, language, brand recall, purchase intention

**Background:** The research on music and advertising is inconsistent. Therefore, this study wants to contribute to the research field by examining vocals in advertising songs. A sung advertising message has an effect on listeners and is supposed to transport emotions and associations (Allan, 2006). But which factors of the vocals affect us the most? First, deeper voices are usually associated with credibility, reliability and attractiveness while higher voices are associated with the opposite (Chattopadhyay et al., 2003). Following this finding, a male voice should lead to a higher purchase intention than a female voice. Second, in many European countries English advertising songs are used even though it is not the native language in the country (Endmark AG, 2013). In a country like Germany English messages have a certain appeal, but are sometimes not comprehended by everyone. This means, the language of the vocals could have an impact on the perception of the spot and eventually on a potential purchase behavior. **Aims:** Since there are no distinct evidences for the effects of vocals in advertising songs, this study wants to examine how sung advertising messages affect reception, brand recall and purchase intentions of the listeners. Especially, we want to take a look at how the sex of the singer and the language used influence the listeners. **Method:** For this purpose, we conducted a 2x2 between-subjects laboratory experiment with 124 German participants (65% female, Mage = 21.6, SD = 4.2). The participants watched a TV commercial segment with seven spots under controlled conditions. In the middle of the segment a spot of an unknown and comparably neutral product (mineral water) was manipulated. The spot used was a foreign commercial to ensure that no
recipient knows the product or commercial. The spot was edited with four different soundtracks. We produced an advertising song that was sung two times by a female and two times by a male singer. The versions were sung in German or in English by both singers. This led to four different experimental conditions (female/German, female/English, male/German, and male/English). After watching the commercials, the participants were asked to complete a standardized questionnaire. On five-point Likert scales the participants should state how enjoyable (4 items, Cronbach's $\alpha = .87$) and credible (3 items, Cronbach's $\alpha = .73$) they received the manipulated spot and with four items they were asked about their purchase intentions for the product (Cronbach's $\alpha = .84$). The brand recall was tested with an unaided recall. Only the correctly recalled brand name was counted as a brand recall. Results: A two factorial ANOVA yields that the language and the sex of the voice have significant effects on the reception of the spot. This means that advertising songs that were sung in German ($M = 2.60$, $SD = 1.13$; English vocals: $M = 1.78$, $SD = .77$, $F(1,120) = 23.89$, $p < .01$) and by a male singer ($M = 2.39$, $SD = 1.19$; female singer: $M = 1.97$, $SD = .84$, $F(1,120) = 6.60$, $p < .05$) were received as more enjoyable. Only the language has an effect on the received credibility of the commercial. An English song was received as more credible ($M = 3.26$, $SD = .71$) than the same song with German vocals ($M = 2.74$, $SD = .89$, $F(1,120) = 12.82$, $p < .01$). But when German vocals were used the participants recalled the brand name (43% correct recall) significantly better in comparison with English lyrics (23% correct recall, $F(1,120) = 5.75$, $p < .05$). Neither the sex of the singer, nor the language of the song influenced the purchase intention significantly. Conclusions: Vocals sung by a male singer are received as more enjoyable than the vocals by the female singer. Which could be explained because of the prevalence of male speakers and singers in German commercials. It seems like a male voice is somehow more suitable for commercials, but we need more mediating factors for the explanation of this result. One of the most interesting results is that the advertising song with English vocals positively influences the credibility of the commercial. This might be because the English language indicates an urbanity and is received as sophisticated by German listeners. In contrast, German lyrics lead to a better recall of the brand name. This result could be explained because of the familiarity with the mother tongue. The message is received, decoded and processed more easily in the native language and therefore more likely activates cognitive scripts and links which eventually lead to a better recall.

References

Poster 31
Construction and validation of new assessment instruments for very short musical stimuli („plinks“)
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Keywords: Rapid assessment, short stimuli, expert rating, plink

Background: In 1942, Gray undertook a groundbreaking study by dividing tape recordings of vocal qualities into snippets in the millisecond range. Having presented the acoustic fragments to his subjects, Gray reported durations as short as 5 milliseconds for the correct retrieval of individual vocal qualities – depending on their fundamental frequencies. During the past 20 years, several studies on rapid assessment processes of musical stimuli in the millisecond range have emerged. In spite of the much-noticed literature in the field, target categories remain rather wide-ranged, such as genre, song titles, emotion, and preference. While genre recognition is reported for stimuli as short as 125-250ms, little effort has been undertaken for the investigation of intra-musical information categories (i.e., instrumentation). Unclear selection criteria and undocumented extraction points add to the difficulty of determining exact durational thresholds for target categories. Aims: Starting a new approach, we (a) randomized the process of stimulus generation with an author-based software script and (b) developed precise items for the recognition of musical information, (c) verified them in an expert-based pre-study, (d) validated them in an online study design and (e) specified psychoacoustic predictors of recognition rates in terms of timbral texture features (TTFs). Method: For a total of 330 stimuli of varying durations [50, 100, 200, 400 and 800 ms], derived from predefined parts of 33 popular songs, we calculated a set of 43 TTFs by means of the MIR toolbox (Lartillot, Toiviainen, & Eerola, 2008) and further software solutions. In an expert rating (n = 6) of these stimuli, we calculated chance-corrected agreement coefficients for several musical items (i.e., the existence or absence of specific instruments, gender of the voice). An extensive online study, which included additional literature-based target categories, was conducted to point out correlations between TTFs and recognition rates of intra-musical information. Results: First results show high degrees of inter-rater agreement (Gwet's AC1 and Brennan-Prediger coefficients) on arrangement features such as the presence of vocals, organ, bells, brass, string sounds and the gender of voice. Neither genre nor decades of production proved to be reliable items in the expert ratings. This seems surprising as previous research in music information retrieval showed that TTFs can be used for mathematical genre distinction, especially the mel-frequency cepstrum coefficients (MFCCs). These sets of 13 de-correlated coefficients per sound file serve as individual fingerprints, enabling us to sum up resembling profiles into genre groups. Ongoing experiments will evaluate the predictability of intra-musical categories by TTFs. Conclusions: We suggest a strictly randomized process of stimulus generation as a reliable basis for further research on durational thresholds of musical perception. After the final analysis of our ongoing online study results, we will present a set of validated items corresponding to a selection of psychoacoustic features. We believe this approach will be a valuable contribution to the introduction of new standards in the domain of rapid assessment of very short musical segments.

References
**Keywords:** Current mood, regulation motivation, music, age differences, physiological reactivity

**Background:** The regulation of momentary affective states represents one central reason for listening to music in the everyday life of individuals from various age groups. On the contrary, evidence suggests that motivations to regulate currently experienced mood states seem to be subject to changes across the lifespan. Older individuals reported a pro-hedonic regulation motivation (the wish to maintain or enhance positive, or to dampen negative affect) considerably more often than younger individuals. However, little is known about whether these differences in mood regulation motivation also play out in behavioral differences between age groups. Moreover, whether these behavioral differences in turn impact the outcomes of affect-regulatory attempts, that is, changes in current mood, is still largely unclear. **Aims:** The present study was guided by an interest in the comprehensive investigation of affect-regulatory preferences as indicated by music listening choices after experiencing different mood states in various age groups. Thus, we pursued the goal to interrelate self-report measures of affect-regulatory motivations with continuous behavioral measures as music listening choices and physiological reactivity in an age-heterogeneous sample. Moreover, we were interested in the overarching question of mood change from before to after listening to self-selected music indicating the efficacy of mood regulation via music. We hypothesized that individuals from various age groups differ in their affect-regulatory preferences but show similarly efficient changes in their current affect from before to after listening to self-selected music in line with regulation motivations. **Method:** In a 4 (mood induction) x 4 (age group) experimental design with \( N = 222 \) participants (51.8% female, 12-75 years) we investigated music listening choices of individuals from various ages after mood induction. To manipulate the valence and arousal of participants’ mood, they were randomly assigned to one of four conditions of a bingo game, varying in task difficulty, time pressure, and bogus performance feedback. Immediately before and after the game, participants indicated their current mood. After that, participants listened to self-selected music from various genres and decades and with distinct levels of valence and arousal (as evaluated in a pre-study) for ten minutes. Following that, they again rated their current mood and answered questions indicating state regulation motivations during the ten minutes of music listening. Additionally, we monitored the physiological reactivity (heart rate, respiration rate, galvanic skin response) of our participants during the whole experiment. **Results:** Although the manipulation of mood states was successful, we found no effect of the experimental condition on music-listening choices but a robust pattern of significant age-related differences in their affective music preferences. Beyond that, results indicate that while listening to music the participant’s mood and physiological reactivity changed significantly across all age groups and mood conditions, as expected. Furthermore, it became evident that older adults reduced their level of self-reported arousal more strongly from before to after music listening than the other age groups. After the experience of negative high-arousal, self-reported regulation motivations and affective music-listening choices were predictive for the change in current affect and physiological reactivity, particularly. **Conclusions:** The present results suggest that listening to self-selected music was an effective means of mood regulation. Specifically, after experiencing a negative high-arousal mood state, music listening-choices as well as regulation motivations significantly predicted the change of mood from before to after music listening. Thus, the present findings can be interpreted in line with previous results suggesting that individuals reverse their currently experienced mood toward mood-incongruent responses to correct for an undesired emotional bias. Findings also support results from other studies showing a more effective mood repair among older adults after experiencing negative affective states regarding their self-reported mood but not regarding physiological recovery from the experience of negative high-arousal.
**Poster 33**

The effect of lyrics on music-induced emotions: A comparison of Portuguese and Swedish listeners

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**Keywords**: Music-induced emotions, lyrics, mechanisms, cross-cultural comparison

**Background**: Emotions aroused by music are frequently researched in the context of instrumental music. However, studies on the effect of lyrics on musical emotions are limited. In addition, previous research indicates that the importance of lyrics for emotions with music may vary cross-culturally. **Aims**: The aim of this study was twofold: first, to investigate the effect of lyrics on emotions and mechanisms with music; and second, to explore whether there is a cultural difference in this effect. **Method**: Fifty participants from two different countries (i.e., Portugal and Sweden) participated in an experiment where they listened to six musical stimuli and rated their felt emotions and the activation of underlying emotion-induction mechanisms. The six stimuli were based on two songs representing each culture: one Portuguese Fado and one Swedish Folk piece. These were presented in three different versions each: the original version, an instrumental version, and the instrumental version with lyrics on the screen. The study employed a 2*3*2 incomplete factorial mixed design, with participant origin as the between-subjects factor and lyrics and music origin as the within-subjects factors. **Results**: The Portuguese and Swedish participants' responses differed notably: the presence of lyrics did not affect happiness-elation in either group, but did increase sadness-melancholy, albeit only in the Portuguese group. Lyrics also increased nostalgia-longing in the Portuguese participants, and surprise-astonishment in the Swedish group. Regarding the activation of mechanisms, lyrics increased the activation of episodic memory in both groups, and the activation of contagion, conditioning, and visual imagery in the Portuguese group. **Conclusions**: Overall, the present study revealed that lyrics had an effect on musical emotions and mechanism activation, which varied between groups of different cultural backgrounds. Surprisingly, these differences were not based on music origin, but on the participant group. Possible explanations for these findings and implications for future cross-cultural studies on lyrics and emotions are discussed.

**Poster 34**

Motivational music promotes risky decision-making but not the execution of a ball-throwing task

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**Keywords**: Social psychology of music, music & movement, motivation, music & sports, self-enhancement, risk-taking

**Background**: Millions of people across the world integrate music into their competition and workout routines. One of the perennial questions is whether using music in sports is beneficial or detrimental. Current research suggests that music has an ergogenic effect (Karageorghis & Priest, 2012a, b) and is used in sports for motivational purposes to get “psyched up” or “pumped up” (Laukka & Quick, 2011). However, only a limited
number of studies investigated the cognitive, affective and behavioral consequences of listening to motivational music. Its influence on typical outcome measures related to motivational effects in sports, such as risk-behavior, self-esteem and anxiety, remain yet to be examined. **Aims:** In order to contribute to current research, a ball-throwing task was employed that has been previously used to assess risk-behavior (DeCharms & Davé, 1965). This paradigm was combined with motivational music that was either experimenter-selected or selected by the participant. In accordance with previous research it was hypothesized that listening to motivational music would have an ergogenic effect, thus (i) improve the execution of a ball-throwing task, (ii) lead to improved self-evaluative cognition (i.e. heightened self-esteem, reduced anxiety) and (iii) influence decision making processes by evoking higher risk-taking behavior. **Method:** We conducted a between-groups experiment (N=150) where we tested the effect of an experimenter playlist and a participant-selected playlist in comparison to a no-music control. Participants were requested to perform a ball-throwing task consisting of two parts. Music was presented throughout the whole task. In the first part, the participants threw a volleyball ten times from seven different distances into a basket. That is where performance was measured (in terms of the sum of scored points). The second part consisted of twenty trials where participants choose distances themselves. In this part, risk-taking behavior was measured as the distance chosen to throw from. Greater distances indicated higher risk. **Results:** We found that music increased risk-taking but did not affect ball-throwing performance. The effect of music on risk-taking was more pronounced in men and also among participants, who listened to their own playlists. Taking higher risks also predicted a higher payoff in incentivized points. Furthermore, self-selected music enhanced state self-esteem in “high-performers” but not in participants who did not perform well during the first part of the task. **Conclusions:** Our findings suggest that music has no influence on the execution of a ball-throwing task but influences the decisions when gauging risks vs. payoffs. Listening to motivational music led to riskier choices. Making risky choices in turn resulted in higher gains of incentivized points, which suggests that listening to motivational music actually was beneficial. Further implications for the use of motivational music will be discussed.

**References**

**Poster 35**
**Pitch proximity vs. tonal proximity in chord perception**
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**Keywords:** Pitch proximity, tonal proximity, reaction time

**Background:** Pitch proximity is a well-documented aspect of melodic organization in most music traditions. Small-interval melodies have been shown to be easier to process and remember than large-interval melodies (Aarden, 2003). Tonal proximity (the use of related chords) is predominant in the most pervasive forms of
Western music. Perceived tonal stability of different triads in major and minor contexts was quantified in probe-tone experiments (Krumhansl, 2001). However, these experiments intentionally suppressed the perception of pitch distance. Priming experiments (Bharucha & Stoeckig, 1986) have established shorter reaction times for related than unrelated triads, but only with highly contrasting chord pairs (e.g., C – F and C – F♯). Aims: Pitch and harmonic proximity have been researched separately, but their interaction is seldom examined. Therefore, a reaction-time experiment was designed to test reaction times in the processing of chord pairs of varying pitch and tonal distance. Method: 21 musically-trained (10 female, age $M=22$ years) and 21 musically-untrained (11 female, age $M=24$ years) listeners were presented 40 chord pairs in random order and asked to indicate as quickly and accurately as possible if the second chord went up or down. The chords were synthesized using equal temperament tuning. Each chord had a duration of 2 seconds and was immediately followed by a target chord of the same duration. Only major triads were used, in either root position, or first and second inversions, the first one being C in all cases. Half of the target chords moved up, half down, in the sense that one or more tones of the first chord moved up or down, but never in opposite directions. Pitch proximity was measured as interval size in semitones (from 2 to 11, excluding 6) between the uppermost chord tones if moving up, and lowermost chord tones if moving down. Half of the target chords were closely tonally related to C (G or F), the other half were chords containing tones that are non-diatomic in C major, their tonal distance from C being 2 to 5 steps on the circle of fifths. Results: There was no significant difference in overall accuracy between the groups, although musicians were significantly faster ($t=-7.78, p<.01; M=540$ ms, $SD=60$) than non-musicians ($M=670$ ms, $SD=80$). Increasing pitch distance resulted in fewer errors and shorter reaction times for all subjects. Chord overlap (the span in semitones shared by the first and second chord) was a good predictor of success (M: $R=.74, p<.01$; NM: $R=.74, p<.01$). For chords with large frequency overlap (4 semitones or less), musicians outperformed non-musicians. No effect of tonal proximity was found, neither as difference between diatomic and non-diatomic target chords, as tonal distance measured in steps on the circle of fifths, nor as correlation with Krumhansl's (2001) ratings of perceived tonal stability of chords in a major context. Also, we found no effect of triad inversion on speed or accuracy. 9.5% of musicians and 24% of non-musicians displayed a bias towards downward movement; their accuracy (but not speed) was better for descending chords over ascending ones. Conclusions: The task of identifying the direction of chord movement becomes easier with growing pitch distance between triads. This finding is consistent with research that considers register change to be one of the most important mechanisms in differentiating acoustic streams (Cherry, 1953). Tonal proximity did not prove to be a reliable predictor of reaction speed. For chords with large frequency overlaps, musicians' expertise in analysing sounds by ear is an advantage; they can hear out the changing tone faster and with greater accuracy. A portion of listeners appears to expect falling rather than rising chord movements. Analysis of a large sample of music would be needed to test for possible effects of statistical learning.

References
How is the perceived musical expressivity of singers affected by their mimic and gestural interpretation?

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Keywords: Musical performance, musical expressivity, visual-auditory interactions, song recital, voice, mimic and gesture

Background: When attending a song recital the audience perceives information of different modalities and integrates them into one unified percept. We take the auditory and visual modality into account and ask, how strongly does the visual information affect the perceived musical expressivity of the auditory modality? Aims: We differentiate the impact of visual information, auditory information and their interaction on the perceived musical expressivity of opera singers. Method: Five singers participated in a workshop for mimic and gesture interpretation in the department for voice and music theater at the Hochschule für Musik Hanns Eisler Berlin, Germany. During the workshop participants had to fulfill the two tasks: (1) singing with expressive mimic and gesture; (2) singing with suppression of any mimic or gesture. Each singer performed two musical pieces in both conditions. Musical pieces were self-chosen, resulting in ten musical pieces of different styles (composers: Händel, Schumann, Offenbach, Puccini, Mahler, de Falla, Strauss, Britten). All singers were accompanied by a repetiteur. A professional camera operator as well as one sound engineer recorded musical performance with combined video and audio equipment. From the basic material of recordings we selected excerpts of high expressivity. We then created the following eight stimuli from each chosen passage: (a) A1: audio only, expressive condition; (b) A2: audio only, suppressed condition; (c) V1: video only, expressive condition; (d) V2: video only, suppressed condition; (e) A1V1: audio and video, expressive condition (original); (f) A2V2: audio and video, suppressed condition (original); (g) A1V2: audio, expressive condition, combined with video, suppressed condition (swapping); (h) A2V1: audio, suppressed condition, combined with video, expressive condition (swapping). We selected 15 passages in total, and extracted the eight stimuli (a to h) from each passage, resulting in a total of 120 excerpts. Mean length of excerpts was about 15 sec. In the video material we decided on a close camera take only, featuring the singer but not the pianist. In Experiment 1 we compared perceived musical expressivity between excerpts. Our goal was to use verbal labels to rate the expressivity that would match an analysis of musical content. For this, we asked two professional musicologists to analyze the pieces and generate adjectives describing the composed emotional content based on notation as well as the audio files from the expressive condition. Note, that the emotional content of music and lyrics mismatched in a few passages that might create a specific tension. We expected here that the mimic and gestural interpretation would disambiguate the perceived expressivity. Twenty-four participants listened to all 120 excerpts in four sessions and rated the emotional content given 25 adjectives as well as overall musical expressivity via a one-dimensional seven-point Likert scale. Excerpts were blocked by the three conditions: audio only, video only, audio and video combined (original and swapped). Serial order of blocks was balanced using a complex Latin square design. Each block contained 10 trials, Selection of passages within blocks was randomized for each participant. Results: Pilot data showed an interesting main effect of visual information, intensifying perceived musical expression. In particular, expressive mimic increased perceived expressivity. The effect of suppressed mimic was less dramatic. When adding the sound to the matching video, high auditory expressivity did not increase perceived visual expressivity. In total, expressive mimic and gestural interpretation resulted in high levels of perceived expressivity, which was not reached in the auditory only presentation. Conclusions: Mimic and gestures have an impact on perceived musical expressivity. Our research
has several implications: First, students of voice need to get special training on expressive acting to supplement their music-specific abilities. Second, a panel of judges in singing competitions or directors of musical performances should be aware of this interaction.

**Poster 37**

**Familiarity matters? Emotions and associations to familiar and unfamiliar background music in ambiguous film scenes**

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**Keywords:** Film music, familiarity, association, emotion

**Background:** Known background music in audiovisual context is more likely to be favored than unknown music. To which degree does familiarity affect music-induced emotional reactions and – even more interesting – the audience’s associations? Music can reinforce and amplify the emotional content of film scenes. Emotions expressed in background music are often attributed to specific combinations of musical parameters, and therefore assumed as independent of music’s familiarity. Although a positive relationship between expressed and induced emotions can be expected (Evans & Schubert, 2008), emotions aroused by familiar music may be influenced by individual musical conditioning processes or music-induced emotional memories (Juslin & Västfjäll, 2008) and consequently show a wider range than emotions aroused by unfamiliar music. Furthermore, music can convey semantic information. Background music known to the audience reacti

**Aims:** So far little attention has been paid to the fact if film music is known or unknown to the audience. Are emotions expressed and elicited, and associations triggered by familiar and unfamiliar music equally predictable? Or – as research suggests – is it more reliable to use unfamiliar music to at least elicit emotions?

**Method:** We performed a 2x2 (familiarity x genre) between-subjects online experiment with 299 German participants (60% female, \(M_{\text{age}} = 29, SD = 8.2\)). To isolate strong music effects we created an ambiguous stop-motion film with a minimum of theatrical gesture and action, but identifiably interacting protagonists. The clip was set to music with eight familiar and unfamiliar background music tracks with romantic and suspenseful connotations (two per experimental condition) – accompanied by a control group without music. Expressed emotions were measured by using a shortened version of GEMS (Zentner, Grandjean & Scherer, 2008; 15 items on 6 dimensions, with each Cronbach’s \(\alpha > .72\)), induced emotions by an adapted version of PANAS (Krohne et al., 1996; 12 items on 6 dimensions, with each Cronbach’s \(\alpha > .72\)). Within the eight music accompanied clips four were identified which matched the required experimental conditions best. They formed the basis of the following data analysis.

**Results:** Recipients of stimuli with romantic/suspenseful connotation named significantly expressed (romantic: \(M = 3.02, SD = 0.43\); suspenseful: \(M = 1.81, SD = 0.38\); \(F(1,137) = 304.67, p < .001, \eta^2 = .69\)) and induced (romantic: \(M = 3.04, SD = 0.48\); suspenseful: \(M = 2.71, SD = 0.48\); \(F(1,137) = 16.61, p < .001, \eta^2 = .11\)) emotions. While familiarity played no role in expressed emotions, only unknown music induced significantly distinguishable suspenseful or romantic emotions in each experimental condition. Depending on the music’s genre the relationship between the two protagonists was expressed as affectionate/antagonistic (romantic: \(M = 2.13, SD = 0.49\); suspenseful: \(M = 3.74, SD = 0.95\); \(F(1,137) = 158.31, p < .001, \eta^2 = .54\)). The protagonists’ feelings were categorized as more positive/more negative (romantic: \(M = 2.4, SD = 0.83\); suspenseful: \(M = 3.75, SD = 0.9, F(1,137)\))
Confiming these tendencies the film plot was labelled different, too – with romantic music in 61% of the cases as “love affair”, with suspenseful music in 72% as “conflict” ($N = 139, x^2(3) = 52.56, p < .001; \text{Cramer’s } V = 0.62, p < .001$). **Conclusions:** Music expresses emotions and triggers associations in ambiguous films - independently of familiarity. The results may be interpreted to indicate that the audience’s familiarity with the music is only relevant while inducing emotions.

References


**Poster 38**

Slow motion in films and video clips: The role of music on perceived duration, emotions and eye movements

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**Keywords:** Audiovisual interactions, perception, expression in media, time, motion

**Background:** Slow motion is widely used in audio-visual media and typically accompanied by particularly expressive music. Media studies (Rogers, 2013) emphasize the different uses of slow motion across various video genres and suggest strong effects on observers. In this regard, stretching time may resemble psychological experiences of highly emotional moments in daily life, in which time seems to pass more slowly. Yet the psychological functioning of slow motion both for emotion and attention processes has not been analysed in detail. Furthermore, to our knowledge no research has investigated the effects on eye movements and individual experiences in movies. Such research may elucidate some of the psychological underpinnings for the success of the highly popular slow-motion footage in movies and on streaming channels showing sports and dance actions, which are often produced with particularly emotional music. **Aims:** We investigated the effects of auditory and visual information in slow motion footage of three different video genres. We analysed the impact of stretched time in slow motion scenes as compared with real-time motion on visual attention via eye movements, as well as estimated durations and perceived emotions. We hypothesized that slow motion has an impact on perceptual intensity and that music modulates these processes. **Method:** Using a multimodal repeated measures design, we asked 42 participants (mean age: 23.52, $SD = 4.31$) to watch original slow-motion excerpts showing human movements taken from a total of nine movie, dance and sport clips (duration: 16–40 s) in versions with or without music (modalities: visual and audio-visual, henceforth V and AV). Excerpts were presented with e-prime both in original slow motion as well as in accelerated versions to match real-time motion (modified and tested in a pilot study). Participants’ eye movements were recorded with an eye-tracking system (SMI). Following each stimulus, participants judged the subjectively perceived duration, valence and arousal of each clip. **Results:** Duration judgments clearly differed between slow motion and real-time motion ($p < .001$), and led to an interaction effect between tempo and modality ($p < .05$), suggesting that AV real-time motion scenes were judged to last longer than V presentations, while this effect was not observed for slow-motion presentations. Across video genres, tempo influenced perceived arousal, which was higher for real-time motion as compared to slow motion ($p < .001$). In contrast, valence was judged higher in slow-motion scenes ($p < .01$), but also higher in AV presentations ($p < .01$). An interaction effect indicates that music increased perceived valence in slow motion, but not in real-
time video clips. Eye-tracking analysis shows that slow-motion scenes influenced eye movements depending on video genre ($p < .01$). While in movie excerpts, slow motion led to an increase in saccadic frequency as well as blink frequency and a decrease in mean fixation duration, a reverse effect was found for sports videos. Music (AV) led to a reduction in saccadic frequency compared to V presentations ($p < .05$). These results show that changes in visual attention of slow-motion compared to real-time presentations depend strongly on video genre. **Conclusions:** Our results provide new insights into the impact of stretched time on perception, attention, and emotion. Slow motion – across genres of movie, sports and dance video clips – was perceived to be higher in valence but lower in arousal, and has an impact on observers’ eye movements and attention in relation to video genre. Emotions were perceived to be more positive when music was present particularly in slow-motion videos. Music as a temporal art that works simultaneously on different time levels (London, 2012) may shape slow motion experiences to a crucial extent.

**References**

**Poster 39**

**Statistical summary representations in music-like perception**

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**Keyword:** Summary statistics, ensemble coding, auditory perception, music perception

**Background:** In the visual domain people tend to group sets of objects as an ensemble representation by averaging their object features very fast and accurately (Alvarez, 2011). Hubert-Wallander and Boynton (2015) indicated that summary representations work differently in temporal domains and found primacy and recency effects for different feature domains of sequences of visual objects. Perceptual averaging was also observed in auditory domain, when listeners asked extract average frequency from a sequence of pure tone s in a temporal sequence (Albert, School, & Chun, 2012; Piazza et al., 2013).

**Aims:** This study aimed to better understand how statistical summary representations are formed in music-like tonal sequences and how there are serial position effects when doing ensemble coding. In Experiment 1, we used eight complex-tone music-like sequences to look at simple mean estimation, and potential temporal effects when extracting pitch means. In Experiment 2, we used four and six complex tone sequences to see whether mean pitch estimation was influenced by length of the tone sequences. As far as we know, this study was the first to investigate statistical summary representations in complex rather than pure tone sequences.

**Method:** At the first experiment, participants listened to sequence of eight tones in piano timbre in each trial. After each sequence, they were asked to choose the tone they believed to represent the average pitch height of the preceding sequence among two tones. One of the two tones was always the mean pitch of all eight tones, whereas the other one was either a tone that was two semitones above or below the mean frequency in the “simple mean estimation” group, the mean pitch of the first four tones in the “primacy distractor” group, or the mean pitch of the last four notes in the “recency distractor” group. In Experiment 2, we tested simple mean estimation for four and six complex tone sequences to see if shorter sequences would lead to more accurate ensemble coding.

**Results:** In Experiment 1, all except the “primacy distractor” group performed at chance level. Given that the test distractors in the primacy and recency groups
were ± 4 (not ±2) semitones off the mean, the primacy mean might have appeared as too “off” to be the mean of the entire sequence, which might have led to a better performance in picking the correct mean. Obviously, the same was not true for the recency distractor, which suggests that even a ± 4 semitone off-the-mean tone calculated from the last four notes must have lured participants to choose that mean as the correct mean 50% of the time. In Experiment 2, results revealed above chance performance for the six- but not four-tone sequences.

**Conclusions:** To our knowledge, this is the first study that tested evidence for statistical summary representations in complex tone sequences. Overall, results of our study showed that participants were able to estimate mean pitch frequency of a complex tone sequence for a six- but not four- or eight-tone sequence. Our findings hint at an inverted U function when using more music-like stimuli as we did. More research is needed to understand the exact functional relationship between sequence length and statistical summary extraction for both pure and complex tones. Our future goal is to further investigate statistical coding with more melody-like stimuli.

**References**


**Poster 40**

**Interpersonal interaction of portamento in singing ensemble performances**

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**Keywords:** Portamento, temporal synchronization, interpersonal interaction, singing ensemble

**Background:** Interpersonal interaction represents a key performance goal between members of a singing ensemble as it fosters musical excellence. Previous studies, often analysing instrumental rather than singing performance, show that temporal synchronisation between performers is maintained through iterative micro-timing adjustments due to expressive interpretations and noise during the cognitive-motor processes. Singing presents unique complexities in this area, with many factors effecting synchronicity, including visual contact, leadership and portamento, referring to the audible transitions between notes occurring in the case of legato singing. The way in which singers use visual cue, leader-follower relationship and portamento to synchronize during vocal ensemble performances remains mostly unexplored.

**Aims:** This study observes the association between portamento and temporal synchronization during singing duo performances, in relation to leader-follower roles and the possibility for visual contact.

**Method:** Fifteen singing duets performed a two-part piece, mostly homophonic in texture, which was composed for the study. Four conditions were applied in a randomised order: with and without visual contact, and alternating the designated leader versus follower. Each condition was presented three times and the singers performed four repetitions within each condition, resulting in 12 performances of the piece in each condition. Singers were instructed to perform legato to the vowel /i/. Data were acquired using electrolaryngograph electrodes and head mounted microphones to allow fundamental frequency
Temporal synchronization was then analysed by extracting onset times from the fundamental frequency values through an automated algorithm. **Results:** Initial results show a complex pattern of Leader-Follower relationships rather than a clear separation of roles, and suggest that both Leader-Follower relationships and visual contact affect the temporal synchronization of *portamento* during ensemble performances. The *portamento* resulting from legato singing on vowels seems to be used by singers as a tool to synchronize in ensembles. **Conclusions:** This study provides a better understanding of the interpersonal interactions between singers that fosters synchronization in ensemble performances. This research will be of particular interest to both music pedagogy practice, as a means to establish strategies to pursue excellence in performance, and to psychology research, in terms of understanding human interpersonal communication and coordination.

**Poster 41**

**Rhythm and trance: From Shamanism to Sufi tradition and psychedelic culture**

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**Keywords:** Rhythm, trance, rhythmic entrainment

**Background:** Synchronization to music is a basic ability for humans and the key component of synchronization is to entrain a particular rhythm. EEG studies show that when we synchronize with a rhythm, our brain waves also synchronize. From this view, trance can be a state of consciousness that is a result of rhythmic entrainment of oscillatory brain networks. It is known that Shamans perform a ceremony with drums and experience trance for centuries. Although using rhythm to mediate trance goes back to Shamanism, it is also a part of different cultures. Trance experience continues its existence with psychedelic trance dance in the West and also with *dhikr* and *Sama* in the East world. If we define the term of “trance” as “a state of *wajd*”, experiences of Shaman rituals, psychedelic dance and *dhikr* are basically same, because of using repetitive rhythm as a mediator. **Aims:** Aim of this study is to discuss the role of rhythm in altered state of consciousness from a psychological point of view. **Main Contribution:** Concept of “trance” has been usually discussed in cultural context by antropologists. Because of this, there is not enough psychological research to explain the role of rhythm in trance experience. Cultural studies show that, Shamans use particular drum rhythm to communicate with other worlds. They believe this rhythm acts as a language to speak with spirits and when they reach to trance state, they feel like God. Likewise, *Sufis* performs a religious ceremony called “*dhikr*”. The purpose of this ritual is to remember God. They sit in a quiet place, close their eyes and they repeat *Allah’s* name silently with a constant rhythm for minutes or hours. When they reach to trance state, they feel like they are mentally with God. Similarly, psychedelic trance dancers gather at intervals to experience trance. They usually meet in the forests, listen trance music which is highly rhythmic, fast and cyclically repetitive and dance to main bass rhythm of this music for hours. When they reach to trance, they feel high and transcendant. In humans, the ability of entrainment to an external stimuli is likely established through oscillatory brain networks. In the presence of a regular auditory rhythm, despite the absence of an intention to move, modulation of beta amplitude followed the tempo of sound stimulation in auditory cortices. According to EEG studies, flashing a bright light into the eyes at a rate close to the alpha rhythm of the resting brain changes the amplitude of the alpha rhythm of the brain. Slightly increasing or decreasing the rhythm of the flashing light stimulates the brain rhythm to adjust in synchrony (Adrian & Matthews, 1934). The key element of synchronization is rhythmic entrainment. It is described as a process whereby two rhythmic processes interact with each other in such a way that they adjust towards and eventually lock in to a common phase or periodicity (Clayton, Sager, & Will, 2005). In early laboratory studies of rhythmic entrainment through
auditory stimuli, normal EEG activities of participants are recorded and these patterns are compared with the EEG activities that observed in response to a drum beating at frequencies of 3, 4, 6 and 8 beats per second (Neher, 1962). As a result, it has been observed that the auditory cortical neuronal activity is altered by rhythm and synchronized with the drum beat. It is reported that the characteristics of auditory stimuli and the behaviors observed in cultural rituals with drum rhythm have similar physiological and psychological characteristics with rhythmic entrainment of oscillatory brain networks to an auditory stimuli in laboratory. Thus, it can be considered that rhythmic entrainment of oscillatory brain networks is similar to focusing on rhythmic pattern in trance experience. **Conclusion:** In conclusion, according to cultural studies and psychophysical findings, there seems to be a similar pattern in different trance experiences and from the perspective of psychology, entrainment to a particular rhythm which causes overstimulation of neural networks is essential for an altered state of consciousness.

**References**


**Poster 42**

The relationship between musical structure and emotion in classical piano scores: A case study on the theme of La Folia

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**Keywords:** La Folia, computational musicology, music structure, expression, emotion

**Background:** How does immanent and performed emotion depend on structure beyond mode and tempo? Juslin (2000) explored the relationship between basic emotions and the musical surface (tempo, dynamics, articulation). Zbikowski (2010) explored relationships between remarkable passages (dissonances, modulations) and emotion. Gomez and Danuser (2007) examined relationships between several structural features and both self-reports of felt pleasantness and arousal and different physiological measures. Previous studies exhibit several limitations, e.g. some musical factors (highly dissonant harmony, unfamiliar rhythmic patterns) were not represented, correlation between factors poorly considered, and verbal reports not regarded. **Aims:** We explore the relationship between musical structure and emotion on different variations of La Folia - a musical theme of Portuguese origin based on a standard harmonic progression. How do different structures induce different emotions? Our approach aims to extend previous research by investigating more factors and comparing different models for music emotion. **Method:** Two separate experiments are conducted: a listening test based on a controlled and balanced design (24 variations with selected combinations of 4 factors: average pitch variation / register, harmonic tension, rhythmic complexity, note density, arranged and recorded in a deadpan performance by the first author), and a listening test based on a real music design (commercial recordings of the first 8 bars of 20 variations by A. Scarlatti, C. P. E. Bach, S. Rachmaninov and F. Liszt, with different combinations of 21 factors). We parameterize the stimuli in terms of musical structure and expression by means of Humdrum (Huron, 1995), Director Musices
(Bisesi et al., in preparation), the Margulis (2005) model of melodic expectation, and the MIR Toolbox (Lartillot, 2014). 12 musicians and 12 non-musicians rate the emotion associated to the stimuli on a graduate scale. Two different models of music emotion are compared: the valence/arousal-based emotion model (Russell, 1980), and the Geneva Emotional Music Scale (GEMS) (Zentner et al., 2008). Results: A pilot study including also the Differential Emotional Scale (DES) (Izard, 1972) showed that, in the real-music designed experiment: (1) the agreement among raters in the DES Model is comparatively lower than in the other models; (2) there exist significant correlations between structural parameters and descriptors for emotions in all of the models; (3) correlations are more remarkable for the valence/arousal-based emotion model and for the first-order GEMS model, and (4) include register, note density, tempo, dynamics, accentuation, and articulation. Conclusions: Our approach links together music theory/analysis, music psychology and empirical aesthetics. We are challenging these three disciplines to work more closely together and take each other’s ideas and methods more seriously.

References

Poster 43
Testing the role of involuntary musical imagery in novel music learning
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Keywords: Involuntary musical imagery, memory consolidation, novel music tunes

Background: Involuntary musical imagery (INMI) is a form of spontaneous cognition involving a musical excerpt being repeatedly played in one’s mind with no conscious effort or presence of music. The body of research covering this phenomenon has increased with psychologists investigating a range of topics such as INMI’s role in daily life, suggesting relations to mood regulation. Additionally, it has been proposed that INMI may have a function relating to the consolidation of musical memories. This could be because the more one is exposed to musical stimuli, the more likely they are to retain it in their long-term memory (LTM). With the fact that INMI continuously repeat on a loop, it could be suggested that long and frequent INMI exposure might increase the likelihood for music to be stored in LTM. However, no researchers have considered this concept and so the current researchers studied this potential function in relation to the consolidation of memories for novel music tunes. With this investigation focusing on memory, the researchers took into consideration that other variables could affect the ability to consolidate new musical memories. Therefore, measures of musical training and active musical engagement were collected to look at the impact of individual differences on musical memory, as well as
the amount and length of INMI experiences. In addition, we used two methods for learning the novel tune – active (singing) and passive (listening). **Aims:** The aim of this research project was to test whether INMI episodes for novel tunes can affect how well one can remember that tune. It was hypothesised that the number of INMI experiences reported and duration (relating specifically to the novel tune), as well as the type of learning method used would affect the memory recall accuracy of the tune. **Method:** 44 participants learned ‘April Showers’ (a novel tune) – by either singing along or listening to it. For the next three days, participants recorded their INMI episodes in an INMI diary. After, they were given a surprise memory test in a two-alternative force choice format (where they were presented with two versions of ‘April Showers’). **Results:** Signal detection theory was used to obtain memory recall accuracy scores (represented by d prime), then they were entered into a multiple regression analysis with the predictor variables of this study - the amount of INMI, length of INMI, musical training and active engagement. The overall analysis was not significant $F(4, 39) = 2.30, p = .08$, yet individually the length of INMI ($\beta = -.95, p = .05$) and musical training ($\beta = .08, p = .02$) significantly predicted variability in memory accuracy. The direction of the relationship for the length of INMI and memory accuracy implies that shorter INMI episodes were related to higher accuracy rates of memory recall, whereas musical training acting as a positive predictor variable indicates that higher musical training was associated with more accurate memory recall. In regards to the type of learning method affecting recall accuracy, a chi-squared test with ranks did not show any significant effects, $\chi^2(1) = .11, p = .74$. Thus whether ‘April Showers’ was learnt in an active or passive manner did not have a significant effect on the participants’ ability to accurately recall this novel tune. **Conclusions:** To conclude, this study was the first in the field of INMI research to look at INMI having a potential role in daily life that is associated with the consolidation of new musical memories. Analyses of the data were not able to provide any significant findings that could have provided indications into the amount of INMI episodes reported, active musical engagement of the participants or the type of learning method used for the novel musical tune having an effect on the memory accuracy for the tune. Thus none of the hypotheses were supported. It did however show that the length of INMI and musical training ability were able to significantly predict variability in the memory accuracy scores. The significant but negative relationship between INMI length and memory accuracy recall does not support a memory consolidation account of INMI. This could possibly be explained by the way in which the INMI duration variable was operationalized – it was perhaps not a reliable measure. Future work is needed to clarify the relationship between INMI duration and memory. Yet, the findings relating to the significance of musical training can be deemed plausible as previous research has shown how musically trained individuals have better musical memory compared to those who have minimal musical training. Despite these results failing to demonstrate another potential function of INMI in daily life, it does manage to shed light on the concept that memory, specifically musical memories, are susceptible to influences from internal and external variables. This is in line with previous literature surrounding factors affecting memory consolidation.

**Poster 44**

**In the Zone: An interactive educational technology based on symmetrical entrainment**

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**Keywords:** Entrainment, music education, interactive music system, technology, visual feedback

**Background:** In order to benefit from the contributions of rhythmic skills for acquiring language skills and reading abilities in primary education (Overy, 2003; Rautenberg, 2015), interactive music systems (IMS) may be useful to support teachers who lack knowledge, skills, and confidence in music teaching as reported in Hoogeveen et al. (2014) by providing insight in the musical process. However, little research addresses the use of IMS for use
in music education in primary education and still more research on effectiveness is needed (King & Himonides, 2016). A common way to learn concepts of rhythm is by playing rhythms together and by finding and keeping the beat where musicians both adapt to each other’s music playing (symmetrical entrainment) or musicians adapt their music playing to a metronome (asymmetrical entrainment). Teaching methods include both strategies, but opposed to asymmetrical entrainment, little research has been focused on symmetrical entrainment (see Repp & Su, 2013). Aims: As a first step in exploring how IMS can contribute to music education in primary education, a new social music game In the Zone (ITZ) was developed and tested. ITZ consists of four drum pads, positioned around a computer screen facing upwards. ITZ allows participants to drum together while receiving visual feedback on the accuracy of in synchronization of the joint drumming in real time. When a certain degree of accuracy in synchronicity is established over a certain amount of hits, a circle is presented on a screen. This may challenge participants to synchronize more accurately. Key questions here: 1) Is ITZ suitable for research in symmetrical entrainment? 2) How does visual feedback presented by ITZ influences symmetrical entrainment? Method: A repeated measures experiment was executed to discover the effects of visual feedback on accuracy in synchronicity when playing together a regular beat (four crotches in common time). Participants (14 females, 10 males, age 18-55, \( M=39.5, \ SD=10.73\) performed, in groups of four, simple drum tasks under several conditions, ranging from no visual feedback to seeing one, or all, other three participants to only seeing the feedback presented on the screen. Participants also filled in three questionnaires to investigate the participants' experience in synchronizing to a visual or aural beat, the experienced difficulty and the participants' own perception of how well they synchronized their music playing. Results: For 23 out of 24 participants the results show significant differences in the accuracy in synchronization in different conditions. However, results are not unambiguous. For example, seeing another participant resulted for some participants in a more accurate synchronization, where for others synchronization turned out to be less accurate. Conclusions: The experiment proofed that ITZ can correctly log entrainment data and can interact with participants, by showing direct feedback and challenging them to improve their joint synchronicity in playing a beat together. Nevertheless, ITZ is still a prototype with a basic design of interactivity and there are challenges to overcome. Currently, ITZ is being further developed with a focus on overcoming some of these challenges and on expanding the system. A further analysis of the obtained data is planned.

References
Modeling perceived segmentation of bodily gestures induced by music

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Keywords: Music, gesture, automatic, segmentation

Background: The correspondence between music and bodily movement has been called musical gesture. People are able to tell where and how bodily gestures occur by visual observation. This is called segmentation. Phenomenological inquiry has observed that musical gestures are perceived in different time scales and that the grouping of shorter-scale gestures into larger entities depends on musical structure, a phenomenon called co-articulation (Godøy et al., 2016). Several studies have investigated the perception of musical bodily gestures by asking people to describe videos that show other people making music or moving to music. A large-scale experimental investigation that produces statistically relevant results, would take the effort of people watching videos of many individuals moving to different kinds of music. This process is costly and it seems reasonable to automate it. This requires to model human perception of gestures, starting by modelling perceived segmentation of gestures. Aims: The purpose of this study is to model the perceived segmentation of bodily movement induced by music.

Method: 1) Multimodal database: Simultaneous video and motion-capture recordings of individuals spontaneously moving to music, in two conditions. In the first condition the participant moves freely. In the second condition the participant is allowed to only move one arm. In both conditions the participant wears a suit with optical motion-capture markers. In the second condition the participant additionally holds an accelerometer sensor with the hand of the arm that moves. 2) Ground truth: An experiment in which participants watch videos of the database and identify gesture boundaries in two conditions: real-time and non-real-time. The real-time condition allows spontaneous reactions and the non-real-time condition allows annotation in different time scales and with greater precision. In the second condition participants are also asked to group the boundaries into longer chunks. 3) Automation: A model is developed as an automated procedure. First, kinetic features are computed from optical motion-capture and accelerometer data. Then, a novelty score is computed for each feature. The peaks of the novelty score indicate segmentation boundaries (Foote & Cooper, 2003). These boundaries are compared with ground truth of the corresponding videos, using a novel similarity measure.

Results: As this investigation is ongoing, results are preliminary. Non-real-time annotation of segmentation boundaries in single-arm gestures has been compared with segmentation boundaries computed from accelerometer data, by performing a brute-force search for highest similarity between regions of annotated and computed boundaries. Different kinetic features yield remarkable closeness between annotated and computed boundaries within specific time-regions of data, but not the full length. This suggests that a combination of those features will improve the model. Conclusions: This investigation is aimed to model perceived segmentation of bodily gestures induced by music. Preliminary results show that specific kinetic features can be used to predict regions, but not the full sequence of perceived boundaries. Further work will focus in: 1) test more complex kinetic features 2) collect more multimodal and perceptual data. The resulting model will be useful to study relationships between musical sound and bodily movement. Furthermore, a real-time implementation could be integrated into the design of electronic musical instruments, as a high-level feature for mapping bodily movement to sound.

References

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Keywords: Emotion, expectation, background music, aesthetics, faces, IDyOM

Background: Music is universal across all societies, in-part due to how we as humans use it to experience and regulate mood and emotions. Cross-modal research on how emotional music can affect our cognition and decision making has been rife – from how emotional music affects our judgement of brightness to how background music can affect the taste of wine. In particular, background music of very short duration has been found to systematically transfer its emotional content to how the perceiver rates emotional faces: happy music primed participants to rate faces as more positive, and sad music vice versa, regardless of facial emotion displayed (Logeswaran & Bhattacharya, 2009). In a similar vein, emotional background music affected the memory for emotional faces – happy music negatively influenced sad face recall, as with sad music on happy face recall. (Woloszyn & Ewert, 2012). Many mechanisms for how music induces such emotions have been theorized and researched, one of which is musical expectancy i.e. when music violates, delays, or confirms our expectations. Expectancy has consequences on the communication of emotion and aesthetics in music, while anticipation of forthcoming events has clear evolutionary advantages in human survival (Huron, 2006). However, it is unclear as to what extent transient changes in only musical expectations can affect our emotions, and thus cognitive processing. Investigating how musical expectancy affects emotion transfer may highlight the role emotional music plays in motivational processing i.e. how emotion elicits approach or avoid behaviours (Elliot, Eder, & Harmon-Jones, 2013) and in how emotions may modulate processing fluency of information i.e. how emotion affects the ease of cognitive processing (Clore & Huntsinger, 2007).

Aims: By using melodies with notes of known expectancy (via computational model, Pearce, Ruiz, Wiggins, & Bhattacharya, 2010), this experiment aims to explore the emotional cross-modal transfer effects of musical expectancy on 1) Approachability ratings of neutral face stimuli, probing motivational processing, and 2) Memory for neutral face stimuli, probing processing fluency.

Method: Fifty-five participants between the age of 20 and 40 (M = 26.48, SD = 3.91), 28 of which described themselves as musicians completed three computer-based behavioural experiments. 1) Participants listened to melodies and rated the approachability of neutral faces when presented concurrently on highly expected or unexpected notes. 2) In an encoding phase, participants listened to melodies and were presented with neutral faces concurrently with every note. A 2-alternative forced choice task was completed in a retrieval phase; novel faces and faces previously shown were presented together and participants had to decide which face they remembered. 3) Participants rated the valence (pleasantness) of the expected and unexpected notes in the melodies heard in experiment 1 and 2. Experiment 1 and 2 were presented first in random order, and experiment 3 was always presented last. Results: Mixed Factoral ANOVA results found ratings of approachability for target stimuli were both significantly higher when presented on expected notes than unexpected notes (F(2, 106) = 8.09, p = .001, η²p = .132), regardless of musical training. No significant differences were found in the 2AFC recognition task (p = .451). Musicians significantly rated melodies as more pleasant than non-musicians (F(2, 106) = 3.89, p = .024, η²p = .068).

Conclusions: Results suggest that the valence associated with melodic expectation...
crossmodally primed decision making tasks, but not memory tasks. Thus this study highlights the influence of solely melodic expectancy on affective priming, highlighting the important role musical expectations play in emotion generation. Furthermore, significant results found for approachability ratings and not recognition tasks suggest that the mechanism by which musical expectation plays in cognition changes may be of a motivational (approach/avoid) nature, rather than in modulating information processing. This has implications on Affect as Information hypothesis, and its role in explaining aesthetic pleasure in music.

References

Poster 47
Music and pictures as mood regulation: A comparative study
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Keywords: Music, mood regulation, pictures, measure development, comparative research

Background: The prevalence of music as a form of mood regulation in daily life has been widely acknowledged, and research on the topic has been growing fast. However, music certainly is not the sole tool available for regulating moods, and other elements of daily life can be argued to fulfill similar goals. Yet, only few comparative studies to investigate music in comparison to other modalities and regulatory assets exist. Therefore, in order to elaborate the specific role and character of music as a medium for mood regulation, the current study engages in a detailed comparative investigation of music contrasted with the daily use of pictures for equal purposes. Aims: The aim of the current study is to directly compare the use of music to the use of pictures for mood regulation in daily life. The comparison involves a range of elements of the mood regulatory behaviour, including the different mood regulation strategies and distinct emotions induced by the activity. Method: Data collection is currently being conducted through an online survey and we are aiming for a considerably large sample of several hundred respondents from several countries. Participants will respond to questions about their mood regulation strategies, which have been formulated based on the Music in Mood Regulation (MMR) scale and revised for comparative purposes regarding pictures. Participants will further respond to questions targeting the related emotion induction mechanisms and various features of the evoked experience, including a list of distinct emotions grounded on prior research about music and emotion induction. Analyses will consist of testing the validity of the revised MMR instrument for comparative assessment of music and pictures, and statistical comparison of the key
elements of musical and visual mood regulation in daily life. **Results:** The findings of the current study will provide comprehensive knowledge about the similarities and differences about how music and pictures serve as tools for mood regulation in people’s daily life. Some grounded hypotheses will be tested and results reported (e.g., whether musical mood regulation is more physical in nature than visual mood regulation). The study further involves methodological development for revising and validating an existing measurement instrument (MMR) for comparative assessment between modalities. Data collection is ongoing at the time of this writing, and the detailed results will be available at the time of the conference. **Conclusions:** Music research is flourishing in its endeavour for understanding the emotional impact and relevance of music for individuals. However, only through comparative research designs with other modalities it becomes possible to engage in reliable comparison and elaboration of characteristics that emerge as unique and special to music, not to other forms of human behaviour. The current study engages in this investigation through comparing the daily use of music with the daily use of pictures for mood regulatory purposes, and further encourages such comparative approach among music researchers for broader, more comprehensive understanding of music as a distinctive feature of human experience.

**Poster 48**

**Spontaneous and voluntary musical imagery across the lifespan**

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**Keywords:** Ageing, musical imagery, musical expertise

**Background:** Musical imagery functions, based on general auditory, visual, and motor imagery abilities, are crucial to musical interactions, from listening to performing, and for all expertise levels. Mental imagery has a central role in memory, creativity, and motivation, and results in similar brain activation as perception. This similarity to perception, and the clinical potential of mental simulation, leads to increasing use of imagery-based paradigms in health care settings, often aimed at older adults. However, the impact of age on imagery ability is unclear, and reported effects of musical expertise are ambiguous. Furthermore, it is yet unknown whether imagery is a single function, or whether spontaneous and voluntary imagery in various modalities are similar. Here, we explore aspects of individual differences, namely age and musical expertise, which speak to its practical usefulness. Furthermore, interrelations of different imagery types and modalities are explored over a large age range. **Aims:** The relationship between ageing, spontaneous and voluntary musical imagery is investigated, while controlling for the role of musical expertise. By exploring the relationship between different types of musical imagery (spontaneous and voluntary) and imagery abilities in other modalities (e.g., visual, movement), a better understanding of imagery processes can be attained. **Method:** A total of 296 subjects (156 females), aged 18-65 (M=41.2, SD=14.1) completed five imagery measures. For spontaneous and voluntary **auditory imagery** we used the Involuntary Musical Imagery Scale (IMIS; Floridou et al., 2015) and the Bucknell Auditory Imagery Scale (BAIS, with Vividness (V) and Controllability (C) subscales; Halpern, 2015), for spontaneous and voluntary **visual imagery**, the Spontaneous Use of Imagery Scale (SUIS; Reisberg et al., 2003) and the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973), and for aspects of voluntary **movement imagery** the Vividness of Movement Imagery Questionnaire-2 (VMIQ2, with External Visual perspective (EV), Internal Visual perspective (IV), & Kinesthetic Imagery (KIN) subscales; Roberts et al., 2008). The frequency, recency, and duration of musical expertise were also assessed. **Results:** Results show a weak decline in spontaneous musical imagery frequency with age ($f(295)=-.14, p=.02$) and a weak increase in voluntary auditory imagery abilities (BAIS-V, $f(295)=.15, p<.001$; BAIS-C, $f(295)=.19$, $p=.03$).
When accounting for musical expertise, the results remain the same. Voluntary auditory and visual imagery abilities are significantly correlated (BAIS-V & VVIQ, \( r_{(296)} = .47, p < .001 \); BAIS-C & VVIQ, \( r_{(296)} = .45, p < .001 \)), as are auditory imagery and different motor imagery subscales (BAIS-V & VMIQ2-EV, \( r_{(296)} = .45, p < .001 \); VMIQ2-IV, \( r_{(296)} = .50, p < .001 \); VMIQ2-KIN, \( r_{(296)} = .48, p < .001 \); BAIS-C & VMIQ2-EV, \( r_{(296)} = .36, p < .001 \); VMIQ2-IV, \( r_{(296)} = .42, p < .001 \); VMIQ2-KIN, \( r_{(296)} = .44, p < .001 \)). Spontaneous imagery in visual and auditory modalities are not significantly associated (spontaneous musical imagery frequency & SUIS, \( r_{(296)} = .10, p = .08 \)).

**Conclusions:** Although ageing is related to cognitive decline, our results indicate that voluntary musical imagery abilities may improve with age, and are independent of musical expertise. The weak increase of ability may suggest a general contribution of auditory experience, which is arguably increased in the elderly. However, the spontaneous musical imagery frequency slightly decreases, perhaps indicating a different relation to cognition for spontaneous imagery. These findings support the general use of mental imagery in health interventions for the elderly. The strong cross-modal inter-relatedness between voluntary imagery abilities supports the notion of a single, multimodal imagery function, with implications for trainability of these skills.

**References**

**Poster 49**

**Accidental sonorities in early polyphony: Evidence for early sensitivity to roughness and harmonicity**

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**Keywords:** Sonority, psychohistory, Renaissance, polyphony, tonality

**Background:** To modern ears, Renaissance polyphony sounds like progressions of mainly major and minor triads, mainly in root position. But in the history of music theory, concepts of sonority, chord, root and inversion first emerged in the 17th century. Music did not "progress" (become aesthetically better) from one historical period to the next, but structural principles such as major-minor tonality did gradually "emerge" - both in musical scores and listeners' subjectivity. **Aims:** To what extent and in what way were Renaissance listeners perceiving and experiencing "sonorities", although they did not have a vocabulary for talking about them? Which polyphonic combinations of chromas were intuitively preferred and why? Were preferences for specific sonorities determined mainly by their psychoacoustic properties or voice-leading principles? What psychohistorical principles can explain the "emergence" of major-minor tonality? **Method:** An analysis of simultaneities of three pitch classes (chromas) in a database of late Medieval and Renaissance polyphony reveals surprisingly large numbers of
dissonant polyphonic “accidents”. Some of these “chords” were intuitively preferred, and these preferences stabilized over time. Inspired by implicit methods in psychology, we consider how the sensitivity of early listeners to “chords” developed, although they did not yet exist as concepts. Simply counting how often they happen in musical scores allows us to explore the early psychological foundations of consonance and dissonance. We assume in a first approximation that all tones in all music of the period can be assigned unambiguously to chromatic scale steps, the chromatic scale being a collection of approximately defined, culturally determined, context-dependent pitch categories. Results: A comparison of “chord” prevalence data with predictions of simple psychoacoustic models suggests that the prevalence of tone simultaneities, and hence their consonance and dissonance, depended on smoothness (Helmholtz), harmonicity (or fusion: Stumpf), and familiarity (Cazden, 1945)—not diatonicity or evenness of spacing (cf. Tymoczko, 2010). Conclusions: Results suggests that musicians gradually learned to recognize and appreciate the consonance of major and minor triads long before these constructs were identified and labeled by music theorists. These sounds gradually appeared more frequently by comparison to other combinations of three pitch classes – both unprepared (with simultaneous onsets) and prepared (with one or more tones held from the previous sonority). As they became more common, they were more often perceived as stable reference points. Musicologists have considered different criteria and dates for the establishment or stabilization of the major-minor system (Dahlhaus, 1967/1990); in a psychohistorical approach, the system stabilized when triads became psychological reference points for the perception of passages, which became prolongations of those triads. Psychoacoustic and music-structural phenomena may have been perceived but not verbalized by musicians, composers, and theorists of the past (even today, we cannot verbalize aspects of our musical experience; Raffmann, 1988). Psychoacoustic principles such as roughness and harmonicity may be compared with gravity (Eric Clarke, personal communication)—a concept invented by Galileo and refined by Newton and Einstein. The structure of buildings is always influenced by gravity, regardless of whether architects and builders understand the concept. Similarly, the structure of western polyphony may always have been influenced by roughness and harmonicity, even if most musicians and theorists of the past lacked these concepts.

References

Poster 50
EEG responses to changes in consonance and dissonance
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Keywords: Consonance, dissonance, music perception

Background: The relationship between two tones played simultaneously (i.e. harmonic intervals) can be described as consonant (stable) or dissonant (unstable). The degree of consonance-dissonance of an interval is related to the simplicity of the frequency ratios between two tones. The simpler the ratio between two tones the
more consonant the sound. Behavioural studies in Western populations have shown that consonant and dissonant musical intervals differ in how easily they are processed. Performance in different tasks is more accurate if they contain consonant rather than dissonant intervals, suggesting a processing advantage for consonance over dissonance (Komeilipoor et al., 2015; Schellenberg & Therub, 1994). Likely, the simplicity of frequency ratios defining the consonant intervals and their predominant use in Western harmonic music is what trigger the processing advantage for consonance when compared to dissonance. **Aims:** The present study explores the neural correlates underlying the processing advantages of consonance over dissonance, and whether formal musical training modulates such advantages. We investigate how the brain responds after a dissonant interval is presented in a consonant context versus when a consonant interval is presented in a dissonant context. **Method:** Thirty-two volunteers participated in the experiment. Half of the participants (N=16) were experienced musicians in Western tonal music. Stimuli consisted of 7 consonant and 7 dissonant harmonic intervals. Consonant intervals were: octave [P8], minor sixth [m6], major sixth [M6], perfect fifth [P5], perfect fourth [P4], minor third [m3] and major third [M3]. Dissonant intervals were: minor ninth [m9], major ninth [M9], minor seventh [m7], major seventh [M7], tritone [TT], minor second [m2] and major second [M2]. Each interval was implemented in four different keys [C, E, G and A]. Participants were tested individually in a soundproof room. During the experiment participants watched a silent movie while the auditory stimuli were presented through loudspeakers. In order to explore a pre-attentive processing of consonance and dissonance, participants were instructed to pay attention only to the silent movie and let the auditory stimuli be perceived as background noise. Event-related brain potentials (ERPs) were recorded while stimuli were presented using an oddball paradigm. We presented sequences of repetitive auditory stimuli (standards) that were occasionally interrupted by infrequent stimuli (deviants). Each participant was presented with two conditions: the Consonance condition (sequences of frequent consonant intervals occasionally interrupted by infrequent dissonant intervals) and the Dissonance condition (sequences of frequent dissonant intervals occasionally interrupted by infrequent consonant intervals). The order of presentation of the conditions was counterbalanced across participants. **Results:** Changes in the Consonance condition elicited a MMN [an ERP component related to attention-independent discrimination of changes in auditory stimuli] in both musicians and non-musicians, suggesting they are processed at a pre-attentive level of auditory processing independently of musical expertise. Changes in the Dissonance condition elicited a late MMN only in participants with formal musical training. Even more, a P100 [an ERP component related to increased processing demands] was elicited only in non-musicians when a dissonant sound appeared in a consonant sequence. **Conclusions:** Our results demonstrate processing asymmetries for consonance and dissonance already at a pre-attentive level. The fact that the MMN was not observed in the Dissonance condition in non-musicians might reflect the difficulty of perceiving changes in dissonance as has been suggested by behavioral studies. Likewise, the P100 component would signal that processing a dissonant sound embedded in a consonant context might be more demanding to non-musicians. Results also highlight that formal musical training enhances processing of musical intervals varying in their degree of consonance.

**References**
**Poster 51**

**Evaluation of different sonification models for balance training**

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**Keywords:** Sonification, audio feedback, balance, neurologic rehabilitation, musical training

**Background:** Sonification (the use of non-speech audio to convey information) can provide additional sensory input for individuals with neurological disabilities, compensating for proprioception deficits. However, the ideal parameter mapping (i.e., the appropriate relationship between body position and sound) has to be developed for specific tasks such as balance training, and prototypes should be user tested before committing to implementation in a clinical setting. **Aims:** The goal of this study was 1) to test and evaluate different sonification models and balance exercises with a certified balance trainer, and 2) to control for factors associated with the outcomes (e.g., musical training). **Method:** 20 healthy participants ($M = 43$, $SD = 13.78$, $f/m = 7/13$) were guided through a balance training that involved target detection, both with and without visual assistance. A basic and synthetic, as well as a more complex and musical (but structurally similar) sonification model were used to provide information about the center of gravity in a previously defined two-dimensional space. Raw data was collected from the exercises itself (e.g., quickness of target finding) and subjective statements were derived from a questionnaire (pleasantness and helpfulness of the models). **Results:** Generally, subjects’ localizing performance was correlated in the two sound models, $r = 0.53$, $p = .028$, and faster with the basic model, $t(16) = -2.65$, $p = 0.017$. A background of musical training was related to better exercise scores in the absence of visual support and to a significantly better subjective evaluation of the complex musical model. **Conclusions:** Sonification may be a valuable tool to (re-)train standing balance in neurological rehabilitation. To prevent cognitive overload, the audio feedback should be kept simple. Further research will be carried out to evaluate our approach in a clinical context.

**References**


Poster 52
Cerebral electrical activity triggered by music imagery and music perception: A comparative EEG study
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Keywords: Music imagery, music perception, EEG, alpha-band activity

Background: This study constitutes a pilot protocol designed to gather information regarding electrical activity triggered by music imagery. The aim of the main study is to obtain evidence of the efferent activation from the auditory cortex on the cochlea. A previous research (Ramos-Amézquita et al., 2007) showed an effect of musical imagery on spontaneous otoacoustic emissions (SOAEs) providing evidence of an efferent influence from the auditory cortex on the basilar membrane. However, considering a possible temporal delay between cortex activation and cochlear response, it was decided to include EEG recordings and SOAEs measurements at the same time. Nevertheless, taking into account that information obtained through EEG recordings from a complex cognitive task - such as music imagery - is not specific regarding areas and patterns of activation, a pilot study was designed to determine the type of cerebral electrical activity related to music imagery and possible differences or similarities compared to music perception. Previous EEG studies have provided evidence of changes in alpha activity related to music imagery (Fu et al., 2001; Schaefer et al., 2011; van Djik et al., 2010) particularly in parietal-occipital areas, considering thus a possible involvement of dorsal attention networks that could support the hypothesis of an efferent activation during auditory imagery. Aims: To obtain evidence of the networks involved and types of cerebral electrical activity related to music imagery and its possible differences with music perception.

Method: Six professional music students were recruited (3 men, 3 women), with 14.6 years of music experience, age 27.6 years old. They all were right handed and none of them had neurological diseases or were taking any medication. Subjects were trained to imagine a familiar Mexican tune. EEG recordings were performed using a 64 channels, 10-20 system, 4 g.USBamp (g.tec)/16 channels through a BCI2000 platform. Subjects were instructed to sit quietly, relaxed, no to move and follow the instructions on the screen. The paradigm consisted of the random presentation of the instruction to either listen or imagine the tune, 10 times each. For the analyses, imagination and perception epochs were extracted, filtered and Welch’s method was used to estimate the Power Spectral Density (PSD) of the signal in the alpha-band (8-12 Hz), for each epoch and each channel and for the epoch mean per channel. Spectrograms were also obtained.

Results: An overall increased alpha PSD was observed during imagery compared to perception. In the prefrontal area no relevant behavior was observed; in frontal, fronto-central and central regions PSD decreased towards the external channels; in temporal, parietal, parietal-occipital and occipital regions a left lateralization was observed during imagery tasks.

Conclusions: These preliminary results appear to be consistent with previous studies where a posterior PSD alpha increase related to auditory expectation, working memory for pitch and imagery of natural musical phrases has been reported. Alpha increased activity may be functioning as an inhibitory process, mainly because its presence in apparently task-irrelevant areas. On the other hand, possible common grounds for imagery and working memory are to be discussed. It is also noticeable that the areas where increased alpha PSD power is observed correspond to dorsal attention networks. Some researchers (Giesbrecht et al., 2003; Shomstein, 2012; Yantis et al., 2002) have described one of the functions of the dorsal parts of the parietal cortex to be top-down modulation of attention, a relevant aspect for the main study of this research. Considering this, the next step in the study will be to perform...
simultaneously EEG and SOAEs recordings during a music imagery task in order to observe the possible efferent activation from neural activity on the cochlea.

References


Poster 53

**The distinctiveness effect in the recognition of musical melodies**

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**Keywords:** Distinctiveness effect, musical memory, recognition

**Background:** Across domains, distinctive stimuli are better recognized than typical stimuli (Schacter & Wiseman, 2006). However, the effect of distinctiveness on memory for music has received little attention. Distinctiveness has been identified as a factor in the point at which a listener can identify and name a melody (Bailes, 2010), and in the recognition of unique tones within a melody (Vuvan, Podolak, & Schmuckler, 2014). However, to date, no studies have examined the distinctiveness effect when recognizing whole melodies. **Aims:** Using an old-new recognition test of musical melodies, we aimed to test whether the distinctiveness effect extended to memory for whole melodies. **Method:** A set of 96 novel melodies (48 high-distinctiveness, 48 low-distinctiveness) in two stimulus lengths (48 eight-note and 48 sixteen-note) were composed according to high and low probability tonal and intervallic events (Bailes, 2010), which should result in the melodies being perceived as more or less distinctive. The melodies were verified as being high and low in distinctive musical features through analysis using the software FANTASTIC (Müllensiefen, 2009) and through subjective ratings made by 36 participants in pilot testing. A separate group of 26 first-year psychology students from the University of Tasmania (3 males, 23 females) completed a recognition test. Participants were exposed to half of the melodies in each condition in randomized order. Participants then listened to the full group of melodies, and were asked to rate whether they had heard the melodies in the previous task. **Results:** Analysis of ratings and ROC curves showed that participant’s ability to distinguish between studied and unstudied melodies was greater for high-distinctiveness than low-distinctiveness melodies. For sixteen-note melodies, the Area Under the Curve (AUC) for high distinctiveness melodies was well above chance at 87.13% (95%CI [77.93%, 96.33%]), whereas performance approximated chance for low distinctiveness melodies at 51.63% (95%CI [35.57%, 67.68%]). The difference
between the two curves was significant, $D = 3.62$, $p < .001$. In the eight note melodies, the AUC for high distinctiveness melodies was again above chance, at 75.96% (95%CI [62.64%, 89.28%]), and the AUC for low distinctiveness melodies was lower, at 61.91%, (95%CI [46.13%, 77.68%]), however the difference between the two curves was not statistically significant, $D = 1.66$, $p = .097$. Inferential testing revealed that the advantage for distinctive melodies in both stimulus lengths was due to a large increase in hits (correct recognition of studied melodies) for high-distinctiveness melodies ($p < .001$, $\eta^2_p = 0.42$), rather than fewer false alarms for high-distinctiveness melodies ($p = .375$, $\eta^2_p = 0.03$). **Conclusions:** The results indicate that the distinctiveness effect as observed in other domains extends to memory for whole melodies. This effect was greater for longer melodies, which may be due to the temporal nature of music, which allows the distinctiveness effect to accumulate over time (Bailes, 2010).

**References**

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**Poster 54**

**Participatory sense making in jazz performance: Agents’ expressive alignment**

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**Keywords:** Music, jazz improvisation, participatory sense making, expressive alignment, Granger causality

**Background:** Role-interaction between musicians in jazz ensembles highlights different ways of sharing movement and sound in time. When musicians play jazz, they play together (J), or take turns (TT). From an enactive perspective, improvisers display expressive alignments (Leman, 2016), accounted for a dialogical dynamic that might be linked to Participatory Sense-Making (PSM) (De Jaegher & Di Paolo, 2007). We assume PSM in music as an ongoing, co-constructive process that emerges from the phenomenological inter-enacted experience of playing together. **Aims:** To explore the flow of mutual influences of the musicians’ expressive alignment, as to characterize the interactional PSM in Jazz improvisation. To inquire the phenomenological musicians experience, as to find cues of PSM. **Method:** Participants: 1 ad hoc professional jazz trio (2 tenor saxophones, 1 piano). **Stimuli:** Jazz Standard “There is no greater love”. **Procedure and Design:** The experiment had two parts. In Part 1, the trio played the standard in 4 conditions: c1: TT- Theme (TT-Th); c2: TT- Improvisation (TT-I); c3: Joint – Improvisation (J-I), and c4: Joint – Theme (J-Th). In Part 2, individual in-depth qualitative-phenomenological interviews were administered to the musicians immediately after completion of Part 1. **Apparatus and Setup:** Musicians’ behavior was captured using a Motion Capture system with 12 infrared cameras. In the present study, we inform results corresponding to data extracted from the markers placed on the saxophones, and on the saxophonists’ heads. **Data Processing:** In Part 1 four time-series data, two related to
movement (1a; 1b), and two related to sound (2a; 2b) were processed. (1a), and (1b) measured the Euclidean distance between the sax centroid and the saxophonist head and a spatial reference center, respectively; (2a), and (2b) measured respectively the amplitude envelope and the fundamental frequencies of the audio signal recorded in the session. **Data Analysis:** Conditional Granger Causality measures (Seth, 2010) were used to analyze the 4 time-series data (1 beat temporal sliding window, 7 beats overlapping). Based on GGCA, a further measure (named Sense Granger (SG)) was developed to test the temporal evolving of significant G-Causality observations. In Part 2, a continuous verbal analysis of responses was run as to derive categories that explain musicians' SM experience. **Results:** An N-way ANOVA, with SG as dependent variable, and 3 Factors (Sax (1, 2), Musicians Interaction (TT, J), and Standard (Th, I)), found significant differences for Sax (F=11.08, p< 0.001), and Musicians Interaction (F=58.9, p< 0.001). Standard was not significant. Sax*Musicians Interaction (F=10.89, p< 0.001) and Standard*Musicians Interaction were also significant (F= 89.63, p < 0.001). This indicates that musicians make sense different when they play TT as to play J, no matter whether they play the Th or the I sections. Audio-video-SG analyses identified SG peaks located around TT areas, accounting for an increment on sensorimotor communication, and transferred information from the current player onto the player who is about to TT. As to the interviews, musicians described their phenomenological interactive experience in terms of “going together”. However, TT and J playing were experienced differently, as “give and take” (TT), or “listen the other as environment” (J). **Conclusions:** Jazz improvisation is a sociocultural practice of PSM. Results indicate that musicians experience performance as going together in time. Nevertheless, they appear to make sense differently whether they play TT or play J. Expressive alignment, a feature that characterizes musicians inter-enaction, accounts for the ways sender and receiver engage dynamically in encoding-decoding perception-action alignment loops. In our study, SG was elaborated as an analytical tool capable of accounting for the ways expressive alignment evolves in time. While aligning expressively, musicians negotiate meanings by means of contingent (playing J) and/or autonomous goal-directed (TT) actions during performance. Significant SG was assumed to attests for features of PSM. In TT instances of apparent agents’ autonomy, communication loops are sequential, while in J instances, communication loops are overlapped. These two contexts bring about different environments for PSM. Whether or not musicians are fully aware of such complexity in their phenomenological experience, the sound-kinetic outcomes of their joint and-or sequential autonomous actions provide significant cues that help understanding the meanings of PSM.

**Poster 55**

Validation of a French translation of the Goldsmiths Musical Sophistication Index, an instrument to assess self-reported musical skills and behaviors

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**Keywords:** Questionnaire, musical sophistication, musical expertise, translation, validity, reliability

**Background:** The Goldsmiths Musical Sophistication Index (Gold-MSI) (1) is a self-report inventory measuring levels of different musical abilities and expertise. Although the Gold-MSI is available in English, German and Danish, no French version has yet been validated. **Aims:** The current study aims at analyzing reliability and validity of a French translation of the Gold-MSI in a large Belgian/French population. **Method:** The French version of the Gold-MSI has been obtained after different traditional translation steps. The final version was completed online by 795 persons. **Results:** The McDonald’s coefficient omega, Cronbach’s alpha and Guttman’s lambda indicate that the French version of the Gold-MSI has very good psychometric properties and internal consistency. **Conclusions:**
This study shows that the French version of the Goldsmiths Musical Sophistication Index is a reliable and valid instrument for measuring levels of different musical abilities and expertise. This translation can contribute to research about musical skills and behaviors in French speaking regions.

Reference

Poster 56
Children dancing with the MIROR-Impro: Does the reflexive interaction enhance movement creativity?

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Keywords: Children's musical and movement creativity, MIROR platform, reflexive interaction, child-machine interaction

Background: We introduce an experimental study carried out with children, dealing with embodied cognition, musical creativity and reflexive technology. The reflexive interaction paradigm refers to a particular kind of human-machine interaction based on the mechanism of repetition and variation, where interactive systems are able to imitate the styles of the user which is playing an instrument (Addessi, 2014; Pachet, Roy, Barbieri, 2011). We are interested to investigate the children's creative processes and abilities to improvise and compose in dance education, by using an interactive reflexive system aimed at stimulating music and motor ability and creativity: the MIROR Platform (www.mirorproject.eu). Aims: We used one of the three components of the MIROR Platform, that is the MIROR-Impro. Our aim is to investigate whether and how the reflexive interaction by using the MIROR-Impro can enhance creative processes and the children abilities to improvise in dance education. We observed if the use of reflexive interaction can improve the quality of children's movements. Method: The study was conducted in two classes of a primary public school, with 47 children aged 7 to 8. We adopted an experimental design involving two groups, experimental (23 children) and control (24 children). Both groups took part in several activities in the classroom with a keyboard. The experimental group also accessed the MIROR-Impro. One child played the keyboard, while the others were invited to dance and move while listening to the music produced by the child (control group) or by the child and the MIROR-Impro (experimental group). A dance teacher and a music teacher lead the activities. Children were tested before and after the activities took place. In order to measure the children motor ability, we used the Torrance’s test (1981). Our main hypothesis was that children participating in the activities involving the reflexive reply of MIROR-Impro (experimental group) would show a significant increase in their creativity and quality of movement, compared to the control group. Results: The results of pre- and post-tests were analysed as reported in the administration, scoring, and norms manual of the TCAM test. Analyses of variance (ANOVAs) were performed on scores obtained by the two groups in pre- and post-test sessions. Results revealed no significant differences between the results obtained in the TCAM test by the control and the experimental group in the pre-test. Yet, in the post-test there was a significant difference between the two groups. In particular, and in line with our hypothesis, there was an increase in the scores of the experimental group with respect to the control group. Conclusions: The results of our study on children’s body and music creativity in a reflexive environment can have important implications in the field of child-machine interaction and technology for children’s embodied music and creativity. The experience allowed the performer
child to invent music, dialogue with the sound, and strengthen her/his musical ideas, and the dancers children to refine the quality of their motor experiences and perceive the embodied qualities of music. The mechanism of repetition and variation gave rise to a process of co-regulation between the children and the machine, where the centre of attention is not the final product but the subject engaged in the interaction (learner-centred learning).

References

Poster 57
Multimodal analysis of synchronization data from patients with dementia
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Keywords: Sensorimotor synchronization, wellbeing, dementia, force plate, tapping time series

Background: Little is known about the abilities of people with dementia to synchronize bodily movements to music. The lack of non-intrusive tools that do not hinder patients, and the absence of appropriate analysis methods may explain why such investigations remain challenging. Aims: This aim of this paper is to present an analysis framework developed for processing sensorimotor synchronization data obtained from multiple measuring devices. The data was collected during an explorative study, carried out at the University Hospital of Reims (F), involving 16 individuals with dementia. The study aimed at testing new methods and tools developed to investigate sensorimotor synchronization capacities in people with dementia. Method: A multimodal dataset was generated using a newly developed force plate measurement system (Lesaffre, Moens, & Desmet, 2017), and audio and video recording. Synchronization was measured in the presence of a musical beat vs. a familiar song of the same tempo; under auditory, visual and audiovisual conditions; and in live vs. recording conditions. Patients (N=16) tapped along with the music or performer. Using a hardware setup based on two force plates developed at IPEM, in combination with webcam video capture and audio recording of tapping, audio time series in different conditions were measured. The data were analysed using Matlab 6.1. The ELAN software package was used as a multimodal editor to annotate the participants’ movements. Results: An analysis framework was developed for the extraction of quantity of motion and synchronization parameters from the multimodal dataset. The framework provides a method for synchronizing video, audio and force plate data using the SyncSink application (Six & Leman, 2015). A Matlab toolbox was developed for handling the multimodal dataset. Noise removal based on wavelet decomposition in combination with a 4-parameter peak detection algorithm enables extracting tapping time series from the recorded audio signals. The sensor output of the force plates is used to calculate Quantity of Motion (QoM), Inter Onset Interval variability (IOI), and Negative Mean Asynchrony (NMA) values. Exploratory results on the synchronizing abilities of the patients show that most tapping was performed in the condition with live singing performance. The least tapping occurred in the recorded pulse conditions (non-live performance). Conclusions: A user-friendly monitoring tool and analysis framework has been established and tested that holds potential to respond to the needs of complex movement data handling. This study enabled...
improving hardware and software robustness. As a result, a strong framework is provided for future experiments involving people with dementia interacting with music.

References

AESTHETIC EXPERIENCE
Blandijn - Auditorium A, 16:30-18:30

16:30-17:00
Listening to (collective) improvisation
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Keywords: Aesthetics, listening behaviors, improvisation, interaction

Background: Is there something peculiar about our appreciation of improvised music? How does knowing that the music we are listening to is improvised affect our experience? According to aesthetic empiricism, what is aesthetically valuable in a musical work can be detected merely by hearing it (Lamarque, 2010). Features that are not directly hearable are thus not part of the focus of appreciation; in particular, properties relating to the work’s origin or provenance are not aesthetically relevant in that perspective. While many arguments have been advanced in order to counter aesthetic empiricism, they often rely on thought experiments involving e.g., indiscernible artworks or artefacts produced in different artistic contexts or experienced in different institutional contexts. But despite some neural evidence (Steinbeis & Koelsch, 2009) little is known on how knowledge about a musical work’s genesis actually informs our aesthetic response to it and the way we listen to it in real-life listening experiences. Aims: The goal of this paper is to assess as precisely as possible which aspects of the aesthetic experience we have when we listen to music are more sensitive to modal considerations, i.e., by how we think the music was produced. Method: An audio recording of the very same piece of music – a saxophone/clarinet freely improvised duet – was presented to 16 listeners, either as an improvisation (“IMPRO” condition) or as the live performance of a composition for saxophone and clarinet (“COMPO” condition). As graduates of Paris Conservatory, all these listeners had a substantial background as performers and were used to listening to improvised music as well as to contemporary music. The piece was selected for its ambiguity (assessed in a preliminary survey) regarding its improvised or composed status. The experimental setting was inspired by François Delalande’s study on listening behaviors (Delalande, 1998): listeners were received individually in a comfortable listening room; they were said that they were going to hear a piece of music two times and would have to comment on the piece and on what they heard in it after each listening. Listeners were encouraged both to reflect on their listening experience and to describe in their own words the music they heard. Listeners’ commentaries were recorded, transcribed and analyzed with Grounded Theory techniques (Glaser & Strauss, 1998). Results: First, evaluative judgments were strongly different in the two listening conditions:
listeners approached the piece with specific set of values in mind, by relying on different features (form or internal coherency in the COMPO condition vs organic quality or unpredictability in the IMPRO condition) or different kinds of criteria (aesthetic ones in the COMPO condition vs ethical ones in the IMPRO condition) to ground their appreciative judgments. Second, and maybe more importantly, listening experiences were quite different in the two conditions: in the COMPO condition, the piece was more commonly experienced as a sonic product, with listeners paying great attention to the various acoustical effects achieved by the musicians and to the overall structure (or lack thereof) while in the IMPRO condition, the music was often described as a kind of communication or relational process, with descriptions that largely interweaved music-specific terms and more broadly social terms. **Conclusions:** Overall, this experiment shows that our listening experience can be dramatically affected by modal considerations, i.e., by how we think the music was actually produced. More specifically, it sheds some light on what constitutes the core of the aesthetic experience of improvisation by exhibiting what is centrally at play (and what is not) when we listen to collectively improvised music.

**References**

**17:00-17:30**

**Tendency towards the average? – The aesthetic evaluation of a quantitatively average music performance: A replication of Repp’s (1997) study**

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**Keywords:** Empirical aesthetics, performance research, music performance

**Background:** Research into facial attractiveness has revealed the high positive evaluation of digitally averaged facial portraits in comparison to individual pictures (Langlois & Roggman, 1990; Thornhill & Gangestad, 1993). This preference is explained by the minimal-distance hypothesis (Repp, 1997) which predicts that an average prototype will be the most attractive stimulus for evaluators because it shows the smallest average distance from and individual’s aesthetic ideal. In a groundbreaking study, Repp (1997) applied this hypothesis to the evaluation of performances of Schumann’s piano piece “Träumerei” (Op. 15, No. 7). Listeners rated 10 individual performances and an additional “average performance” version which resulted from the averaged timing data of the individual players’ MIDI recordings. As a result, only one individual interpretation outperformed the average version. **Aims:** This study sought to replicate the findings of Repp’s (1997) publication 20 years on and to add a cross-cultural perspective for the test of the minimal-distance hypothesis. **Method:** In a first step, Repp’s sound examples (MIDI files) were resampled by means of a high quality sound library grand piano sound (Vienna Symphonic Library). Stimulus duration was limited to the first 30 seconds of each version. Third, the number of versions was limited to four: the best rated version from the original study, the worst evaluated version from the original study, a version evaluated as being of medium quality, and the average performance version. The study was conducted as an online survey (2 × 2 design with the repeated measures variable “Interpretation” and the
between subject variable “Country”). Participants from Germany (n = 84) and Taiwan (n = 121) rated the aesthetic quality of the sound examples based on the items of the original study (mean age of all participants = 29.4 years, SD = 8.9 years). Additionally, we controlled for the degree of participants’ musical sophistication (Gold-MSI), response reliability, and rater sensitivity. Results: Based on N = 205 valid responses, items were first analyzed by factor analysis and items with loadings on the first factor (eigenvalue = 3.78) were analyzed for internal consistency. The 5 items loading high on factor 1 (tempo, dynamics, expression, wish to continue to listen, and overall quality) showed a good internal reliability (Cronbach’s α = .86) and were summed up to a Performance Evaluation Score (PES). No significant differences were found for the main effect “Country” (Taiwanese and Germans participants’ evaluations) As expected, the main effect “Interpretation” showed significant differences in the aesthetic evaluation of versions, with the average performance outperforming all other versions (η² = .13).

Conclusions: Our findings confirmed the general preference for a prototypical musical interpretation, which seems to be independent of the listener’s cultural background. In contrast to Repp’s original study (1997), the best individual interpretation did not outperform the average performance version. This result is in line with previous findings for the evaluation of rhythm performances (Kopiez, Langner, & Steinhagen, 1999). We assume that the aesthetic attractiveness of an average performance is culturally invariant in the musical domain.

References

17:30-18:00

Schöne Stellen – A lab study on beautiful passages in music
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Keywords: Aesthetic experience, music analysis, semantic analysis

Background: Very often, pleasurable or intense moments experienced during music listening are tied to particular passages felt by the listener to be beautiful. These “Schöne Stellen” (Adorno, 1965) can influence the perception of a piece as a whole as well as our attraction to and appreciation of it. Such “beautiful passages” in music can be described as unique and irreplaceable (Adorno, 1965). Thus they are also related to the concept of peak or strong emotional experiences with music as described in the literature (e.g., Gabrielsson & Lindström, 2010; Sloboda, 1991). The physiological reactions to these cognitive and emotional reactions have been reported to range from a lightly elevated heart rate to chills (e.g., Grewe et al., 2007; Panksepp, 1995). Aims: This interdisciplinary project aimed to examine the dimensions of Schöne Stellen in Music (SSIM) by investigating the connecting lines between subjective aesthetic experience, musical/acoustic characteristics, and the verbalization or conceptualization of beautiful passages in music in particular. Method: In a lab study, participants were required to listen carefully to self-selected music of any musical style or genre that contained at least three passages they considered to be SSIM. While listening, they were asked to indicate the position of the SSIM in each of the pieces by pressing down the space bar as soon as one of these passages started and releasing it as soon as it ended. Subsequently, they were required to give information specifically on
the following three questions: (1) What exactly were you paying attention to while listening? (2) How would you describe the sound at that moment? (3) Which feelings did the Music induce at that moment? This procedure was repeated every time a SSIM was experienced within the selected pieces. A total number of 40 participants (25 female) with a mean age of 28.1 years (age range: 19-66 years) volunteered to take part in the study. In the current talk, the verbalization or conceptualization of beautiful passages will be focused on in particular. **Results:** A total number of 115 self-selected pieces of music was presented to participants. The overall number of documented SSIM was 431 with an average duration of 31.58s. Analysis of the verbal data involved Natural Language Processing, frequency analysis and semantic clustering. Verbal data on question (1) reveals that the most frequent words are related to the text, voice and melody content of the pieces. Positively valenced vocabulary, such as *joy*, *happiness*, *hope* or *relief*, were reported in question (3). Interestingly, linguistic analysis of question (2) also revealed a tendency for melancholic types of feelings or emotions to be related to the sound of *Schöne Stellen*. **Conclusions:** In order to elucidate how SSIM are subjectively experienced, conceptualized and embodied, multimethod approaches have and will be applied such that verbal reports and music analysis are combined with complementary information from physiology. Ultimately, results of the present study will allow the classification of SSIM passages into potentially distinct types and help to characterize them in more detail.

**References**


**18:00-18:30**

**Interaction between aesthetic judgement and emotional processing: Studying a concert audience listening to contemporary music**

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**Keywords:** Emotion, affect, judgement, psychophysiology

**Background:** Musicologists, practitioners, and critics have recognized that contemporary music is often challenging to audiences used to traditional western music structures. There are several theories of emotional processing of music, including emotional contagion, musical expectation, or brain stem reflexes that might explain why music that is complex, dissonant, or loud induce negative emotional responses. However, such music can be also enjoyable to some listeners. This could be because aesthetic value judgement on dimensions such as originality, tastefulness, skillfulness, or expressiveness interacts with the way we respond emotionally to music (Juslin, 2013). In our view, this form of aesthetic judgement could be similar to general cognitive appraisal and reappraisal, which have been discussed to function in emotion regulation in general. Therefore, studying aesthetic value judgement and emotional responses to music might allow to show insights to the interaction of cognitive
and affective systems involved in music listening. **Aims:** The aim of the presented study is to test for the impact of aesthetic judgement on various psychophysiological response measures of emotion that were assessed in parallel from an entire audience listening to contemporary music. Conducting this study in a naturalistic concert setting allowed to present the music in an artistic frame that is likely to trigger aesthetic judgement processes. In order to induce different levels of aesthetic judgments in participants, we assigned them randomly to one of two groups in a between-subjects design: one group received a lecture on the music presented, illustrating its aesthetic value, and the other group received a lecture on an unrelated non-musical topic. We hypothesized that receiving the lecture on aesthetic value will increase corresponding ratings of subsequently presented music. Furthermore, we hypothesize that high aesthetic value judgments lead to different psychophysiological responses to the music compared to lower value ratings. **Method:** During the concert, we assessed three different emotional response components of from 41 participants (18 music students, 23 non-music students; 10 males; mean age 23 years, range 18-42 years): a) retrospective rating of the 25-item version of the Geneva Emotion Music Scales; b) activation of the peripheral nervous system through skin conductance and heart rate; c) the activity of two facial muscles associated with emotional valence (corrugator = negative valence; zygomaticus major = positive valence). Participants listened to four contemporary pieces of which three were live performed. After each performance, participants completed an online questionnaire and assessed here the music presented according to a list of commonly discussed aesthetic judgment criteria, all thought to contribute to the perceived aesthetic value of a piece of art. **Results:** Data analyses show that the lecture on the aesthetic and artistic value of the music significantly increased the aesthetic judgment ratings compared to attending the lecture on a different non-related subject. This effect was stronger for non-music students than music students. Furthermore, aesthetic judgment was shown to be related to the subjective and physiological responses to music. **Conclusions:** The findings reported in this study help to understand the contribution of aesthetic judgment processes in emotional responding to music. Those results exemplify the role of cognitive-affective interactions in processing music stimuli. Furthermore, understanding if and how providing additional background information on music informs aesthetic judgment processes of music that in turn can modify our emotional responses to music, will help those that try to support music that might be emotionally problematic to some.

References

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**CROSS-MODAL & CONDUCTING**
Blandijn - Auditorium B, 16:30-18:30

**16:30-17:00**

The sound of salsa: Enhancing the evaluation of piquancy by means of a customised crossmodally congruent soundtrack

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**Keywords:** Crossmodal correspondences, soundtracks, spiciness, expectation disconfirmation, assimilation, contrast, sonic seasoning, neurogastronomy, gastrophysics
Background: A number of crossmodal correspondences have been demonstrated between sound and basic tastes, but the impact of sound on more complex flavours and oral-somatosenory sensations is a relatively new area of exploration. The focus of the present work concerns the trigeminal sensation of spiciness/piquancy, triggered by the activation of capsaicin receptors in the mouth. No crossmodal correspondences have been documented between sounds and spiciness until now. Aims: To uncover the auditory parameters that correspond to the experience of spiciness/piquancy in food, and to verify whether spicy-congruent soundtracks might enhance spiciness ratings by acting on participants’ sensory expectations. Method: Experiment 1: Participants were asked to listen to a series of short sound clips that were composed to reflect different variations of specific musical parameters. They chose the sound clip that best matched imagined spicy foods. The results were then used to compose a spicy soundscape that was incorporated into the subsequent experiments. Experiment 2: A between-participants study was conducted at a restaurant in Nashville, TN, USA. Four sound conditions were used in testing: the spicy soundtrack derived from Experiment 1, a sweet soundtrack, white noise, and silence. A prepared dish was served and the participants were instructed to look at the dish while listening to one of the four sound conditions. Next, the participants were instructed to eat the dish as they experienced one of the four sound conditions. Expectations and actual taste were rated in terms of its sweetness, spiciness, flavour intensity, and likability. Experiment 3: Participants at Vanderbilt University (Nashville, TN, USA) were instructed to taste four salsa samples. All salsa samples were identical in terms of their level of piquancy, which was much spicier than the dish used in Experiment 2. Each sample was tasted while listening to one of four sound conditions used in the previous experiment. Participants rated the salsa’s flavour intensity, pleasantness, and level of spiciness. Experiment 4: A final experiment was conducted at the Crossmodal Research Laboratory at the University of Oxford, using salsa of two spiciness levels – mild and hot. Two soundscapes were used (the spicy soundtrack from Experiment 1 and silence). Participants were required to blind taste salsa samples while listening to the soundtracks at the same time, then evaluate the salsa in terms of spiciness and flavour intensity. Each participant heard each soundtrack twice and tasted each salsa sample twice. Results: Experiment 1: The musical features that were associated most strongly with spiciness were high pitch, fast tempo, and a distorted timbre. In addition, faster tempo ambient music clips, a classical music clip featuring gypsy violins, and a percussion clip featuring samba drums, were matched more often with spiciness. Experiment 2: The expected spiciness of the dish was significantly higher in the spicy soundscape group as compared to the other groups. However, no significant differences were observed in the actual taste ratings. A contributing factor to this later result may have been the mild degree of spiciness of the test dish itself. Experiment 3: The rated spiciness of the food sample was significantly higher in the spicy soundtrack condition as compared to the other sound conditions. The mean spiciness rating under the spicy soundtrack condition was similar to the expected spiciness from an additional control study. This supports our hypothesis that the spicy soundtrack only modifies taste evaluations if the participants’ expectations are similar enough to reality. Experiment 4: Ratings of the spiciness of the salsa samples were significantly higher while listening to the spicy soundtrack as compared to silence, but only for the hot salsa sample. An opposite trend was seen with the mild salsa sample, where the participants rated the salsa to be less spicy while listening to the spicy soundtrack compared to silence. The effect of sound on spiciness ratings can thus be explained in terms of an assimilation and contrast model. Conclusions: The research demonstrates, for the first time, the existence of crossmodal correspondences between spiciness/piquancy and sound attributes. These results also provide evidence that such correspondences can be used to modify people’s evaluation of the expected and actual spiciness of foods, likely via a mechanism of inducing sensory expectations.
Cross-modal correspondences of tonal stability

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Keywords: Cross-modal correspondence, cross-domain mappings, metaphor, tonality, tonal stability

Background: Musicians and music scholars habitually discuss tonal relationships in terms of cross-modal metaphors, associating tonal function or tonal tension with percepts such as visual brightness or physical gravity. While cross-domain mappings in music have received ample scholarly attention, little empirical research has tested whether cross-modal metaphors for tonal relationships are grounded in perceived cross-modal correspondences (CMC), and particularly whether such correspondences (e.g., chromatic tones being “darker” than diatonic tones) may be perceived by non-musicians, lacking any conceptual music-theoretical background. Aims: We examine whether CMC between tonal stability and several non-auditory dimensions, including visual brightness and visually-depicted emotion (facial expressions, may be reliably established for both musicians and non-musicians. Method: For each dimension, two experimental paradigms were used, examining explicit and implicit CMC of tonal stability. In the matching experiments, adapting Krumhansl's probe-tone paradigm (Krumhansl & Shepard, 1979), participants heard in each trial a tonality-establishing context followed by a single probe tone, and matched each probe to one of several visual stimuli (greyscale circles varying in brightness or faces varying in expressed valence). In the implicit association experiments, adapting Parise and Spence’s (2012) version of the Implicit Association Test (IAT), participants were presented in each trial with one of 4 stimuli: a tonally-stable auditory stimulus, (A_s) a tonally unstable auditory stimulus (A_i), or one of two contrasting visual stimuli (e.g., a bright or dark circle, V_b, V_d). Stimuli were presented in a block design. In half of the blocks, participants were asked to rapidly press a specified key (e.g., K) when A_s or V_b were presented, and another key (e.g., D) when A_i or V_d were presented. In the other blocks, the audio-visual match was reversed: and participants pressed one key when A_s or V_b were presented, and another when A_i or V_d were presented. We hypothesized that average response times would be faster in blocks matching congruent stimuli (e.g., stable tones and bright circles, instable tones and dark circles), as compared to blocks matching incongruent stimuli (e.g., stable tones and dark circles, instable tones and bright circles). Results: For brightness, Exp1 (matching) reveals significant correspondences between tonal stability and visual brightness: stabler tones were associated with visually brighter stimuli. Such correspondences were observed for both musically trained and untrained participants, suggesting they do not solely rely on explicit declarative knowledge. Additionally, analysis of the cross-modal task (but not of GOF) revealed highly significant differences between results for the two context keys used (D-flat and G), suggesting unexpected absolute pitch effects. Exp2 (IAT) did not reveal any significant cross-modal effects. For facial expression, partial results of Experiment 3 (matching) suggest significant correspondences between tonal stability and visually-expressed valence, as stabler tones are associated with “happier” facial expressions. Experiment 4 (IAT – facial expression) is currently in progress. Conclusions: Results may have implications both for music cognition research and for our understanding of cross-modal correspondences. Revealing consistent mappings of tonal relationships with visual percepts, they suggest that cross-modal correspondences are not confined to basic perceptual dimensions, but may involve systematic mappings of higher-level percepts, generated by quasi-syntactic cognitive schemas such as tonality.

References


25th Anniversary Conference of the European Society for the Cognitive Sciences of Music, 31 July-4 August 2017, Ghent, Belgium

17:30-18:00

**Music composition for deaf and hearing alike: The sense ensemble, Study #1 - Merging performance with clinical study to examine the cross-modal and intersubjective nature of musical experience**

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**Keywords:** Music, cross-modal, inter-subjectivity, deafness, multi-sensory, music composition

**Background:** Music composition for the deaf is considered with a view to broadening the understanding of composition in general by regarding the musical experience as a ‘sense ensemble’, involving all the senses in its creation and appreciation. This line of inquiry is grounded on the following arguments based on embodied cognition studies, and on neuroscientific research: 1) music is fundamentally a whole-body, physical experience, 2) the senses work collaboratively in our perception of music (cross-modality) and 3) our cognitive apparatus for experiencing music is developed from infancy into adulthood through specifically human relationships (intersubjectivity/social cognition). **Aims:** In developing a cross-modal harmonic technique, the P.I. begins with the question: what compositional strategies can be adopted to alert and sensitize a mixed deaf and hearing audience to the physical, multi-sensory and intersubjective potential of the musical experience; and how can the success of such a strategy be assessed? **Method:** The P.I. and 3 musical research assistants conducted The Sense Ensemble Study #1 for 26 participants; 22 hearing and 4 deaf. The study was devised to test a cross-modal and intersubjective approach to music through an interactive performance that involved no spoken or written language. Qualitative assessment of this cross-modal, intersubjective experience was to be drawn through feedback from participant interaction during performance and subsequent interviews. The composition itself was based on a series of 4 ISL (Irish Sign Language) gestures, which presented a visual and quasi-percussive pattern over four bars of 4/4. Upon entry to the venue participants were divided into 4 seating sections, and each section was respectively taught a different gesture - i.e., a different part of the overall pattern - by a trained musician/signer. The gestural pattern as a whole suggested an essential rhythmic motif that was later transferred into other modal expressions – sounds, vibrations – and was subjected to variations on the pattern as the musical piece developed. The audience were invited to perform the pattern with the signer, each section presenting their single gesture as a module of the overall pattern in a form of gestural hocket. In the course of the 15-minute piece, the minimalist unimodal gestures evolved into a multi-dimensional composition comprising the continued use of the gestures and multi-modal variations thereof: low frequency vibrations sent through the floor of the venue via bass shaker speakers, low frequency vibrations sent through the air via subwoofers, materials pulsating percussively and visibly in open speaker cones, an engaging performance by a dedicated ensemble playing conventional instruments (guitar, bass and drums) and smoke rings shot rhythmically from a vortex cannon. All musical forms continued to reference the original gestural motif. **Results:** The audience's success at performing their individual gestures as part of a group constituted a vital form of intersubjective feedback, i.e., the signer communicated a pattern successfully to the participants who in turn performed the pattern as a coordinated group. Moreover, in the post study questionnaires and discussion: 1) 87% participants reported a heightened awareness of visual and tactile musical potential 2) 92% confirmed that they experienced the ISL gestures as music per se, and themselves as performing musicians 3) 100% of the deaf participants...
reported being ‘musically engaged’ during the study. **Conclusions:** This study has presented one model for a multi-modal experimental method, and presents results that support the hypothesis that all music has a cross-modal intersubjective potential which can be appreciated by audiences irrespective of hearing ability. Further studies would be recommended which aimed for greater precision in feedback.

**18:00-18:30**

**The role of experience in conducting gestures**

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**Keywords:** Conducting, beat patterns, pedagogy, expert performance, motion capture, expression

**Background:** Conductors use technical and expressive hand gestures to convey temporal and musical information to ensemble musicians. While the teaching of the technical and expressive aspects of gestures is an integral part of conducting pedagogy, it is unclear how the gestures of expert conductors differ from those of novice conductors. To our knowledge, this is the first study to use quantitative methods to examine unrestricted conducting gestures in a naturalistic setting. **Aims:** To assess the role of experience in conductors’ hand gestures and to explore quantitative methods for analyzing the temporal and expressive aspects of naturalistic conducting gestures. **Method:** Five expert and five novice conductors had their right and left hand movements recorded with motion capture while they conducted a live choir performing four different musical works. **Results:** Mirroring of movements between the left and right hands (gesture shape similarity) was analyzed using reverse-scored procrustes analysis on the frontal plane position data of the right and left hands. Novices exhibited significantly greater mirroring than experts (novices M = .45, experts M = .15, p = .001). The complexity of the movements of each hand was analyzed using Principal Components Analysis. The degree of complexity was quantified as the proportion of the variance unexplained in the first five principal components (Burger, Saarikallo, Luck, Thompson, & Toivianen, 2013). Novices exhibited significantly less complex movements in their right hands (novices M = .77, experts M = .87, p = .04), but not in their left hands (novices M = .76, experts M = .77 p = .95). Conductors typically convey the pulse of the music as a downward gesture. We analyzed the periodicity (regularity) of movement in the vertical dimension by identifying the peak magnitude using enhanced autocorrelation (Tzanetakis & Cook, 2002). Novices exhibited significantly higher periodicity than experts in both hands (Right hand: novices M = .66, experts M = .24, p < 0.001; Left hand: novices M = .40, experts M = .05, p = .002). The regularity of movement kinematics along the gesture trajectory was assessed with another enhanced autocorrelation of the acceleration magnitude. Novices exhibited significantly higher periodicity in the left hand (novices M = .26, experts M = .12, p = .005), but not the right hand (novices M = .28, experts M = .23, p = .15). Each of the analyses described above were statistically compared using repeated-measures ANOVA with song as the repeated measure and experience as the between-subject variable. **Conclusions:** Conducting experience was reflected in the degree of mirroring, complexity, and periodicity of the gestures, with experts exhibiting less mirroring of the hands, greater complexity of right hand movement, less regularity of the vertical position of gestures, and less regularity in acceleration along the trajectory of left-hand gestures. However, conducting experience did not affect the regularity in acceleration along the trajectory of right-hand gestures, or the complexity of left-hand gestures. Taken together, these results suggest that the experts exhibited periodicity at the beat-level in their right hand, despite movements of that hand being more complex and less regular in position. Expert conductors may therefore incorporate expressive gestures along with temporal gestures in the right hand. These results have
implications for conducting pedagogy, and suggest that incorporating expressive gestures in beat patterns is a feat that conductors master only with experience.

References


DANCE
Blandijn - Room 100.072, 16:30-18:30

The impact of soundtrack congruency on the aesthetic experience of contemporary dance: Exploring aesthetic interaction in terms of arousal and enjoyment ratings in three audio settings
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**Keywords:** Aesthetics, dance cognition, kinaesthetic empathy, physiological interaction, audiovisual congruency

**Background:** Music and dance are two art forms that can exist independently, or simultaneously. Often music is used to emphasize particular dance gestures, or dance can be used to illustrate particular passages of music. While each form relies on different sensory modalities, previous studies have demonstrated the ability to deduce the common structures between music and dance, even when each form is presented independently. However, from an aesthetic perspective, music and dance are not always used congruently, to emphasize or complement each other, but are sometimes used in competition, or conflict with each other to emphasize the narrative (Fogelsanger & Afanador, 2006). With this deliberate shift in congruency between stimuli, this begs the questions as to whether congruence between stimuli enhances aesthetic judgements for contemporary pieces, in line with the congruence association model.

**Aims:** This study aims to empirically test the assertions that altering the congruency between a contemporary dance and soundtrack leads to a different aesthetic perception of the presentation; and to identify whether aesthetic responses are mediated by a group physiological response, in line with the theory of kinaesthetic empathy which claims that aesthetic responses are mediated by a proprioceptive body-to-body effect.

**Method:** Thirty-four participants, were randomly assigned to watch a recorded dance performance in a theatre setting, with either the original soundtrack, no soundtrack or the original soundtrack reversed. Aesthetic interaction was measured in terms of continuous enjoyment ratings using an ASUS tablet, and physiological arousal was measured using Empatica 4 wristbands. The Gold MSI and two dance experience questionnaires were also administered in paper format.

**Results:** Granger causality analysis indicated that rate of visual change of the stimulus granger caused electrodermal activity, for the congruent and incongruent sound conditions, but not for the silent condition. Group enjoyment scores did not mirror group physiological responses; in that they were not predicted by visual change of the performance. Additionally, the silent and congruent conditions were rated as less enjoyable as the incongruent condition. Qualitative data demonstrated that
participants found the congruent sound condition the most engaging than the silent or incongruent sound conditions; the two sound conditions more absorbing than the silent condition; and the incongruent sound condition the least understood. **Conclusions:** In line with the Congruence Association Model (CAM), disrupting the congruency between the dance performance and the sound file, did lead to a more ambiguous response from the audience. However contrary to the CAM, there was no difference between the physiological responses of the congruent and incongruent conditions, as the visual stimulus in both conditions predicted Electrodermal Activity. Additionally, the absence of a relationship between the visual stimulus and physiological arousal in the silent condition suggests that sound is a mediator of proprioceptive and kinaesthetic responses. Overall it seems that enjoyment scores were not related to physiological arousal, undermining the idea that aesthetic responses to contemporary dance are based on a proprioceptive body-to-body effect.

**References**

**17:00-17:30**
**Music-induced synchrony and social affiliation in tango**
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**Keywords:** Music-induced synchrony, social affiliation, motion capture, leader-follower dynamic, tango

**Background:** When listening to music, humans often spontaneously move their bodies accordingly (Burger et al., 2012; Toiviainen et al., 2010). Such music-induced movement (i.e., dance) promotes affiliation and social bonding via behavioural synchrony (spontaneously coordinating movements in time) (Behrends et al., 2012; Hove & Risen, 2009; Tarr et al., 2014). Despite the fact that social dance involves dynamic movements of at least two individuals, little attention has been directed to assessing in real time how two individuals coordinate their spontaneous movements as aided by auditory cues. To better understand music-induced movement in a social context, the present study employed motion capture technology to track spontaneous body movement in tango, a genre of Latin dancing that emphasizes behavioural synchrony. **Aims:** The present experiment was designed to explore the effect of auditory cues on physical coordination and social affiliation. **Method:** Finnish amateur tango dancers (N = 16) participated in a 2-hour study on “tango movement” at the MoCap lab at University of Jyväskylä. Dancers participated one pair at a time (9 total). Each participant wore wireless headphones and a motion capture suit with 26 markers. They danced in 4 auditory conditions: the “full” condition (leader-music follower-music, L=F), the “follower-impoverished” condition (leader-music follower-beat, L>F), the “follower-absent” condition (leader-music follower-silence, L>F), and the “leader impoverished” condition (leader-beat follower-music, L<F). Each condition consisted of four 1-minute excerpts of instrumental tango music (selected using the MIR Toolbox based on pulse clarity, tempo, and instrumentation), four 1-minute beat tracks (extracted from the music tracks using a beat tracking algorithm), or silence. Throughout the experiment, each participant answered a brief questionnaire about their in-the-moment feelings (e.g., perceived synchrony, self-other overlap, etc.) once before the motion capture session and once after dancing to each auditory condition. **Results:** Motion data was processed using the MoCap Toolbox. Mixed models analyses were conducted on both the motion data and the social affiliation ratings. Because no statistically significant difference was found between the “follower-impoverished” and the “follower-absent” conditions, these two conditions were tentatively treated as one scenario where the leader received more
auditory information than the follower (L>F). A significant linear trend was found across conditions: as auditory cues became more impoverished (in the order of L=F, L>F, L<F), dancers showed less physical closeness ($F(1,141) = 4.572, p < .05$), experienced less synchrony ($F(1,55) = 11.135, p < .01$) and self-other overlap ($F(1,55) = 5.882, p < .05$) with their dance partner, and followers' foot movement became less expressive ($F(1,142) = 5.926, p < .05$).

**Conclusions:** Results show the powerful effects of auditory cues on physical coordination and social affiliation in tango, assessed with motion data and dancers' subjective experience of synchrony and affiliation. Not surprisingly, dancers' experience became more impoverished when music was replaced by beat and silence. However, results from various levels of impoverished experience raised several interesting points. The lack of difference between the “follower-impoverished” and the “follower-absent” conditions suggests that compared to silence, beat did not better induce closeness, perceived synchrony, self-other overlap, or expressiveness. Contrary to existing understanding of the importance of beat in music-induced movement, the lack of salience in isolated beat points to the richness of the musical context that gives rise to the beat. In addition, the two seemingly equivalent “impoverished” conditions, where auditory stimuli were reversed for the leader and the follower (“follower-impoverished” and the “leader-impoverished”), yielded non-equivalent subjective judgments. This indicates the importance of the leader-follower dynamic in social dancing, where auditory information for the leader seems to be more impactful than for the follower.

**References**

**17:30-18:00**

**Musical meter, movement and cultural roles: A comparison between different types of movement responses to music**

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**Keywords:** Meter, musical cultures, spontaneous movement, dance

**Background:** Musical cultures seem to benefit from an intrinsic relationship with dance cultures. However, this relationship does not seem to be homogeneous. Acculturated individuals -- musicians, dancers, audience, dance teachers -- enact their music interaction in a diversity of ways, by engaging different levels of expertise or interests. These differences somewhat help characterize roles in the cultural setting but do not explain what are the common elements that make musical identities recognizable. How can we identify these elements in such a
variety of movement displays? In this study, we look at the differences and similarities between two kinds of music engagement: traditional dances and spontaneous movement. One of the main problems is how to compare movements that are performed in so many ways. A great part of the literature solves this problem by designing strictly controlled experimental tasks (e.g., tapping to a sensor). Although these studies take the advantage of claiming more significance due to the control of variables, they decrease the validity of findings by avoiding the multiple variables of real-world cultural settings. In this study, we use a method that collects and represents unconstrained movement events in time and space. **Aims:** The study aims at comparing rhythm structure encoded in the movement of traditional dancers and spontaneous movement of acculturated individuals responding to the same style of music. **Method:** We compared datasets of motion capture recordings synchronized with music realized in Brazil and Argentina. The subjects were trained musicians and professional Brazilian dancers. Non-dancers were instructed to move without restrictions (SM – spontaneous movement) while dancers were instructed to dance the *samba-no-pé* style (DM – dance movements). The musical stimuli were composed of excerpts of samba (Brazil). All recordings were realized with a motion capture system and only data of the hands was analysed. The analysis method used PCA (Principal component analysis) combined with zero-crossing detection to find events across velocity patterns. This technique, detailed in Naveda et al. (2016), allows retrieving the changes of directions of the movements across metric levels (annotated in the musical stimuli). The basic assumption behind the method is that any change in the direction of the movement is a potential metrical accent. Metrical accents detected in the movement patterns are accumulated and represented by means of histograms displaying metrical levels (horizontal) and the quantity of events (vertical). **Results:** The results show that dancers (DM) tend to explore only 2 dimensions, which is denoted by the lack of events and by the PCA variances compared with non-dancers performing spontaneous movements (SM). The peaks of the events in the beginning of metrical levels seem to be more attached to metrical levels in SM, but the structure and recurrence of patterns seem to be much more predictable in the patterns of DM. Surprisingly, for DM the changes of directions are less recurrent at beat points. There are strong differences between the histograms of events performed by dancers from different cities. The results suggest that differences between different types of rhythm engagement are spread across morphology of the gesture and rhythm priorities. The idea that expertise is reflected in terms of synchronization with beat profiles is not reflected in the results. It suggests that mechanisms of metrical engagement are more complex or that synchronization could be attached to other body parts. **Conclusions:** The analysis contributes to a number of questions and to clarify how forms of dance may represent the metrical model in itself. The results also indicate that the metrical structure may be interpreted in different ways depending on the cultural role and that care must be taken in interpreting rhythm engagement as a simple, univariate task related to the perception of the beat.

**References**

**18:00-18:30**

**Investigating musical meter as shape: Two case studies of Brazilian samba and Norwegian telespringar**

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Keywords: Samba, telespringar, music and motion, rhythm, meter, dance, motion capture

The perception of musical meter is fundamental for rhythm production and perception in much music. Musical meter is often described as successive points in time. This paper investigates whether experienced musical meter may not only include points in time, or the duration between the points, but also trajectories between the points — that is, metrical shapes. It is suggested that such metrical shapes can be understood by investigating performers’ periodic body motion. **Background:** Previous studies have pointed out that there seem to be a relationship between musical meter and periodic body motion (e.g., Godøy & Leman, 2010). The notion of meter as dynamic shape related to body motion has previously been proposed in Western classical music as composer specific gestures, or “personal curves” (Becking, 1928; Clynes, 1995). In music styles with an intimate relationship with dance, it has been suggested that meter should be understood in relation to the corresponding dance. In Brazilian samba a relationship between repetitive dance patterns and musical meter has been suggested (e.g., Leman & Naveda, 2010). In telespringar it has been suggested that musical meter should be understood in relation with the dancers’ periodic vertical body motion (e.g., Blom, 1981). **Aims:** This paper investigates musical meter in two music styles in non-isochronous meter and with an intimate relationship with dance, namely, Brazilian samba and Norwegian telespringar, and whether metrical points and trajectories in these music styles can be understood by investigating performers’ (musicians’ and dancers’) periodic body motion. **Method:** Two motion capture studies form the empirical basis of this paper; first, a percussionist and a dancer performing samba; second, a fiddler and two dancers performing telespringar. The participants’ body motions were recorded using an advanced optical motion capture system from Qualisys. **Results:** The analysis showed that it seemed to be a relationship between the periodic fluctuation in audio amplitude and the performers’ periodic foot motion on sixteenth note level in samba. Furthermore, similar periodic shapes in both percussionist and dancer foot motion was found. In telespringar there seemed to be a relationship between musical meter and the fiddler’s foot stamping. In addition, the beat duration pattern, as indicated by the fiddler’s periodic foot stamping, seemed to correspond to the shape of the dancers’ vertical body motion. **Conclusions:** The results support the view that there is a close relationship between musical meter and performers’ periodic body motion. Furthermore, they suggest that musical meter may not only include metrical points in time, but that each metrical beat/subdivision duration has a corresponding metrical trajectory with a certain shape. If this is the case, then perceivers’ and performers’ implicit knowledge of the underlying reference structure in samba and telespringar might also incorporate knowledge about the underlying metrical shape.

**References**


THURSDAY 3rd August

KEYNOTE
Blandijn - Auditorium C, 09:00-10:00

Aesthetic empowerment through music
Elvira Brattico
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While not having any obvious survival value, aesthetic enjoyment of music can be regarded as a basic phenomenon of human life. Even infants seem to enjoy music; for example, they are calmed down by the tunes sung by their own mothers. The feelings of pleasure triggered by music processing, similarly to other arts, must have a biological basis, namely, must be founded on specific brain structures solely or mainly devoted to this experience. The power of music is testified by documented therapeutic applications, such as stroke rehabilitation, schizophrenia, anxiety, and depression. Overall, considerable body of scientific research, which investigates the benefits of music on health and wellbeing, has begun to emerge. But why has music such a deep impact on our emotional and aesthetic life? What are the biological determinants of music enjoyment? Why are some people touched by music more than others? In this talk, I present the recent neuroimaging findings revealing the brain functions enabling us, and some individuals more than others, to enjoy and derive pleasure from music. Also, I demonstrate the way familiarity and expertise modulate neural activity and connectivity during music listening. Finally, I illustrate the latest directions towards imaging genetics, drawing the connections between dopamine-related genes and the reactivity of music-processing structures in the brain.

LAUREATE GHENT UNIVERSITY AWARD
Blandijn - Auditorium C, 10:00-10:30

Seeing the music in their hands: How conductors' depictions shape the music
Kathryn Emerson*¹, Victoria Williamson#², Ray Wilkinson*³

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Keywords
Choral conducting, gesture, conversation analysis

Background: Streeck (2008) described gestures as seeing “a bit of the world in the actions of someone’s hand” (p.286). Previous research has looked at how gestures are used in conversation, with a wide variety of descriptions, categorisations and explanations being given by different researchers. However, much less research has focused on how (non-beating) gestures are used by choral conductors. This is particularly strange given how important gesture is to a conductor and how much of their role, as leader, trainer and fellow musician, is played out through gesture. Part of their job is communicating to the ensemble their ideas about the music, and guiding
the musicians towards that performance through the rehearsal process. While talk has a large part to play in this development, so too does gesture, either in isolation or in combination with talk. In order to convey meaning to choirs, conductors often use a mixture of description (or ‘telling’) and depiction (or ‘showing’), incorporating gestures, facial expressions, and demonstrations. Metaphor, used in both depiction and description, is also an important part of choral rehearsals, where gestures or talk show how physical experiences are mapped onto an abstract concept. Vocal and non-vocal modelling is one way that conductors can depict meaning to their choirs. While modelling is acknowledged as important, less research has considered its use in conveying meaning to ensembles. In particular, the way that physical depictions or gestures combine with vocal models is an important part of understanding how conductors use this method effectively.

**Aims:** The aim of the present study is to use qualitative research to consider how choral conductors use gestures and talk to shape the music created by the choir. Examples of depiction will be examined to consider the multi-modality of depiction, and how these modalities can combine with verbal description, to create and convey meaning to the choir. **Method:** Choir rehearsals with eight different conductors were video-recorded, and following their rehearsal, each conductor was interviewed. The semi-structured interviews were also video-recorded, and based on an interview schedule developed specifically for the current study. The interviews comprised of four main sections: Background (how the conductors became interested in conducting, and any formal training), Rehearsing/performing (the meaning of ‘good’ or ‘bad’ rehearsals and performances, and the effect of having an audience), Music (talking about pieces the conductors had or would be conducting) and Gesture (talking about the use of conducting gestures, using video clips from their own rehearsal as prompts). Conversation Analysis (CA) was used to examine the video data. CA focuses on the organisation of verbal and non-verbal communication in interactions meaning that gestures and talk can be considered within the contexts in which they occurred. This allows for better understanding of their use at specific points and within certain activities (e.g., modelling) in natural interaction. **Results:** Analysis of the video data revealed that the choral conductors used many examples of depiction, including modelling. These often involved utilising verbal description, gestures, facial expressions and body movements to create multi-modal models. Contrast pairs (Weeks, 1996) were also used, and non-vocal aspects of communication played a large role, adding to the meaning conveyed by the vocalisations. Many of the gestures demonstrated links with metaphors (e.g., pitch mapped onto physical verticality), and how depiction and description were combined by the conductors was also an important finding. **Conclusions:** The depictive models used by choral conductors to convey meaning are often multi-modal, combining vocal tone, gesture, facial expression and body language in order to show one coherent meaning. Depictions may also combine with talk in order to both ‘show’ and ‘tell’ at the same time. Metaphors are utilised to create meaning, and depictions may be semantically-congruent with the verbal description, or give additional information to the choir. It is clear that conductors can effectively use multi-modal depiction both alone and in combination with their talk in order to create and convey a coherent and expressive meaning to their choirs. Building on the work of Streeck (2008) and others showing how viewers can see a little bit of the world through gestures, here we consider some ways in which conductors allow the choir to see (as well as hear) aspects of the music.

**References**


Reconsidering cognitive effects of music listening: Evaluating the Arousal-Mood Hypothesis over the life span

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Keywords: Music & cognition, ageing, arousal-mood hypothesis

Background: Based on initial findings of briefly increased visuo-spatial function after listening to a Mozart sonata (Rauscher et al., 1995), follow-up studies indicated that not the specific musical piece, but other factors, such as preference for the stimulus, might drive this effect. This result was interpreted as an effect of improved mood, thought to lead to a transient rise in physiological arousal, in turn was thought to lead to a short-lived increase in cognitive performance (e.g., Thompson et al., 2001). This idea, termed the Arousal-Mood Hypothesis (AMH), although intuitive, has to our knowledge not been tested directly on a large set of musical stimuli. Although follow-up research focused mostly on cognitive improvement related to musical activities, the AMH clearly also has relevance to health applications in older adults. While the use of music in dementia care is receiving broad media attention, scientific evidence for this is not straightforward. To select appropriate music for interventions aimed at older individuals, more information is needed on the crucial musical aspects that elicit arousal and may lead to cognitive benefits.

Aims: Two studies systematically assess the hypothesized steps of how music listening might improve cognitive function, by testing the self-rated mood, self-rated arousal, physiological arousal, ratings of preference, ratings of perceived arousal, and performance on cognitive tasks after listening to a large range of musical stimuli, in older and younger adults, in slightly different set-ups. To test the AMH in both age groups, we first assess the effect of preference on induced mood, then the effect of mood on arousal (subjective or physiological) and then the effect of arousal on cognitive performance.

Method: In two separate experiments, 64 young (40 female, age M=21.7, SD=4.0) and 78 older subjects (41 female, age M=71.7, SD=4.3) participated. Although the experiments are slightly different, both include ratings of preference, induced mood and arousal, and a Shepard-Metzler mental rotation task (MRT) to assess visuo-spatial functioning after music listening. To test the AMH, relationships at each step of the proposed process are tested using predictive models (linear mixed models for the younger group and regression for the elderly, controlling for baseline cognitive performance). The physiological data for the elderly group will be included as the project progresses.

The music that was used was taken from a stimulus pool in which especially the arousal content was varied systematically, and in the case of the older participants selected for each individual.

Results: Preliminary analyses indicate that in the younger group, increased ratings of liking significantly predict positive mood (β=.13, p=.004), and this estimate was even higher for the older participants (β=.86, p<.001), supporting the first step in the reasoning of the AMH. Ratings of mood did however not correlate with subjective arousal in the younger (β=-.01, p=.88) or older (β=-.01, p=.93) group. In turn, subjective arousal did not predict performance on the MRT in the younger (β=.04, p=.08) or older (β=.05, p=.67) group. However, the heart rate variability data of the younger groups approach significance in predicting lower MRT performance with increased physiological arousal during the music (β=-.03, p=.053). These analyses will be expanded further with physiological data for the older
group, which might shed more light on the effect of aging on this relationship. **Conclusions:** The results, although preliminary, do not support the AMH as it was originally formulated. However, preferred music does not appear to become less effective at improving mood with age, rather the opposite. This finding, although not unexpected, provides strong support for the (continued) use of music for mood modulation in health care settings. In terms of cognition however, the current data do not show an increase in arousal related to preference, nor the expected relationship between arousal and cognitive function. If anything, physiological stress appeared to potentially impair MRT performance. These results underline the need for a better understanding of the effects of music listening.

**References**

**11:30-12:00**
**Singing in the brain: Investigating the cognitive basis of earworms**

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**Keywords:** Earworm, involuntary musical imagery, phonological loop

**Background:** The experience of having a song ‘stuck’ in the head (an ‘earworm’) is highly common, yet little is known about the cognitive basis of this phenomenon. While often conceptualised as an intrusive thought, the present study argued that earworms are better understood to be an active process, maintained by mental singing along. **Aims:** The aim of this study was to investigate whether earworms involve subvocal articulatory processes, by employing a dual-task working memory paradigm. **Method:** Participants ($N = 52$) undertook a phonological task (serial recall or lexical decision) while a song was presented, and then the same task in silence immediately afterwards, during which time it was anticipated that the song would remain stuck in the participant’s head. Songs were self-selected from a pool by participants at the outset of the first session, and consisted of either those which they had pre-rated as wanting to sing along with (five in one session) or not (five in another session). **Results:** Results demonstrated that, for each task, certain songs were more disruptive to performance accuracy while they were concurrently heard; moreover, some songs engendered further interference to accuracy following their presentation in the corresponding silent condition, indicating a continued representation of the song in phonological working memory. This effect was greater for songs rated higher in terms of a desire to sing along. Unexpectedly, results from the lexical decision task demonstrated that for many participants, reaction time was significantly affected by the tempo of each given song, with reaction times slowing during and following songs with a slower tempo, and speeding up during and following songs with a faster tempo. **Conclusions:** These data indicate that phonological working memory is occupied following auditory presentation of certain songs, particularly those with which people want to sing along. Results therefore provide support for the hypothesis, that earworms are characterised by mental ‘singing’, subserved by subvocal articulation. These findings demonstrate the effective use of a dual-task paradigm for investigating earworms, and have significant implications for how the earworm is conceptualised as a cognitive phenomenon.
The enjoyment of sadness-inducing music is mediated by feelings of being moved
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Keywords: Music-induced emotion, sadness, being moved, liking, beauty, empathy

Background: Why do we enjoy listening to music that makes us sad? The paradox of “pleasurable sadness” has attracted significant research interest among music scholars in recent years, but the puzzle remains to be solved. Juslin (2013) has proposed that the enjoyment of sadness-inducing music has nothing to do with sadness itself, but that sad music is pleasurable simply because it is aesthetically pleasing or ‘beautiful’. But what makes sad music beautiful (and is ‘beauty’ not just another way of describing pleasurable stimuli)? Recent findings from a study on sad films suggest that feelings of ‘being moved’ or ‘touched’ may play an important role in the process, mediating the positive relationship between felt sadness and enjoyment (Hanich et al., 2014). However, it is not yet known whether such mediation also takes place in the context of music listening. Aims: The aim of the two experiments reported in this presentation was to investigate whether feelings of being moved could account for the paradoxical pleasure drawn from sadness-inducing music. Specifically, we investigated whether ‘being moved’ would mediate the positive effect of sadness on liking and perceived beauty. We also investigated whether trait empathy – a trait repeatedly associated with the enjoyment of sad music – would modulate this relationship.

Method: Experiment 1 was carried out as an online experiment: 308 participants listened to 5 sad music excerpts varying in movingness, and rated their liking and felt emotions. Experiment 2 was carried out in a laboratory; 19 participants listened to 27 short music excerpts that represented independently varying levels of sadness and beauty (high, medium, and low levels of both in a 3 x 3 design; 3 excerpts per combination). Participants rated their perceived emotions, perceived beauty, and liking. Results: Experiment 1: A multilevel mediation analysis was carried out to investigate the hypothesis that feelings of being moved mediate the positive effect of felt sadness on liking. The initial, total effect of felt sadness on liking was significant (path c; \( \beta = 0.25, t = 8.46 \)). However, when feelings of being moved were controlled for, the direct effect of felt sadness on liking became non-significant (path c’; \( \beta = -0.042, t = -1.67 \)). The estimated indirect effect of felt sadness on liking was 0.30 (95% CI [0.25; 0.34]), suggesting that the initial positive relationship between liking and felt sadness was fully mediated by feelings of being moved. Trait empathy was significantly associated with mean ratings of felt sadness (\( r = .18, p < .01 \)), being moved (\( r = .25, p < .001 \)), and liking (\( r = .15, p < .01 \)), but did not modulate the relationships between the variables. Experiment 2: A similar multilevel mediation analysis was carried out to investigate whether perceived movingness mediated the contribution of perceived sadness on liking and perceived beauty. For liking, the results revealed a pattern very similar to Exp. 1: When perceived movingness is controlled for, the direct effect of perceived sadness on liking becomes significantly negative (path c’; \( \beta = -0.13, t = -2.62 \)). The estimated indirect effect of perceived sadness on liking (mediated by perceived movingness) was 0.22 (95% CI [0.14; 0.31]). For perceived beauty, the direct effect of perceived sadness on beauty was also negative (but non-significant; path c’; \( \beta = -0.068, t = -1.30 \)), while the estimated indirect effect of sadness on beauty was 0.24. Conclusions: These
findings suggest that the pleasure drawn from sad music – similarly to the enjoyment of sad films – is mediated by feelings of being moved. Contrary to Juslin's (2013) proposal, it appears that felt sadness may indeed contribute to the enjoyment of sadness-inducing music by directly intensifying feelings of being moved.

References

11:30-12:00
Facing a new era in studying music-induced emotions – How letting go of the status quo may help seeing the seemingly invisible
Diana Kayser
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Keywords: Music and emotion, methodology, music-induced emotion

**Background:** One challenge when studying emotions in music is the need for further specification in emotions perceived in music and emotions induced by music. Emotions perceived in music can briefly be described as emotional features that can be recognized in music, based on cultural background, frequent exposure to music, as well as features music shares with other means of communicating emotions (e.g., prosody in language). Music-induced emotions are experiences felt in response to music. These two phenomena can overlap, meaning that music that is perceived as sad can also evoke a feeling of sadness in the listener. Methods used for investigating these two distinctive phenomena can overlap which makes results less reliable. Data collected by some form of self-report subsequent to a musical stimulus, may be valid for studying perceived emotions, as overall judgments on the perceived emotional content seem to be more stable. Music-induced emotions however are in constant flux during the whole listening experience. Methods that include continuous assessment of self-report take this emotional evolution into account, but force listeners to permanently focus on their inner states in order to be able to report emotional experiences. There is still no guarantee for them to report a subjectively felt sensation rather than their judgment of the emotional content. Even though the method of continuously measuring physiological changes (e.g., heart-rate reliability, electrodermal activity) that are associated with emotional changes is trying to deliver a more objective approach, so-called ‘peaks’ in the data do not necessarily indicate an emotional experience and have to be validated through continuous self-report, which, again, requires a constant awareness and cognitive load. **Aims:** The aim of this paper is to open a discussion about current methods that are used for studying emotions in music, while focusing on the more complex and more difficult to obtain phenomenon of music-induced emotion. **Method:** Research methods used for studying emotions in music have been evaluated and discussed in terms of their suitability for studying emotions in music. The focus in this analysis was especially put on the ecological validity of the methods used, and the reliability of the results for both phenomena. In addition, a new method using facial expressions of emotion for studying music-induced emotions has been discussed. **Results:** Research methods used for studying music-induced emotions are, for the most part, poor in terms of ecological validity and reliability of the obtained data and need to be improved. It has been suggested that using facial expressions of emotion as an indicator for emotional experiences could facilitate the investigation of emotions experienced in response to music. Facial expressions of emotion of the so-
called *basic emotions* are widely agreed on to be universal across cultures. The display of facial expressions of emotion is involuntary and spontaneous. They are displayed even when subjects are not consciously aware of experiencing an emotion. As subjects do not have to be consciously aware of an emotion in order to display facial expressions of emotion, there is a good chance that music-induced emotions can be accessed this way. No emotion labels have to be selected by the researcher and listener, which decreases the chance of researcher bias and demand characteristics. Reliability of the results can be increased as facial expressions of emotion indicate a subjective experience rather than the judgment of the perceived emotional content of a musical stimulus. In terms of ecological validity, using software that automatically detects activated facial muscles and puts them into algorithmically determined emotion categories can provide objective and comparable results. Conclusions: There may be ways for studying music-induced emotion that give more reliable results than some of the state-of-the-art methods that have been established several decades ago. One method that could be considered for studying music-induced emotion is the use of facial expressions of emotion in order to determine if a conscious or subconscious emotional reaction has been evoked by a musical stimulus. This leads new opportunities of conducting cross-cultural research on music-induced emotions.

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**WELL-BEING: PARKINSON**

Blandijn - Room 100.072, 11:00-12:00

**11:00-11:30**

Musical feedback in gait training for Parkinson’s patients

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Keywords: Parkinson’s disease, gait training, musical feedback, RAS

**Background:** Patients suffering from idiopathic Parkinson’s disease (PD) are unable to steadily generate regular steps due to an impairment of the basal ganglia that do not cue the supplementary motor area properly. In the 1990s the use of acoustic stimulation for the rehabilitation of gait disorders in PD was developed under the concept of rhythmic auditory stimulation (RAS) (Thaut, 2005). RAS consists of a clear accentuated rhythm that can be either a simple metronome or music with emphasized on-beats, and is able to stimulate the production of rhythmical movements. Building on the fact that PD patients maintain intact their ability to modulate walking cadence, RAS provides a steady tempo (bpm, beats per minute) that stimulates cadence (spm, steps per minute) and consistently leads to a coupling between the two. From the therapeutic point of view, the comparison between the simple beats of a metronome and the more complex beats of a musical piece still needs to be disentangled. However, our study ties in with Michael Thaut’s early approach using rhythmic stimuli embedded in a musical structure, which is based on findings that rhythmic patterns within a musical context reduced response variability and synchronization offset more effectively than did single-pulse patterns in the frequency range of 60 to 120 spm (Thaut, 1996). The efficacy of this approach may be attributed to the fact that, compared to the plain metronome, musical texture provides additional timing information and may therefore facilitate detection and synchronization to the beat. Moreover, music facilitates emotional involvement and motivates engagement in a task, and might thus be a more efficient stimulation than the metronome beat. Based on these premises, we investigated the effectiveness of musical stimulation, excluding the use of the metronome. We integrated sensor-based musical feedback that was interactively related to the patient’s stride length. **Aims:** The purpose of the
The present study was to investigate the effectiveness of musical feedback on the stride length of PD patients. To do that, we extended the concept of rhythmic auditory stimulation (RAS) with interactive musical feedback, aiming at closing the action-perception loop that non-interactive cues such as RAS leave open. **Method:** The comparison between RAS, MF, and no stimulation was conducted on a sample of 15 PD patients in a randomized repeated-measures design. As a countercheck, a further investigation with the same design was conducted on 10 healthy subjects matched for age, sex, and height. We used functional music with a clearly accentuated rhythm and a superimposed salient high-pitched bell sound (standard RAS) and compared it with an extended version of RAS, in which music was not intended as constant cue, but as sensor-based musical feedback (MF), and responded directly to the patient's stride length, the goal of our training protocol. MF was based on the increase of musical parameter instrumentation proportionally to motor parameter stride length, and created a rewarding system where full orchestration was the prize for reaching the longest strides. In the MF condition, as the stride length increased, the musical complexity increased over five different levels, ranging from a simple beat to a full orchestral sound. All three interventions included verbal instructions to make bigger steps. We hypothesized that MF, operating on a fast, nearly automatic level, fosters a greater stride length than other conditions. We investigated also participants' subjective perception asking them questions about the training. **Results:** Both PD and healthy participants confirmed our hypothesis in the within-subjects comparison. For patients, MF was significantly more effective than other conditions. The mean difference between MF and RAS was significant and had a large effect size, \( t(28) = 2.37, p = .025 \) (one-tailed), \( \eta^2 = .17 \). For healthy participants, MF did not show significance against RAS, but had nonetheless a small effect size, \( t(18) = .61, p = .551 \) (one-tailed), \( \eta^2 = .02 \). Participants' subjective perception was in line with objective data: 80% of the patients and 100% of the healthy participants had the feeling they were influencing MF's changes, whereas 66% of the patients and 60% of the healthy participants claimed MF was their preferred condition. **Conclusions:** Our results encourage further research on the role of MF as a therapeutic device in the neurologic rehabilitation of PD patients and may therefore pave the way for a new trend of musical stimulation in gait training. Our mapping proves to be in line with the current trend of sonification strategies (Dubus, 2013). However, the question of which acoustic parameter should preferably vary to allow patients to reach the therapy goal represents a theoretical point that should be further investigated. Through musical feedback we were able to show that the ability to produce a normal stride pattern in PD is not lost, but just needs to be adequately stimulated to overcome the parkinsonian disorder of motor set for gait and the tendency to overestimate active movements. In this sense, the combination of rhythmic cues and feedback seems to be more effective than simple cues, since it interacts with the subject's embodied self-perception instead of merely giving him inputs. We consider MF as an interactive sonification of stride length that improves proprioception and, consequently, performance.

**11:30-12:00**

**Effects of adaptive-tempo music-based RAS for Parkinson's disease patients**

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**Keywords:** Parkinson Disease, gait timings, falling risk, cueing, rhythmic auditory stimuli (RAS), adaptive-tempo music, fractal scaling
**Background:** Parkinson’s disease is a basal ganglia impairment, which can lead to problems of movement timing and rhythm. This can cause gait disturbances such as shuffling steps, start hesitation and freezing. These symptoms of Parkinson’s disease (PD) have been associated with increased risk of falling. Pharmacological and surgical approaches have only limited efficacy in treating these gait disorders. Rhythmic auditory stimulation (RAS), often fixed-tempo metronomes, has been shown to be an effective method in improving gait in PD patients and reducing costs associated with falling. Positive effects of the RAS cueing can even lead to benefits beyond gait such as improvement of quality of life. **Aims:** This work evaluates three different RAS approaches: fixed-tempo metronomes, fixed-tempo music and adaptive-tempo music. In addition to spatiotemporal gait parameters, such as velocity, step length and cadence, we also look at gait dynamics using Detrended Fluctuation Analysis, which is associated with gait adaptability and is one of the best measures of predicting falling. **Method:** 29 Parkinson disease patients were tested in a repeated measures experiment to compare gait parameters in different RAS conditions. Baseline measures without RAS were taken, followed by counterbalanced two-minute trials of the three RAS methods. The **fixed-tempo metronome** played back a metronome with a fixed tempo matching the baseline steps per minute (SPM) or cadence measurement. The **fixed-tempo music** RAS selects a song from the music database and tempo-matches it to the baseline SPM measurement. The **adaptive-tempo music** RAS condition continuously adapts the songs’ tempo to the current SPM of the patient. **Results:** Compared to the baseline, beneficial effects were found for all RAS types. **Fixed-tempo metronomes** resulted in the highest increase for cadence, velocity and stride length, **fixed-tempo music** increased velocity and stride length, and **adaptive-tempo music** increased stride length. However, metronomes lowered the fractal scaling value compared to the baseline, possibly increasing the risk for falling, while adaptive music increased the fractal scaling to healthy levels, potentially reducing the risk for falling. Finally, participants prefer music to metronome as a stimulus. **Conclusions:** Our main conclusion is that metronome-based RAS should not always be considered the best cueing stimuli for Parkinson Disease patients. Music shows less pronounced effects on typical measures such as cadence and velocity, but it has a positive effect on the gait predictability or the fractal scaling. Adaptive music even increased the fractal scaling towards healthy-gait variability, potentially lowering fall risk. In contrast, metronomes make inter-step intervals unpredictable, which increases risk of falling.

**References**


**CONSUMPTION**

Blandijn - Room 110.079, 11:00-12:00
11:00-11:30

Predicting musical meaning in audio branding scenarios

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Keywords: Audio branding, music recommendation, musical semantics, prediction model, random forest regression, GMBI, MIR

Background: In the field of Audio Branding, companies become more and more interested in systems for automated music recommendation. Thereto, certain music pieces are automatically selected from a large music archive and subsequently presented to consumers in order to communicate specific expressions. These expressions will contribute to a strategically-planned brand image perceived by the recipients. Examples include marketing activities like point of sale background music or music used in audiovisual advertisements. A significant amount of research has already been carried out to investigate the correlations between musical attributes on one side and emotional qualities on the other. Thus, most approaches focus so far only on predicting mood or emotional effects of music. Our project, however, also investigates the associative cognitive meaning impact of music on listeners. Aims: The aim of the presented study was to test the feasibility of predicting the music-induced activation of branding relevant semantic associations. In order to achieve this, we aim to predict brand attributes (such as ‘young’, ‘urban’, ‘trustworthy’ or ‘playful’) based on a variety of low-level and high-level audio and music features and based on the moderating influence of the individual differences of music listeners. Furthermore, we aim on developing a prototype system for automatic music recommendation within the audio branding domain. Method: We conducted a large-scale online listening experiment with 3,485 participants from three different countries (Germany, United Kingdom, and Spain). Through the use of Online Access Panels, we recruited participants based on quotas that allowed for an equal distribution of three socio-demographic parameters: gender, age and level of education. The music corpus for this experiment consisted of 183 music excerpts, representing 61 different music styles grouped into 10 different genres. Each participant was asked to listen to a subset of five randomly-assigned excerpts with a duration of 30 seconds each. After each stimulus, participants were asked to rate the fit between the excerpt and each item of the preliminary General Music Branding Inventory (preGMBI). The preGMBI is a new measurement instrument for assessing the music-induced association of attributes that are frequently and reliably used in the field of music branding. It consists of 51 attributes that were rated using a Likert scale from 1 (very bad fit) to 6 (very good fit). Finally, the participants also reported their genre preferences, degree of musicality, and the audio setup used for the experiment. Results: Based on the comprehensive empirical ground truth resulting from this study, we developed a 4-factor ESEM solution representing a parametric orthogonal features space of musical expressions. Audio- and music features as well as lyric-based features are introduced as independent variables of the prediction model. Furthermore, we described Random Forest Regression as a concept for feature selection required to develop a Multi-Level Regression Model, which is taking individual listener parameters into account. First results from a preliminary stepwise regression model indicate that especially high-level features such as intensity, complexity and pop appeal of a song as well as information about style and genre contribute most to the perception of the four expression dimensions (Easy-Going, Joyful, Authentic and Progressive). Conclusions: Our work describes results derived from a large-scale online listening experiment and introduces our approach for predicting perceived musical expressions. It describes the application of Music Information Retrieval, Machine Learning, Structural Equation Modeling and Random Forest Regression techniques to adequately model brand-music-consumer relationships. Additionally, we present findings from four preliminary regression models. The final model will
integrate a large set of high-level and low-level audio features as well as lyric-based features in one comprehensive multi-level regression model and allow to automatically predict perceived expressions of new musical pieces. Recommender algorithms derived from such a model will have the potential to vastly stimulate the music branding sector and the cooperation within related industries.

11:30-12:00
From preference to consumption: How musical taste shapes listening habits
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Keywords: Music preferences, individual differences, music streaming, engagement with music

Background: Recent developments in global availability of music via digital streaming technology, coupled with the ubiquity of portable streaming hardware, allow global music consumption behaviour to be tracked more easily than ever before. Yet connections between individual differences and such behaviour have yet to be fully elucidated. Music preferences have been shown to correlate with a range of characteristics including age, gender, personality, and other measures of individual difference, geographic location, and various sociocultural factors. Other work suggests that many of these factors will likely affect specific aspects of one's engagement with music. To explore these phenomena on a global scale, relationships and differences between music preferences and selected music engagement behaviours of individuals from key music markets around the world were examined.

Aims: The aim was to offer insights into a range of facets of music consumption and listening behaviour around the world, in particular in relation to musical taste and cultural background.

Method: A total of 3916 respondents (52% female) aged 18-60 from five key global music markets (USA, UK, Australia, India, Finland) completed one of a series of six surveys designed to examine relationships between their music preferences, live music attendance, modes of listening, level of musical training, and selected demographic attributes. Respondents answered a range of items concerning the importance of music in their everyday life, weekly listening time, frequency and type of concerts attended, and their use of headphones. Responses were collected via a series of SurveyMonkey survey panels. Musical taste was measured using the Short Test of Musical Preference (STOMP), and demographic information included gender, age, education, income, and nationality. Relationships and differences between the various phenomena under investigation were explored using a range of statistical methods, including Pearson correlations, t tests, ANOVA, and regression.

Results: Results demonstrated clear connections between listeners' musical taste, their cultural background, and their music consumption behaviour. Such connections ranged from the obvious to the surprising. For example, the importance of music in everyday life was higher for musicians compared to nonmusicians, t(592) = 5.210, p = 0.0001, but also for those with lower levels of education, F (4,397) = 2.637, p = .034, with the highest rating given by individuals with a high school degree-only. Correlations between the importance of attending live concerts and scores on the four STOMP classifications of music preferences were highest for fans of IntenseRebellious, r = .279, p = .01, and ReflectiveComplex, r = .216, p = .01, music. Cross-cultural differences were also identified, with Finnish respondents rating the experience of live music as being more important than their US counterparts, F (10, 575) = 6.69, p = .0001.

Conclusions: Results broadly support previous work in this area, but offer some tantalising insights into effects of musical taste, culture, and demographics on specific elements of engagement with music. Findings are discussed within an affect-driven music consumption framework, and considered in terms of the insights they offer concerning music consumption in the digital streaming age.
**Background:** Expectation, structure, and movement are significant topics in music cognition whose interactions have been approached from numerous perspectives. These include affective reactions to the confirmation or violation of expectations with regards to musical structure (Meyer 1956); Lerdahl and Jackendoff’s “grouping structures” and “structural time hierarchies” (1983); and the “future-oriented attending” of Jones and Boltz (1989). To investigate the interrelations of these three fundamental aspects of music cognition, one might exploit the expectation-arousing features of a stimulus that has clear meter, typically periodic form, highly salient structural moment, and is in a genre facilitating a listener’s use of stylistic tropes. In electronic dance music, the “drop,” a structurally-anticipated but sudden shift in tessitura, intensity, and activity that features in the genres of Dubstep and Drum & Bass, provides a promising platform for such a study.

**Aims:** This study investigates whether there is a relationship between structural expectation and bodily responses. The hypothesis is that physical responses to music will be significantly larger at moments associated with structural importance (aligned with the drop) than at less structurally important moments (at other typical 8-bar phrase boundaries) or at moments of no structural significance (mid-phrase). Additionally, responses are anticipated to be better synchronised with the specific musical events of structurally salient moments than at less salient points in the music. In short, responses will be harder and faster at moments of greater structural importance than elsewhere.

**Method:** 35 participants listened to numerous excerpts sourced from an online poll of the “Top 10 Brutal Dubstep Drops” as well as some distractor stimuli from pop that exhibit similar build up and drop techniques. Participants were instructed to grip a hand dynamometer when cued by a visual signal. This visual signal (a green “Go”) cues the participants at either a typical 8-bar phrase boundary before or after the drop, an insignificant beat within a phrase, or at the moment of the drop. After practice trials to familiarise the participants with the experimental set up, 25 trials were recorded (20 dubstep, 5 pop).

**Results:** Results have borne out our hypotheses in the following manner: a) response times at the drop are significantly faster than at all other locations (p<0.0001), which do not themselves vary from one another significantly; b) increased grip strength is positively correlated with response time (p<0.0001) although, due to wide difference between individual participants’ native grip strength, this does not reach significance as a statistical measure by itself. Qualitative results from the debriefings suggest that the physical responses are independent of individuals’ liking of the music.

**Conclusions:** Our results suggest direct correlations between structural importance within a piece of music and gesture response time and magnitude. This supports the intuitions of athletes and gym-goers who utilise music for its ergogenic qualities. The findings add to the literature on music within exercise and sport, providing evidence for responses that are heightened by precise moments within a piece of music to complement the less time-specific findings of, for example, DeNora about musical structure and exercise classes (2000). It is hoped that these...
results that interrelate structure, expectancy, and gesture will be applicable to other genres and more subtle situations, such as key changes or cadences, as well.

References

14:00-14:30

**Tracing melodies: An observation study of hand movements to vocal phrases from different musical cultures**

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**Keywords:** Melody, embodiment, melodic contour, music and motion

**Background:** Melodic contour, defined as the overarching shape of rising and falling of pitch over time, has been studied using sound tracings, melodic similarity and expectation ratings and other methods. Some methods to compare melodic contours have been investigated comparatively (Schmuckler, 1999). One of the methods used to investigate music perception as motion, is sound tracings (Nymoen et al, 2011). It is a way to spontaneously render a sound on paper or in space as one listens to it. The idea is to be able to access the intermodal synthesis of the auditory experience of music. Sound tracing studies have been mostly carried out using digital tablets or on paper. In this abstract, we present qualitative analysis of a sound tracing study in three dimensional space, and strategies that are used by people to represent musical features and move to melodies across genres. We report an analysis of movement pertaining to different genres of melody, and propose some reasons for those constructions.

**Aims:** The aim of this experiment is to analyse the complex relationship between the perception of melodic contour and body motion. Some of the research questions are as follows: 1. Are melodic tracings systematic over time? 2. What are the strategies used for melodic tracings? 3. What is the effect of pitch height on melodic tracings? **Method:** Participants: We asked 32 participants (17 female, 15 male) to move to melodic stimuli in a lab setting. The mean age of the participants was 31 years, s.d. 9. We also recorded their familiarity with the musical genres used, and quantified their musical sophistication using the OMSI questionnaire. Stimuli: We selected 16 melodic fragments from 4 genres of music that use vocalisations without words: scat singing, classical vocalise, Norwegian joik, and north Indian music. The melodic fragments were taken from real recordings containing complete phrases. There was a pause before as well as after each phrase. The phrases were an average of 4.5 seconds in duration, s.d. of 1.5s. These samples were presented in two conditions: 1. The real recording, and 2. A resynthesis through a sawtooth wave from an autocorrelation analysis of the pitch profile. There was thus a total of 32 stimuli. **Procedure:** The participants were asked to trace all 32 phrases in random order and their bodily responses were measured with a Qualisys motion capture system. This system records the position of reflective markers attached to the body, through infrared cameras. We placed 21 markers at all joints except finger digits. Participants were asked to move as if their hand motion was ‘producing’ the melody. **Analysis:** The motion data for all 21 markers was postprocessed in Qualisys Track Manager, and imported into Matlab for analysis. **Results:** We find some distinct patterns of musical movement and representations in different hands. 1) The body: We observe that all participants represent melodies using hand movement readily.
The coefficients of variation of movement in all three axes for both hands are calculated. This figure represents the degree of variance of the distributions for each dimension. These coefficients are found to be LH (x,y,z) = (63.7, 45.7, 26.6); RH (x,y,z) = (56.6, 87.8, 23.1), suggesting that the amount of dispersion in z, which is the vertical axis, is the most consistent. This suggests that a wide array of representations in x and y axes are used.

**Strategy:** Upon observation, we find that a finite array of strategies is used to represent intervallic distance in the melodies with the body. These include representing melody through hand height relative to the body, hand distance from the body, distance between two hands.

**3) Pitch height:** The standard deviation was found to be the maximum for the right hand in the vertical axis at 257 mm, whereas deviation in RHX and RHY were found to be 110 and 102 mm. In the left hand, the standard deviation in the vertical axis was 185 mm, whereas in LHX and LHY it was found to be 99 and 89 mm respectively. This suggests a stronger effect of right-handedness. This also suggests a tendency towards representing contours vertically. Having said so, a local representation of height is observed to be far more persistent and important than a global representation. Pitch height, therefore, always means relative height in a melodic phrase, and its representation also depends upon the memory of the melody.

**Conclusions:** Through this experiment, we conclude that melodic tracings are systematic and show some specific patterns. Future work will include the exploration of differences between melodic tracings across participants, investigating strategies used for genres, and sound features in the melodies.

**References**

**14:30-15:00**

**Break, build and drop: Embodied listening as expressive interaction with electronic dance music**

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**Keywords:** Electronic dance music, peak experiences, pleasure, skin conductance, expectancy

**Background:** Typically, electronic dance music (EDM) tracks contain at least one section of major structural and dynamic change, consisting of breakdown, build-up and drop (the “break routine”). Producers and dancers view these moments as significant factors in the shaping of peak experience (Butler, 2006; Gadir, 2014), but little is known about the experiential quality of intense, pleasurable experiences with EDM, nor the extent to which these are associated with specific musical features. **Aims:** We report a study which aimed to determine the role of the break routine in peak pleasurable experience with EDM using examples from the genre. **Method:** Twenty-four participants listened to five EDM extracts. Measures were taken of skin conductance activity, self-reported affect (Schimmack & Grob, 2000), subjective experience (10 Likert-type adjective items), incidence of pleasant bodily sensations, and demographic variables. **Results:** Participants reported intense affective and embodied experience with EDM despite being removed from the club context, and attributed this experience to the break routine and to the drop within it. Analysis of the self-report items revealed that the music was experienced as “activating” and “uplifting”, and indicated a kinaesthetic experience of the music. The relationships between skin conductance
response, structural characteristics of the break routine and subjective response were explored and will be reported orally. Music analysis indicates that features of the drop are broadly akin to those associated with peak response in other genres (e.g., increase in loudness level, change of texture or form, expansion of frequency spectrum and pitch range) (Gomez & Danuser, 2007), but manifest in ways specific to EDM (e.g., increase in loudness level, contrasting breakdown section, use of drum roll prior to the drop, band pass filtering effects). **Conclusions:** These results indicate that peak experience is important in musical pleasure with EDM, is related to musical features, and has embodied spatial and kinaesthetic experiential qualities even when listened to without dancing and away from the club context. Our results could suggest that an affect space does not effectively characterize listeners' experiences of EDM, which are better captured by more embodied states, specifically sensations of flying, rising, and being uplifted. This would support recent critiques of research which frame music listening primarily in terms of affect to the neglect of other domains of musical experience (Clarke, 2014). Just as dancing to EDM is an embodied form of expressive interaction with music, our research shows that so too is listening.

**References**


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**15:00-15:30**

**Arm and head movements to musical passages of electronic dance music**

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**Keywords:** Electronic dance music, dance, motion capture, group interaction, embodiment

**Background:** Electronic dance music (EDM) is produced with the intention of making people dance, something that can be observed when crowds move together in clubs. EDM is characterised by its energetic musical style, a strong four-to-the-floor beat, and typically large and sudden structural and dynamical changes in the tracks. These changes can be referred to as the break routine, consisting of the passages (1) breakdown, (2) build-up, and (3) drop. A key feature of the break routine is the temporary removal and reintroduction of the beat and the rhythmic patterns of the music. It is also common to apply intensifying effects, such as increasing pitch and brightness together with drum rolls. Previous research on EDM has mostly dealt with historical, social and cultural aspects of the music. There are considerably fewer empirical and quantitative investigations, from a psychological and embodied point of view, such as the various sound-accompanying body movements occurring in an EDM setting.

**Aims:** This paper investigates how people move and synchronize to musical features occurring in the course of a DJ set comprised of EDM tracks. More specifically, it compares the patterns of people's head and arm movements, in addition to comparing data gathered from two different motion capture systems. We explore (1) how these two
types of sound-accompanying movements embody the various musical features of EDM, (2) how these movements are influenced by dancing together with others, and (3) with how such movements can be captured using different types of motion capture systems. **Method:** We created a club-like environment and recorded the dancing of 29 participants (15 females, 14 males) using an optical motion capture system (Qualisys) and small inertial activity trackers (Axivity AX3). The participants danced in separate groups of 9 and 10 to a 10-minute-long continuous and beat-matched DJ set. The set consisted of four EDM tracks. Two of the tracks comprised the break routine whereas the two others had a relatively flat structural development. Each participant was equipped with one reflective motion capture marker positioned on the head, as well as two inertial activity trackers attached around each of their wrists. **Results:** The results show both similarities and differences between the overall movement patterns as evidenced through tracking of the head markers and the movement extremities measured through the arms. The Qualisys system gave precise information about the position pattern of the participants. We found that the horizontal movement pattern varied greatly across groups and music segments, but more similar tendencies were found in the the vertical movement pattern. Especially after the drop moment, the participants demonstrated a more systematic and obvious vertical pattern which was more synchronized to the musical beat. When it comes to the overall level of the participants’ movement there was obvious correspondences between arm and head movements (measured with both the Qualisys and Axivity systems), which related to the large dynamical changes in the break routine. **Conclusions:** The results suggest that the presence of a clear rhythmic framework in the EDM has a profound effect on keeping people highly synchronized to the beat. Our results further imply that the form and shape of an EDM track is important in how a dancing crowd respond to the musical sound. It also seems like people embody musical features in EDM differently through their arm and head movements, and that dancing together with others influences these movement patterns. Finally, even though the Axivity data does not provide the same level of spatiotemporal resolution (and position information) as from the Qualisys system, it is of sufficient quality to warrant future studies outside the lab. Our aim is now to study how people move in an actual club setting, which will also enable us to look more carefully at the dance culture and its pertaining social components.

**PREFERENCE & FAMILIARITY**

Blandijn - Auditorium B, 13:30-15:30

13:30-14:00

**Characterization of newly gained statistical knowledge of an unfamiliar music system**

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**Keywords:** Statistical learning, EEG, ERP, musical structure

**Background:** How do we acquire knowledge about a specific music system? Music system specific knowledge is important for our ability to differentiate between different music systems, and serves as a framework for appreciating new music. Krumhansl (1990) has proposed that we develop a representation of a music system by abstracting its statistical regularities during exposure. This idea has been supported by developmental, cross-cultural, and cognitive research. For instance, participants are able to abstract statistical regularities of an unfamiliar music system after short exposures. In a previous experiment in our lab we exposed participants to an
unfamiliar music system defined by the frequency of occurrence of different pitches. Before and after the exposure phase, probe tone ratings were obtained for different tones following tone sequences from the same music system (contexts). Crucially, some tones occurred as part of the music system during the exposure phase, but never as part of a context. Before exposure, ratings of these tones were lower than ratings of tones that occurred in the context, suggesting that participants use short-term regularities. However, ratings of these tones increased after exposure, whereas ratings of tones, which never occurred as part of the music system remained similar. This suggests that participants had also used abstracted knowledge over and above the information that was present in the context after exposure. Thus we propose that participants are able to abstract short-term as well as long-term knowledge about an unfamiliar music system after short exposure. Several electroencephalographic (EEG) markers have been found to characterize different kinds of musical knowledge, thus presenting an opportunity to test our conclusions. The mismatch negativity (MMN) is known to indicate violation of representations of short-term regularities, i.e., short-term knowledge. On the other hand, the early right anterior negativity (ERAN) is thought to indicate violation of representations of longer-term regularities, i.e., long-term knowledge (Koelsch, 2009).

Aims: Using ERPs as diagnostic measures of different kinds of knowledge, we want to describe the nature of abstracted musical knowledge in more detail. Results will further our understanding of how we gain knowledge about a specific music system. Method: We will expose participants to an unfamiliar music system for 30 minutes defined by the distribution of the system’s constituent pitches. Before and after the exposure phase, ERPs are recorded with a 128 electrode dense array EEG system for probe tones following tone sequences (contexts), which are generated from a similar but not identical distribution. Tone sequences heard during exposure and used as contexts will differ in 12% of their constituent tones, but overlap in the used pitches otherwise, suggesting that both types of tone sequences are from the same music genre. This will allow us to compare ERPs to probe tones that occur (a) both during exposure and in contexts, (b) only in contexts, (c) only during exposure, and (d) neither during exposure or in contexts. Furthermore, ERPs collected after the exposure phase will be compared to ERPs collected before the exposure phase for each type of probe tone. Results: Our presentation at ESCOM 2017 will consist of a summary of our work to date, and will outline in particular our behavioral data that, we propose, identifies short-term and long-term representations of pitch distributions. We will also present new EEG data from comparisons of different EEG-recording conditions. Conclusions: Data will inform us about the nature of statistical knowledge abstracted from exposure to music. Our design will allow us to draw conclusions about the time course of statistical learning, and advance our understanding of how we gain knowledge about a specific music system.

References
**Background:** Previous evidence suggests that music listening may transiently increase cognitive performance in healthy older adults, possibly by impacting mood and arousal levels, as stated in the so-called arousal-mood hypothesis. However, these studies often ignore possible effects of arousal content of the music, music preference and subject’s familiarity with the music stimulus, making it difficult to interpret these results. Given the potential impact of music interventions on cognitive function in healthy older adults or even individuals with dementia, more robust conclusions are needed regarding the effect of these aspects of music listening on specific cognitive tasks, and the possible mediating role of the music-induced emotional response. We investigated whether familiarity with music affects arousal and mood levels, and subsequent cognitive performance in older adults. Next to intuitive ideas about familiar music, there is also evidence suggesting that familiar music is related to strong positive mood, and sometimes increased arousal levels (Pereira et al., 2001; van den Bosch et al., 2013). The combination of a positive mood and heightened arousal levels may lead to cognitive enhancement, in line with the arousal-mood hypothesis. **Aims:** To examine the influence of familiar music on mood, arousal, and cognitive performance in healthy older adults, we assessed working memory, memory search and visuospatial skills after music listening, along with ratings of mood and subjective arousal, and measured heart rate, as a physiological index of arousal. Notably, our paradigm does not assess cognitive responses to music generally, but focuses on the influences of familiarity with musical pieces. Although various music listening applications claim a beneficial effect of using music that participants are familiar with, this has to our knowledge not yet been evaluated directly. **Method:** Seventy-eight healthy older adults (age µ=71.68, range 65-84), 46 female, completed the forward Digit Span (DS), Letter Fluency (LF) and a Mental Rotation task (MRT) after listening to music with differing degrees of familiarity between subjects. The musical piece was individually selected a stimulus pool to vary familiarity and perceived arousal content, through a pre-test listening session that also included baseline cognitive measurements. A finger oximeter measured heart rate, and various ratings (i.e. familiarity, induced mood and arousal, preference) were collected, as well as information regarding music experience. The relationship between music familiarity, mood and subjective arousal was assessed using a partial correlation that controlled for the influence of preference. For every cognitive outcome variable (DS, LF and MRT), a hierarchical multiple regression was performed. Independent variables included the baseline performance score and the familiarity rating. Induced arousal and the role of music in life were added to the analyses as covariates to address findings from previous literature. Physiological arousal data are currently not included, but will be added to these analyses in the course of the project. **Results:** The partial correlations show that familiarity impacted subjective arousal (\(r = .36, p<.001\)) but not mood (\(r = .01, p>0.05\)), after controlling for preference. For all cognitive measures, no significant influence of familiarity was found when controlling for baseline cognitive performance, subjective arousal, and possible mediating factors such as musical background. **Conclusions:** Our findings do not confirm the prediction that familiarity with music would lead to increased positive mood and a related increase in cognitive function in healthy older adults. However, a relationship between music familiarity and subjective arousal was found that did not affect cognitive performance. Inclusion of the physiological data will further clarify the relationship between familiarity and arousal music listening. The implications of these findings speak to the underlying theoretical aspects of the arousal-mood hypothesis, as well as clinical applications of music-based health interventions.

**References**


14:30-15:00

Replication and validation of an experimental paradigm of measuring open earedness
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Keywords: Open-earedness, openness to experience, experience seeking, openness to aesthetic experience, empirical aesthetic

Background: The current state of research on open-earedness (OE) could be categorized by two general paradigms: a) the valence-oriented paradigm and b) the decision-making-paradigm. First one measures OE via the situational valence for specific music pieces which are often categorized in conventional and unconventional by the experimenter subjectively (for an overview of German literature Auhagen et al., 2014). These approaches can be criticized referring the theoretical framework and the operationalization (Bötsch & Rothmann, 2016; Hargreaves & Bonneville-Roussy, 2017; von Georgi & Frieler, 2014). Openness to experiences as a related construct of OE (Hargreaves & Bonneville-Roussy, 2017) is a central aspect of the decision-making-paradigm by von Georgi and Frieler (2014). OE is defined as an open behavior towards music, which is experimentally measured by the variation in decision behavior for different categories of music independently of valence and music categories. Therefore, OE correlates with Openness to Experience and Experience Seeking. Aims: Aim of this study was the replication and validation of the decision-making paradigm by two independent samples of 30 to 50 and 50+ years old. Furthermore, we are interested in the development over lifetime by combining the samples of existing studies (von Georgi & Frieler, 2014, Bötsch and Rothmann 2016 and the following samples). Another aim is to identify other psychological constructs such as general music preferences which may predict OE. Method: By this point the whole sample, considering the samples by von Georgi and Frieler (2014), and Bötsch and Rothmann (2016) also, consist of 242 subjects, 51.3 percent are females, with an average age of 30.87 (Md=25.00; SD=17.94; min=12; max=83). All subjects were asked to choose a piece of music considering their own individual preferences and interests out of a pool of music-categories (genres). Valence was measured after each listening. After 15 times of decision-making the subjects conducted the NEO-FFI and the Sensations Seeking Scale V. For analyses the Entropy (Shannon, 1948) and the Oewd, a contentual established density coefficient, were computed (Georgi & Frieler, 2014). Hypotheses and explorative questions were tested by correlation and regression analyses. The level of significance was set at α≤.05. Results: The results of the new samples are consistent with the hypotheses. We found significant correlations between Entropy and Oewd (rs=.90; p<.001). Both coefficients of density are correlated to Openness to Experience (rs[Entropy]=.29; rs[Oewd]=.26; p=.001). The results showed that the variation coefficient of measured music preferences (rs [Oewd]=-.64, p<.001; rs [Entropy] = -.59, p=.01) as a single indicator of multiple music preferences seems to be a further predictor of OE. Conclusions: The decisions-making paradigm is an experimental design for measuring OE independently of valence and different types of music. Probably OE is part of a meta-construct openness to aesthetic experiences, which could be explained as a trait which could be measured by the used experimental paradigm. Because of the stimulus-independent measurement, this design could be used a broader range of an openness to aesthetic experiences.

References


15:00-15:30
Musically-induced chills: The effects of “chills sections” in music
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Keywords: Chills, music, emotion, induction mechanisms, intensity

Background: Musically-induced chills, the experience of shivers down the spine, gooseflesh or tingling sensations in response to music, have been linked to specific musical features. Studies have found associations between chills and musical features, such as sudden dynamic changes (Grewe et al., 2007). However, there exists no empirical research that has tested these associations through the manipulation of pieces of music; in addition, rarely has the phenomenon of chills been contextualized in terms of the processes underlying emotional experiences with music. Aims: The current study aimed to understand the proposed relationships between chills and certain moments within music. This was achieved through testing the effects of identified “chills sections” in musical stimuli reported to elicit chills across several listeners in a previous survey. To explore the theoretical basis for musically-induced chills, chills sections are contextualized in terms of possible activation of underlying mechanisms in the BRECVMAC framework (Juslin, 2013).

Method: Participants (N = 24) listened to original and manipulated versions of three pieces of music reported by participants in an earlier survey on chills (N = 375). Chills sections reported in the survey were removed from the music to create manipulated versions, maintaining a natural musical progression. After each piece participants completed a set of self-reports, confirming if they experienced chills, how intense the experience was, and how moved they were. Additionally, the possible activation of underlying mechanisms was assessed via an updated MecScale instrument. Skin conductance (SCR) and continuous measurements of chills intensity were also collected during listening. Two listening sessions were separated by distractor questions. Finally, information on familiarity, preferences, personality and musical sophistication were collected.

Results: Early analysis of the data offer support for the importance of chills sections in the experience of chills; chills were experienced more frequently in original conditions for all stimuli, but differences did not reach statistical significance (p = 0.11). Experiences of chills were reported as significantly more intense than no chills experiences (p <.01). Additionally, ratings of being moved were significantly higher during the experience of chills for most pieces (p <.01). In original stimuli, SCR and continuous measurement values were compared between chills sections and “control sections”, a segment in the music of equal duration; mean comparisons showed that SCR and continuous ratings of chills intensity were significantly higher in the chills sections for all three pieces (p <.001). Chills sections were hypothesized to activate certain underlying mechanisms; however, ratings did not significantly differ between conditions.

Conclusions: The study provides a novel contribution to the field by testing associations between chills and aspects of a piece of music; to our
knowledge this investigation is the first of its kind. Results suggest that chills are intense emotional experiences, and indicate the mixed state of being moved. The frequency of chills was higher in pieces with identified chills sections, but the difference was not significant; further analysis is required to assess the consistency of self-reports alongside time-series data (e.g., SCR). Results highlight moments in some pieces which are emotionally intense; further enquiries should investigate what makes these moments so emotional. Finally, the context of underlying mechanisms in music and emotion is useful, and should lead to experiments with higher control over variables, to develop an understanding of the causal processes underlying musically-induced chills.

References

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**WELL-BEING**

Blandijn - Room 100.072, 13:30-15:30

**13:30-14:00**

**Music and movement synchronization in people with dementia**

Matthieu Ghilain*, Loris Schiaratura*, Micheline Lesaffre*, Joren Six*, Frank Desmet*, Séverine Samson*

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Keywords: Synchronization, dementia, music, metronome

**Background:** Recent evidence showed that music-based interventions can enhance emotional state and well-being in people with Alzheimer's disease (Narme et al., 2014). Moreover, it has been frequently reported that patients with dementia (PWD) are able to spontaneously synchronize movements with music. However, the reasons why music-based interventions produce such benefits need further studies. These effects could be influenced by pleasure and nonverbal communication induced by movements synchronization in musical activities. Several lines of evidence suggest that rhythmic entrainment could influence motor, emotional, cognitive and social behaviors, and be enhanced by music. We can therefore predict that these responses will improve communication between patients, professionals and relatives. However, to our knowledge, there is no clinical evidence to support this idea. The link between synchronization to music and emotional state was not evaluated in PWD. Before assessing this effect, we need first to understand the impact of environmental factors on synchronization. The purpose of the present study was to validate a new tool to rigorously examine sensorimotor synchronization in PWD. More specifically, we tested the effect of auditory sequences (music vs metronomic) and the influence of social factors (interaction with a real or virtual person) on synchronized movements. **Aims:** Our primary objectives were to examine (1) the influence of auditory sequences (music vs metronomic sequences) and (2) social (real vs virtual experimenter) factors on sensorimotor synchronization to identify the conditions that lead to the most accurate and consistent synchronization in PWD. Our secondary objectives were to determine (1) the effect of tempo (slow vs fast) of the auditory sequences and (2) the impact of the musical
structure (binary vs ternary) on sensorimotor synchronization. **Method:** 34 PWD were asked to tap in synchronization with auditory sequences (metronomic vs music) and in presence of real vs virtual experimenter. The order of presentation of the conditions was randomized for each individual. Sensorimotor synchronization was measured by a new tool (Music Balance Board, Lesaffre, Moens, & Desmet, 2017), specially developed to record body movements and hand tapping of aged people, in a comfortable and natural position. Data collected were analyzed with circular functions using the Matlab Toolbox. We predicted, based on scientific literature, that synchronization will be more accurate and more consistent 1) in the metronomic than in the musical conditions, and 2) in real than in virtual presence of the experimenter. We also hypothesized that synchronization will be more accurate and more consistent 1) in fast tempo (90 bpm) than slower tempo (75 bpm) and 2) with binary than ternary metric. **Results:** The analysis showed that PWD synchronized more consistently and accurately and produced more body movements in music than in metronomic conditions. Interactions were found between auditory and human factors on consistency and accuracy. PWD were more consistent but not more accurate in presence of a real than a virtual experimenter in metronomic conditions whereas they were more consistent and more accurate in presence of a virtual than a real human in music conditions. Finally, in the music conditions, we found a Social by Tempo and by Metric interaction on consistency but no effect on accuracy. **Conclusions:** These results suggest that sensorimotor synchronization of PWD is influenced by auditory (metronome vs music) and social (real vs virtual human) factors highlighting the effects of interpersonal communication during musical interventions. The validation of the proposed methodology in neurodegenerative disease will be useful for future clinical studies. It will also allow better understanding of synchronization mechanism in normal and pathological aging and its possible link to emotional state.

**References**


**14:00-14:30**

**Developing a personal playlist app for dementia**

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**Keywords:** Dementia, personalised, technology, identity

**Background:** Personally meaningful music and digital technology are powerful tools for wellbeing in dementia, yet their synergy has been relatively unexplored through evidence based strategies for dementia care. There is a need to better understand uses and functions of current personal music technologies in dementia care, and to develop new technologies which promote access to and scaffold use of personally meaningful music. Further, there is a need to ensure such technologies are co-designed, evidence-based, evaluated for impact on wellbeing, and contextualised to existing and novel theoretical frameworks of dementia care. **Aims:** In collaboration with charity Playlist for Life, the primary aim of this project was to develop a personal playlist app for delivery from post-diagnosis to end of life, inclusive, accessible and evidence-based. This aim was addressed through two
Phases of research and participatory design to ensure the app and its constituent elements were co-designed with those living with dementia. Phase 1 ‘Scoping Study’ generated user-driven requirements to inform the app design, while Phase 1 ‘Iterative Prototyping’ employed the user-driven requirements to iterate a prototype app. The secondary aim was to better understand the impact of app, once built, on user wellbeing, and the interface between musical identities, dementia and technology to propose a model of music and technology in dementia. This was addressed through Phase 2 Evaluation: the prototype was piloted in the home and Care Home through Nesta/Department of Health’s ‘Dementia Citizens’ Citizen Science Platform. This paper presents findings from Project Phase 1. Phase 2 is ongoing and due for completion September 2017. **Method:** One-to-one semi-structured interviews were carried out with 30 participants (15 formal carers and 15 pairs of informal carer and person with dementia). The interviews explored perceived opportunities and outcomes of personal music technologies in dementia care, current uses of music and technology in daily life, ideal features and functions of a personal music technology and review of current Playlist for Life guidance and materials. In addition, demographic information and usability data were recorded regarding use of music technologies and Playlist for Life materials. **Results:** Qualitative thematic analysis of Phase 1 interviews, usability data and generated requirements will be presented, focusing on: Perceived Opportunities and Outcomes of personal music and technology in dementia care; Current uses, requirements and attitudes towards music, technology and music technology; Perceived features and functions of a personal music app to support and enrich wellbeing of those living with dementia; Barriers/constraints regarding successful implementation across care context and disease severity; Recommendations and guidelines to aid efficacious and innovative care and practice. The resultant iteration of a Personal Playlist app will be presented, as well as initial findings from ongoing Phase 2. **Conclusions:** Conclusions are pending: this initial work provides a basis for better understanding the interface between musical identity, digital technology and dementia care, and the optimal design of technologies to support and enrich our access to and use of personal music. Main project outcomes will be a set of evidence-based guidelines for use of personal music technologies in dementia care, a framework to guide the design of future personal music technologies for dementia, and a model of music and technology in dementia.

14:30-15:00

**Effect of motor entrainment to auditory cues and music during walking on quality of movement and perceived fatigue in persons with Multiple Sclerosis**

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**Keywords:** Entrainment, synchronization, music, metronome, D-jogger, Multiple Sclerosis, quality of movement, walking, perceived fatigue

**Background:** Multiple Sclerosis is a demyelinating inflammatory disease affecting the central nervous system. Motor dysfunctions are prevalent symptoms, where people with multiple sclerosis (PwMS) have difficulties in walking, as high levels of fatigue is experienced. Novel rehabilitation approaches targeting these symptoms are warranted. Empirical evidence in the field of systematic musicology have shown that entrainment improves performance and decreases perceived fatigue in sports performance. In recent times, a keen interest is present in applying concepts from systematic musicology such as entrainment into practical applications in the neurological rehabilitation. **Aims:** We aim to investigate if PwMS can entrain to the beats of the music compared to metronomes, and its effect on quality of movement and perceived cognitive and/or mental fatigue during walking. **Method:** 25 PwMS and 25 healthy controls will be included in the study. They will undergo four sessions in total.
(one descriptive and three experimental), each session held a week apart. In all the experimental sessions participants will be equipped with the D-Jogger system (Moens et al., 2014) and accelerometers. In sessions two and three, they will be asked to walk to six different conditions. The difference between session two and three, will be that in session two, no instructions will be given to synchronize. In session three, instructions will be given to synchronize, and additionally to the music, metronomes will be used. Each condition will contain three phases: 30s of silence, 2m30s of auditory condition, and 3m of rest. In the auditory phase, music or metronome stimuli will be presented in six different tempos. The tempo (beats per minute) of the auditory stimuli marking the six conditions will be the natural steps per minute of the participants, as well as +2, 4, 6, 8 and 10% of their natural cadence. All conditions will be randomized, as well as the music/metronome blocks. Spatio-temporal parameters from the accelerometers and the synchronization with the D-jogger system will be measured. In the last session, participants will be asked to walk in three conditions: silence, music and metronome for twelve minutes each with rest periods in between the conditions. The tempo for the auditory stimuli, which provides the optimal movement quality from sessions two and three, will be used in session four. In addition to measuring synchronization and quality of movement in this session, we will also measure the perceived mental and physical fatigue with a BORG scale. **Results:** We hypothesize that PwMS may entrain and synchronize to different tempos. Additionally, we expect a higher quality of movement and decreased perceived physical and/or mental fatigue during the music condition compared to metronome or silence, specifically in the more cognitively impaired patient population. If our hypothesis is proven, these results will have strong practical implications to train PwMS at higher intensities with decreased perceived physical and/or mental fatigue. **Conclusions:** Conclusions will be drawn once the results are obtained.

**References**

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**POSTER SESSION 3**
Blandijn - Floor +1, 15:30-16:30

**Poster 58**
Musical trajectories and creative orientation of music lessons affect the development of interest in ‘music’ in secondary schools’ students

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**Keywords:** Musical trajectories, musical sophistication, musical self-concept, creative music teaching interventions

**Background:** Trajectories of musical development can be very different across adolescence and the causes and mechanisms leading to these differences are often the focus of research in music education (Müllensiefen et al., 2015). To measure the aspects of musical development, the psychometric constructs ‘musical self-concept’, assessed with the Musical Self-Concept Inquiry by Spychiger (2017), and ‘musical sophistication’, measured with the Goldsmiths Musical Sophistication Index by Müllensiefen et al. (2014) as well as ‘interest in music as a school

subject’ (Rakoczy et al., 2008) can be used. However, there is no study, which shows that there are different developmental trajectory groups of these constructs, which differ from the absolute level as well as them continually changing over time. Moreover, there are also only very few studies, which analyzes the effects of specific music lessons – especially of creative music teaching interventions (about 10 double-lessons) – on the development of the target variable of this research study ‘interest in music as a school subject’. To analyze these effects, the specific music lessons or the creative music teaching interventions include a higher amount of creative, i.e. productive and transformative, forms of activities as well as methods (e.g., composing, improvising, arranging, dancing or drawing to music, etc.). Aims: The aims of this repeated-measurement study with four different time-points in the school years 2014/2015 and 2015/2016 were: (1) to identify different developmental trajectories (regarding the constructs) within a sample of secondary school students, and (2) to analyze how ‘musical self-concept’ and ‘musical sophistication’ as well as creative music teaching interventions contribute to the development of ‘interest in music as a school subject’. Method: Data of 167 students (f = 94, m = 73) from two Grammar Schools and two Middle Schools are presented. The data comprised the self-assessed psychometric constructs as well as music-specific and demographic background variables (e.g., age, sex, musical status, etc.) at four time points across nearly two school years. The data were analyzed using sequence pattern analyses and multilevel linear models. Results: The sequence pattern analyses identified three developmental trajectories of ‘musical self-concept’ and ‘musical sophistication’. From these, two typical trajectories of musical development were identified and associations with the variables sex (phi = .299, p ≤ .001), musical status (phi = .221, p ≤ .001), type of school (n.s.), and the overall self-assessed marks in ‘music’ (n.s.) as well as the self-closeness to the school subject ‘music’ (r = .250, p ≤ .001), were found. The multilevel analysis shows that the two identified typical developmental trajectories affect students’ interest in music as a school subject over the four time points. Additional, the multilevel analysis shows that the interest in ‘music’ is decreasing (p ≤ .001), but students in the high developmental trajectory demonstrate a significant higher interest in ‘music’ over time (p ≤ .001) – compared to the students in the low developmental trajectory. Moreover, a further analysis shows that creative music teaching interventions (p ≤ .05) as well as the high developmental trajectory of students (p ≤ .001) contribute to the development of the target variable ‘interest in music as a school subject’, while interest in ‘music’ is generally decreasing over time (p ≤ .001). Conclusions: In summary, the identified two typical trajectories as well as creative music teaching interventions contribute to the development of ‘interest in music as a school subject’ over time. Hence, this study makes an important contribution to the understanding of the mechanisms and reasons of musical development during adolescence, and of the effects of a creative orientation of music lessons as well as an expressive interaction with music in general.

References
**The influence of attention and familiarity on the effects of music with prosocial lyrics**

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**Keywords:** Prosocial behavior, pop music, empathy, thoughts, lyrics

**Background:** “If you wanna make the world a better place, take a look at yourself and then make a change”, sings Michael Jackson in his song “Man in the Mirror”. This and other songs with prosocial lyrics certainly affect people who listen to it. But not everyone changes his or her behavior because of a song. Still, there are some studies that prove the effects of this kind of music. Field studies showed that people in a café or restaurant show more prosocial behavior when exposed to songs with prosocial compared to neutral lyrics (e.g., Ruth, 2017). Other studies yielded that prosocial music increases prosocial cognition, empathy, and arousal, but decreases aggressive thoughts, feelings and behavior (e.g., Greitemeyer, 2009). These studies are based on the General Learning Model (GLM, Buckley & Anderson, 2006), which postulates that personal and situational inputs lead to a certain internal state of a person which leads to an appraisal process and eventually to a certain behavior. Most of the mentioned studies used popular songs. We cannot tell if it is the music, the lyrics or the knowledge we have about the songs that initiates the postulated process. Maybe unknown songs with prosocial lyrics have an effect on the listener, too. Whereas a familiar song could affect us because of the knowledge we have about it (e.g., we know about the socio-environmental engagement of the musician, corresponding charity projects like USA for Africa) even though we do not listen to the music with our full attention. **Aims:** This study wants to investigate how familiar and unfamiliar songs with prosocial lyrics affect listeners that listen attentively or inattentively to the music. An attentive listener should be affected by known and unknown prosocial music in a comparable way, while an inattentive listener should more likely be influenced by familiar music due to other factors like knowledge of the song which can be triggered unconsciously. In this study I want to examine how these factors affect variables like prosocial thoughts, empathy and prosocial behavior. **Method:** For this purpose, an online-based 2x2 between-subjects experiment with 138 German participants (58.7% female, $M_{age}$ = 26, $SD = 8.2$) was conducted. The participants were randomly assigned to one of the four experimental conditions. In two groups the recipients were distracted by a mathematical task while there was no other task than listening in the other conditions. One distracted and one attentive group listened to two familiar songs with prosocial lyrics (1 German, 1 English song) while the other groups listened to comparable unfamiliar ones. The songs used were evaluated in a pilot study ($N = 41$). After listening to the songs the participants were asked to answer a standardized questionnaire. First, they did a word completion task to access their prosocial cognition. Afterwards, their state empathy was tested using the FEPAA questionnaire. Finally, prosocial behavior was accessed through participants’ willingness to donate parts of their incentives to a charity project. **Results:** A two factorial ANOVA yields that the attention of the listeners and the familiarity of the songs with prosocial lyrics have significant effects on the prosocial behavior of participants. A significant interaction effect, $F(1,137) = 7.62$, $p < .01$, $\eta^2 = .05$ and a significant main effect for familiarity were found, $F(1,137) = 4.47$, $p < .05$, $\eta^2 = .03$. This means, attentive listeners do not behave differently after listening to familiar ($M = 5.67$, $SD = 1.55$) or unfamiliar songs ($M = 5.88$, $SD = 1.44$), while inattentive listeners behave more prosocial when listening to a familiar song ($M = 6.14$, $SD = 1.57$) than when listening to an unfamiliar one ($M = 4.58$, $SD = 2.8$). Other results indicate that familiarity and attention have main effects on prosocial thoughts ($F_{attention}(1,137) = 4.03$, $p < .05$, $\eta^2 = .03$; $F_{familiarity}(1,137) = 7.11$, $p < .01$, $\eta^2 = .05$) and state empathy ($F_{attention}(1,137) = 9.07$, $p < .01$, $\eta^2 = .06$; $F_{familiarity}(1,137) = 4.02$, $p < .05$, $\eta^2 = .03$). **Conclusions:** Based on the results, it can be concluded that familiarity of prosocial songs is substantial for the investigated effects, especially when we listen to the music inattentively. These results give...
us further evidence which situational and personal factors are relevant for the effects. It seems reasonable that it is not only the music or the lyrics that trigger the postulated process but also information, associations and knowledge we have with the familiar music. Maybe when we listen to a song like “Man in the Mirror” we are reminded of the Band Aid project and the media coverage that came with the song. Still, even though familiar music affects the listener more likely there was an effect of unfamiliar music with prosocial lyrics, too. This indicates that the music and the message can initiate a process and lead to a prosocial behavior, too. Particularly, when the recipient listens attentively.

References

Poster 60
Cross-cultural evidence for promoting life-long musical investment through music education: Exploring best practice approaches
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Keywords: Music educators, facilitation, content analysis, life-long, self-determination theory

Background: While research has broadly considered the wide-ranging intellectual, social, personal, and physical benefits of active musical participation across the lifespan, there is little research that has focused specifically on how music educators can best promote participant investment inside school and beyond. The slim quantity of existing research that does consider recruitment and retention for musical participation has been limited focusing, for instance, on single points in time such as the transition from elementary to secondary school. However, with increasing evidence supporting musical participation for health and wellbeing benefit, it is important to consider how music facilitators can promote continued participation. Aims: In the context above, the present research, specifically aimed to: (I) Investigate what constitutes best practice in music education, focusing on skills to facilitate on-going engagement in music, and (II) Explore these practices within a range of cultural and pedagogical contexts. Method: The present study was based on interviews with leading European and Australian music educator-research experts from within a secondary school system as well as tertiary institutions. The data collection focused on the participants’ reflections of their own practice and beliefs. Semi-structured interviews began by asking the main research questions, but also allowed for deeper exploration tailored to each participant’s experience. Following transcription of the interviews, a qualitative interpretative phenomenological analysis was performed. Results: Emergent areas of interest included the knowledge and skills involved in teaching music, education philosophy and pedagogy, the support of one’s peers, supervisors and school and local community, and past personal experience. It was clear that interviewees were deeply influenced by local/national cultural trends and that some had to counteract the myth that not everyone is/can be musical, while others were able to amplify positive cultural beliefs around music’s value to culture. Further, new/beginning music educators
needed to think beyond the structure of their own music education to provide more culturally diverse educational experiences for their students. Findings provide evidence that: developing autonomous engagement can generate personal meaning and value in music, which translates to deeper, longer musical investment; students need to feel competent in their participation; and students need to have a strong sense of affiliation and social connectedness in their activities. Thus, the evidence supports adopting the theory of self-determination, which is based around the satisfaction of specific psychological needs (connectedness, autonomy, and competency), leading to positive motivation, development, and well-being. **Conclusions:** The study revealed that the educators needed to create environments in which they could work in simultaneous roles as facilitators and co-producers guiding their students in their pursuits in learner-centred and even learner-directed environments. Indeed, the relevancy of self-determination theory argues for a shift away from the prevailing music pedagogical practices, based centrally on expertise training, to an acute appreciation of connectedness, autonomy, and competency, which will promote sustained investment in musical activities.

**References**

**Poster 61**

**A multimodal interactive installation for collaborative music making: From preservation to enhanced user design**

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**Keywords:** Interactive art, multimedia installations, dynamic preservation, multimedia heritage, embodied cognition, digital humanities

**Background:** Interactive installations are complex cultural objects. They can be examined from different perspectives, some of which show interesting overlaps. This work approaches a multimedia interactive installation for collaborative music making called BilliArT from the viewpoints of conservation, aesthetic experience and artistic design. BilliArT is a dynamic system in which generative music and visual textures emerge from the interaction of the participants with a standard carom billiard table. It was developed by Tim Vets at Ghent University, and first presented to the public in 2013. Besides the original character of the installation, featuring a jazz-inspired “algomorphic” approach to real-time music composition, the installation represents a unique case study for scientific investigation because it was specifically designed to be an artistic work as well as a measuring tool. This means that besides achieving the artistic effect, BilliArT meets specific requirements for the study of user interaction, namely: (1) the use of a motion capture system for the tracking of the balls trajectories on the billiard table; and (2) sonic and visual properties that are expressed with qualitative labels, familiar to the musically untrained participants. **Aims:** The aim of this experiment is to document the installation in a systematic way, and to show how the information that can be derived from the documents is useful to the work of the conservator, as well as to that of the researcher, and that of the artist. **Methods:** The installation was set up in a laboratory environment, where quantitative and qualitative data were collected during the interaction with the installation of 25 single users: video recordings from different angles, audio recording of the musical output, the data log of the motion capture system involved in the installation, a questionnaire before and after the playing session, and an (audio recorded) interview after the session. **Results:** The data were examined for all
the participants together, but also for groups of men and women separately. Interesting feedback was received on how the interaction was perceived in first person vs. how it would be reported to someone who has never seen the installation. A number of creative ways to display the data has been produced together with the artist: they serve as input for future installations, besides showing aesthetic value on their own. Conclusions: Systematic documentation can benefit multiple areas from conservation to artistic practice, while keeping the theoretical discussion alive and vibrant.

**Poster 62**

**A new test of the ability to detect mistuning in real music**

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**Keywords:** Pitch perception, musical abilities, pitch accuracy, Gold-MSI

**Background:** Evaluating melodies as in- or out-of-tune is a common musical activity. The ability to detect mistuning varies greatly between listeners, with “expert” musicians being thought to be particularly good at this task. Nonetheless, musical expertise does not perfectly predict mistuning perception ability, and listeners without formal musical training can be surprisingly reliable and consistent when evaluating the pitch accuracy of melodic performances. It would be interesting to explore which factors cause these individual differences in mistuning perception ability. Such work would depend on an effective standardised test for mistuning perception ability. However, no mistuning test yet exists that uses the rigorous methodology of item response theory as well as ecologically valid musical stimuli. Item response theory represents the state of the art in test construction techniques, and is an essential tool for developing efficient and reliable tests. Ecological validity is important to ensure that our test measures real-world listening abilities. **Aims:** The present study aims to develop and validate an efficient test of mistuning detection ability in music, similar to other high-level listening tasks that are part of the Goldsmiths Musical Sophistication Index (Gold-MSI). In order to achieve maximum test efficiency, the test is designed to be adaptive by homing in on an individual's ability level through on-the-fly item selection. The discriminatory power of the test stems from automatic item generation resulting in a large item pool that allows testing participants on a fine grid of task difficulty. This study comprises two main steps: test construction and calibration. Test construction comprises the automatic generation of a large number of test items. In the calibration step, a statistical model is estimated empirically that predicts psychometric parameters for items based on their structural item features. These psychometric parameters are then used for the adaptive procedure, enhancing the test’s reliability. **Method:** Materials. 37 short music excerpts were selected from the Medley database, http://steinhardt.nyu.edu/marl/research/medleydb, following several criteria: natural singing style, popular music genre, clear tonal structure, diversity of popular genres across the sample, and single melodic vocal line. Each excerpt was then used to create 76 two-alternative forced choice items (2812 items in total), where the test-taker has to distinguish between an in-tune version and an out-of-tune version of the same excerpt. Out-of-tune versions were created by pitch-shifting the vocal track relative to the instrumental tracks. Mistuning amounts varied in increments of 5 cents from 10 cents to 100 cents, both sharp and flat. **Participants.** 333 participants (227 women) exhibiting large variation in musical training (sum scores ranging from 7 to 48 on the Gold-MSI musical training subscale), were tested in the lab (n = 185) and online (n = 148). **Procedure and analysis.** Each participant took 37 items from the item bank. Items were administered pseudo-randomly, with no repetition of musical excerpts. Response data were analysed using explanatory item response modelling (i.e.
mixed effects models), enabling psychometric parameters to be predicted on the basis of structural item features. These parameters form the basis of the subsequent adaptive test. **Results:** The random effect structure of the explanatory item response models was selected using the corrected Akaike Information Criterion (AICc). The final model included random intercepts for participants and musical excerpts as well as random slopes for the interaction of excerpts with mistuning direction. The final model indicates that the degree of mistuning strongly relates to psychometric difficulty of the item, with greater mistuning producing significantly decreased item difficulty (standardized $\beta = 1.29$, $\chi^2(1) = 715.58$, $p < .001$). In addition, self-reported musical training has a positive relationship with mistuning perception ability (standardized $\beta = 0.667$, $\chi^2(1) = 69.02$, $p < .001$). As expected, neither age nor gender was significant factors in the model. **Conclusion and perspectives:** Results suggest that mistuning detection difficulty can be modelled closely with a few factors, which is important for achieving high reliability in the future adaptive test. Initial results also support the test’s convergent validity, with musical training being an effective predictor of test-taker ability. In future work, we intend to investigate the test’s convergent and divergent validity, to determine population norms, and to clarify the effect of other factors potentially contributing to mistuning detection in real music.

**Poster 63**

**Gestural interaction in a jazz jam session**

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**Keywords:** Musical gestures, turn taking, jazz, conversation

**Background:** Studying gestures occurring during musical interaction is a relatively new field in musicology. Specifically, research on body movements and their meaning for musical interplay is lacking. So far, gesture research has explored which gestures occur (Godøy/Leman, 2010) and what role they play in musical interaction (Davidson, 2012). The research focuses on communicative gestures made by one musician. This study, on the other hand, investigates the structure of musical gestures in interaction. In a jazz jam session most decisions about the structure of the piece are made spontaneously. Musicians must communicate effectively to ensure that every participant understands the structure and common goals and to foster creative output. Hence, interactive musical gestures are observed as interplay between two musicians. **Aims:** In analogy with research on gestures in speech communication, this study examines how turn-taking processes work in musical “conversation”, how the gestures can be described and how intention is expressed. In turn-taking research, the analysis of gestures is one way to investigate the inner structure of the conversation. Gestures also express intentions of interaction. By comparing a linguistic conversation to a musical jam session, gestures in interaction and their underlying intention will be identified. **Method:** A jazz trio (piano, double bass, drums) jamming together for the first time was videotaped. The video was transcribed to discover turn-taking events and subdivided into distinct intervals. Two excerpts containing several intervals each and showing examples of communicative gestures were analysed by two observers. In structured observation, a quasi-quantitative method used to validate and objectify single observations (Robson, 2002), they assigned five categories to the intervals in the video, choosing between “no visible communication”, and gestures with the communicative intention of “attention”, “invitation”, “initiative” and “agreement”. **Results:** Kappa results show that a communicative intention expressed in gestures is visible for spectators who are not jazz musicians themselves. Actions include two types of gestures, “initiative” and “invitation”. Initiative gestures signify the wish to play a solo; invitational gestures invite others to play a solo. Both types of gestures provoke specific responses. The only reaction pattern observed was agreement. Therefore patterns of gestural actions and reactions can be identified as paired gestures. These gestures are only visible in
musical interaction; hence the classification of musical gestures has to be expanded to accommodate a new type of interactive musical gestures. **Conclusions:** Musical gestures in interaction are shaped by the underlying intention. This intention is not conventionalised in specific movements; yet it is understood by fellow musicians and observers. The results demonstrate the need to analyse paired gestures, the pattern of actions and reactions expressed by underlying interactive musical gestures, further.

**References**


**Poster 64**

**Novel involuntary musical imagery: The genesis of a tune in the mind**

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**Keywords:** Novel involuntary musical imagery, earworms, creative cognition, interview

**Background:** Music can exist without sound. In the absence of an externally generated sound, the mind can, deliberately or not, recall familiar music or produce seemingly novel musical material. Research on musical mental imagery to date has largely focused on experiences of familiar voluntary and involuntary musical imagery (INMI or ‘earworms’; Williamson et al., 2012); novel musical imagery episodes by comparison have been largely unexplored. The focus of the present study is novel INMI, which we define as experiences of INMI where the music itself, to the best of the individual’s knowledge, has never been heard before as real music. **Aims:** The current study aims to investigate (a) the phenomenology of novel INMI and (b) how this experience can be translated to external outcomes in the form of musical composition. **Method:** A semi-structured interview was designed and conducted with 6 music composers (3 female), who had reported experiencing novel INMI regularly. The interview was divided in two phases: in the first phase, participants provided information about the music they generally compose as well as their familiar INMI experiences. The second phase of the interview focused on novel INMI phenomenology (situational antecedents, familiarity, feelings, musical features, repetition). The remaining questions asked whether and how novel INMI can be translated to music composition. **Results:** Based on grounded theory techniques, two descriptive models were developed for each of the research aims. The first model indicated that the occurrence of novel INMI is more likely when individuals report being in states of low attention, self-conscious reflection, or are in situations where they are engaging in repetitive movement. The feelings associated with novel INMI were classified as largely positive, energetic, and peaceful. The form of novel INMI was described by the participants in terms of three dimensions; basic musical structure such as melody, rhythm, and pitch, the formal structure associated with the tune and its duration, and linguistic elements associated with the lyrics and voice. Finally, the repetition within novel INMI was frequently related both to improved memory consolidation and a driving force that lead to composition. The second model indicated that
the initial steps of translation from musical imagery to musical composition were achieved with a variety of different methods such as manuscript paper, mobile phone apps, and on-hand musical instruments. Factors that influenced the success of any attempt to translate novel INMI to a new piece of music included the musical skills of the composer and the complexity of the novel INMI tune. **Conclusions:** Overall, this work extends understanding of this unique form of creative musical imagery and places the experience in the framework of existing knowledge regarding both familiar INMI and spontaneous cognition. In particular, this is one of the first studies to suggest a possible function of this type of imagery related to memory consolidation and interactions between the musical expertise of the composer and the complexity of the novel INMI in the creative outcome as composition.

**References**

**Poster 65**

**Musical gestures as an interface of performers’ intentionality: A case study of western embodiment of Karnatic music**

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**Keywords:** Musical gestures, embodied music cognition, music performance, music intentions and expressivity, music interpretation

**Background:** Music performance has a strong corporeal dimension, involving different types of gestures (technical gestures, expressive gestures, etc.) that performers employ to transform a written score into live music (Leman, 2007). This transformation is based on the musical intentions that arise from the performers' personal interpretation of the composition as an outcome of their artistic praxis, which leads to decisions on how to play the music in terms of its structure, articulation of the phrases, dynamics, timber and the necessary motor strategies to realize these decisions in the sounding music. **Aims:** This research wants to investigate musical gestures as an interface of performers' intentionality, i.e. an outcome of the artistic praxis and the process of embodiment, in the light of the recent theories on enactment and embodied music cognition (Leman, 2016). For this reason, we considered a case study based on the interpretation of a piece that includes the acquisition and embodiment of musical knowledge quite known to the performer in order to map the modifications in the corporeal engagement from an intuitive approach to a conscious approach. The composition chosen was a contemporary piano piece based on a non-western music tradition: the Karnatic modes from South India. **Method:** To assist the performer in (re)framing the phases of her artistic process, a methodology, called performer based analysis method (Caruso et al, in press), was developed to establish also the procedures of a performative experiment where the performance of the 8th cycle from the 72 Etudes Karnatiques pour piano by Jacques Charpentier (b.1933) was taken as a case study. The performative experiment required a period of preparation, which concerns the performer/researcher's artistic praxis (to embody the piece) and the self-observation of a video recording archive of her performances in order to map and describe the artistic praxis. The pianist conducted a musicological research on the influence of Indian music in the French contemporary piano repertoire and had a collaborative three years practice with the composer and with two experts in Karnatic music. The experiment was recorded by a video camera, a microphone and the motion capture system. **Results:** To catch the
development between the initial intuitive performance and the final embodied performance, two recordings of one fragment from the piece played with these two different approaches (intuitive and conscious) were compared. The analysis of these fragments was based on an alignment between qualitative data acquired through subjective descriptions - based on a performance model and a score annotation - and quantitative data (objective measurements) produced by the audio-video and motion capture recordings. The qualitative and quantitative data (audio and video) were processed through the ELAN software. Gestural similarities and differences between the intuitive and conscious versions were detected by comparing the kinematic and audio measurements (quantitative data) with the performer's subjective annotations (qualitative data) concerning the motor strategies and the interpretative cues. The results show a different corporeal engagement of the pianist related to the different intentions through a parallel configuration of these two different subjective and objective layers. **Conclusions:** The actual investigation wants to present musical gestures as vehicles of idiosyncratic intentions and expressions by linking performers' corporeal engagement to the embodiment of their interpretation in order to better understand the connection between musical intentions, goal actions and sound. The role of the technology-mediated approach (third-person's perspective) gives the opportunity to study, as in a mirror-like tool, some aspects, which imply the performer's subjective involvement (first-person's perspective). This method provides specifically to musicians/researchers an easier access to music performance analysis. Furthermore, with the implementation of a transdisciplinary and collaborative practice (with the composer, the Indians singer and dancer) plus the aid of technology (the motion and audio analysis) the actual study adds an alternative perspective concerning the exploration and the design of new paths within the artistic research area.

**References**

**Poster 66**

**Perceived spaciousness in music using different reproduction techniques: Analysis of musical cues**
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**Keywords:** Music perception, spaciousness, psychoacoustics, wave field synthesis, musical analysis

**Background:** Spatial impression depends on the sound level among others. A high amount of low frequencies evokes a spatial sensation. Spaciousness means that auditory events, in a characteristic way, are themselves perceived as being spread out in an extended region of space. The perception of ‘good acoustics’ strongly correlates with the appearance of auditory spaciousness in spaces for music. According to Blauert’s model (1997), the auditory information processing of spatial hearing comprises three different aspects: the physical, psychophysical, and the psychological aspect. Bottom-up processes are involved in the psychophysical aspect and top-down processes in the psychological aspect. The tonal space includes pitch and distance of tones in the vertical dimension, the process in time in the horizontal dimension and timbre as a third dimension. **Aims:** The study aims to find characteristics in the perception of spaciousness in music itself. It also aims to discover the perceptual differences when participants listen with wave field synthesis, headphones and loudspeakers.
Finally, the study’s goal is to figure out to what extent headphones can be replaced by wave field synthesis for listening tests. **Method:** A listening test was conducted to ask participants for their spacious impression. 28 participants rated 30 music excerpts on a 7 Point-Likert-Scale from “little spacious” to “much spacious”. The music excerpts were recorded in an anechoic chamber with various instruments and played to participants through headphones, loudspeakers and a wave field synthesis system including a tracking system. Dummy head measurements for an objective comparison were made. **Results:** Analysis with 3x3 ANOVA repeated measures show the result of a significant Within-Subject effect for the factors technical devices (F = 4.541, p < 0.05) and instrument groups (F = 71.281, p < 0.01). Even an interaction effect between technical devices and instrument groups (F = 7.700, p < 0.01) was found. A higher amount of low frequencies was identified for the higher rated factor level of instrument groups and a tendency of a higher sound level for higher rated music excerpts was detected. Further analysis on musical cues will be presented at the conference. **Conclusions:** The kind and number of music instruments as well as the reproduction technique have an impact on the perception of spaciousness. The study confirmed previous research that found low frequencies evoking a spatial sensation. The interaction of both aspects increases the influence on the perception.

**Poster 67**

**The effect of hand shape familiarity on guitarists’ perceptions of sonic congruence: An altered auditory feedback study**

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**Keywords:** Embodied cognition, altered auditory feedback, sensory-motor simulation

**Background:** Considerable attention has been given to the role of sensory-motor simulation during music performance. This involves forward models, in which the perceptual consequences of motor actions can be predicted, and inverse models via which the appropriate motor patterns can be activated to produce an intended perceptual consequence. In this embodied paradigm, musical performance involves multi-modal imagery on the part of performers. Questions remain regarding the operation of these models during different kinds of musical performance. For example, to what extent does the ability of a performer to predict the sound produced by a gesture depend on the familiarity of the gesture? Altered auditory feedback (AAF) has been used to examine these effects (Pfordresher, 2012). To date, this has mainly involved participants playing a MIDI piano keyboard, which has a one-to-one spatial mapping of key to pitch height. The development of MIDI guitar pickups offers an opportunity to study the effects of AAF using an instrument with a many-to-one mapping of fingerboard locations to pitches. This allows the hand shape used to play a chord, and thus the familiarity, to be varied while the chord pitches and timbre are kept constant. **Aims:** The aim of our study is to investigate how chord shape familiarity affects guitarists’ judgement of the congruency of auditory feedback in an AAF paradigm. **Method:** We have collected data from 20 experienced guitarists, and expect to recruit 23 total. **Materials:** Tablature diagrams created with the Encore music software program were presented on a Toshiba laptop via a custom MAX patch, which also recorded response data. The patch delivered auditory feedback via Bose noise cancelling headphones, which cancelled the sound from the actual guitar strings. Participants played chords on a guitar fitted with a Fishman MIDI guitar pickup and responded via a Fishman FC-1 foot controller. A latency test confirmed an acceptable amount of jitter (3.55 ms). **Design:** Four conditions comprised two factors with two levels each. The factors were familiarity of guitar chord shape (familiar, unfamiliar) and auditory feedback congruence (congruent, incongruent). We measured reaction times and accuracy. **Procedure:** The experiment consisted of four blocks of sixty-four trials each. The participants sat wearing headphones in front of the laptop.
screen. In each block, tablature diagrams were randomly ordered using MATLAB with no conditions on the ordering. Each diagram specified one of eight distinct four-note chords in either a familiar or less familiar position on the guitar fingerboard (requiring a less familiar hand shape). Participants then played the chord and heard only the audio generated by the MAX patch through the headphones. In half of the trials, the auditory feedback was altered by changing the pitch of one of the notes. Participants then judged whether the feedback was altered or not, responding as quickly as possible by pressing one of two buttons on the FC-1. In a subsequent session, participants ranked the familiarity of the stimuli by means of a questionnaire. Results: We expect that participants' judgements of sonic congruence should be slower and less accurate in the unfamiliar condition compared to the familiar condition. Conclusions: If our hypothesis is supported, this would further embodied theories of music cognition by demonstrating the effects of familiarity on perception-action coupling.

References

Poster 68
Back to the wild: Social interactions need a non-individualistic explanatory unit
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Keywords: Enactive approach, social cognition, sense-making, dynamical systems, phenomenology, intersubjectivity

Background: Ontological and methodological individualism has so far dominated the study of mind and cognition, including music psychology and “embodied music cognition” theories. These approaches explain the fundamental process of the mind within the boundaries of the individual's skull and within a narrow temporal range. Other persons, in that view, are simply external triggers of an individual's interior mentality. In consequence, the importance of social phenomena for explanations of cognition and emotion is neglected. These theories regard interaction, intersubjectivity, and social cognition as an effect of the unfolding in social contexts of what is an individual's business of cognitive and emotional processing capacities and mechanisms. Contemporary approaches such as the enactive approach to cognition and radical embodied cognitive science challenge these assumptions. These approaches bring together new phenomenological studies, dynamical systems theory, and empirical findings in interaction research. One common assumption in these theories is that the explanatory unit of mental phenomena (e.g., perception, action, cognition, etc.) is a dynamical system constituted by causal connections beyond the brain and body, and thus not limited to the individual's internal processes. Aims: I argue for the adoption of a multi-person explanatory unit of music cognition in real-time social interaction – i.e. in “the wild”. I suggest that the explananda of “expressive interaction with music” include aspects of mentality that lie at the blind spot of individualistic approaches. I show how some important mental phenomena in music are only possible in social interactive and participatory situations. Method: The proposal is a theoretical argument bringing together empirical and philosophical discussions. Results: I review evidence from the perceptual crossing paradigm (Auvray & Rohde, 2012) that show how in dyadic interactions minimal mutual recognition emerges from online interactive dynamics. Based on the notion of participatory sense-making proposed by the enactive approach to cognition, I argue that interactive behavior and individual experiences can be determined by the systemic evolution of the interaction process itself (De Jaegher & Di Paolo, 2007). In consequence, individuals gain access to cognitive processes in a way that is not accessible to each individual on their own, or “offline”. I
suggest that musical interactions, such as those in group musical improvisation and emerging timing in music-making collectives manifest participatory sense-making. Finally, based on the same enactive approach, I will show how dynamical systems theory allows us to understand socially embedded cognitive processes in terms of single self-organizing collective behavior with causal loops cutting across various bodies, brains, and the environment. And based on proposals such as Thompson's (2007) I will argue that aspects of social interaction can be grasped via phenomenology in terms of intersubjective incorporation – i.e. forms of learning about the other’s experiences that do not involve an intellectualized “observer’s perspective”. Conclusions: The present proposal regards “expressive interaction with music” taking into consideration sensorimotor, affective, and social factors in a non-reductive, non-individualistic framework. It re-conceptualizes the explanatory unit of music mental phenomena by making a radical consideration of the role of intersubjective and social interaction dynamics – to wit, online and interactive-based dynamics at a multi-person level of analysis. This re-conceptualization has the potential of bringing together findings in the lab, and insights “in the wild” from anthropology of music.

References

Poster 69

Using zygonic theory to predict expectations in repeated melodic stimuli
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Keywords
Zygonic theory, melodic expectations, repetition

Background: The generation of expectations is integral to the perception and cognition of music; however most models of expectation tend to focus on the first hearing of musical pieces. It is known that familiarity leads to increased liking of a stimulus, contributing to the experience of savouring anticipated moments in music. The knowledge that unexpectedness leads to a desired aesthetic response that can be achieved by the same stimulus more than once provokes the question: if the disruption of expectations causes an emotional response, how can elements of music continue to be unexpected (and thus arouse emotion) even when the listener knows what is coming next? The zygonic model of musical understanding (Ockelford, 2012) proposes that the answer resides in the interplay between three forms of expectation arising from a) previously heard musical structures encoded schematically that offer a general sense of what is to come, b) current musical structures that offer a secondary source of general implication, e.g. pattern continuation, and c) previously heard musical structures encoded veridically, providing specific knowledge about what is to come. In a previous experiment, Zygonic model Z3 was found to successfully predict participants' expectations for the first hearing of a novel melody (Thorpe et al., 2012), taking into account adjacency, recency and between-group projections. Aims: The current study's main aim is to model listeners' melodic expectations in response to rehearing music by extending the theoretical
underpinnings of the paper by Thorpe et al., (2012). A revised model which additionally comprises patterns within groups [Z4] will be compared with adult listeners’ responses to an 8 x repeated melodic stimulus. **Method:** Forty-three adult listeners (27 male) recruited from the University of Roehampton and by word of mouth attended two experimental sessions separated by one week. A twenty-six note melodic stimulus played at 40bpm with a piano timbre in a major key was presented to participants four times during each session. Repetitions of the (initially novel) stimulus were separated by a seven second distractor made up of random pitches. Participants made note-by-note expectancy ratings for each stimulus presentation by using a touch sensitive apparatus known as a Continuous Response Measurement Apparatus or CReMA, which transmits MIDI data to a connected laptop. **Results:** Analysis is ongoing. Initial findings show a systematic shift between three forms of expectation in response to stimulus repetition during session one, a week-long period of rest, and further stimulus repetition during session two. Specifically, schematic expectations tend to remain intact with each stimulus repetition, whereas veridically encoded expectations are affected incrementally, representing an increase in perceived familiarity with each repetition. Furthermore, the relationship between schematic and veridical expectations appears to be ‘reset’ during the period of rest, albeit to a lesser degree than when the stimulus was initially presented. **Conclusions:** A discussion will be couched in relation to the revised zygonic (Z4) model of expectation, providing insight into the way that familiar music retains powerful moments of expressivity. Results will contribute towards a comprehensive model of expectation that uniquely incorporates the common behaviour of rehearing music.

**References**

**Poster 70**
New musical interfaces and expressivity
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Keywords: New musical interfaces, expressivity, musical glove

**Background:** Development of technology has inspired musicians and instrument makers to invent new interfaces for creating music. In some cases new features based on digital technology has been added to traditional instruments, such as in Seyboard, which is like a traditional keyboard, but after touch feature added. Another solution has been to create totally new interfaces, which are not closely related to any existing instruments, such as Alpha Sphere and Imogen Heap. Group of musicologists and music educators at the University of Jyväskylä have created a new musical interface, musical glove, which offers for musicians a new way to control musical parameters expressively. **Aims:** The aim of the paper is to describe results of an experiment the aim of which was to compare expressivity when using a new musical interface, the musical glove, midi keyboard and traditional instruments. The study focused on the following questions: 1) What is the impact of new musical interface (musical glove) on expressive playing? 2) What are the aspects of expressivity into which the new interface suits best? 3) What are musicians' preferences of the most suitable sounds for the midi-instruments from the point of view of expressive playing? **Method:** Four professional musicians were asked to play a melody (Brahms, Lullaby) with his/her main instrument (guitar, oboe, flute, violin), keyboard (X-Key) and with the musical glove. The test
melody was the same for every participant, but in addition to that every musician were free to test the keyboard and the glove with a melody/improvisation chosen by the participant himself/herself. After playing the melody with musicians own instrument, they were asked to play the melody with the mini keyboard and the musical glove. With the keyboard and the musical glove the sound used was first the one of his/her own instrument. After that, different sounds (Logic Pro) were suggested and musicians tested those from the point of view of expressive playing. Expressive elements were analysed from the sound files (Sonic Visualizer, Praat). In addition to sound analysis three expert musicians rated subjectively the quality of expressive playing. Participants were interviewed about their experiences of expressive playing with traditional instruments, midi keyboard and the musical glove. **Results:** No big differences were found in expressivity when participants used their own traditional instruments. The quality of the midi keyboard caused problems with controlling dynamical details. Musical glove gave more possibilities for expressive playing compared with the midi keyboard, but did not give as much possibilities for expressive playing as musicians' own instrument. Advantages of the new interface were clear when compared with the midi keyboard, but not when compared with the traditional instrument. Free improvisation with the glove gave best possibilities for the participants to explore expressive playing with the glove. Benefits of the musical glove were mentioned to be the tactile/haptic feedback, and immediate response to the touch. Continuous control of the sound (after touch) and “the feeling of playing” were mentioned to be the features of the glove which appeared to be the biggest advantages of this new musical interface. The preferred sounds varied a lot, but harp like sounds received positive feedback with the midi keyboard, wind instrument sounds were preferred with the musical glove (flute, clarinet). In the interviews the mapping of the notes were mentioned to be a problem (notes not in one row, but are placed in two rows). **Conclusions:** The preliminary results suggest that new musical interfaces can create new playing experiences, which may have an impact also on expressive playing. The best way to compare features of traditional and new musical interfaces is to ensure that musicians have a possibility to take an advantage of all possible capabilities of the traditional and the new instrument. Both midi keyboard and musical glove has limitations, which prevent musicians to fully express their musical intentions (especially control of dynamical finesses). New musical interfaces, such as the musical glove, should be compared with traditional instruments in a way in which the new features can be fully exploited. Strengths and weaknesses of traditional and new musical interfaces are different depending on the kind of music played. Thus, the qualities of the test melody may have an impact on the results.
dancers explored the embodiment of social emotions. They also investigated the expression, communication and contagion of emotions. They created a duet choreography to be performed in different emotional contexts, depicting different degrees of loving and loathing. Motion capture of the performances was made, and principal component analysis (PCA) was used to map dancers’ emotional expressions and 372 extracted kinematic features. In a perceptual experiment, the valence, arousal and dominance of a set of 66 stick-figure animations of the performances were evaluated. 275 individual raters each evaluated up to 20 videos, so that altogether we collected 30 evaluations for each video. For these parts, no music was involved, but in the artistic performance, two cellists emulated the artistic research process in musical context, and improvised based on pre-composed material. **Results:** We discovered a high match between how each emotion was embodied in artistic research, and the bodily maps of emotions (Nummenmaa et al., 2014), both matching findings on affect recognition in body expression (Kleinsmith & Bianchi, 2013). The kinematic features of the loving–loathing performances were captured in two PCA components. PC1 (51.6% of variance), consists mainly of velocity features, and correlates with the overall amount of love and loathing. PC2 (24.9%) captures the stylistic contrast in the two performer’s dances. In perceptual experiments, even though the raters were instructed to evaluate only one of the two stick figures in each animation, the partnering figure influenced their evaluations of dominance as well as valence. In general, there was a tendency to rate all movement as positive or at least neutral. The only negative ratings were observed when a character depicting loathing was seen with a loving partner. **Conclusions:** We explored the links between bodily sensations, embodied expressions, and perceptions of emotions. Our study represents a rare combination of embodied, social, and dynamic approach to emotion research. The results of our artistic research can help performers understand emotional interactions between themselves, and with audience. The results of the kinematic study shows that movement velocity and similarity are key factors in distinguishing loving and loathing, and our perceptual study suggests that contrasts between animated characters influence how they are perceived.

**References**

**Poster 72**

**Music@work: Role of background music on task performance**

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**Keywords:** Background music, task performance, arousal, emotion

**Background:** Previous studies have shown that background music enhances our cognitive performance (Furnham & Bradley, 1997). On the contrary, a handful of studies have shown that listening to music during complex cognitive tasks can impair performance (Cassidy & MacDonald, 2007). A large body of literature suggests that music evokes emotion and arousal (Meyer, 2008). However, the role of musically induced arousal in relation to task performance is poorly understood. **Aim:** The objective of the current research is to explore the role of musically induced arousal on human performance. **Method:** A simple number-key press task was design and conducted on 42 musically untrained participants. Participants were randomly assigned to three different group
(Slow Music, Fast Music and No-Music) consisting of 14 participants each group. In Slow-Music condition, participants listened to music with low tempo, rhythms, and soft pace and in Fast-Music condition music with high tempo, rhythms, and fast pace. However, in No-Music condition, participants perform the task in the absence of music. The experiment was conducted in two phases: training and testing, in the training phase, participants were introduced to the number-key press task and displayed the 1-9 numbers on the screen sequentially, and they were asked to press the corresponding key as soon as possible. However, in the testing phase, everything was identical except we presented number 1-9 randomly. Three blocks of 270 trails were presented to all the participants. To avoid the fatigue effect, a 2-min gap was introduced after each block. Response time and accuracy was recorded from the participant. Also, pre and post arousal level was measured using Self-Assessment Manikin (SAM) scale. Results: To investigate the statistical significance, a one-way Analysis of Variance (ANOVA) was employed on the dependent variables i.e. accuracy and response time. The analysis suggests that the group RTs are significantly different across the group, F(2,18) = 8.266, P<0.05. The result also shows that the participants from the No-Music group appeared faster while slow-Music group participants being slower on the task than Fast-Music group. Further, the accuracy analysis reveals that the Fast-Music and Slow Music groups are significantly different on the accuracy (p = 0.0005) whereas, the Slow-Music and No-Music group does not differ on the accuracy (p = 0.932). The arousal analysis shows that the induced arousal in the music group was high compared to no music condition. Conclusions: The music poses an attentional demand while performing the task and that lead to interfere with the task performance. It can be concluded that music is not always good for the concurrent task and can affect the human performance.

References

Poster 73
How do personality traits influence the effect of listening to sad music on induced musical emotions?
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Keywords: Sad music, emotional intelligence, empathy, musical empathizer, personality traits

Background: Studies revealed that motives and the impact of listening to sad music are complex and not yet fully understood. However, various personality traits have already been shown to be associated with liking for sad music. Trait empathy can be regarded as one of the most important personality traits essential to liking for sad music. More specific is the musical empathy that is also linked to the appreciation of sad music. Even though trait empathy is an essential facet of the Emotional Intelligence (EI), findings linking EI and listening to sad music are scarce. In addition, there are few studies dealing with the question how differences in listener characteristics might lead to individual differences in the emotional effects in the course of listening to sad music. Aims: Our study aimed on investigating how effects of listening to sad music are moderated by listener characteristics. In detail, we wanted to explore how liking for sad music, the EI and its facets (emotional self-regulation, capability
for self-motivation, empathy), as well as musical empathy influences the effect of sad music on induced emotions.

**Method:** One hundred three people with a mean age of 27.1 years (SD=7.4) participated in an online survey (35% female). In the course of this study, they reported on how much they like sad music and how strongly different emotions are induced in the course of listening to it. Participants reported on the following emotions: nostalgia, sadness, motivation, relaxation, wonder, emotional communion, peacefulness, reflection, melancholia, and love. Moreover, they filled out standard questionnaires on the EI (TEIQue) and on musical empathizing and systemizing (Kreutz et al., 2008).

**Results:** In the first step, correlation analyses were carried out to explore associations between the EI and its facets, musical empathy, and liking for sad music. In our study, only musical empathy was significantly correlated with the liking for sad music ($r=.277, p<.01$) In addition, the relationship between liking for sad music and emotional self-regulation showed a tendency towards statistical significance ($r=-.18, p=.07$). In the second step, several MANOVAs were computed to explore the influence of listener characteristics on felt emotions in the course of listening to sad music. A one-way MANOVA revealed a significant effect of liking for sad music on the emotions induced by it ($p<.01$). In detail, “lovers” of sad music (i.e. participants scoring higher on that item than half of the sample) reported higher ratings on feelings of sadness, nostalgia, melancholia, reflection, and love while listening to sad music than “non-lovers”. Another MANOVA revealed an influence of musical empathy on felt emotions in the course of listening to sad music ($p<.05$). Here, “musical empathizers” reported significantly stronger emotions of nostalgia, emotional communion, reflection, and melancholia while listening to sad music than “non-empathizers”. Moreover, EI and emotional self-regulation were shown to have a negative, however non-significant, impact on the intensity on almost every emotion ($p_{Empathy}=.06$ and $p_{Self-reg}=.16$). Also, trait empathy and capability for self-motivation as facets of the EI could not be shown to be significantly associated with the emotions felt during listening of sad music ($p_{Empathy}=.19$, $p_{Self-motivation}=.47$). 

**Conclusions:** Our study contributes to the findings that people vary in the way they like and listen to sad music and how they process it emotionally. Musical empathy and liking for sad music significantly increased the intensity of the feeling of various mixed emotions, e.g. nostalgia and melancholia. Our results further suggest that EI and in particular emotional self-regulation might have a negative effect on the intensity of various negative emotions. On the contrary, our results indicate that participants with a low self-regulation have higher likenings for sad music and higher ratings of negative emotions in the course of listening to it. This corroborates previous findings that certain people might listen to sad music due to maladaptive mood regulation habits. Thus, further studies will aim on investigating the relationship between emotional self-regulation and the effects of listening to sad music as well as the moderating role of a broader set of personality traits in more detail.

**References**

**Poster 74**

**Development and evaluation of a general attribute inventory for music in branding**

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**Keywords:** Music, branding, association, inventory

**Background:** Within marketing activities, Audio Branding describes the creative practice to use sound and music to form a long-term image of a brand in the mind of the consumer. The goal of a marketing strategist is to
communicate specific meaning content. To conceptualize this scenario, the use of music in branding can be interpreted as a special case of sign-based communication. The use of certain music features in branding communication will evoke extra-musical associations in consumers. Hitherto, no standardized measurement instrument, that allows systematic assessment of music-induced associations relevant to the branding context, has been developed. **Aims:** The aim of the presented work was to collect and evaluate the newly developed General Music Branding Inventory (GMBI). It consists of a list of branding-relevant attributes that can be reliably communicated with music. We therefore conducted a mixed-methods project that consists of three interrelated studies: a focus group consisting of music consultants constructed and defined an initial list of relevant branding attributes that in their view can be communicated through music (Study 1). This list was then evaluated and reduced in size in a subsequent online survey of branding experts (Study 2). Finally, several thousand participants rated the fit of the remaining items to a broad selection of music excerpts (Study 3). **Method:** In Study 1, nine internationally recognized experts in Audio Branding participated in the four-hour long focus group workshop. They identified several branding-relevant meaning dimensions that they used in their work and then suggested related adjectives. Subsequently, an online survey was conducted with 305 marketing experts who selected those attributes that, according to their experience, would exhibit high relevance in marketing in general. Furthermore, they rated the general fit of the selected relevant attributes to the brand with which they had most recently worked (Study 2). In Study 3, 3,485 participants from three European countries listened to four different music excerpts that were randomly chosen from a total of 183 excerpts, which represented 61 different styles of music. After each excerpt, they rated its fit to a subset of the most relevant attributes. **Results:** Focus group participants initially identified 19 different meaning dimensions including emotionality, traditionalism, complexity, sophistication, conformity, hedonism, gender, time and location, and dynamics (Study 1). Subsequently, focus group members identified 130 associated adjectives. In Study 2, these attributes were reduced to the 50 that were rated to be most relevant in the general branding and marketing activities (based on the selection of different expert participants). Data analyses in Study 3 then subsequently identified four underlying factors in fit ratings: **Easy-Going, Joyful, Authentic, and Progressive.** Finally, for each factor, we chose the most relevant three attributes that can now be used as measurement instrument in future research. **Conclusions:** The resulting measurement instrument (GMBI) will enable users to reliably assess extra-musical associations that are relevant to branding practices. Furthermore, it will be used to build a music recommendation system that enables a user to find music pieces that elicit brand-fitting associations. Therefore, a statistical model that learns to associate musical features with attribute ratings of listeners will be built. In doing so, we will also test for the impact of inter-individual listener differences in associative responses to music. Based on these findings, the final system will allow a user to specify a relevant target group and desired associative qualities (through the previously collected and validated attributes), and then recommend a list of music pieces from a large music archive.

**Poster 75**

**Machine listening: The expressive potential of human+computer systems in real rooms**

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**Keywords:** Interactive music systems, sound analysis, auditory perception

**Background:** During music-making, as at all times, the human auditory system adjusts to its surroundings and activities, re-adapting at every stage between the ear and brain. Our well-honed listening skills let us settle at will on subtle aspects of sound. Contrast this with a machine listener, however, which lacks adaptation to noise background and room acoustic. Here, a microphone collects information indiscriminately from pressure...
fluctuations in the air, and subsequent sound analysis programs are executed with typically scant regard for environmental context or the musical task at hand. As a result, computational hearing systems tend to react to sound in a different manner to our own biological systems. Sound analyses carried out by such (in)active listeners can easily become irrelevant — and produce disappointing results when considered from a musical perspective — since they are often affected strongly by non-intentional changes in the sound-world of a given work (e.g., by moving the whole performance to a new venue), leaving little room for intentional changes which have been specifically designed or composed to effect an expressive interaction in the system (e.g., a musician performing a particular technique on an acoustic instrument). **Aims:** This paper discusses three works that include performance systems with aspects of live sound analysis. We consider the affordances and constraints implied by the use of performed sound as audio input to a machine listener. In so doing, we aim to encourage system designers and performers alike to more closely consider the limitations of machine listening techniques so that they may begin to account for or exploit the likely acoustic variation arising in real rooms. **Discussion:** Firstly, we turn to *gruntCount* by Martin Parker (2011). This work has been adapted for a range of solo performers (each playing different instruments) and thus exists in several versions. Underlying each is the same mechanism: a system that collects and analyses live sound produced by the (typically acoustic) instrument. Each time the amplitude of this input signal crosses a threshold, a ‘grunt’ is counted; and when sufficient grunts have occurred, the next section of the piece may begin. In this construction, Parker grants two degrees of freedom to the performer: s/he may manually adjust parameters for the grunt threshold and for the number of grunts per section in order to deal with the ‘liveness’ of the room. While this is quite unlike our own auditory process of compensation for reverberation, it serves a similar function by allowing the performer to adapt the work to the room, and ensures the synthetic sound response to the instrument is suitable for that particular performance environment. Secondly, we consider Owen Green’s *And Now for Some Music* (2007). Here, sound analysis is used to split the player’s input from the microphone into one of two classes, pitched or noisy. Consciously exploiting the fragility of the pitch tracking algorithms, while simultaneously side-stepping the potential issue of parameter mismatch that unanticipated microphone and room conditions may induce, Green seeks the middle value of the pitch to noise continuum rather than quantifying its edges. This central value he derives is then subject to continual adaptation, somewhat simulating our own compensation for spectral colouration, in order to maintain the equilibrium of so-called noise or so-called pitch in the sound textures produced. The final work studied is *Background Noise Study, in the Vocal Tract* by Agostino Di Scipio (2005). In addition to the room effect due to the venue itself, which gives each performance its own character, the human performer uses their mouth as a second, miniature room by enclosing a microphone therein. Here, Di Scipio derives control signals from psychoacoustically relevant sound features, and uses these to regulate the audio, both in terms of overall level and in shaping the spectrum of sound produced through speakers. Movements of the performer’s mouth cause tiny sounds that feed the system further, and the performer’s expressivity is bound up in those movements and in their responses to the system’s reactions. **Conclusions:** Different approaches to room adaptation have been adopted in each of the three works described above. Whether adaptation remains the responsibility of the human performer (cf. *gruntCount*), of a particular machine listening algorithm (cf. *And Now for Some Music*) or emerges as a result of the performance system as a whole (cf. *Background Noise Study, in the Vocal Tract*), the composer has in each case clearly planned adaptation as a necessary component of the work itself. To increase the potential for expressivity in human+computer music systems in future, there is much scope to further assess and accommodate mismatches between human and machine listening in an increasingly flexible manner.
Activation of musical gender-associations at primary school age
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Keywords: Music listening, gender-associations, gender, priming, music preferences, identity, musical concepts

Background: Previous research has shown that primary school children's music preferences vary with regard to the variables age and genre (May, 1985). Some studies found marked sex-differences concerning specific music genres (e.g. Busch et al., 2016). Especially classical and pop music seem to be liked better by girls at different age levels. Qualitative data indicate an early functionalization of music preferences in gender-identity development that is argued to explain sex-differences in music preferences (Bunte, in prep.; Busch et al. 2016). Initial work on musical gender-associations, framed as gender-specific musical concepts (Behne, 1975, p. 36), reveals that girls and boys in primary school age alike name specific musical genres and musical features when asked to describe music boy's listen to (boys' music) and music girl's listen to (girls' music) verbally (Bunte, in prep.). Thus it can be assumed that musical gender-associations are relevant to primary school children's music preferences.

Aims: The study investigates the role of associations of specific music as boys' music or girls' music in the process of evaluating music. Specifically, it is hypothesized that primary school children possess gender-specific musical concepts – understood as associative networks stored in memory – that can be activated from memory and that are relevant to their music preferences.

Method: In a pilot study, second and fourth grade students (n=57) listened to a set of 9 musical examples that on the basis of primary investigations (Bunte, in prep.) were chosen to represent stereotypical boys' music, stereotypical girls' music or gender-neutral music. In order to test the strength of the gender-association for each example as well as their association to specific adjectives, children rated the examples on a gender-association scale as well as on different adjective scales (e.g., loud, cool). Two main experiments with primary school children shall investigate the activation of musical concepts using priming paradigms with speed decision tasks. The first experiment follows a semantic priming paradigm. In a within-subject-design we test the hypothesis, that concept-congruent words (e.g., loud) as primes foster the processing of a target-word belonging to the same concept (e.g., boy) as compared to the processing of a target-word from a different concept (e.g., girl). The dependent variables are reaction time and correctness of the decision. The second experiment follows a cross modal design, using the musical examples identified in the pilot study as primes and keeping the rest of the experimental setting as in experiment one.

Results: The results of the pilot study vastly support the hypothesized strong gender-associations for the musical examples chosen as stereotypical boys' music and as stereotypical girls' music. The rock example showed the highest mean boy-association whereas a violin and piano piece by Einaudi showed the highest mean girl-association. Besides further results from the pilot study, preliminary results of the experiments as well as methodological aspect shall be presented and discussed at the conference.

Conclusions: Significant differences in the depended variables between the two conditions (concept-congruent vs. concept-incongruent prime-target-pairs) would be interpreted as automatic activation of gender-specific musical concepts from memory. This would support the view of an early and unconscious influence of such gender-associations on music preferences both on a verbal and on a sound level.

References
Poster 77
Investigating the development of joint attentional skills in early ontogeny through musical joint action
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Keywords: Social interaction, development, joint attention, gaze, musical joint action, structured observation

Background: Joint attention is an important basis for social interaction, which emerges in early ontogeny and scaffolds further social cognitive development. The emergence of joint attention in infants is studied through joint attentional skills, i.e. communicative, non-verbal, observable behaviors, which develop during the so-called 9-month revolution around 9 to 15 months of age in the following order, reflecting their increasing complexity: checking attention, following attention, and directing attention (Carpenter et al., 1989). Although the emergence of joint attention has been extensively studied, research on a possible further enhancement of joint attentional skills alongside the infants' social cognitive development is rare. Especially, research on a possible enhancement exceeding the period of the development of cognitive mechanisms like Theory of Mind is still missing. Aims: Therefore, the goal of our current study is investigating whether joint attentional skills show enhancement in the later course of development of typically developed children and thus potentially facilitating increasingly more complex social interaction. Especially, in the this paper, we present a coding scheme for analyzing joint attentional skills in a more natural, group interaction setting. Method: An observational study was conducted with children of different age groups (1.5–2.5 y; 3–4 y; 5–6 y) in a musical joint action setting. Music is an appropriate domain to study intersubjective, non-verbal interactions in this early developmental stage because it is communicative independent of children's language skills. Structural observation was chosen as it allows us to examine children's nonverbal behavior in a natural environment and investigate processes, i.e. behavior that unfolds in time, by coding behaviors which are, in the current case, video recorded. Video recordings took place in regular lessons of music education for young children and twenty-three children participated in the study. For the analysis, a short opening song was selected which includes singing and interactive joint rhythm tasks such as clapping and moving to music together with other group members under the guidance of a tutor. Our preliminary coding scheme we developed includes two categories: gaze and musical gestures. In particular, trained observers code the children's and the tutor's gaze directed to other participants. Furthermore, this coding scheme includes modifiers distinguishing whether the gaze targets the face or the body. Musical gestures include music and rhythm related actions such as trampling, clapping, and singing. The coding and statistical analyses are conducted using Noldus’ “The Observer XT”. Results: We present and discuss the design of the abovementioned-coding scheme in detail and report results from our first application of this coding scheme to our video recordings. We point out how our coding scheme enables investigating the development of joint attentional skills and children's...
interactive behavior by analyzing gaze and musical gestures in an ecologically valid setting. In particular, by examining different patterns of gaze directions (e.g., child A looks at tutor -> tutor looks at child B -> child A also looks at child B), we can investigate joint attentional skills such as following attention. Analysis of between-group differences in frequencies as well as patterns of gaze allows us to study possible enhancement of joint attentional skills. Moreover, we show how our coding of musical gestures allows us to determine possible changes in children's interactive behaviors. By examining the relationship between gaze and musical gestures, we can investigate whether children's interactive behaviors are facilitated by enhanced joint attentional skills. **Conclusions:** The development of joint attention in the range of 1.5 to 6-year-old children can be investigated in a natural musical joint action setting by applying our coding scheme. To the best of our knowledge, our study is the first empirical developmental study of musical joint action in a natural setting investigating whether an enhancement of joint attentional skills takes place in the course of ontogenetic development, and whether, given an enhancement of these skills, it corresponds to complexity of social interaction.

**References**

**Poster 78**
On the effect of synchronized and non-synchronized music on runners’ foot strike impact
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**Keywords:** Running, foot strike impact, SPM, synchronization

**Background:** Running is a widespread and growing physical activity with known positive effects on health. However, the severity of foot strike impact on the ground is a known cause of lower limb injuries for runners (van Gent et al., 2007). The Department of Movement and Sport Sciences of UGent, in collaboration with IPEM, is working on the reduction of foot strike impact through music and sonification of movements. **Aims:** This work aims at investigating the effect of different music synchronization strategies on runners' foot strike impact, specifically on the effect of the alignment of music beats with footfalls. The results of the present tests will be used in later experiments to investigate the feasibility of impact reduction through embodied music sonification. **Method:** Experiments were carried out on the outside track of the Flanders Sports Arena (~330 meters) with 28 non-professional experienced runners (average age: 24 +/- 5). For each participant, a test consisted of five different conditions of the duration of 210 seconds. For each condition the g-force on both legs, SPM, and speed were recorded. The first 30 seconds of each condition featured no music and were used to calculate the average runner's speed. The runner was then requested to keep this speed constant throughout the condition. Visual feedback of the speed and deviation from the reference speed were provided by three screens placed along the track. The five conditions consisted of: (1) a reference condition without music, (2) *Adaptive sync*, an adaptive BPM and phase synchronization based on the DJogger technology (Moenst et al., 2014), (3) *initial sync*, a tempo synchronization condition based on the initial step-per-minute (SPM) of the runner, (4) *plus 30%*, a non-sync condition with music BPM constantly 30% higher than the runner SPM, and (5) *min 30%*, a non-sync condition with music BPM constantly 30% lower than the runner SPM. Conditions were randomized across participants to
minimize fatigue effects. After each condition, participants were asked to fill out a set of rating scales: perceived exertion (BORG), enjoyment (PACES), and music motivational qualities (BMRI-II).

**Results:** The mean values of the g-force, SPM and speed are calculated respectively from the start of the experiment to the start of the music (30 seconds) (part1) and after 30 seconds from the start of the music for a duration of two minutes (part2) for each participant. The differences and ratios of the means (with music/without music) are used to evaluate the effect of the different synchronization strategies for all participants separately. From statistical analysis, no significant effect on the average g-level and SPM with and without music could be observed among the different synchronization conditions. By paired comparisons between part1 and part2, it could be observed that music has the general effect of increasing impact level with respect to the no music phase (part1) for all conditions except the no-music reference, in particular for high BPM (plus 30%). No significant differences in SPM were observed across conditions and with or without music. From the rating scales, the initial sync condition appears to be the most motivating and pleasant. People with musical background rated the adaptive sync and the plus 30% conditions the highest in terms of pleasantness. No significant differences due to gender and training level were found.

**Conclusions:** From the analysis, synchronization of music with footfalls seems not to cause an increase of foot strike impact. The music onset seems to lead to a slightly increased impact level when compared to running without music. This increase could also be ascribed to the specific music choice. Further research will be devoted to investigate the effect of specific music features on runner's foot strike impact. The motivational effect of music is particularly evident when the BPM of the music matches the comfort tempo of the runner, not necessarily the phase.

**References**


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**Poster 79**

**A novel tool for measuring musical abilities in children**

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**Keywords:** Melodic discrimination, rhythmic discrimination, musical ability, working memory

**Background:** An important discovery in modern neuroscience of music is that the brain changes both anatomically and functionally due to long-term music training. The Musical Ear Test (MET) is a test of melodic and rhythmic discrimination skills in adults. It demonstrates good discrimination between musicians and non-musicians (Hansen et al., 2012; Wallentin et al., 2010) and has been shown to be a suitable proxy for measuring musical ability in adults. However, no test yet exists to measure auditory discrimination skills in children. We therefore sought to develop a novel tool for measuring musical ability in children based on the MET. **Aims:** This study forms the first step in developing a test of music discrimination skills in children and adolescents. Firstly,
we aim to demonstrate the psychometric properties of the MET for children (miniMET). Secondly, we aim to show that miniMET can be used as proxy for musical ability. Finally, we aimed to replicate in children the finding that musical ability is related to working memory ability. **Method:** 30,000 children (age 6-18 years) were tested on the miniMET, which comprised of 52 items assessing melodic and rhythmic discrimination. We employed the Concurrent Musical Activity (Müllensiefen et al., 2015) inventory as an additional test for musical ability in order to assess validity. We further administered a forward digit span test to assess working memory ability. In addition, we conducted various demographic measures including age, school, region and age of commencement playing a musical instrument. **Results:** Data analysis is in progress. We will conduct item response analysis in order to reduce the number of items in the miniMET and to optimise the inventory. We expect that the miniMET will be able to discriminate between musician and non-musician groups in children, reflecting the performance of the MET in adults. Finally, we will investigate the relationship between digit span score and miniMET score. **Conclusions:** The expected results of this study will produce a short measure of musical ability in children that is comparable to adults.

**References**

**Poster 80**
Mood regulation and involuntary musical imagery
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**Keywords:** Mood regulation, mood manipulation, INMI, earworms, TSST, music listening

**Background:** Music is frequently used in everyday life in a functional manner – as an accompaniment for sports, domestic tasks, study, travel, etcetera. The functionality of music seems to relate to the entertainment, motivation, and entrainment possibilities music affords. In many instances, music as a means to regulate mood is key. We are interested in the connection between these uses of music and the occurrence of involuntary musical imagery (INMI). INMI has generally been understood to occur in musically engaged individuals, and to depend on recent and frequent exposure to music (Byron & Fowles, 2015). Following this line of reasoning, we predict that the occurrence of INMI depends on the everyday use of music of participants. This project investigates INMI under the scope of a music listening dependency hypothesis – if music is used for mood regulation purposes, then INMI could occur under similar situations. The project is part of the bigger hypothesis that INMI derives from a conditioning process from everyday music listening. Individuals who systematically use music in certain situations will most likely experience INMI in these situations in the absence of music, as they trained themselves to the combination. According to this hypothesis, individuals who use music to regulate their mood would experience INMI in an analogous situation. **Aims:** A pre-screening survey was designed to investigate (potential) participants' everyday uses of music and the relationship with occurrences of INMI. Subsequently, a controlled experiment was designed to test whether participants, who use music as a means to regulate mood, experience
InMI when put in a situation that requires mood regulation. **Method:** Participants were recruited from the pre-screening online survey. The survey included questions regarding music listening habits and INMI experiences, along with musicality, demographics. Volunteers for this study were divided into two groups, based on their responses. The test group comprised individuals who often use music to relax and unwind in stressful situations, while the control group included individuals who use other methods than music to relax. We controlled for educational level, as undergraduates would potentially be more prone to the stress induction of this experiment, as they would be less experienced. The experiment consisted of two conditions — one stressful and one not stressful. The Trier’s Social Stress Test (TSST) paradigm was used, as it offers an ecologically valid stressful situation, which most people will experience: a difficult job interview is followed by a difficult task (Kirschbaum & Hellhammer, 1993). The test condition comprised a mock job interview, followed by a difficult numerical task, all being recorded with a video camera, in the presence of a judge. In the control condition, participants were reading a text out loud, and performed an easy numerical task, without being recorded, while being alone in the room. After each of these conditions, participants were asked to unwind and relax for a few minutes. After this period, they filled out a questionnaire assessing the development in stress levels and their way of dealing with the stress and manner of ‘unwinding’, including questions about occurrences of INMI. **Results:** Results from the pre-screening questionnaire showed that 71% of participants reported that music helps them relax, and 73.2% reported listening to music when they feel sad (N= 258). Initial results from the experimental study were positive (N=15), as the first participants experienced INMI only after the stress condition, while trying to relax, and not in the control condition. As this is an ongoing study, full results will be presented in detail at the conference. **Conclusions:** Involuntary musical imagery is a phenomenon which is difficult to investigate in controlled experiments, as it can occur for several reasons that are often unrelated to the study. Nevertheless, simulations of real-life experiences in experimental studies are feasible and can be a powerful means to shed light on causal factors contributing to hard to capture experiences such as INMI.

References

**Poster 81**

**Playing with the phantom: Human-virtual interactions in jazz performance**

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**Keywords:** Music, jazz improvisation, human-virtual interaction, participatory sense making, Granger causality

**Background:** When playing together face-to-face, jazz musicians engage in a performance that they define as interactive. Music is co-created through embodied-enacted interaction, an experience of Participatory Sense-Making (PSM) (De Jaegher & Di Paolo, 2007). Here, music communication is explored according to: (1) a musician interacting face-to-face with real co-performers; and (2) a musician interacting ‘virtually’ with a recorded performance. Based on PSM previous results about intra-group live interaction involving two or more jazz
musicians playing face-to-face, we test now human-virtual contexts where one of the musicians interacts with a screen displaying an audio-video recorded performance. **Aims:** To investigate the dynamics of human-virtual (h-v) interaction between musicians in a jazz trio, comparing: (i) the experience of PSM human-human (h-h) interactive performance, with (ii) the experience of interaction between one musician and the audio-video recording of the two remaining, as a differentiated instance of sense-making (SM). **Method:** Participants: 2 ad hoc prof. jazz trios (2 saxs, 1 piano each). **Stimuli:** Jazz Std “There is no greater love”. **Procedure and Design:** In Part 1, Trios A/B performed the Std live. Then, Saxs 1A, 1B, 2A, and 2B played with audio-video recordings of trios’ A or B (their own/other role removed). We report results concerning Sax 2B playing with the recording of Trio A (Sax 2A removed). In Part 2, phenomenological in-depth interviews were administered individually. **Apparatus and Setup:** Musicians’ behavior was captured using a Motion Capture system. Only results based on data extracted from sax markers, and saxophonists’ heads are reported. The ‘phantom’ track was setup removing the signal of one sax player. **Data Processing:** 4 time-series data (1a-1b related to movement; 2a-2b related to sound) were processed. 1a-1b measured the Euclidean distance between both the sax centroid and the saxophonist head and a spatial reference center; 2a-2b measured the amplitude envelope, and the fundamental frequencies of the recorded audio signal. **Data Analysis:** Conditional Granger Causality (Seth, 2010) was used to analyze the 4 time-series data (1 beat temporal sliding window, 7 beats overlapping). Based on GGCA, a further measure, named Sense Granger (SG), was developed as to test the temporal evolving of significant G-Causality observations. In Part 2, continuous verbal analysis of responses was run as to derive categories that explain musicians’ SM experience. **Results:** An N-way ANOVA, with SG as dependent variable, and 3 Factors (Sax (1A, 2B), Musicians Interaction (MI) (TT, J), and Standard (Theme (Th), Improvisation (I))), found significant differences for factors Sax (F=16.87, p< 0.001), Standard (F=37, p< 0.001, and MI (F=25.9, p< 0.001). Both Sax*MI (F=80.87, p< 0.001), and Standard*MI (F=154.69, p< 0.001) were also significant. Sax*Standard was not significant. This indicates that when the live musicians interacts with the ‘phantom’, he makes sense different when playing TT, as to playing J; SM is also different, in Th or I sections. These differences might inform of a live expressive alignment with a less predictable environmental signal. Audio-video-SG analyses show that in TT sections, sequential alignments are the outcome of the live response to the phantom’s actions; in J sections, instead, live alignment arises as emergent autonomous activity. As to the interviews, the live musician described his phenomenological interactive experience with the ‘phantom’ as playing together, in spite of being aware that the screen couldn’t react to what he was doing. **Conclusions:** The extent to which PSM takes part in contexts of h-h/h-v musical interaction brings about the question of the type of SM elaborated in each context. Expressive alignment in h-v interactions presents a particular type of PSM: although the physical features of a recorded performance do not modify themselves as performance takes place, the environmental outcome does effectively change, due to the ongoing sound-kinetic enaction of the live performer; it emerges as the live SM to the intrinsic agency conveyed by the audio-visual sonic-moving form. In spite of the metaphorical phenomenology of interacting with the phantom -as reported by the live musician- differences were found between Th and I in the MI Condition (TT vs J) -that were not found in h-h SG analyses- informing about a potential breaking of SM, due to the level of uncertainty in channel communication, where a unifying condition that stabilizes the communicative loop is absent.

**Poster 82**

**Evaluation of movement sonification: Perception of auditory and visual displays of musical performance gestures**

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25th Anniversary Conference of the European Society for the Cognitive Sciences of Music, 31 July-4 August 2017, Ghent, Belgium
**Keywords:** Movement sonification, musical gestures, prototypicality, motion capture

**Background:** Research in movement sonification is a highly application-oriented field. Previous studies show various effects of sonifying movement data on movement learning or rehabilitation. So far, we know about the most frequently used mappings of auditory and physical dimensions in sonification studies, but often an evaluation of sonification mappings is missing in experimental designs (Dubus & Bresin, 2013). In order to evaluate sonified movements, it is necessary to use gestures that are recognised by a high number of people, hence have prototypical qualities. The prototypicality of musical movements has been investigated from early years of music psychology research (Truslit, 1938), and has recently been studied within the fields of performing and perceiving musical gestures (Hohagen & Wöllner, 2016; Wöllner et al., 2012).

**Aims:** This study aims at evaluating different sonification mappings of acoustical and movement parameters by investigating perceptual judgments about audio-visual excerpts of musical performance gestures. Since there is only limited theory-driven research in this area, we believe that the evaluation of quality ratings for different parameter mapping approaches may lead to a better understanding of perceptual processes of movement sonification and could potentially aid applications. We assume that domain-related performance experiences of musicians, athletes and dancers lead to different perceptions of visually displayed musical gestures and the appropriate sonifications. Furthermore, we expect differences in judgments for individual and averaged (morphed) gestures as well as for expert and amateur performers.

**Method:** We collected short excerpts of performance gestures from 32 right-handed participants (50% musicians), tracked by a 12-camera motion capture system. The recording session consisted of two parts. First, participants should imagine an “on stage” performing situation as a singer or a musician. They read 4 different metaphor-based movement instructions (2 simple & 2 complex) and performed 5 short gestures with their right arm afterwards without listening to music. In a second part, participants drew geometrical figures in the air and performed standard conductor movements in synchrony with a metronome. In a next step, we animated visual point-light displays of selected gestures from part 1 and created different auditory display mappings for each visual clip, based on the movement sonification literature. Furthermore, recordings of figure drawings and conductor gestures from part 2 were used to build visual point-light displays of average movements (morphs). The animated audio-visual displays were implemented into an online-study, in which musicians, dancers, and athletes rated the correspondence of visual and auditory display of musical gestures, i.e. they judged the quality of the movement-sound combination for each of the presented excerpts. All stimuli, also the averaged gesture displays, were presented in randomized order within a judgment perception paradigm.

**Results:** First descriptive analysis of motion capture recordings show that all participants understood the movement instructions in the same manner and therefore executed comparable musical gestures. The interpretations of the more complex metaphor-like instructions lead to a variety of gesture executions, although all participants read the same instructions. Results of the ratings in the online-study will be presented at the conference.

**Conclusions:** With this evaluation approach, it is our aim to investigate the processes while perceiving movement sonifications of musical gestures. We hope to gain more insights into the fundamental relationship between acoustical and movement parameters.

**References**


**Poster 83**

**Entrainment and shared representations in joint finger tapping**

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**Keywords:** Entrainment, joint-action, shared-cortical-representations, transcranial magnetic stimulation

**Background:** Cognitive musicology has studied the spatial-temporal coordination between a person and an external rhythm (called “entrainment”), and, more crucially for the issue of social interaction, the coordination between two or more persons with such a rhythm (called “interpersonal entrainment”, Clayton, 2013). The latter phenomenon has been shown to occur especially among musicians (playing Indian, classic, jazz music) and in a few studies on non-musicians (Leman, 2007). In particular, it is not clear if entrainment could occur also in non-musicians in an alternate joint-tapping task, whereas it has been shown in synchronous joint tapping (Kovalinka et al., 2010).

**Aims:** In order to explore interpersonal entrainment and its neural representation in non-musicians, we also draw on literature about action observation, in particular on those Trans-cranial Magnetic Stimulation (TMS) experiments that reveal high cortico-spinal excitability in the observers’ effector, when they watch someone else performing movements with that same effector (in accordance with the mirror neurons paradigm, e.g., Fadiga et al. 1995). It is worth noting that subsequent experiments have shown that the cortical representations shared by the observer and the actor are not neutral, that is, they can tell apart our action and the observed action (Schutz-Bosbach et al., 2006). A recent experiment with pianists seems to confirm such a phenomenon also in the musical domain (Novembre et al., 2012). However, it is not clear to which extent the position of the partner can modulate these representations (Della Gatta et al., 2016; Maeda et al., 2002). The hypotheses that drive our experiments are the following: (1) Exactly like musicians, pairs of non-musicians are able to entrain to each other in a simple, proto-musical task like tapping in alternation with a metronome; (2) When a member of the pair taps alone, the motor cortex activation of the hand at rest should be lower than when he/she taps with the partner in front of him/her, in accordance with the results of the above literature; (3) but, if the partner is tapping beside him/her (in a congruent position with respect to the participant’s body), the motor cortex activation of the hand at rest should be lower than 2), because the egocentric position of the other’s hand may induce a sense of ownership with regard to that hand.

**Method:** While hypotheses 2) and 3) are currently being tested in our laboratory, we have already collected data in a preliminary experiment regarding hypothesis 1. We compared a group of nine musicians with a group of nine non-musicians in a tapping test in which they had to tap on a drum pad either alone or in couple. In both conditions they had auditory and visual feedback about their actions and heard the beats of a metronome on which they had to tap in alternation.

**Results and Conclusions:** We measured the asynchronies between participants and metronome and we found positive correlations between the time series of the couples in both groups. This means that not only musicians, but also non-musicians are able to automatically adapt their timing to each other. We think that such ability might be considered as an important pre-requisite for the subsequent sensorimotor training of professional musicians.
References


Poster 84
Reflexive attunement in child-child interaction and child-machine interaction: Two case studies
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**Keywords:** Children's musical improvisation, reflexive interaction, child-machine interaction, musical creativity

**Background:** Several scholars tackled the issue of children's music improvisation from different learning/teaching perspectives and by using different methodologies. We investigated this issue through the "reflexive interaction" paradigm. This paradigm refers to a particular kind of human-machine interaction based on the mechanism of repetition and variation, where interactive systems are able to imitate the styles of the user which is playing an instrument (Addessi et al., 2017; Pachet et al., 2011). **Aims:** We investigated whether the "reflexive interaction" influences the children's skillfulness to improvise, at the beginning stage of musical learning. We used a particular system, the MIROR-Impro, implemented in the MIROR project, which is able to reply to the child playing a keyboard by mirroring (with repetitions and variations) her inputs. **Method:** The study was conducted in a primary public school, with 47 children, not musicians, aged 6 to 7. Experimental design: the "convergence procedure", based on three sample groups (one control group and two experimental groups), allowing to verify if the MIROR-Impro and the reflexive interaction are necessary and sufficient to improve the children's abilities to improvise, in solo and in duet. Independent variables: to play (1) only the keyboard, (2) the keyboard with the MIROR-Impro but with not-reflexive reply, (3) the keyboard with the MIROR-Impro with reflexive reply. Dependent variables: children's ability to improvise (1) in solo, and (2) in duet. Procedure: Each child carried out 5 weekly individual 12 minutes sessions. The CG played the complete package of independent variables (v1+v2+v3); EG1 played the keyboard and the keyboard with the MIROR-Impro with not-reflexive reply (v1+v2); EG2 played only the keyboard with the reflexive system (v3). One week after, the children were asked to (1) improvise a musical piece on the keyboard (Solo task), and (2) play the keyboard like in a dialogue, in pair with a friend (Duet task). Activities and test were videorecorded. **Results:** Three independent judges assessed the Solo task and the Duet task by means of a grid based on the TAI-Test for Ability to Improvise (McPherson, 2005) rating scale. The following assessment criteria were used: Instrumental Fluency, Musical Organization, Creativity, Musical Quality. For the Duet task also the following criteria were evaluated: Quality of the Musical Dialogue, Reflexive Interaction, and Attention Span. The results show an interesting trend that could support the hypothesis that the reflexive interaction with MIROR-Impro alone is "sufficient" to increase the improvisational skills, both when the children improvising alone and in a duet, and it is "necessary" when they improvise in duets. **Conclusions:** These results and the relevance of the paradigm of reflexive interaction will be discussed on the
light of the experimental procedure and the recent literature in neuroscience and music education. The discussion will focus on the observation and analysis of two case studies: two children interacting with the reflexive system during the training phases, and then with a friend during the Duet task. In particular way we will discuss the efficacy of “reflexive” pedagogy in the field of children’s music performance and technology-enhanced learning and the issue of the analysis and assessment of the children’s ability to improvise in duet, with human and virtual partners.

References

Poster 85
Identification of children’s affective states in music-making: Insights from the PAD model
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Keywords: Affective states, early childhood, music making

Background: Practice has indicated that affective engagement is a prerequisite for young children’s sustained involvement in music making. However, the relevant literature on music and emotions shows that early childhood is an under-investigated target age group. For the investigation of children’s emotional activity, the model of Pleasure, Arousal and Dominance (PAD) (Mehrabian, 1996) was adjusted in the context of collaborative music making for young children. The axis of pleasure corresponds to judgments of the musical stimulus; the axis of arousal accommodates children’s embodied reactions; and the axis of dominance represents the feeling of control in regard to the social partner. The interplay of the three dimensions was the main motivation for investigation. Aims: This empirical longitudinal study aimed to delineate the affective states that are behaviourally exhibited by participant children during music making on the basis of the PAD model (RQ1). Subsequently, the correlations are examined between these states in the context of spontaneous and deliberate music making (RQ2). Lastly, the development is described of the affective states over the period of one session and over repeated sessions (RQ3). Method: A naturalistic setting was chosen at a kindergarten computer lab. Participants included N=16 children (8 girls) aged 53 to 79 months (M=69, SD=7.39). They constructed musical pieces in pairs in weekly sessions over a period of 8 weeks. The total duration of sessions was 1192 minutes. Each pair was video-recorded separately; participants’ behaviours were manually transcribed individually. Content analysis of verbal utterances and analysis of non-verbal micro-behaviours were based on the following variables: (i) appraisal (satisfaction, dissatisfaction and musical preference) in response to the musical choices that indicated the state of pleasure, (ii) music-induced behaviours of body movement that indicated participants’ arousal (iii) social interactions that indicated participants’ dominance (potency), (iv) spontaneous music making and (v) deliberate music making, which was identified by verbal utterances of intentionality. The data were normalized to address the different duration of sessions. Results: The data analysis indicated behavioural manifestations that correspond to the PAD model as follows: verbal utterances, which indicate appraisal had the
frequency \( F_{ap} = 127.81 \) per participant child; arousal in the form of music-induced body movements appeared \( F_{ar} = 29.81 \); dominance had the frequency of \( F_{d} = 9.81 \). Interestingly, overall, the mean frequency of occurrence of spontaneous musicking was \( F_{sm} = 77.27 \), while of deliberate musicking was \( F_{dm} = 141.54 \). A moderate positive correlation between the appraisal and the arousal (\( r = 0.63 \)) was found and between the appraisal and the dominant behaviour (\( r = 0.64 \)). Lastly, all the three PAD dimensions seem to increase over time. **Conclusions:** The results indicate that the PAD model of measurement of affective states can be used for the assessment of children's affective states in the context of music making. The positive correlation between the appraisal and the arousal may be based on young children's characteristic of spontaneous affective reaction to music in a naturalistic setting. This study aims to contribute to the dialogue about music making and the investigation of children's affective states in the period of rapid development.

**References**
FRIDAY 4th August

PLENARY
Blandijn - Auditorium C, 09:00-9:30

ICMPC-ESCOM 2018
Richard Parncutt\textsuperscript{1}, Renee Timmers\textsuperscript{2}
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In this presentation and discussion session, Richard Parncutt and Renee Timmers will introduce the ideas behind the organization of ICMPC-ESCOM 2018, and the results of a technical trial of the semi-virtual conference format.

WORKSHOP 1A/1B
Blandijn - Room 110.079, 09:30-10:45 AND 11:15-12:30

Wearables in music education and research
Jukka Louhivuori
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Wearable (music) technology is a new field which has quickly changed the environment into which technology can be embedded. Smart watches, heart rate monitoring systems, iPod/smart phone controllers and sensors in jackets, are already in markets. In music research especially in motion capture field wearables are frequently used. In pop/rock genre only a few artists have showed major interest in this field. Imogen Heap and Remidi musical gloves are examples of wearables meant to be used by artists. In addition to these areas, musical gloves has been used as a rehabilitation tool for stroke patients. The aim of the workshop is to introduce wearable products developed at the University of Jyväskylä, Department of Music, Art and Culture Studies and later by a company, Taction Enterprises Inc., originated from a university research project. The aim of the research group has been to develop new musical interfaces especially for music educational purposes, but the advanced versions of the products can be used in professional live music and dance performances and as a rehabilitation tool. In the workshop participants have an opportunity to explore and test in practice several different implementations of wearables in music, such as Musical Glove, Musical Fingerless Glove, Wrist Music Controller, Edu/Music Mat, Board Controller/Game and Music Shirt/Vest. Examples will be given of different possibilities how to implement wearable music technology in music education, research and live music performances.
WORKSHOP 2A/2B
Blandijn - Room 100.072, 09:30-10:45 AND 11:15-12:30

The MIROR Workshop
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The MIROR workshop provides participants with the opportunity to have a practical experience to improvising and composing with the MIROR Platform, a new device for children music and dance creativity implemented in the framework of the MIROR Project (Musical Interaction Relying On reflexion, EU-FP7). The MIROR platform is based on the “reflexive interaction” paradigm and was designed to promote abilities in the field of music improvisation, composition and creative movement, both in formal learning contexts (kindergarten, primary, music school, schools of dance) and informal ones (home, centres for early infancy, etc.). The MIROR platform is composed by three applications:

- **MIROR-Impro** addresses music improvisation: this application allows children to improvise with a virtual copy of themselves as a kind of partner, discovering what elements in the replies of MIROR-Impro stay the same or what changes;
- **MIROR-Compo** addresses music composition. This application acts as a sort of “musical scaffolding” that allows children to combine several musical phrases on the basis of their own style and musical taste.
- **MIROR-Body Gesture** allows children to create music and control their own musical improvisations and compositions via movement.

Activities:

The workshop will consist of a brief introduction to the MIROR technology accompanied by video observation of examples of child-machine interaction and educational practices. Participants in the workshop will have the opportunity to try out the MIROR applications and will be invited to explore the didactic possibilities of two components of the MIROR platform, namely MIROR Impro and Compo. A debriefing with the participants will conclude the workshop.

For more information about the MIROR platform see the official website of the MIROR Project: www.mirorproject.eu.
WORKSHOP 3
Blandijn - Logos Foundation, 11:15-12:30

Musical interaction with robots
Godfried-Willem Raes
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The Logos robot orchestra is an extensive collection of nearly 70 automatons. The orchestra features organ-like instruments, monophonic wind instruments, string instruments, percussion instruments, and noise generators. Traditional instruments such as a piano, percussion, brass or woodwind are combined with unheard sounds produced by newly invented instruments.

All these automatons are fully acoustic and do neither use electronic sounds nor amplification. The Logos Robot Orchestra only has genuine musical instruments, driven by the magic of 21st-century robotics, in its ranks. The automatons have full dynamic control as well as full polyphony. Their capabilities easily exceed those of human players. It is not our intention to replace human performers, but to expand musical possibilities. Most automata can play faster, and produce more simultaneous notes, than a human performer could ever achieve, each with precisely controlled dynamics. Most of the orchestra's robots are tuned to twelve-tone equal temperament. Four instruments (Qt, Tubi, Xy, and Puff) are tuned to equal-tempered quarter tones. Sire, as well as all of the monophonic wind instruments, can be tuned with sub-cent precision and can thus be used with nearly any tuning system. The microtonal capabilities and extreme precision of the automatons turn them into the perfect tool to explore musical and expressive possibilities.

The instruments are designed with the intention that any composer who possesses a basic knowledge of sequencing, notation, or other MIDI software, and who is familiar with the specifics of controlling the automata, will be able to write for them.

All of the automatons are permanently set up in Logos's tetrahedron-shaped concert hall. Although the automata are sometimes presented at other venues, at the beginning of August 2017 a part of the orchestra will be presented in Liepaja, Latvia; they always return to the Logos concert hall.

This demonstration will introduce you to snippets of tango, old music as well as experimental music. But the orchestra does more than just play any style of music, it can create astonishing interactive music in real time. Dancers and musicians use gesture-sensing technologies including sonar and radar systems - developed in-house - to control the sounds directly with their own bodies. The generated music is gesture-controlled. Instead of dancers reacting to music, the music is derived from the movement of the dancers.

www.logosfoundation.org/mnm/index.html
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