The Royal Academy of Music
Aarhus / Aalborg

THE DANISH NATIONAL RESEARCH FOUNDATION'S
MIB
CENTER FOR MUSIC IN THE BRAIN

Course on Experimental Musicology Part 2

Lectures with Center for Music in the Brain's researchers

Time:

October-December 2016

Venue:

DNC Building, Aarhus University Hospital,

Nørrebrogade 44, Aarhus

Monday 10 October 14.00-15.00

Boris Kleber: An introduction to the neurosciences and music: from daily practice to neural shaping

Learning outcomes

Students will gain the following:

- Knowledge of what it takes to become a musician
- An understanding of why musicians are an interesting model for scientists
- An understanding of the connections between our brain and our behaviour
- An understanding of the basic learning mechanisms and how they alter the brain's organisation

Abstract

This course presents you with an introduction to the science and neuroscience of music. It will begin with a focus on the development of musical expertise and the role of musical practice, which then leads to the question of why studying musicians may help us understanding how our brain can be shaped by experience. This also involves the question of how musicians may utilise sensory feedback differently compared to non-musicians. Another aspect is related to learning mechanisms in the brain, which do not only help us acquiring the desired skills but can also lead to the (unwanted) association of co-occuring behaviours. The latter may have implications for music learning in a broader psychological context. Finally, we will scratch the surface of a new emerging field that taps into the genetic basis of musicianship.

Background literature

Gottfried Schlaug: Musicians and music making as a model for the study of brain plasticity

Rachel M. Brown, Robert J. Zatorre, Virginia B. Penhune: Expert music performance: cognitive, neural, and developmental bases

Monday 10 October 15.20-16.30

Bjørn Petersen: "Key, Meter, Bar and Tonic?" - an ouverture to the basic theory of music

Learning outcomes

Students will gain the following:

- An understanding of how rhythm is structured in beat, subdivision, bar, meter and period
- Knowledge of the organization of notes in scales, intervals, keys and phrases
- An understanding of harmony and its relation with scales and keys
- An understanding of the basic rules of notation of the above
- An overview of chords, inversions, chord progression and functional harmony

Abstract

Music theory is to music what grammar is to language and without it music would still be there. With the long tradition of (Western) music, however, a fascinating and complex theoretical framework for the organization and communication of musical sounds has been established. This lecture will shed light on the very basic building blocks of music theory, with a particular focus on rhythm, melody and harmony.

Background literature

Catherine Schmidt-Jones & Russell Jones, Understanding Basic Music Theory, 2007, C O N N E X I O N S, Rice University, Houston, Texas. http://cnx.org/content/col10363/1.3/

Music Theory:
https://en.wikipedia.org/wiki/Music_theory

Webite in Danish:
http://www.musikipedia.dk/

Monday 24 October 14.00-15.00

Ole Adrian Heggli: Sound before the brain - an introduction to the features and functions of sound a brain researcher should be aware of

Learning outcomes

Students will gain the following:

- An understanding of properties of sound waves.
- An overview of how method of delivery will influence sound.
- The ability to correctly use audio engineering terms in dissemination of research.
- The ability to spot acoustic and electroacoustic confounds in research paradigms.

Abstract

Sound is all around you and is affected by a multitude of factors. Understanding the contributions of factors such as room structure and headphone response curve is crucial for securing correct delivery of stimuli in auditory paradigms. This short lecture aims to introduce features and functions of sound, ranging from basic physical and electroacoustical properties of sound waves, to room acoustic contributions to the perceived sound.

Recommended further reading

Benade, A. H. (1990). *Fundamentals of Musical Acoustics*, 2nd edition. New York: Dover Publications.

Olson, H. F. (1967). *Music, physics and engineering*, 2nd edition. New York: Dover Publications.

Everest, F. A., Pohlmann, K. C. (2015). *Master Handbook of Acoustics*, 6th edition. US: McGraw-Hill.

Monday 24 October 15.20-16.30

Ole Adrian Heggli: "My sine wave is running away": An introduction to basic psychoacoustic concerns in music and audio research

Learning outcomes

Students will gain the following:

- An understanding of how psychoacoustical features changes sound perception.
- The ability to tailor sound stimulus with consideration to psychoacoustical concerns.

Abstract

Psychoacoustics can be described as the black box between a sent sound signal and a perceived sound signal. This process transforms the sound to a point where you in auditory paradigms run the risk of not testing what you think you are testing. This short lecture aims to spread awareness of some of the more common psychoacoustical concerns, such as perceived loudness and masking in time and frequency.

Recommended further reading

Yost, W. A. (2015). Psychoacoustics: A Brief Historical Overview. *Acoustics Today: A Publication of the Acoustical Society of America*, 11(3), 46-53.

Moore, B. C. (2012). *An introduction to the psychology of hearing*. Brill.

Monday 31 October 14.00-15.00

Suzi Ross: Pitch and tonality perception

Learning outcomes

After the lecture, the students will be able to:

- Describe the structure and function of the basilar membrane
- Name at least one theory of pitch perception and explain why it cannot fully account for perception of pitch
- Describe the tritone paradox and explain what it can tell us about the influence of environment on pitch perception
- Explain how Gestalt principles relate to melodic perception
- Explain the difference between relative and absolute pitch perception in humans
- Evaluate the influence of learning versus genetics on the acquisition of absolute pitch

Abstract

Pitch is one of the fundamental building blocks of music. In this lecture, we will uncover the main theories of how pitch is perceived. We will begin by looking at how sound travels through the ear into the brain, specifically focusing on the role of the cochlea and how neuronal firing rate contributes to pitch perception. Next we will explore some auditory illusions and discover what they can tell us about pitch perception. Finally, we will look at a seemingly-rare ability known as 'absolute pitch', and explore why this ability might not be so rare after all.

Recommended further reading

Interactive Biology (2011, 21 February). *How we hear different pitches*. Retrieved from: https://www.youtube.com/watch?v=Id-LO_7e9BI

TEDx Talks (2011, 25 November). *Henkjan Honing: What makes us musical animals?* Retrieved from: https://youtu.be/EU7HcV83RXc?t=25s

Monday 31 October 15.20-16.30

Maria Witek: Groove, synchronisation and social bonding

Learning outcomes

Students will gain the following:

- Learn about the relationship between rhythm, body-movement and pleasure
- Understand the social-psychological significance of musical engagement
- Learn about how finger-tapping studies can be used to study social interaction
- Acquire a critical understanding of evolutionary explanations of music

Abstract

In this lecture, we will consider what it is about music that makes us want to move, and why it feels good. We will review studies about the psychology of groove (e.g. funk, hip-hop, electronic dance music, jazz), and talk about what kinds of rhythms affect our emotions and our bodies in this way. Finally, we will discuss the potential evolutionary explanation for why we like to synchronise to music and to the movements of other people, and examine the links between musical engagement and social bonding.

Recommended further reading

Witek, M. A., Clarke, E. F., Wallentin, M., Kringelbach, M. L., & Vuust, P. (2014). Syncopation, body-movement and pleasure in groove music. *PloS one*, *9*(4), e94446. http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0094446

Kirschner, S., & Tomasello, M. (2010). Joint music making promotes prosocial behavior in 4-year-old children. *Evolution and Human Behavior*, *31*(5), 354-364. http://www.sciencedirect.com/science/article/pii/S1090513810000462

Monday 14 November 14.00-15.00

Line Gebauer: Clinical applications of music

Learning outcomes

Students will gain the following:

- Knowledge of conditions/disorders where there is good evidence for using music interventions
- An understanding of the neural mechanisms underlying the positive effects behind music interventions
- An understanding of the elements that should be taken into account when designing music interventions
- The ability to evaluate the quality of studies on music interventions
- Inspiration for novel clinical fields/conditions where music interventions could be applied in the future

Abstract

The lecture will focus on how music interventions can be beneficial to people with somatic and psychiatric disorders, and on the underlying neural and neurochemical mechanisms. The auditory environment has a huge impact on our wellbeing and the body's ability to recovery after disease. In recent years, solid biomedical and psychological evidence has emerged, demonstrating the beneficial effects of music in a variety of somatic and psychiatric disorders, and for improving general well-being in healthy individuals. This evidence is now beginning to affect the design of healthcare facilities and development of novel technologies for providing music interventions.

Background literature

Gebauer, L. & Vuust, P. (2014). Music Interventions in Healthcare. White paper produced in collaboration with Danish Sound, SoundFocus, Widex, and DKsystems. http://issuu.com/danishsound/docs/whitepaper_digital_enkelsidet

Bradt, J., Dileo, C., & Shim, M. (2013). Music interventions for preoperative anxiety. *The Cochrane Library*.

Monday 14 November 15.20-16.30

Tomas Matthews: The neural bases of rhythm and timing

Learning outcomes

Students will gain an understanding of:

- The network of brain regions involved in musical rhythm perception and production
- Some of the methods involved in characterizing these brain regions
- Theories of rhythm perception and production and how they relate to motor timing and attention
- How musical rhythm can be used to study general timing processes

Abstract

Rhythm is ubiquitous in our environment as well as our physiology, from the day/night cycle to the way we walk. Musical rhythm can be used as a tool to answer questions about how humans interact with rhythmic environments and each other in temporally precise ways. For example, do humans have an internal master clock that tracks the time between two events (notes, words etc.) or do we have multiple adaptive clocks that synchronize to rhythms at different time scales? This lecture will focus on several brain regions that are crucial for perceiving and producing musical rhythms and how each of these areas contributes to this 'rhythm network' in different ways. The methods involved in characterizing this network will be also discussed. Several theories of rhythm perception and production will be highlighted while making connections to broader theories of perceptual and action timing as well as prediction and attention. Finally, there will be a discussion about what studying rhythm can tell us about how we process time in general.

Background literature

Grahn, J. A., & Rowe, J. B. (2009). Feeling the beat: premotor and striatal interactions in musicians and non-musicians during beat perception. *The Journal of Neuroscience: The Official Journal of the Society for Neuroscience*, *29*(23), 7540–7548. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2702750/pdf/ukmss-27156.pdf

Geiser, E., Walker, K. M. M., & Bendor, D. (2014). Global timing: a conceptual framework to investigate the neural basis of rhythm perception in humans and non-human species. *Frontiers in psychology*, *5*, 159. http://journal.frontiersin.org/article/10.3389/fpsyg.2014.00159/full

Monday 21 November 14.00-16.30

Suzanne Ross: Designing an experiment (parts 1 and 2)

Learning outcomes

By the end of these two lectures, students will be able to:

- Devise a research question based on existing literature that 'fills a gap' in our knowledge
- Construct a well-defined hypothesis and null hypothesis
- Explain the premise of null-hypothesis significance testing
- Identify observational versus experimental designs
- Define independent variables and operationalise a dependent variables
- Write up an experiment in the IMRAC format
- Read a scientific paper

Abstract

Experimental design is a critical skill in any scientific field, not only for conducting good scientific research, but also for understanding the work of others. In the first part of the class, we will explore different types of research design, how to design a research question, devise a hypothesis and define your experimental variables and outcome measures. In the second part, we will conduct an in-class experiment on pitch memory with you as the participants. We will then explore how to draw inferences from the results and discuss how these findings relate to theories of auditory working memory. Finally, we will 'write' (orally) a short scientific article describing how the experiment was conducted and what we found.

Background literature

PIcho, K., & Artino, A. R. (2016). 7 deadly sins in educational research, Journal of Graduate Medical Education, : http://www.jgme.org/doi/full/10.4300/JGME-D-16-00332.1 (PDF attached)

Just read the abstract of the following article:
Deutsch, D. (1970). Tones and numbers: Specificity of interference in immediate memory, Science, 168(3), 1604-1605. http://science.sciencemag.org/content/168/3939/1604

Monday 12 December 12 2016 14.00-15.00

Henrique Fernandes: The musical brain: an anatomical perspective

Learning outcomes

Students will gain knowledge and understanding of the following:

- Structure and function of neurons.
- Networks of the brain.
- Neural systems involved in perception and creation of music.

Abstract

It is common sense that our ability to perceive, judge or create music is controlled by our brain. But how is this really happening? How does the brain process the many inputs from the world and defines the outputs of our actions?
This talks serves as an introductory survey of topics in brain anatomy, ranging from the structure of individual neurons to the function of the brain and its subsystems. An introduction to the orchestra of brain areas involved in the processing of music, from perception to creation.

Background literature

Sacks, O. (2007). *Musicophilia: Tales of music and the brain*. New York: Alfred A. Knopf.

Olaf Sporns. 2010. *Networks of the Brain* (1st ed.). The MIT Press.

https://en.wikipedia.org/wiki/Cognitive_neuroscience_of_music

Monday 12 December 2016 15.20-16.30

Maria Celeste Fasano: Music therapy in children

Learning outcomes

Students will gain the following:

- An overview of the models of music therapy practice around the world
- An understanding of why music therapy is particularly important in children
- An understanding of the effects of music therapy
- An understanding of a specific approach of non-conventional music therapy: El Sistema

Abstract

Music therapy has been defined as an intervention in which a therapist uses musical experiences and the relationships developing through them to achieve health goals in a client (Bruscia, 1998). This lecture will shed light on the potential of music therapy in children, focusing on a non-conventional music therapy that has been developing very quickly around the world in the last years: El Sistema approach.

Background literature

Majno M., From the model of El Sistema in Venezuela to current applications: learning and integration through collective music education, 2012, Ann N Y Acad Sci 1252: 56-64

Gold C., et al., Effects of music therapy for children and adolescents with psychopathology: A meta-analysis, 2004, Journal of Child Psychology and Psychiatry 45(6): 1054-63

Gold C., et al., Effectiveness of music therapy for children and adolescents with psychopathology: A quasi-experimental study, 2007, Psychotherapy Research 17(3): 289-296