



Music, Mind, & Technology

Introduction



Dr. Vinoo Alluri

mind

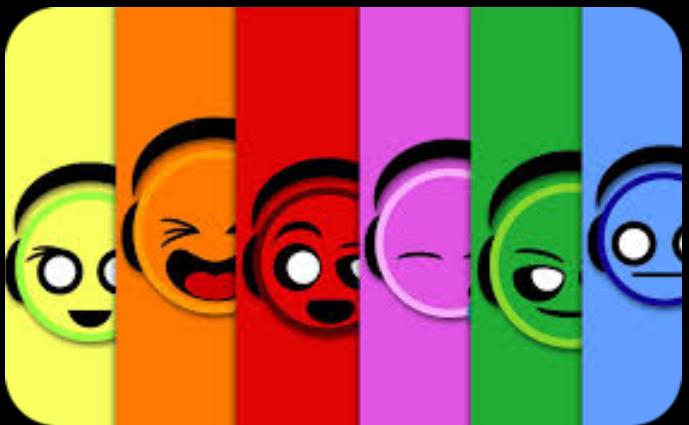
psychoacoustics, music
psychology (behaviour)

neuromusicology (brain)



music information retrieval (MIR)

technology



emotional regulation

(Lamont et al. 2016)

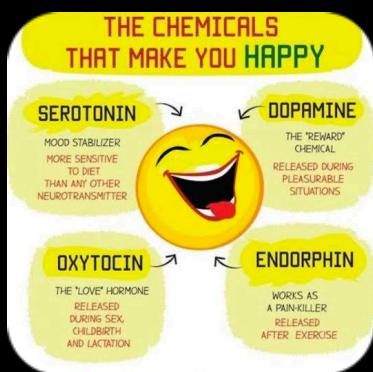


positive mood

(Saarikallio & Erkkilä 2007,
Erkkilä et al. 2011)

decreased cortisol levels, increased oxytocin and β -endorphin

(Khalfa et al., 2003; Koelsch & Stegemann 2012;
Kreutz et al. 2012)



pleasure

reward system

(Salimpoor et al., 2011)



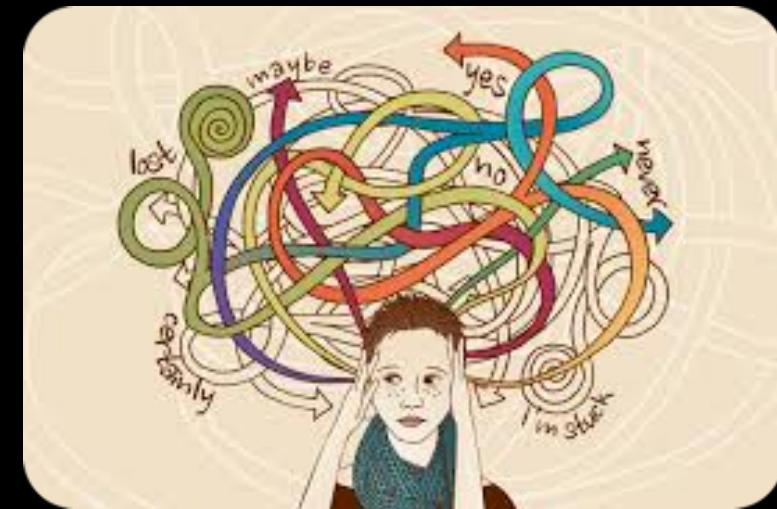
social bonding, prosocial behaviour

(Cross 2014; Kirschner & Tomasello 2012)



pain management

(Bradt et al., 2016; Cepeda et al., 2013)



reduced depressive symptoms

(Aalbers et al., 2017; Geretsegger et al 2017)



emotional & behavioural benefits

(Grau-Sánchez et al., 2017)



improve social interaction & communication

(Geretsegger et al., 2014)



stroke recovery (passive listening)

(Saarkamo et al., 2008)



music improvisational therapy

(Street et al., 2020)



gait in parkinson's

(Ashoori et al., 2015)



enhance autobiographical recall

(Baird & Samson, 2015)

What's for din - ner?
(x 2)

How are you doing today?

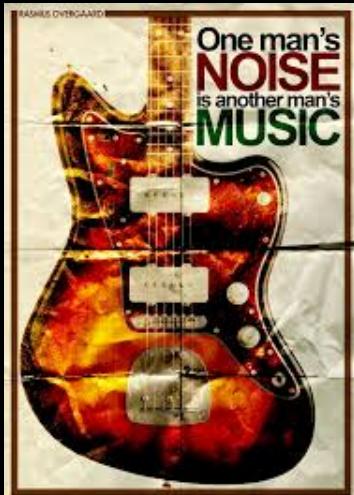


melodic intonation therapy for speech recovery

(Norton et al., 2009)

one of the things in common.....

preference



familiarity

PLOS ONE

OPEN ACCESS PEER-REVIEWED

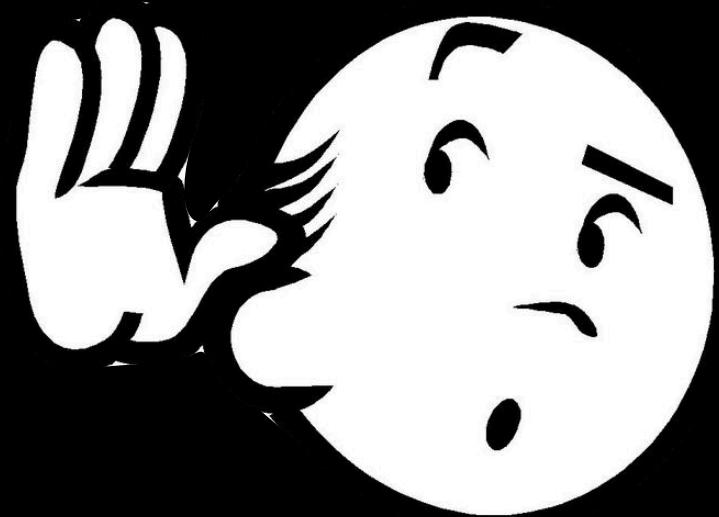
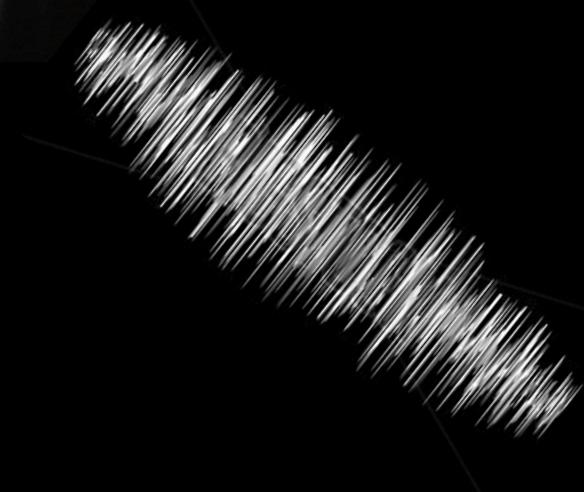
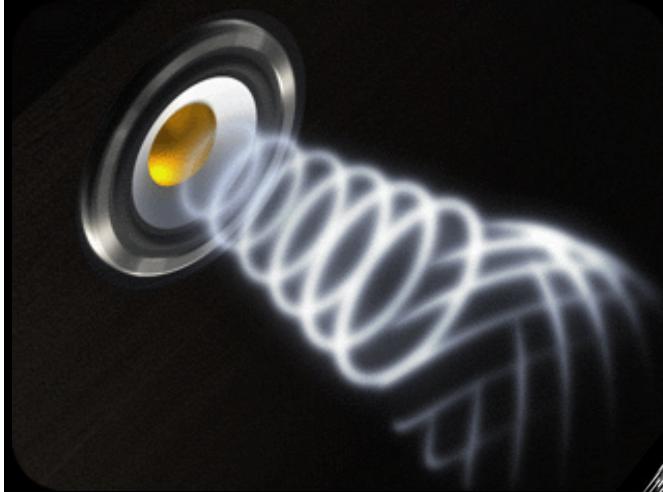
RESEARCH ARTICLE

Music and Emotions in the Brain: Familiarity Matters

Carlos Silva Pereira , João Teixeira, Patrícia Figueiredo, João Xavier, São Luís Castro, Elvira Brattico

Published: November 16, 2011 • <https://doi.org/10.1371/journal.pone.0027241>

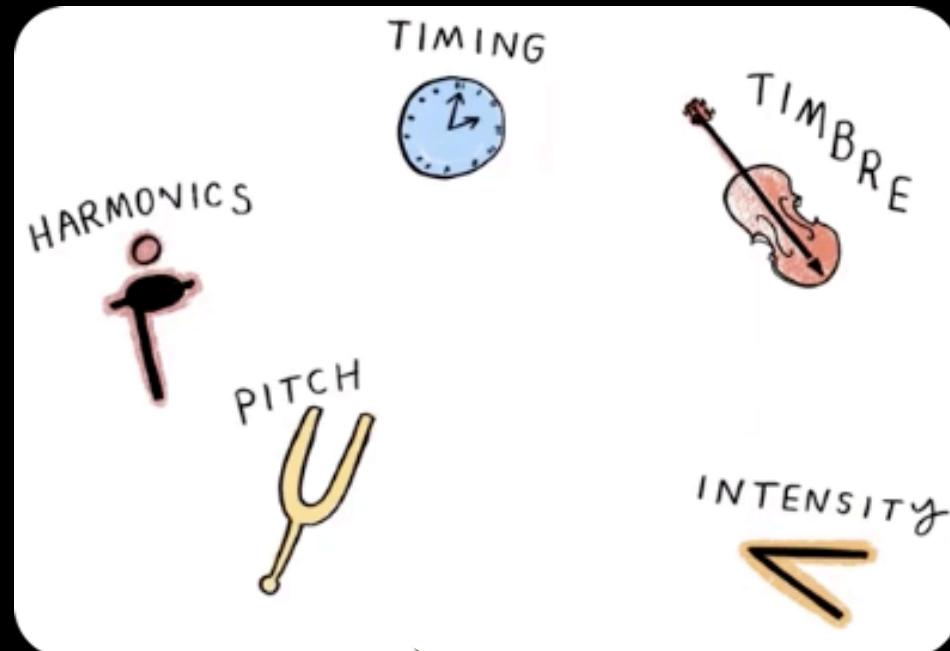




What happens in the brain?

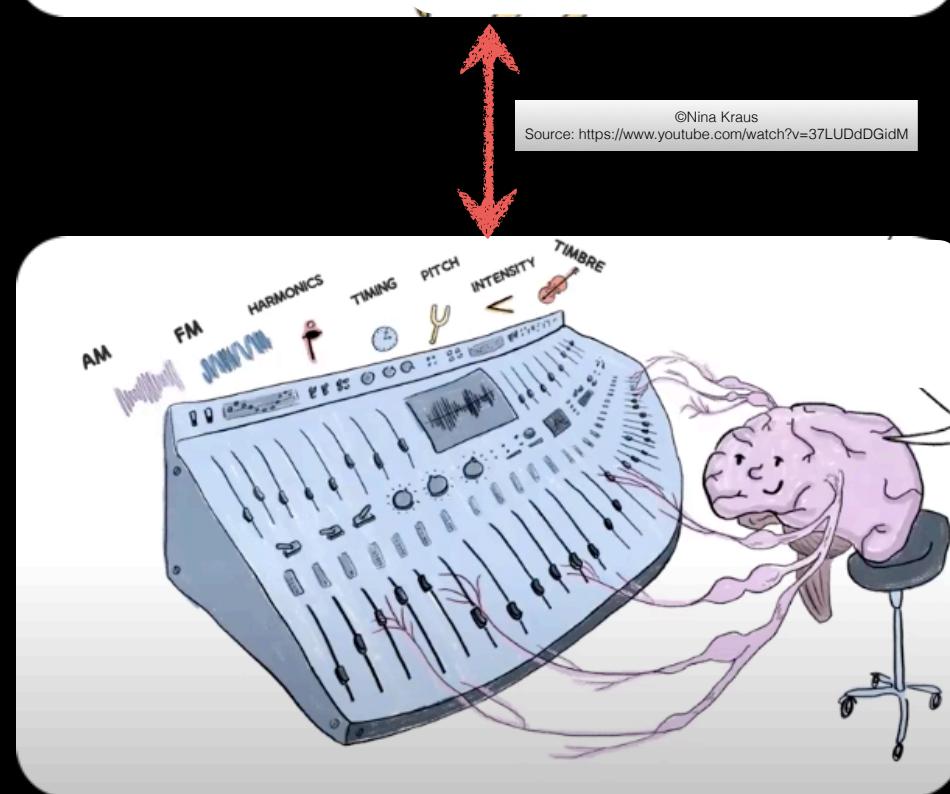


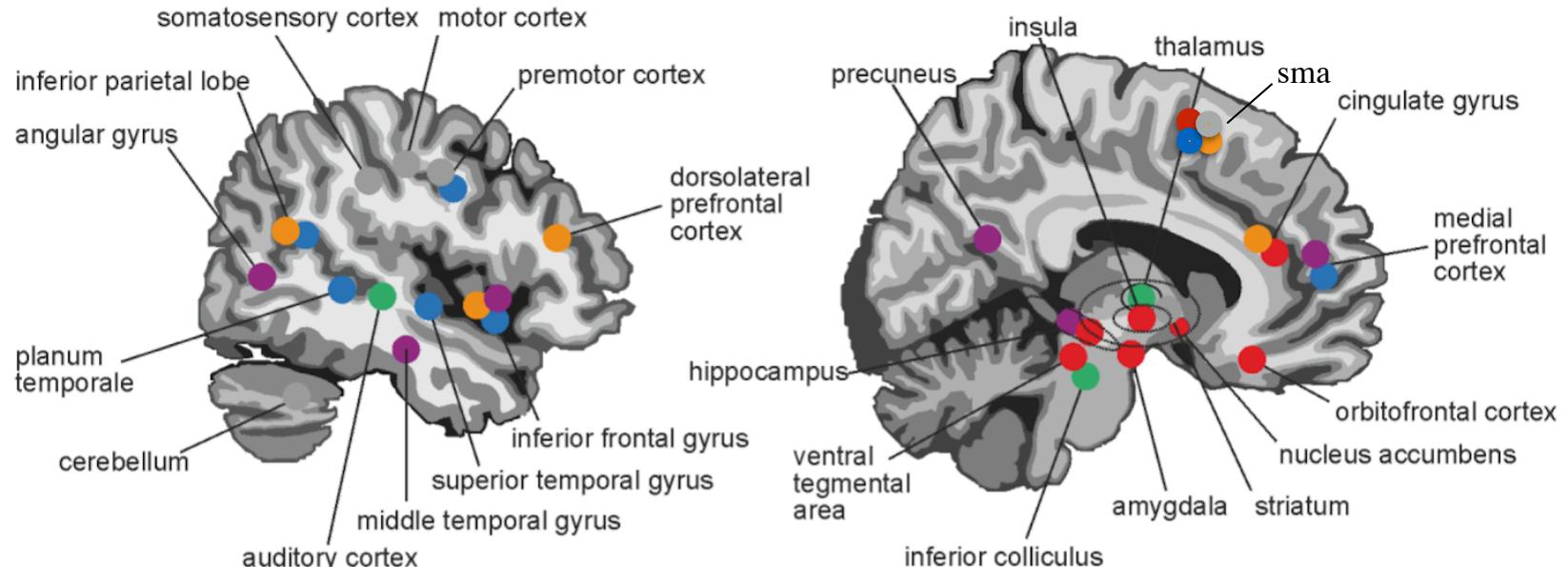
→
separate



Melody
Harmony
Memories
Rhythm
Key
Identify
Emotions

←
integrate



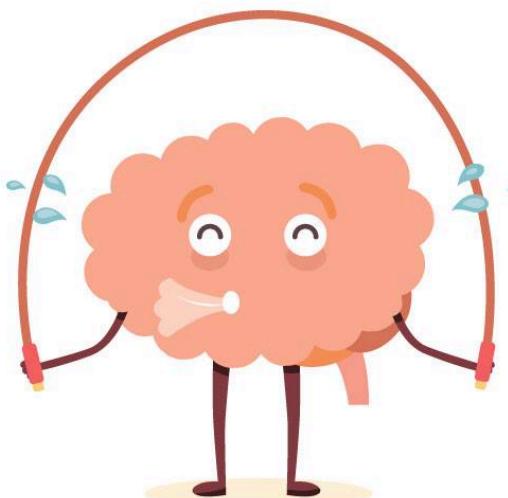


Sihvonen et al. (2017)

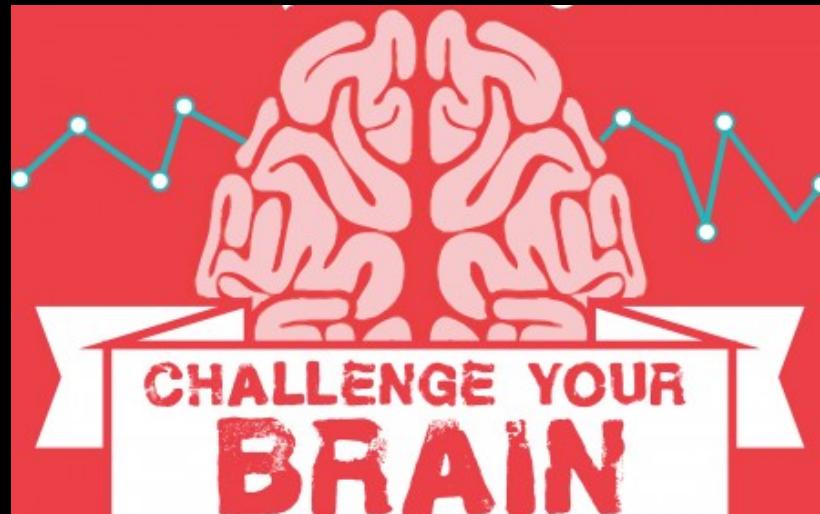
- sensory** ● Basic auditory pathway: perceiving the basic acoustic features of music
- syntax** ● Music-syntactic network: perceiving higher-order musical features
- temporal attention** ● Attention and working memory network: focusing and keeping track of music in time
- episodic memory** ● Episodic memory network: recognizing music and recalling associated memories
- motor** ● Motor network: playing, singing and moving to the beat of music **rhythmic entrainment**
- reward/emotion** ● Reward and emotion network: music-evoked emotions and experiencing pleasure and reward

**associations
semantics**

LISTENING TO MUSIC IS A WAY TO
EXERCISE THE BRAIN !



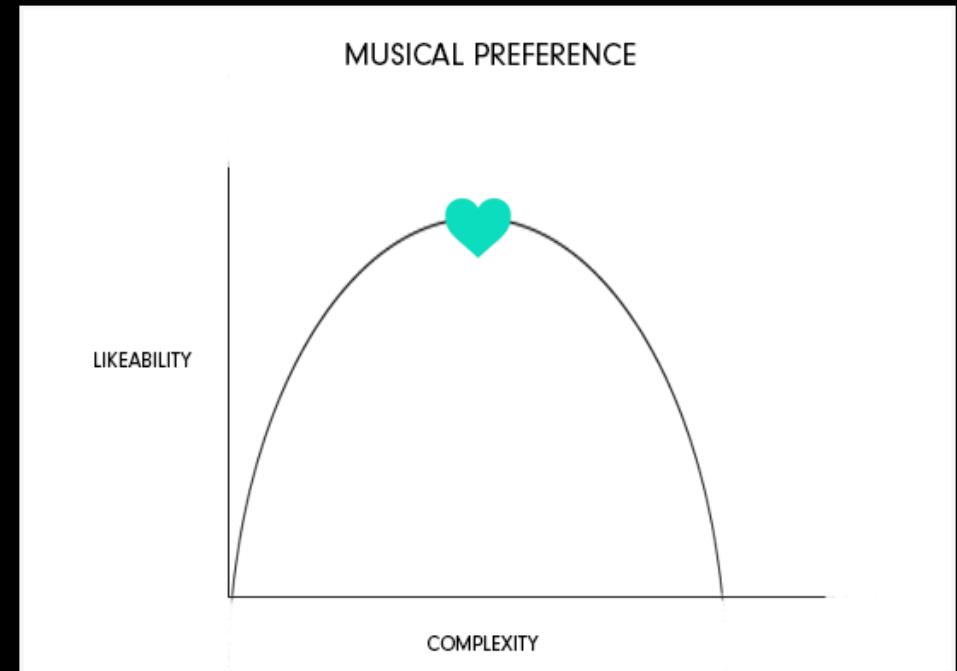
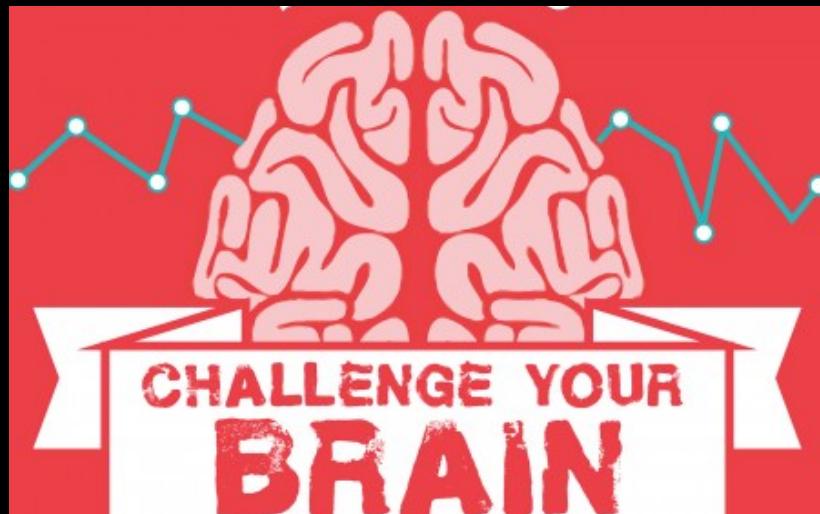
Musical Complexity



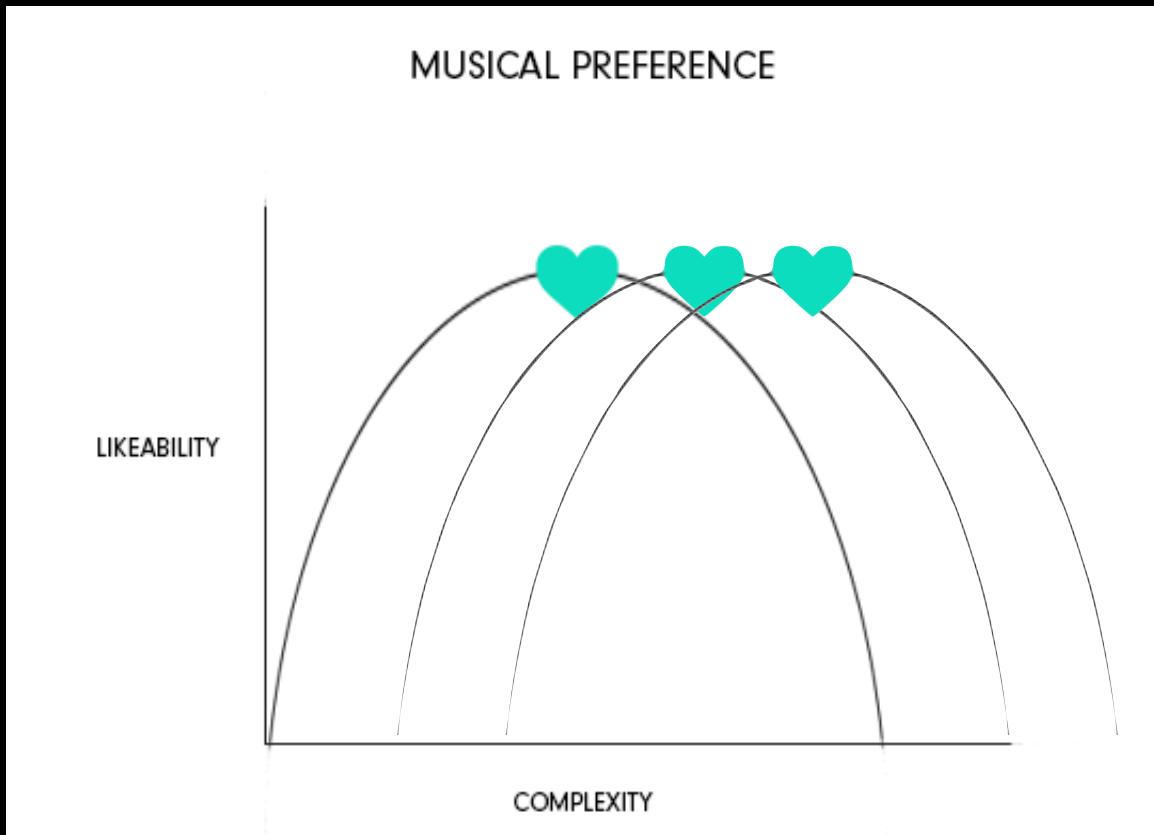
What determines complexity in music?

complexity vs preference?

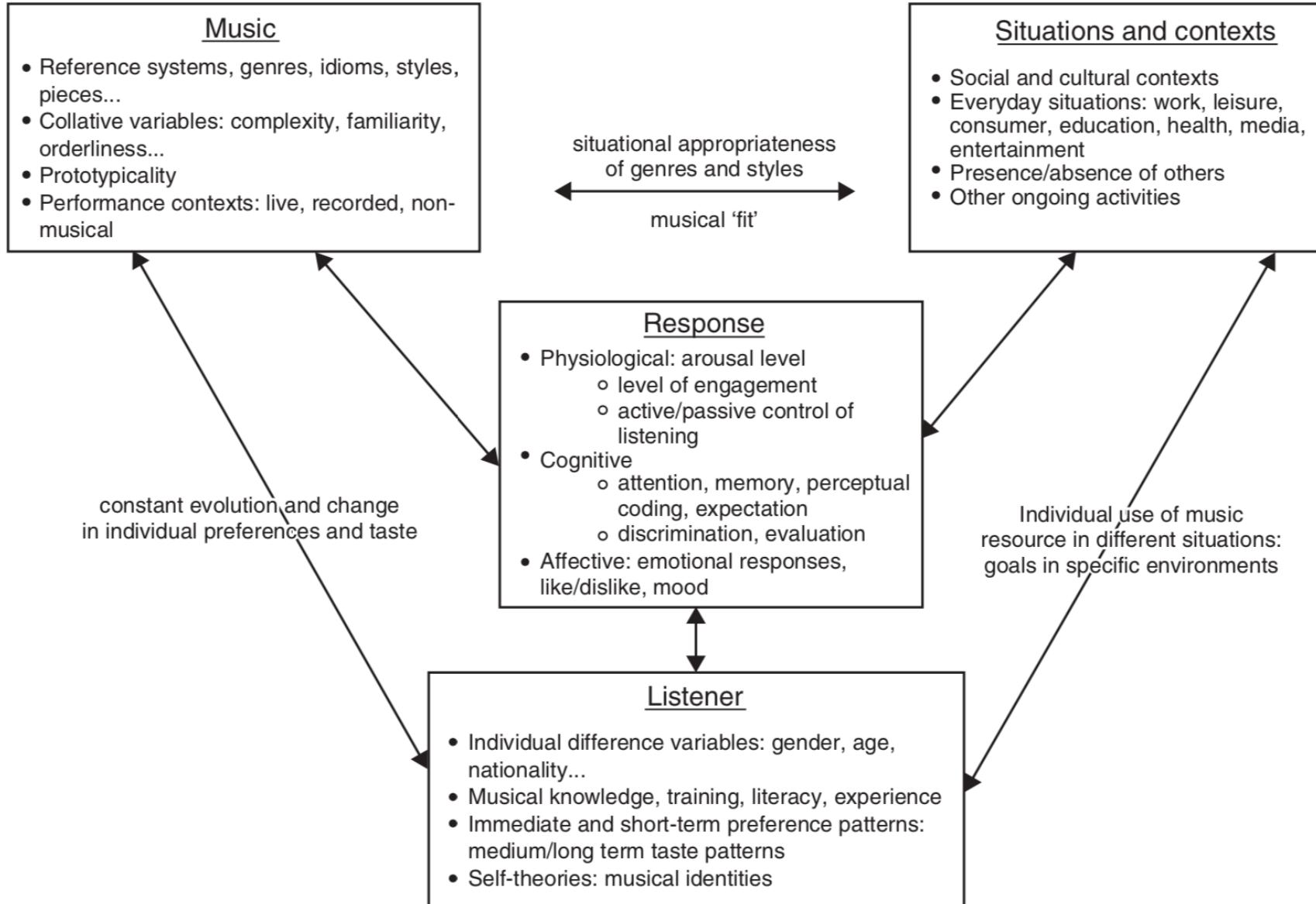
Musical Complexity & Preference



Musical Complexity & Preference



Musical Experience



Reciprocal feedback model of musical response

Music Research (broadly)

Music cognition

- Music perception
(pitch, rhythm,
timbre, tonality...)
- Music and emotion

Social psychology of music

- Musical preferences, attitudes
- Everyday music listening behaviour
- Individual differences
- Social cognition of music

MIR

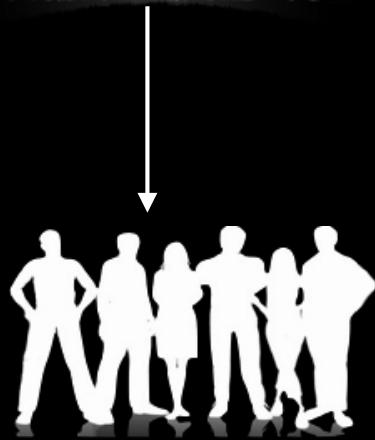
- Feature Extraction
- Sound Generation &
Analysis
- Retrieval &
Classification

Neuroscience of music

- Neural substrates of music
cognition
- Brain changes associated with
musical training

Why is Music Psychology/
Cognition important for MIR (or
vice-versa)?

EXAMPLE



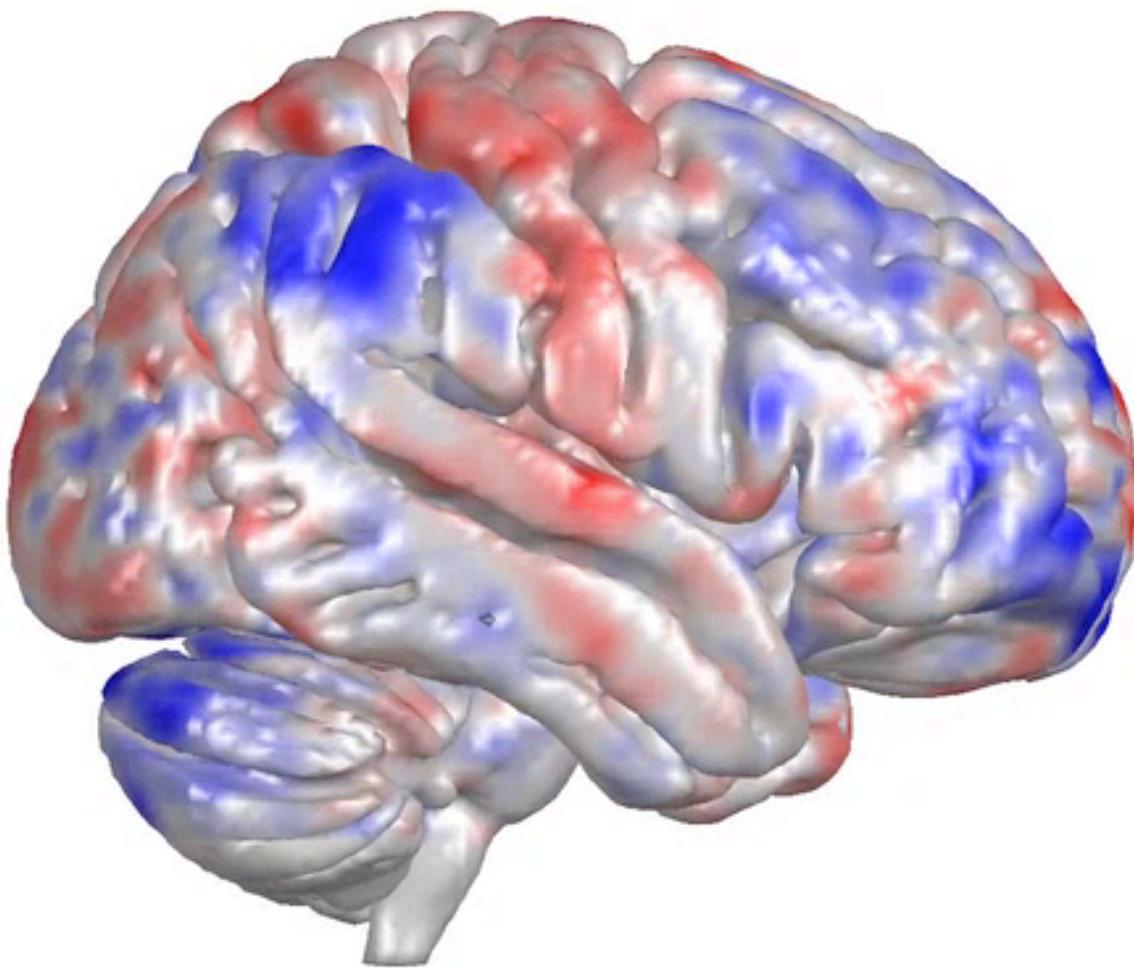
Dreamtheater:
Stream of Consciousness (7'50")



Astor Piazzolla:
Adiós Nonino (8'30")



Igor Stravinsky:
Rite of Spring (three dances; 7'50")



NeuroImage 59 (2012) 3677–3689



Contents lists available at SciVerse ScienceDirect

NeuroImage

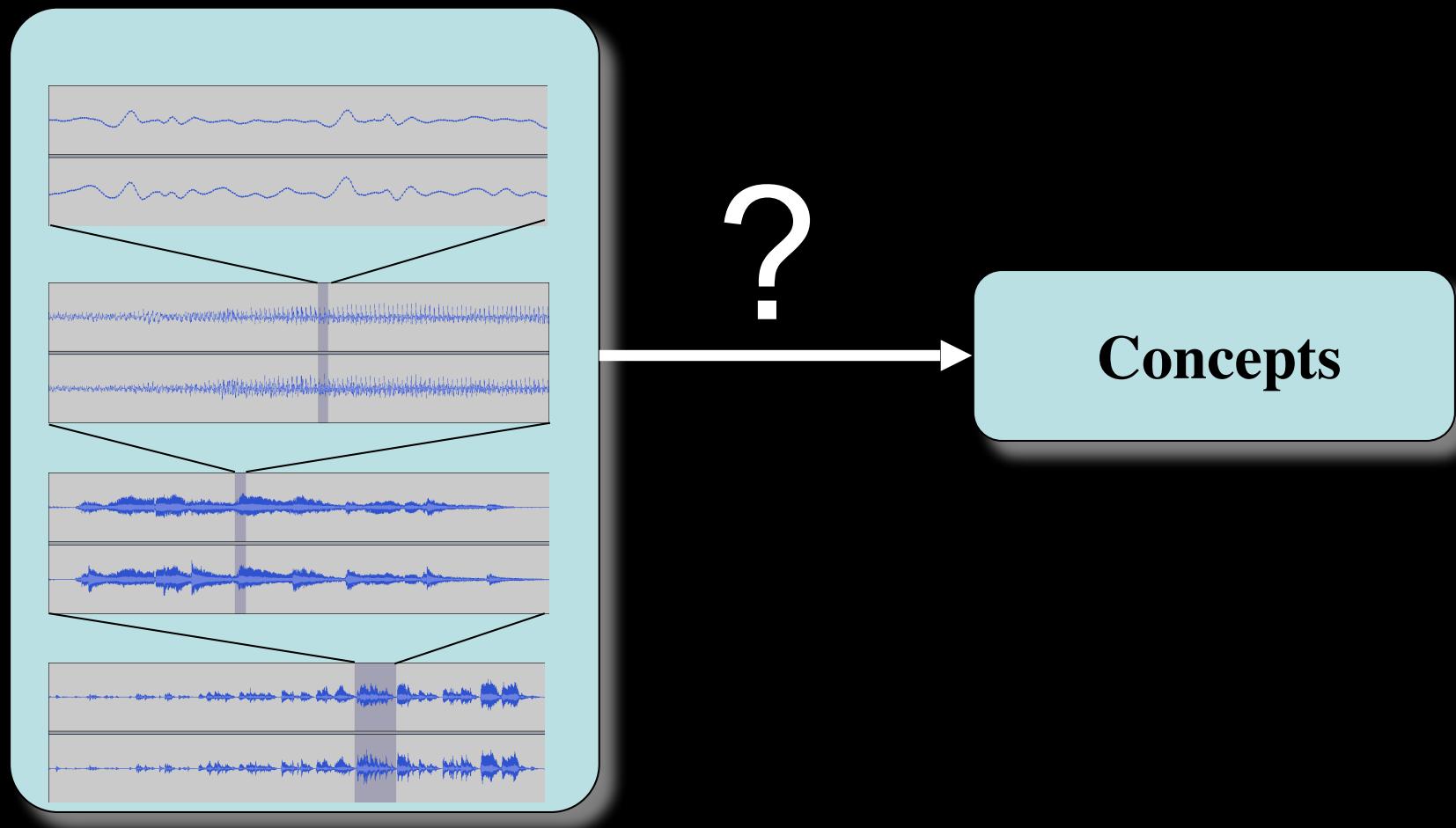
journal homepage: www.elsevier.com/locate/ynim



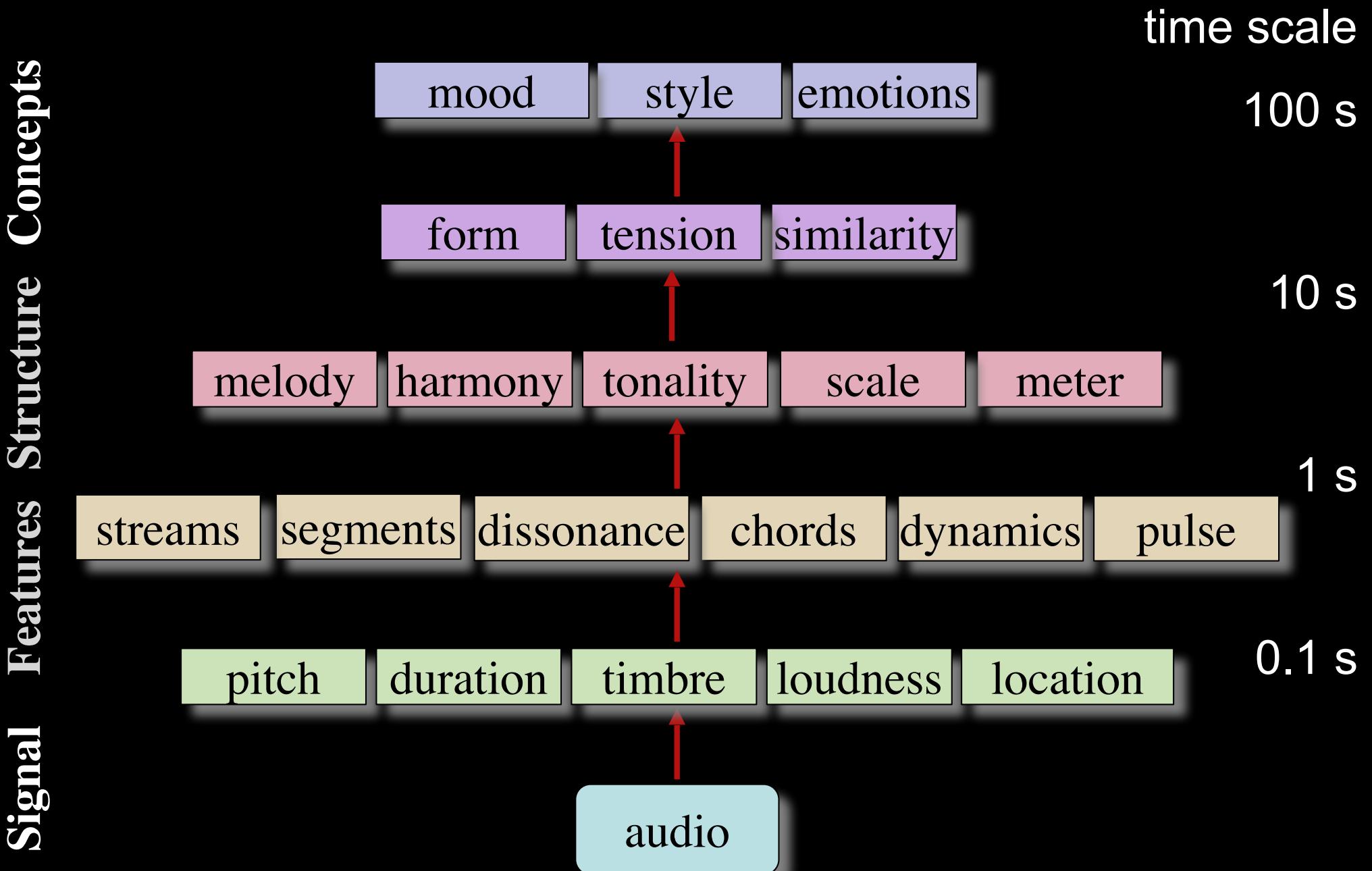
Large-scale brain networks emerge from dynamic processing of musical timbre, key and rhythm

Vinoo Alluri ^{a,*}, Petri Toivainen ^{a,1}, Jiro P. Jääskeläinen ^{c,d,2}, Enrico Glerean ^{c,d,2},
Mikko Sams ^{c,d,2}, Elvira Brattico ^{a,b,3}

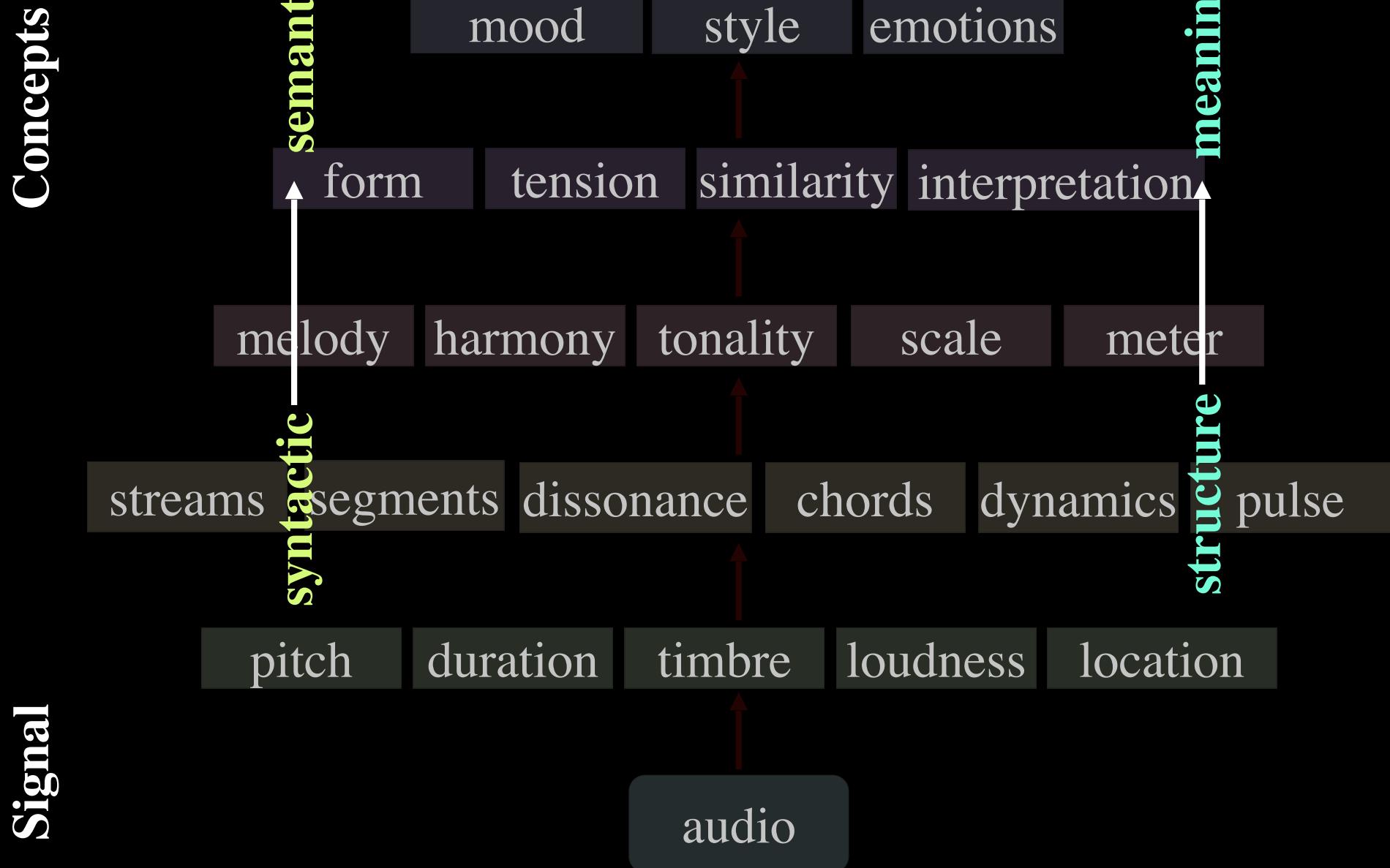
Music signal Processing



Levels of Music Processing



Levels of Music Processing



Lecture

Intro & Course Logistics

Evolutionary Origins. Functions of Music. Embodied music cognition

Musical Meter and Movement

Music Preferences & Individual Differences

Music preference discussion continues, Music & Emotion (Perceived & Felt)

Music & Emotion contd, Cross-Cultural research

"Negative effects" of music - Maladaptive Music Usage and Mental Well-Being

Big Music Data - Representation of the Self

Audition - physical and perceptual correlates of sound, critical bands

Sound, Physical and Perceptual correlates

Audition - spectral vs virtual Pitch, Sensation to Perception

Auditory Scene Analysis, Cross-modal perception,

Sampling Theorem, FFT - STFT, Uncertainty Principle, Time vs frequency domain representation of

Acoustic features and perceptual relevance, Genre/Emotion classification

Timbre, Music Structure matching, Music Segmentation, Lyrics Structure

Audio Synthesis & Digital Filters

Intro to Neuromusicology, Structure, Function, Controlled vs Naturalistic, Segregated vs Integrated

Individual Differences and Neural Responses to Music

Student Presentations

Psychology of Music

Psychoacoustics

&

MIR

Neuromusicology

Student Presentations

Guest Lectures



Andrew Danso Adu

The Use of Technology in Music-based Interventions for
Health and Education



Henna Peltola

Music Aversion



Kaustuv Ganguli



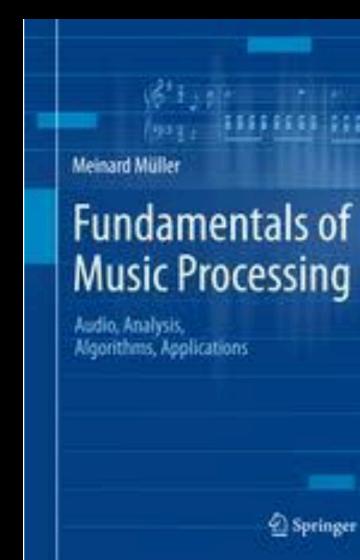
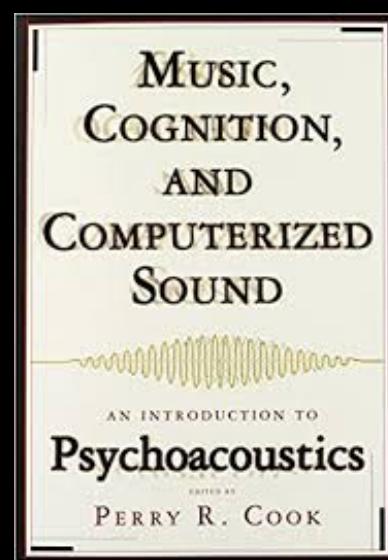
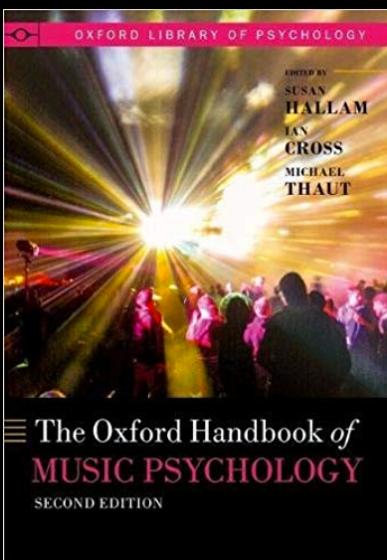
Joshua Bamford

social effects of synchronised action and the
biological basis for music and dance.

Literature

- **Recommended Course Text**

- The Oxford Handbook of Music Psychology (2016)
- Music, Cognition, and Computerized Sound
- Fundamentals of Music Processing
- Journal Articles



Resources

- **Project**
 - resources on Moodle
- **Audio Processing / MIR (Python)**
 - MIRTOOLBOX: <https://www.jyu.fi/hytk/fi/laitokset/mutku/en/research/materials/mirtoolbox> (MATLAB)
 - librosa, madmon, FMP notebooks (audio / music processing)
 - pysox, soundfile (audio I/O & manipulation)

TAs

- Jatin Agarwala
- Ishan Kavathekar
- ***Project:***
 - Atharva Gogate (Spotify <-> behavioural tendencies + depression risk)
 - Pavani Chowdary ([last.fm](#) <-> depression risk)
 - Pratyaksh Gautam (DL - interpretability + neuroscience)
 - Prince Varshney (music-induced movement)

Grading

Assignments (4)	20 %	>=85	A
Quizzes (2)	20 %	80-85	A-
Project	35 %	75-80	B
Mid-Term	15 %	70-75	B-
End-Sem *	10 %	63-70	C
		55-63	C-
		45-55	D
		<45	F

Project Deadlines

- Team - 2 (3 if approved)
- Proposal Submission - 3rd Feb
- Midsem eval - 24th Mar (5%)
- Final Presentation - 16th April onwards (25%)
- Report Submission - Individual Contribution and Learning (5%)

