

Music, Mind, & Technology

Introduction



Dr. Vinoo Alluri



my background



BE: Electronics and Communication



PhD+: Musicology



MSc: Music Engineering
Technology



Postdoctoral: Neuroscience+Psychology

music + technology?

there is such a
course as music engineering
technology??? — 2004

you actually get paid for
doing research in music???
— 2008

i don't do research that has no
societal benefits — 2019

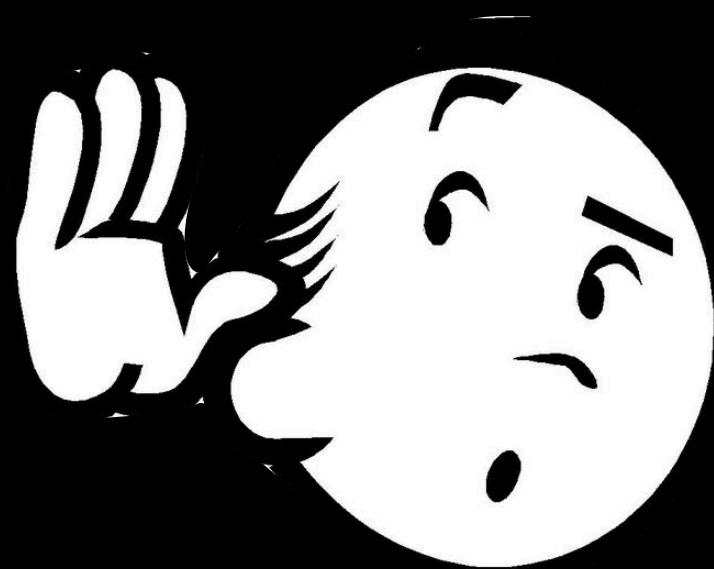
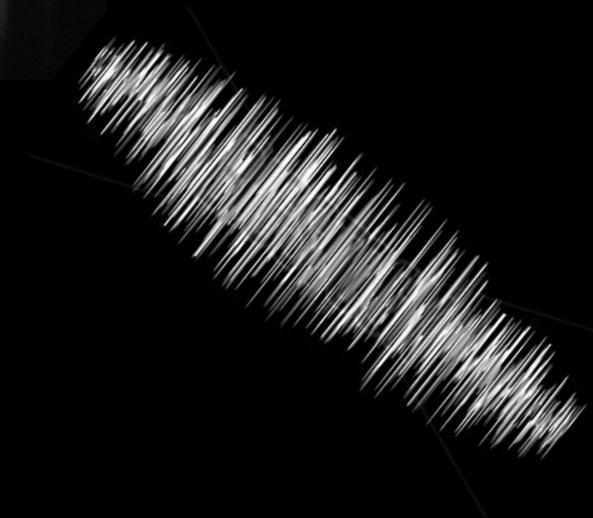
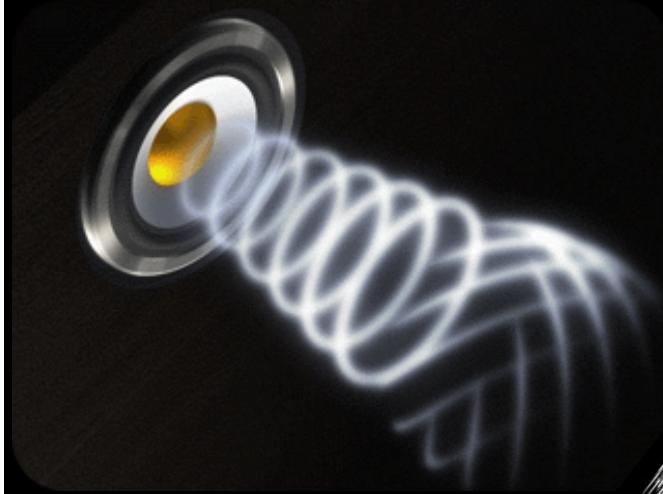
Music (Mind &) Technology?

societal benefit?

What happens when we listen to
music?



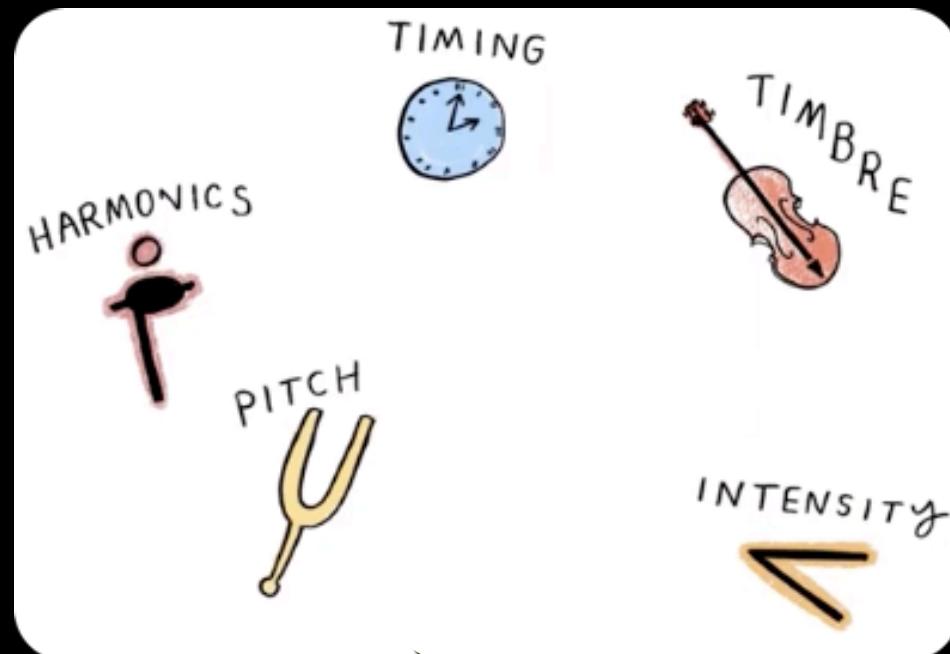
What happens in the brain/body?



What happens in the brain?

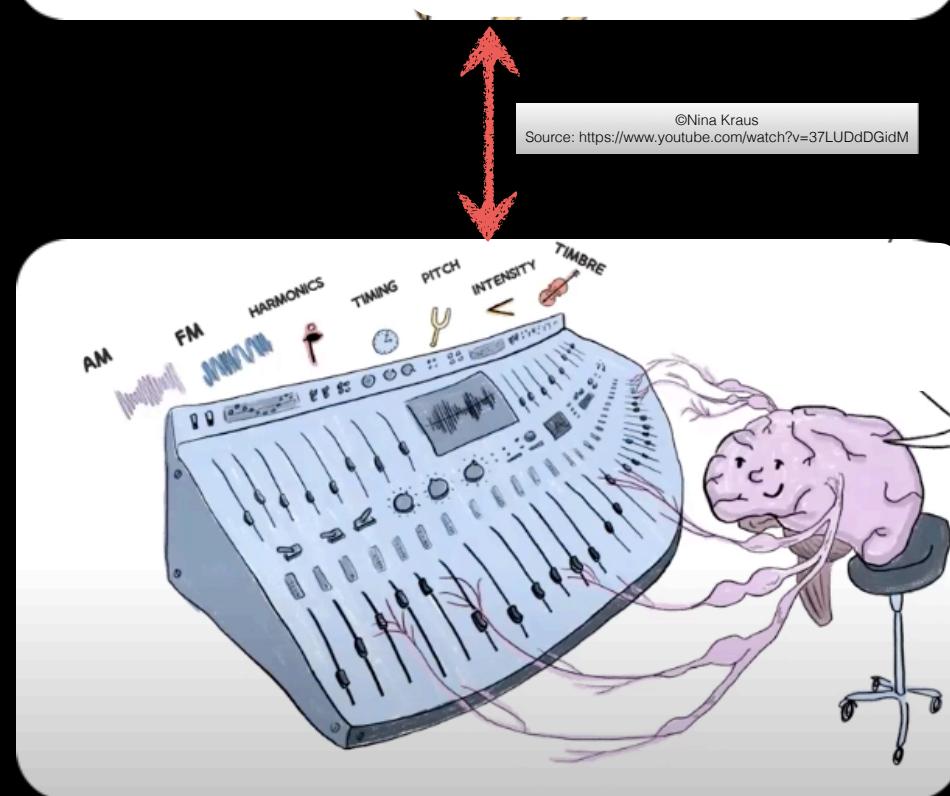


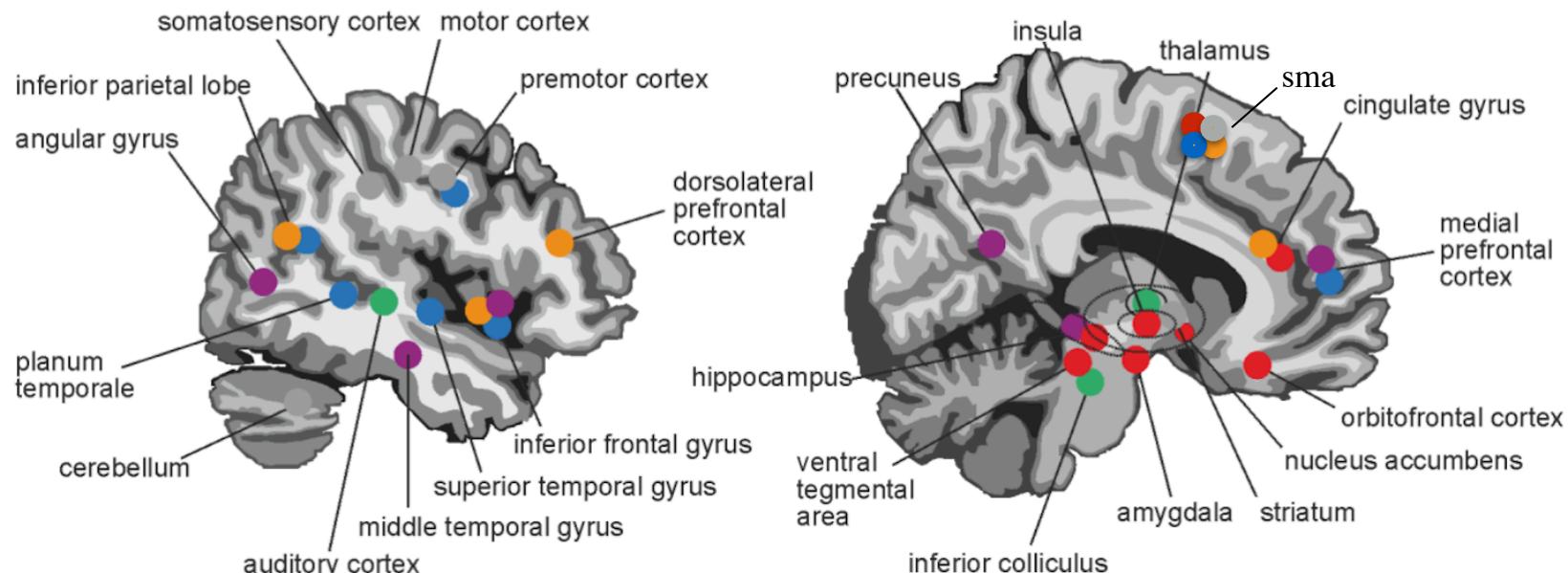
→
separate



Melody
Harmony
Memories
Rhythm
Key
Identify
Emotions

←
integrate

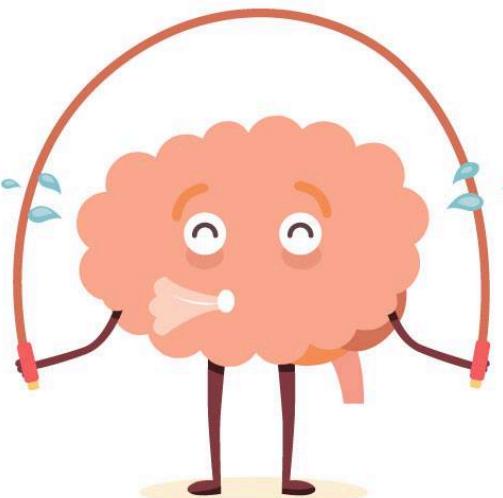




Sihvonen et al. (2017)

- 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
- emotions** ● Reward and emotion network: music-evoked emotions and experiencing pleasure and reward
- associations** ● Episodic memory network: recognizing music and recalling associated memories
- semantics** ● Motor network: playing, singing and moving to the beat of music rhythmic entrainment

LISTENING TO MUSIC IS A WAY TO
EXERCISE THE BRAIN !



mind

psychoacoustics, music
psychology (behaviour)

neuromusicology (brain)



music information retrieval (MIR)

technology

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

Grading (Relative)

Assignments (4)	20 %
Quizzes (2)	20 %
Project	35 %
Mid-Term	15 %
End-Sem	10 %

Project Deadlines

- Team - 2 (3 if approved)
- Proposal Submission - 14th Feb
- Midsem eval - 14th March (5%)
- Final Presentation - 17th April onwards (25%)
- Report Submission - Individual Contribution and Learning (5%)



Guest Lectures



Deniz Duman

What makes us groove?



Katrina McFerran

Music selection



Blair Kaneshiro

Music and the brain



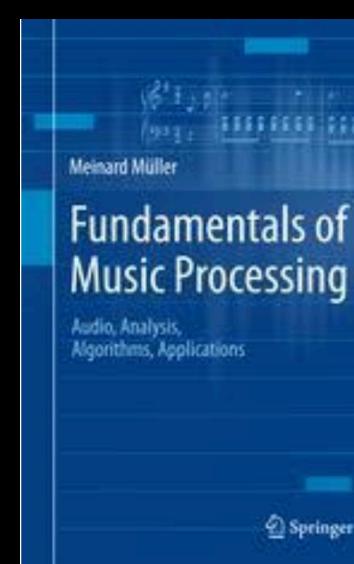
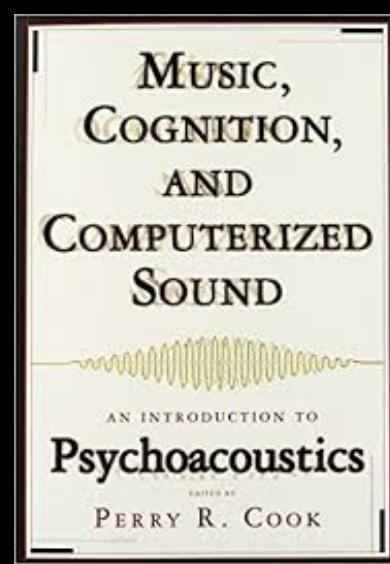
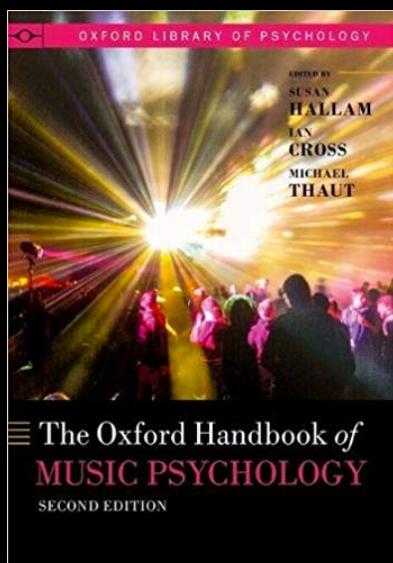
Pedro Neto

Playlist Ordering

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

- Lalit Mohan
- Arghya Roy
- Vedansh Agrawal
- Khushi Goyal



Lalit
Mohan

- ***Project ideas:***
 - Contact MCG@IIIT



Pratyaksh
Gautam



Jatin
Agrawala

Movement

- identify universal grammar in music-induced movement
- predicting interaction from dancing dyads
- predicting individual traits from music-induced movement



Social Media

- analysing online discourse on musical experiences and associations
- online music sharing vs private streaming
- music sharing during social movements



Lyrics

- emotion prediction and topic modelling from lyrics using NLP
- lyrical structural analyses
- associating lyrical preferences with individual differences



Soundtrack Generation for Books

- automatic retrieval of soundtracks for books with movie adaptations
- automatic generation of soundtracks for books



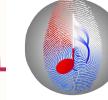
Perception

- cross-cultural studies on music perception and related emotions
- role of music as a social surrogate
- musical aptitude: testing different demographics



Health and Well-being

- predicting risk for depression via music listening habits via digital traces in online music listening platforms
- autism and music preferences



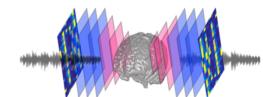
Neuroscience

- analysing individual differences that modulate brain responses to music
- decoding brain states using functional MRI
- multimodal fusion of structural and functional MRI

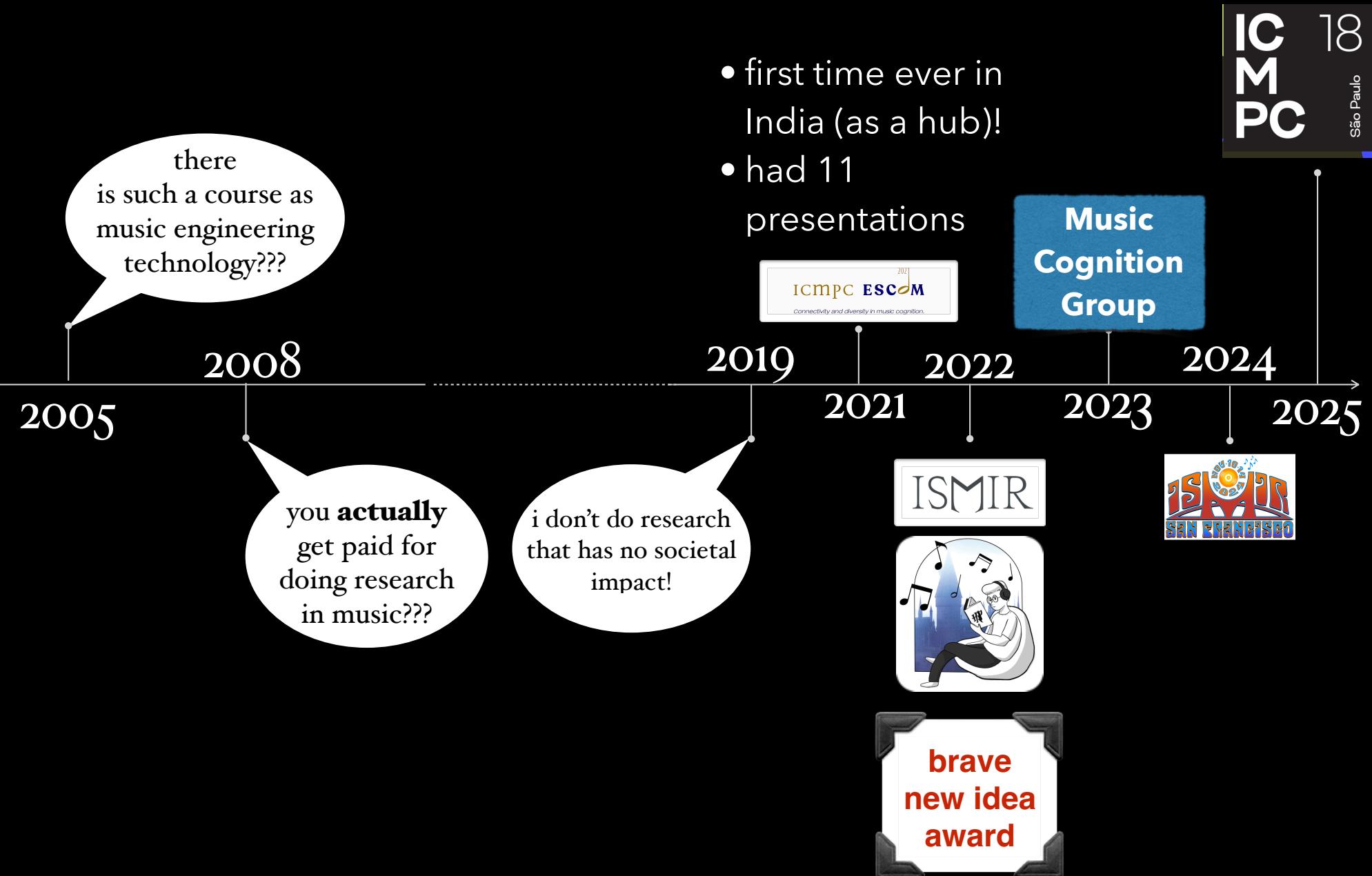


Representation

- analysing music representations generated via deep learning
- analysing multimodal representations of music & lyrics



the long and winding road until now



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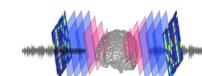
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Online Discourse

PLOS ONE

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE



r/depression
899k Members

"Help! I need some music!": Analysing music discourse & depression on Reddit

Bhavyajeet Singh , Kunal Vaswani , Sreeharsha Paruchuri, Suvi Saarikallio, Ponnurangam Kumaraguru, Vinoo Alluri

Published: July 20, 2023 • <https://doi.org/10.1371/journal.pone.0287975>



Online Discourse

957k members+ created Jan 2009

keyword: music

Jan 1st 2010 - Jan 1st 2022

Sort By: Best

2 Need some relaxation music

1 Please help. I am horrible at remember bands or even having a decent playlist. I am feeling depressed tonight and need something to ease my mind so I can get some sleep. I don't want any inspirational music, just some calm relaxing music. I would really appreciate it.

3 Comments Award Share Save ...

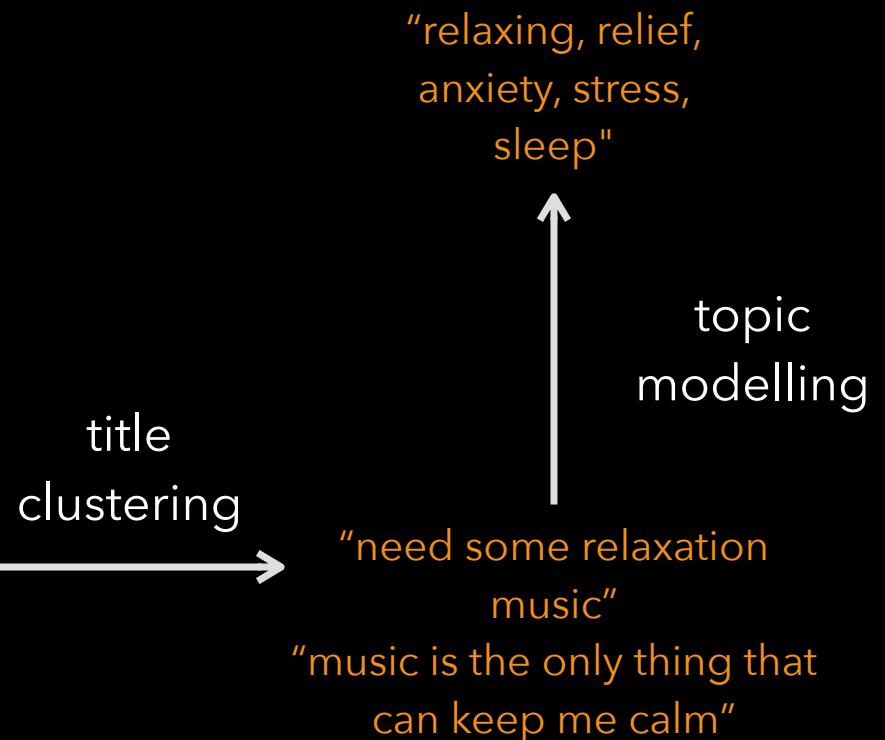
Riobux 8 yr. ago

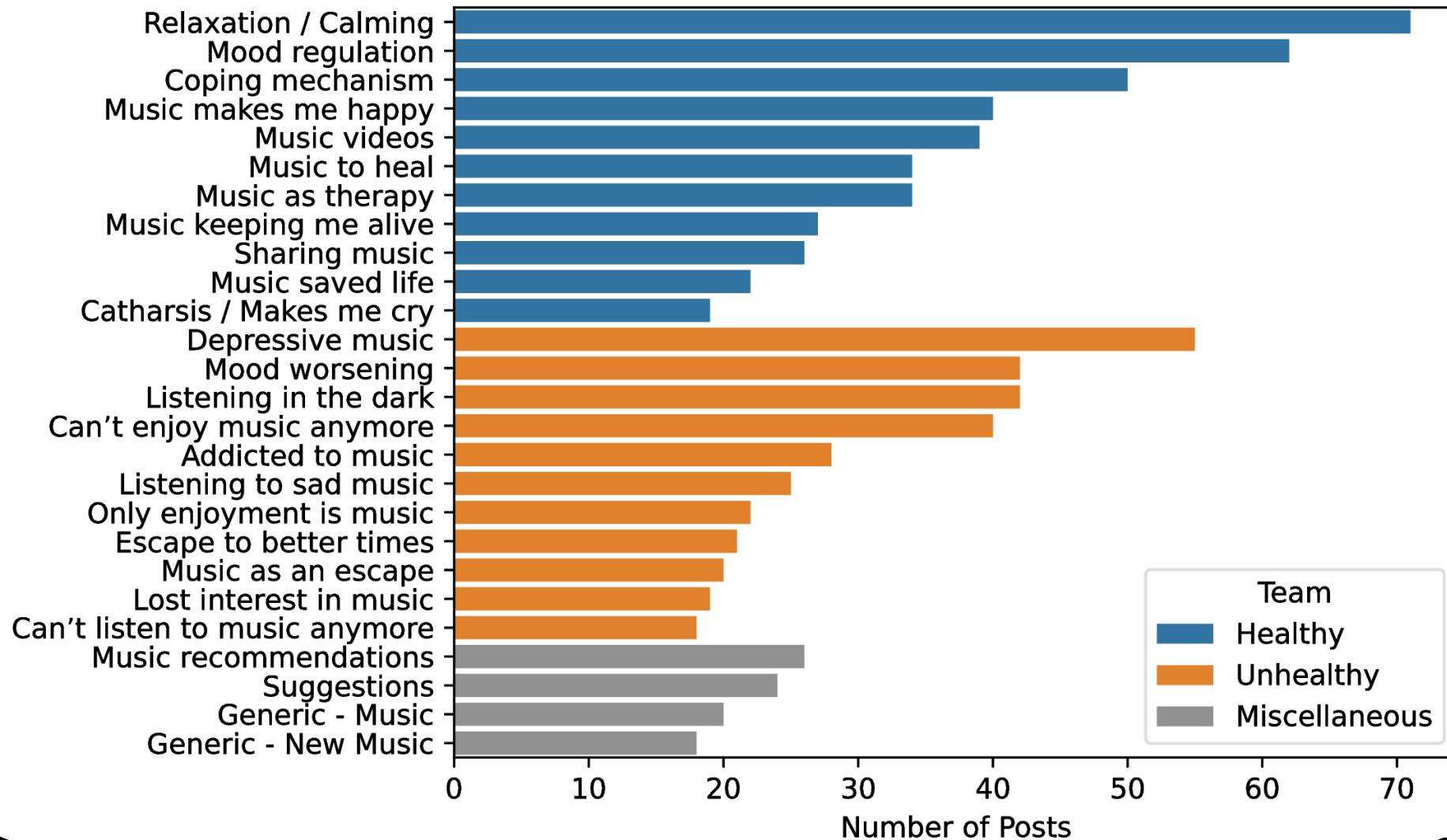
I tried to keep with instrumental, as it makes it easier to just listen on repeat without paying attention. I hope these help.

War Makes Men Mad: <https://www.youtube.com/watch?v=4pWz5007HxM>

Morphogenetic Sorrow: <https://www.youtube.com/watch?v=qbZuu66tWEs>

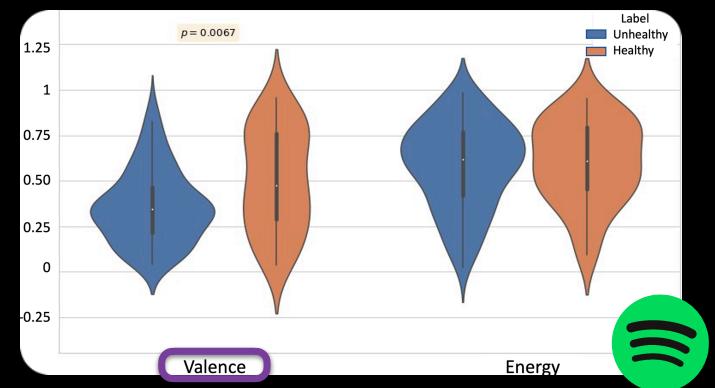
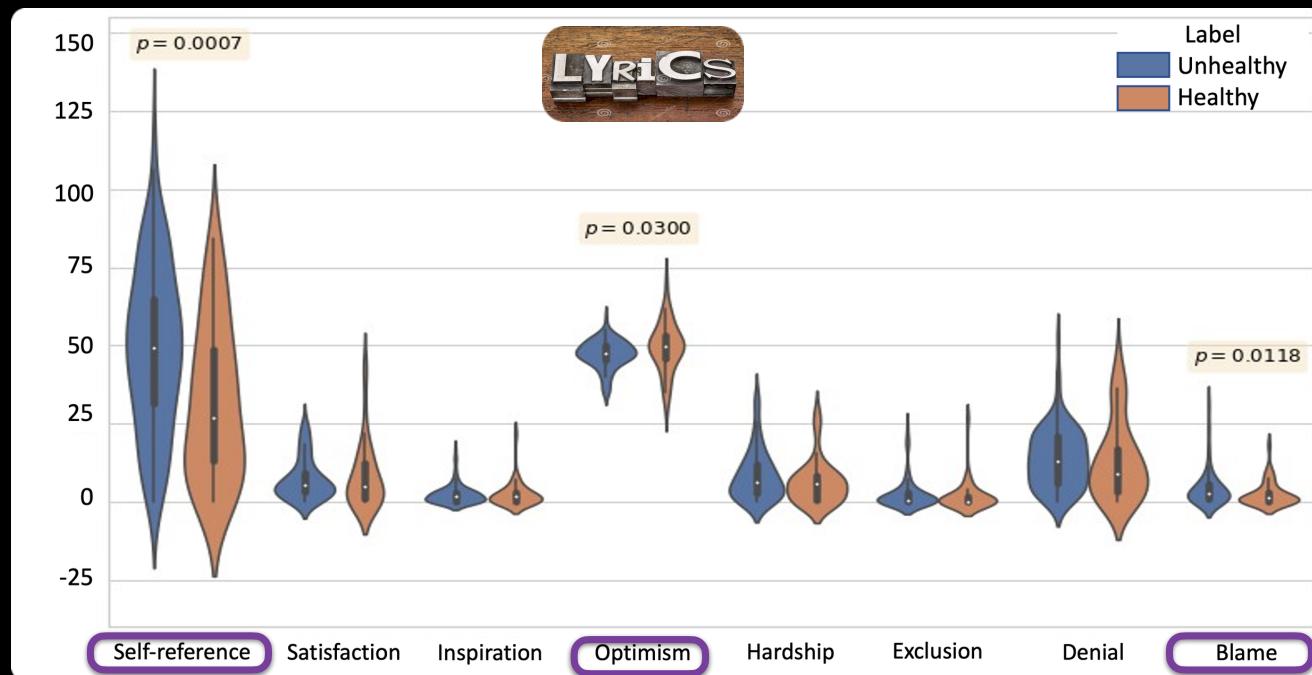
2788 posts







Online Discourse





Online Discourse



Chinmay
Pateria

obsession
enslavement
dependence
addict abuse mania
craving

addict abuse

music

habit weakness
tendency
compulsion

Binge-Listening?

Analyse • Visualise • Download



MUSE IT

Welcome to Muse-it, your gateway to exploring and visualising your Reddit music data. Dive into insightful analyses and seamlessly download CSV files for research purposes.



[Search Reddit](#)



[Visualise your Reddit data](#)





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Agrawala



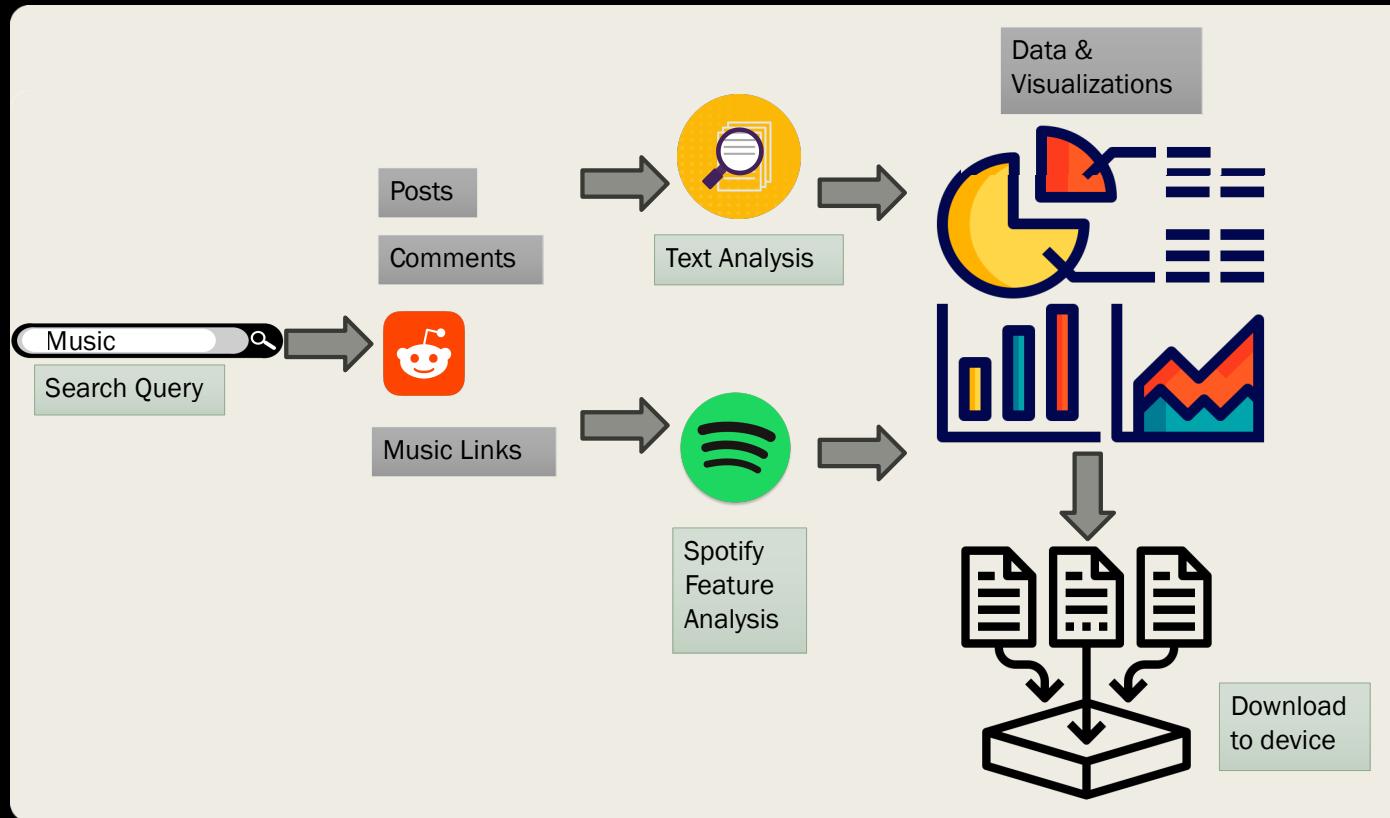
George
Paul



Harsha
Nemani



Muse-it



Online Music Consumption Patterns & Individual Differences/Well-Being



Lalit
Mohan



Sriharsha
MSS



Pavani
Chowdary



Atharva
Gogate

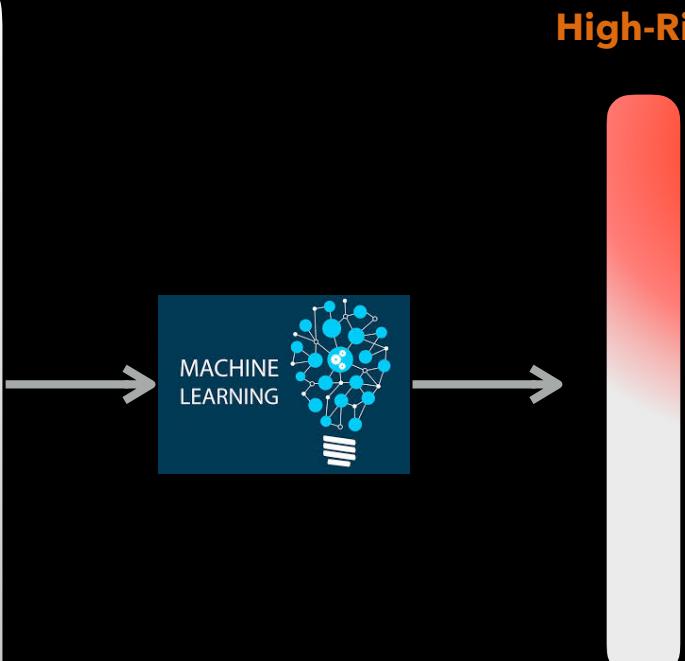
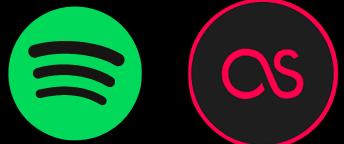


Ashvin Vinod
Kaimal



Jatin
Agrawala

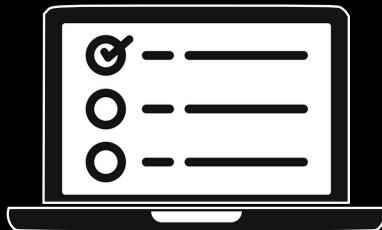
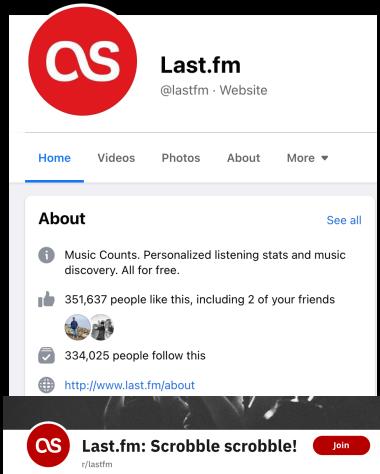
Music Consumption Patterns & Well-Being



Datasets



~600 users



- Kessler's Psychological Distress Scale (K10)
- Healthy-Unhealthy Music Scale
- Personality
- last.fm user name



- **At-Risk** individuals prefer songs with
 - topics
 - high in *Self-reference, Denial, Blame*



- prefer songs with lyrics associated with low valence and low arousal

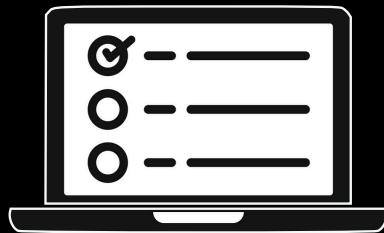




Datasets



~650 users



- Kessler's Psychological Distress Scale (K10)
- Healthy-Unhealthy Music Scale
- Empathy (IRI)
- Highly Sensitive Person Scale
- Life Satisfaction
- Perceived Social Support
- Spotify 1-yr history (300)

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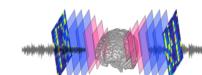
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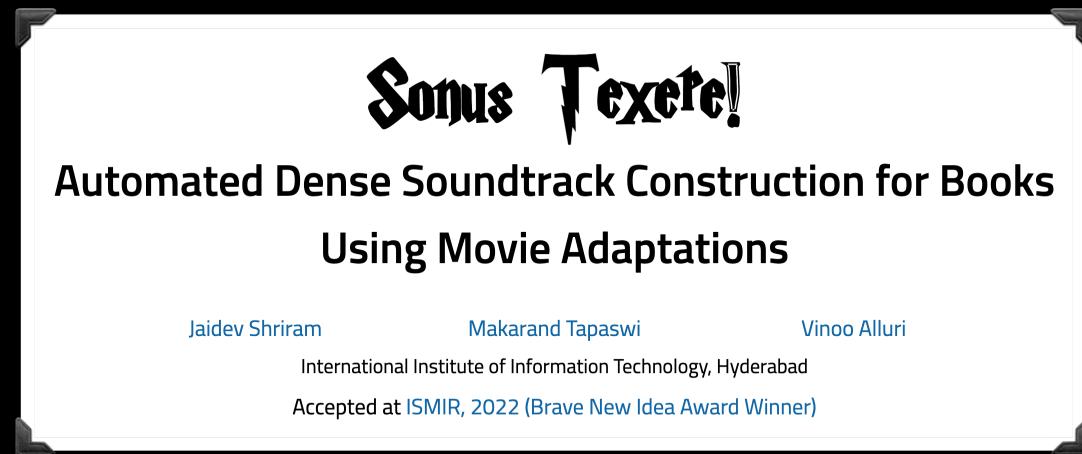
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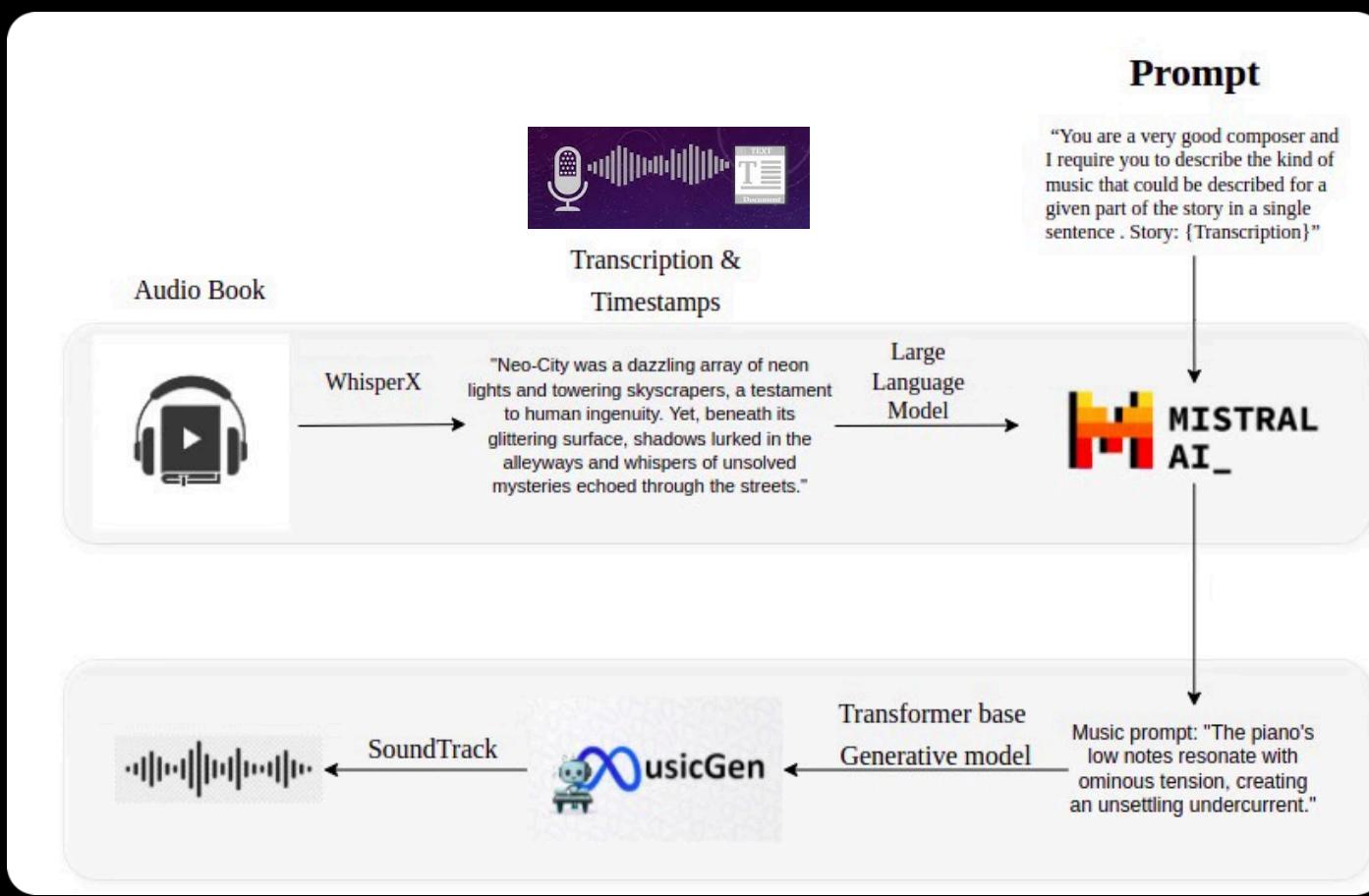


Makarand
Tapaswi

Soundtrack Generation



Soundtrack Generation



Vedansh
Agarwal

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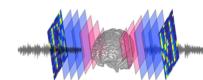
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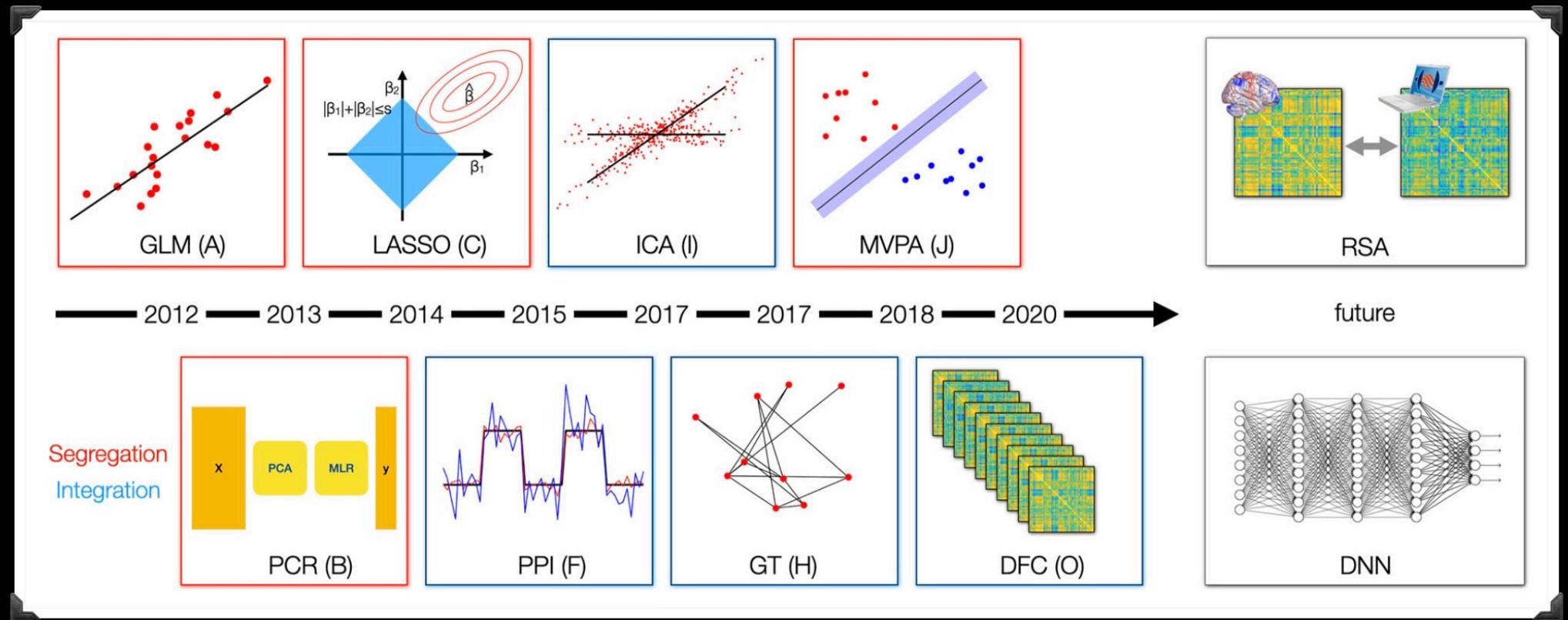


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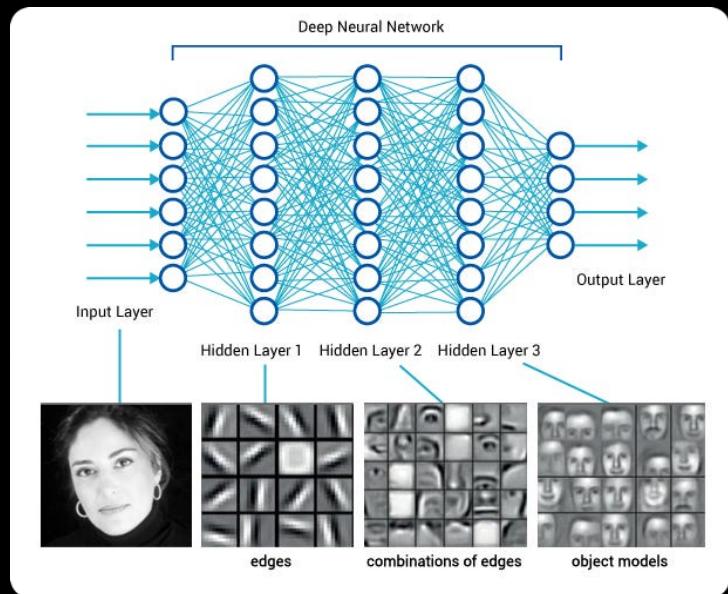
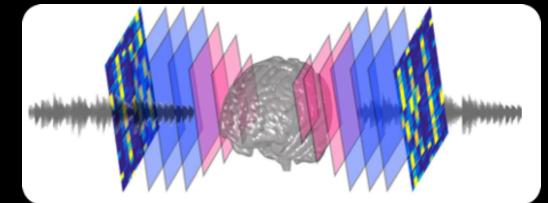
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Hierarchical Representations



Hierarchical Representations

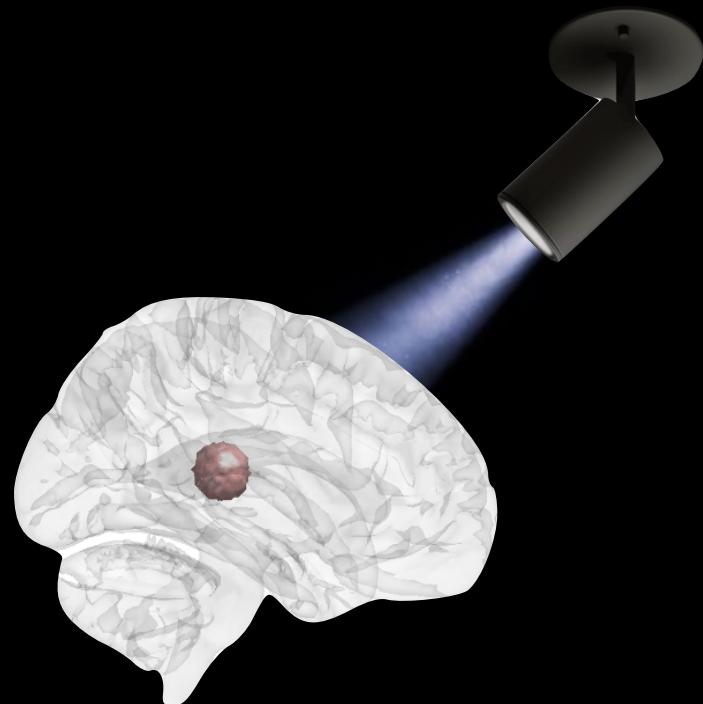
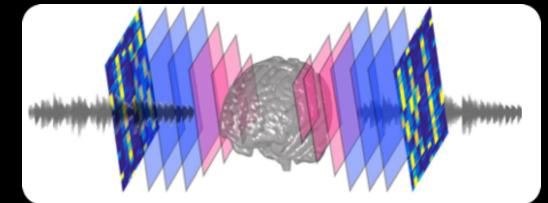


What do
layers of
audio CNNs
encode?

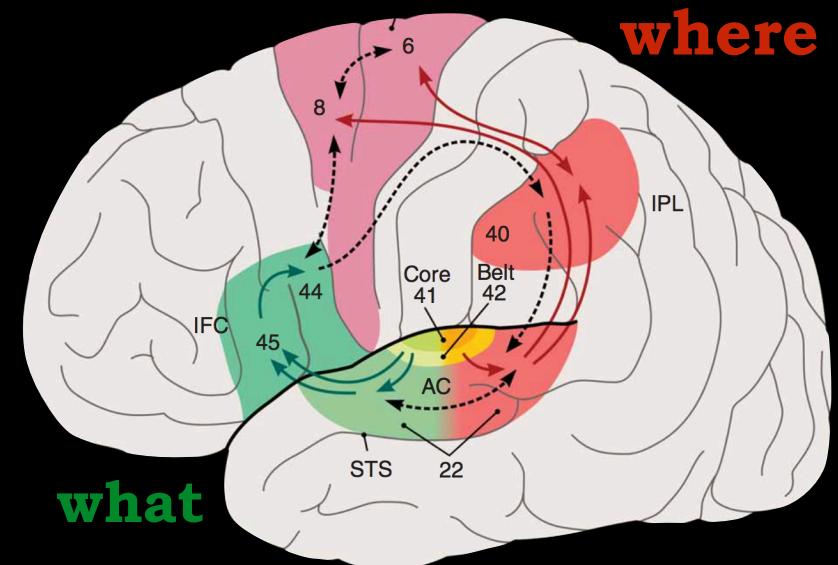


Pratyaksh
Gautam

Hierarchical Representations



Sai Deekshit



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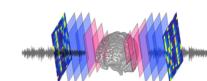
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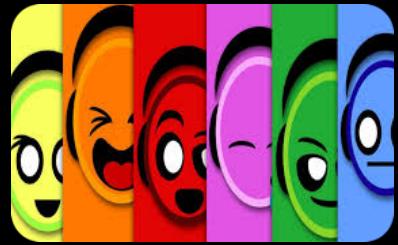
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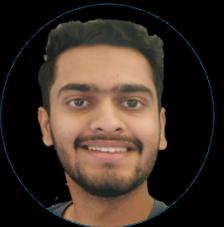
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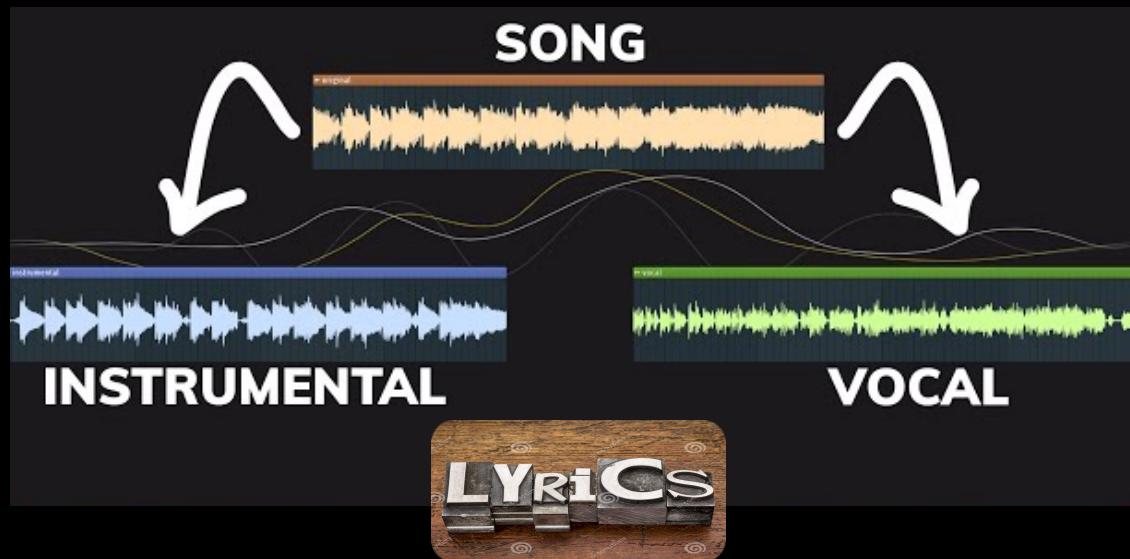




Music & Emotions



Aditya
Raghuvanshi



Evolution of Genres



Arghya Roy

- understanding evolution of music genres through
 - acoustic features
 - social and historical factors

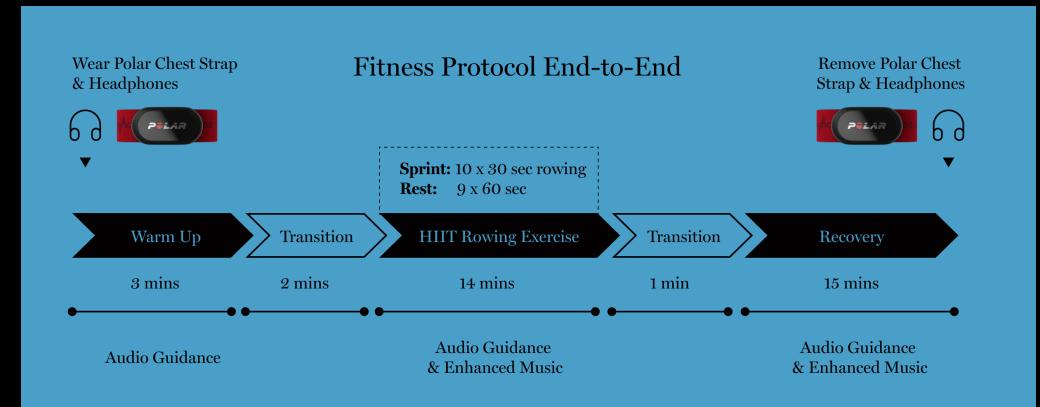


Fitness



Dipansh
Giridhar

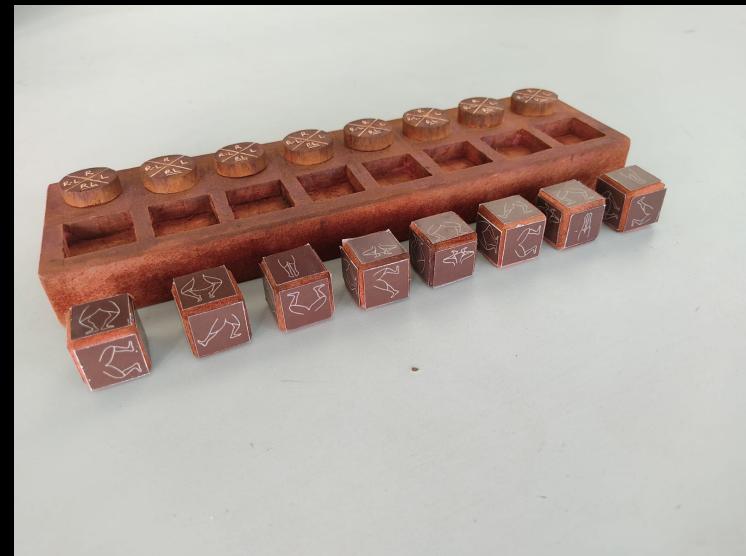
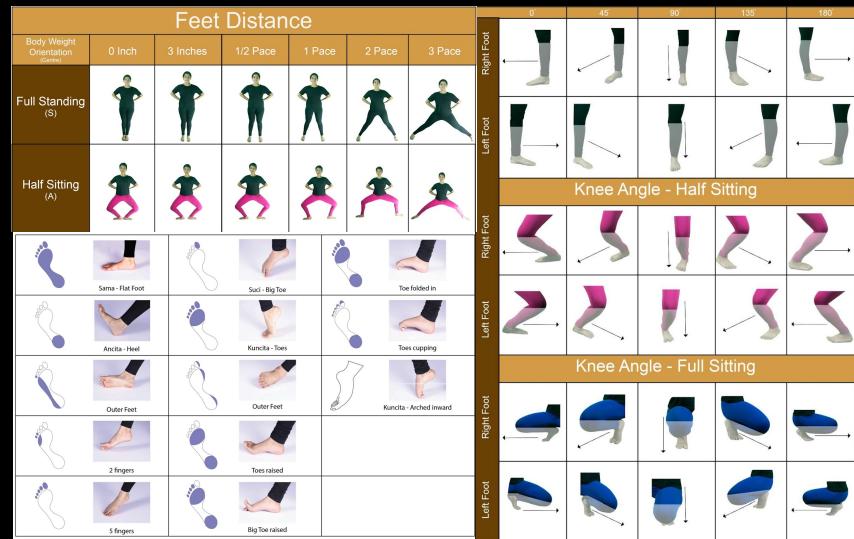
soundBrilliance™



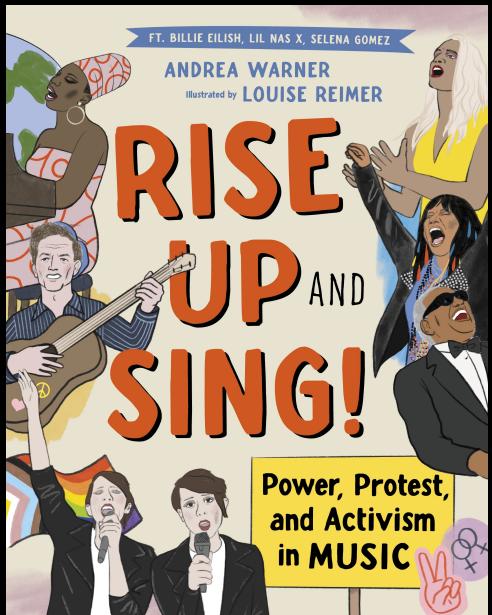
Dance Grammar



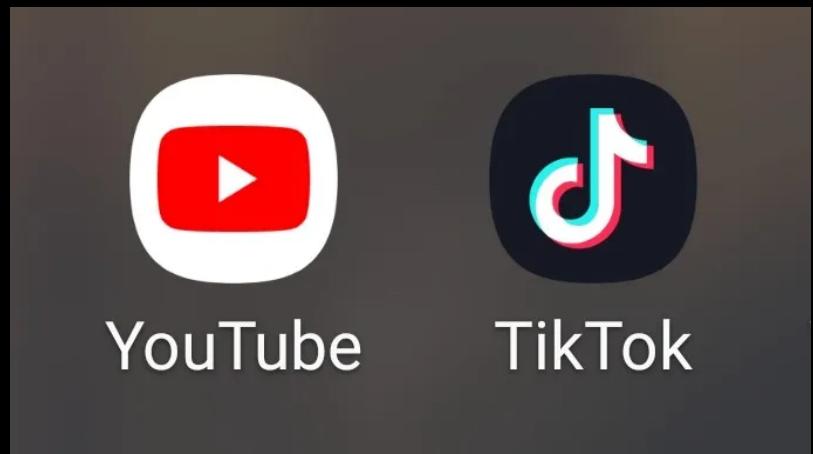
Jayachandran
Surendran



Protest Music



Viral Music



Why do we use music?

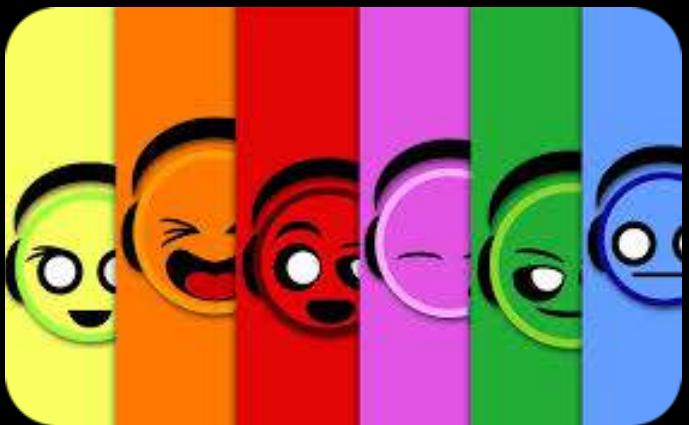
What effect does music have on us?

What determines these effects?

why do we use music?



what effect does it have on us?



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)



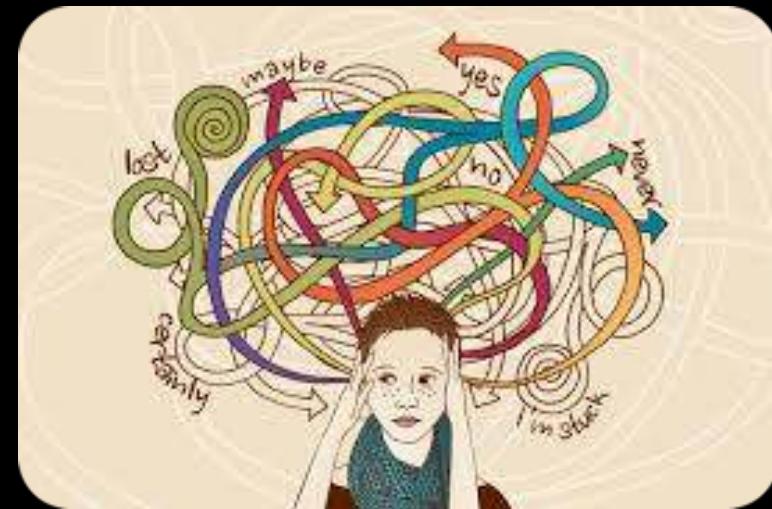
social bonding, prosocial behaviour

(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)



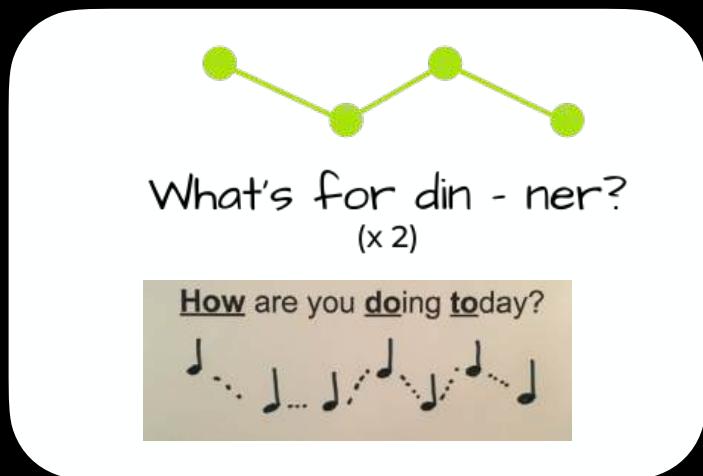
music improvisational therapy

(Street et al., 2020)



gait in parkinson's

(Ashoori et al., 2015)



melodic intonation therapy for speech recovery

(Norton et al., 2009)

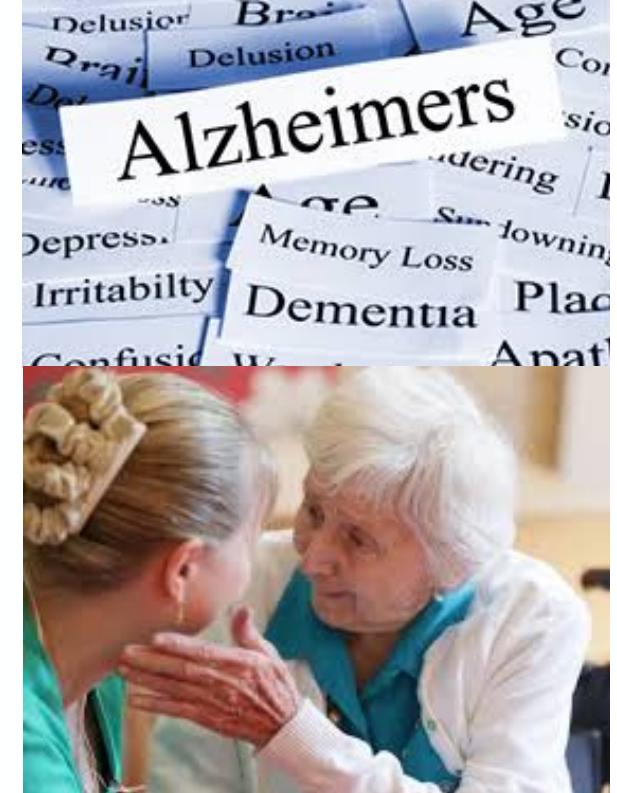


enhance autobiographical recall

(Baird & Samson, 2015)

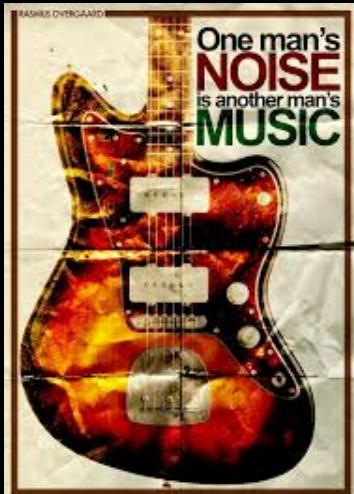
Music in dementia care

- Persons with advanced Alzheimer's disease often retain their ability to perceive and respond emotionally to music, recognise familiar songs, and recall familiar lyrics (Cuddy et al., 2005; Drapeau et al., 2009, Johnson et al., 2010; Samson et al., 2009)
 - Listening to pleasant music can have a temporary positive effect on mood and cognitive functioning in persons with dementia (Cacciafesta et al., 2010; Irish et al., 2006, Thompson et al., 2005)
 - Cognitively **stimulating musical hobbies** (eg: playing a musical instrument, dancing) are associated with better mental health, executive functioning, and working memory and with a **reduced risk of developing dementia** in healthy older patients (Bugos et al., 2007; Cohen et al., 2006, Kattenstroth et al., 2010; Skingley & Bungay 2010)



one of the things in common.....

preference



familiarity

PLOS ONE

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Music and Emotions in the Brain: Familiarity Matters

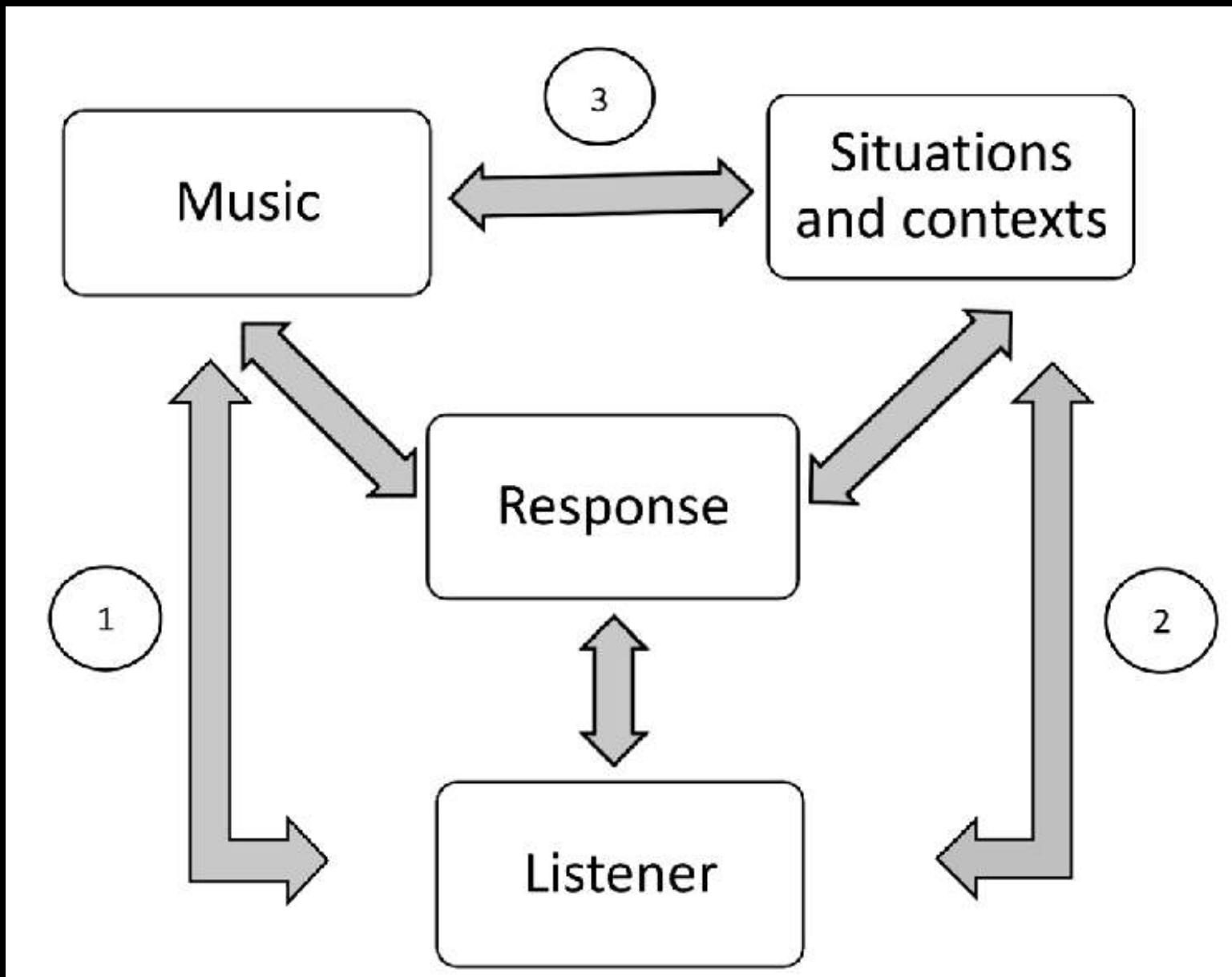
Carlos Silva Pereira, João Teixeira, Patrícia Figueiredo, João Xavier, São Luís Castro, Elvira Brattico

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

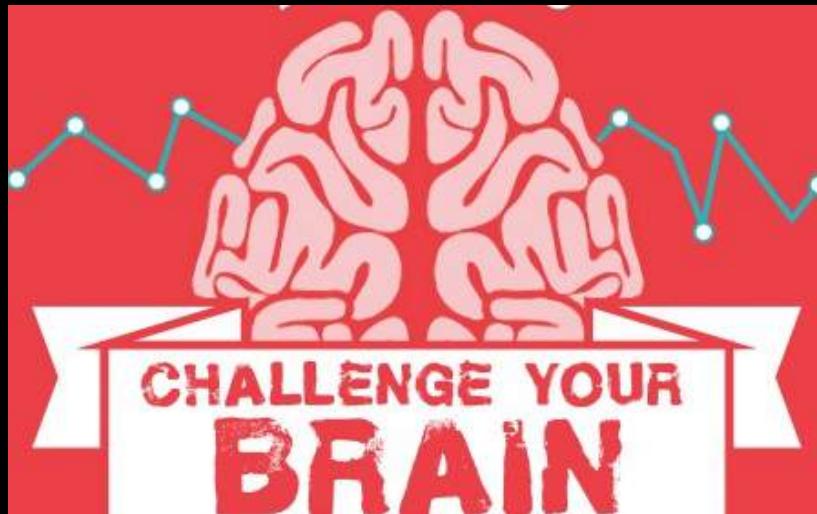


what factors determine these responses?

Musical Experience



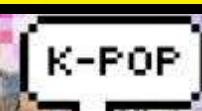
Musical Complexity & Preference



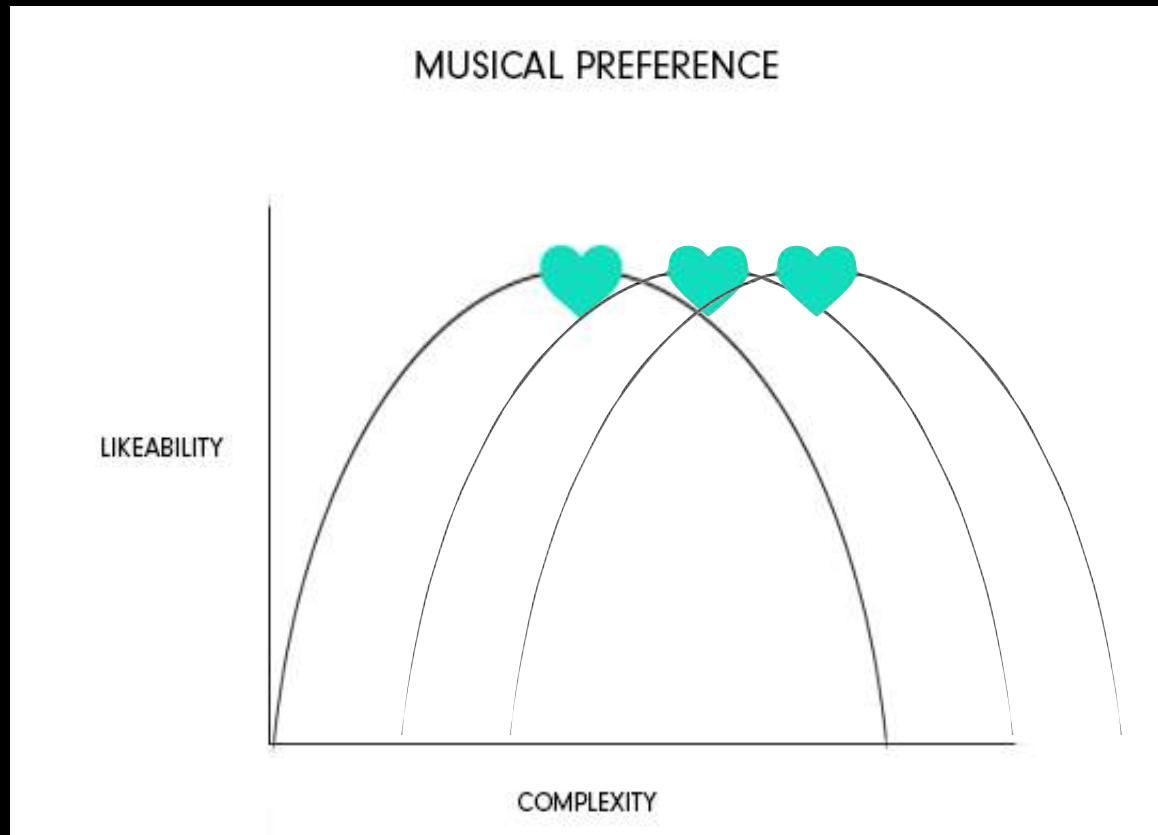
What determines complexity in music?

complexity vs preference?

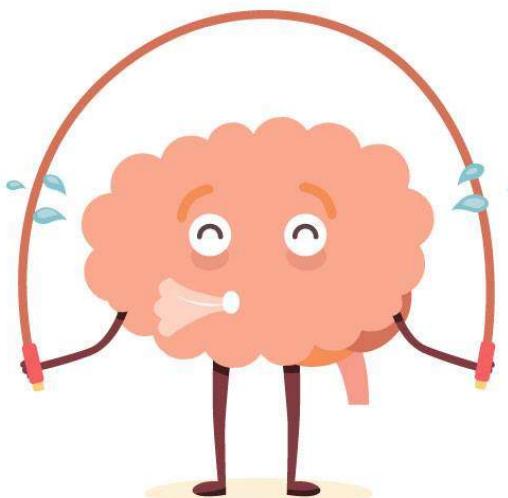
Musical Complexity & Preference



Musical Complexity & Preference



LISTENING TO MUSIC IS A WAY TO
EXERCISE THE BRAIN !

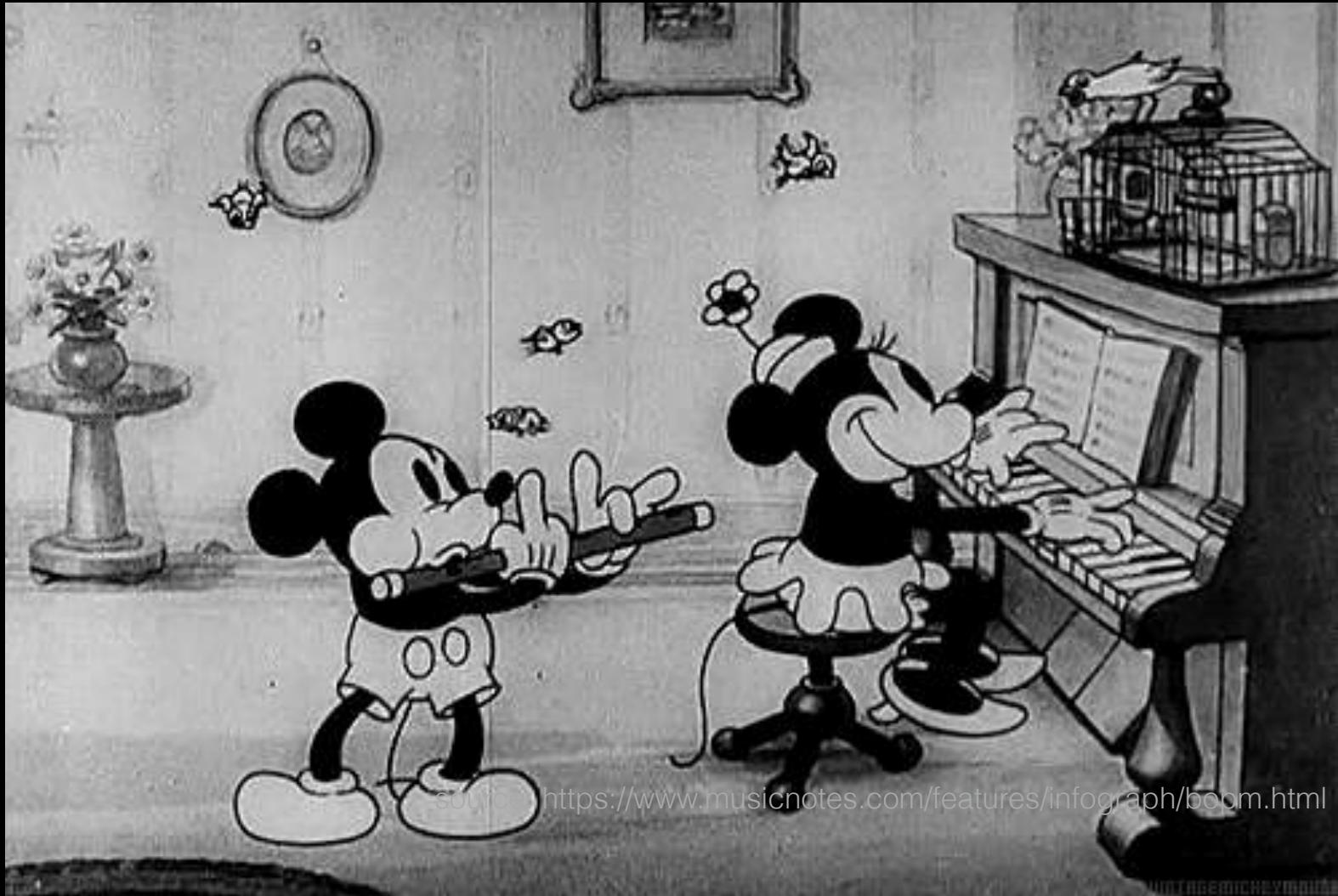


music making?

attention
listen

working memory
synchronise

adapt
planning
emote



transfer effects?



Does **music listening** help improve non-musical abilities?

BBC (2013)

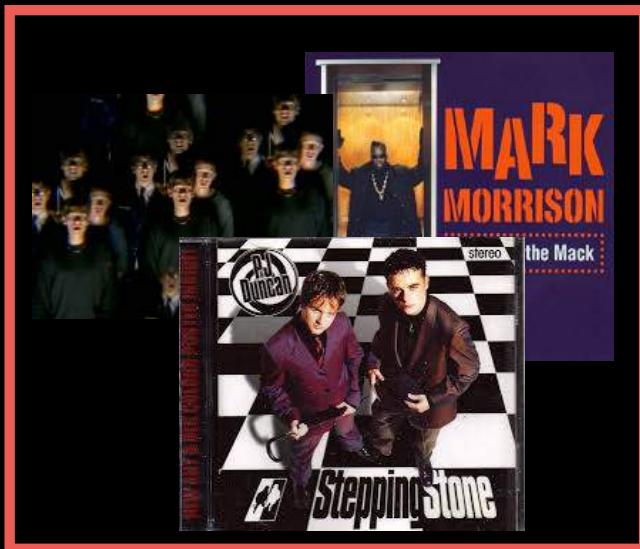


Does listening to Mozart really boost your brainpower?



Cognitive (transfer) effects

8120 children
10-11 year olds



10 mins

“there is no merit to the claim of a link between listening to music composed by Mozart to the exclusion of music by other composers”

Schellenberg EG, Hallam S (2005) Music listening and cognitive abilities in 10- and 11-year-olds: the Blur effect. Ann NY Acad Sci 1060:202–209.

Cognitive (transfer) effects

- creativity in Japanese 5 year olds
(Schellenberg et al., 2005)



Sang Familiar
songs

“familiarity and liking matters”

Transfer Effects of Musical Training

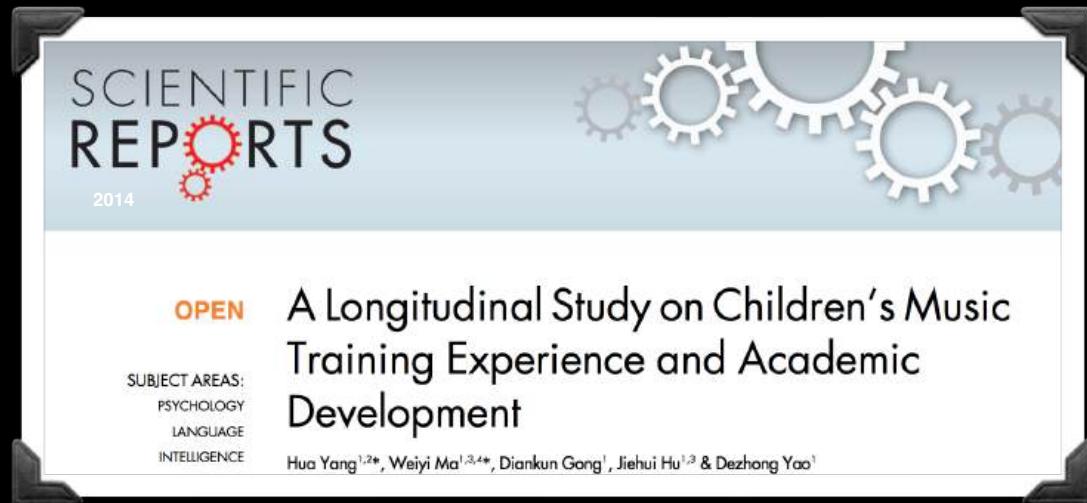


“evidence of reviewed studies seems suggestive of mild to moderate beneficial effects (some mixed results)”

Why some mixed results?

- duration of instruction (short-term)
- type of instruction
- sample size & heterogeneity
- attrition
- how long is “**long**” ?

Transfer Effects of Musical Training



250 students

~6 years

45 mins/week

3.5 years



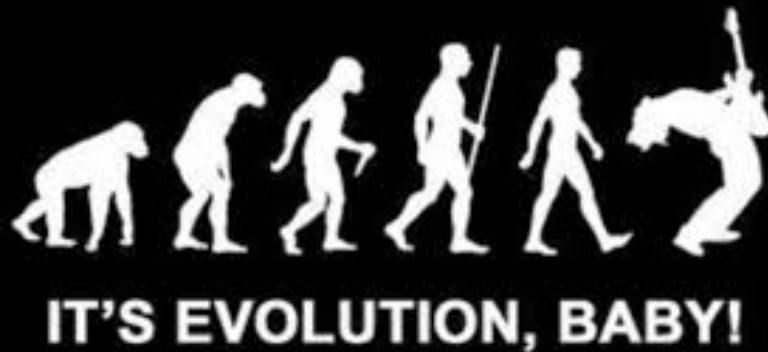
Transfer effects

The
Guardian

How to improve the school results: not extra maths but music, loads of it



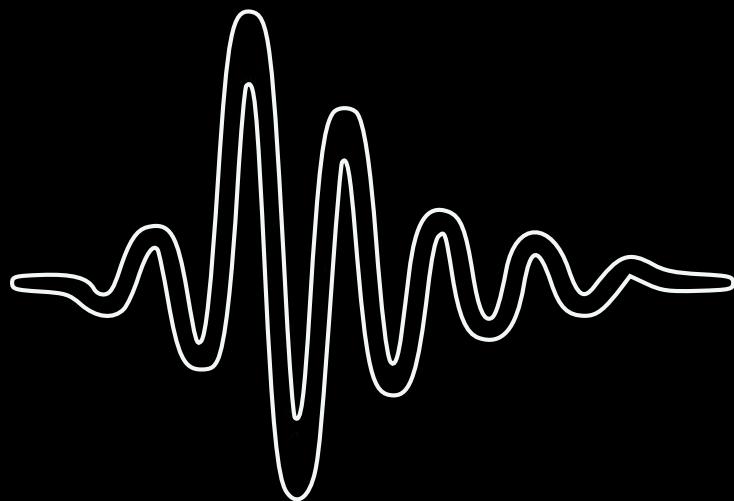
Evolutionary origin of music?



biologically useful? survival value?

a side effect of other evolutionary or cultural processes?

Music as a (Sound) Signal



primitive sounds and instruments?

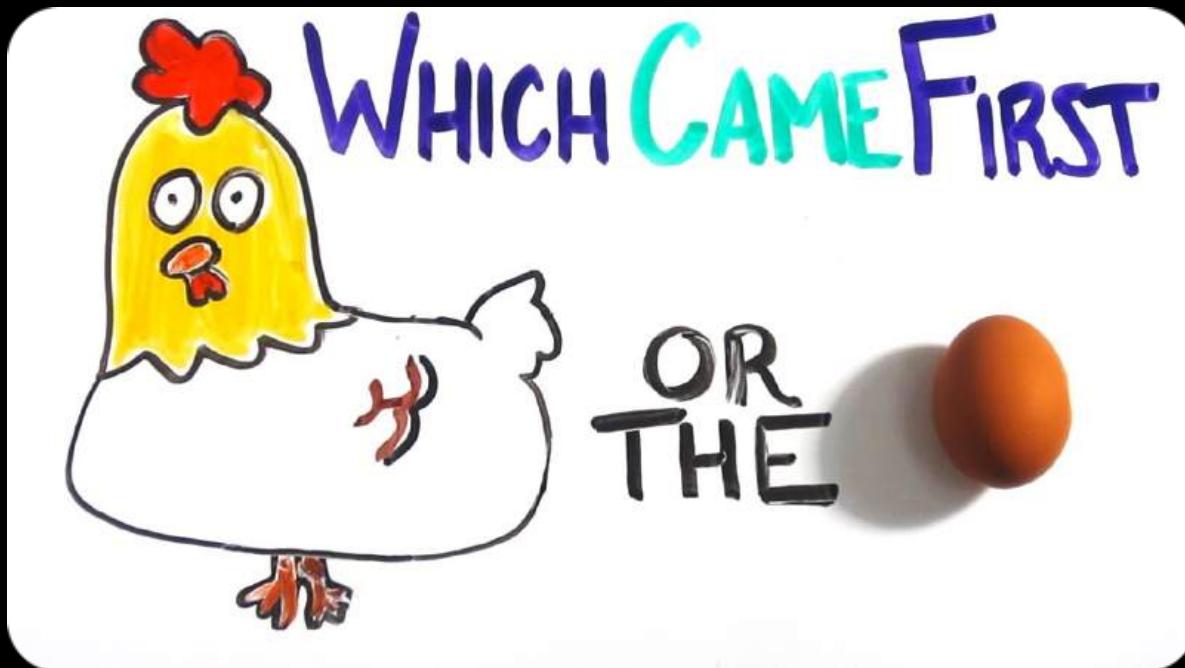


~42,000
years old

Survival benefit?



Language or Music?



wordless courtship songs predated our linguistic abilities, and that such singing provided the scaffolding upon which language itself evolved

DARWIN





TEDxPenn

Prof. Daniel Everett



music's benefits were primarily reproductive and best explained by the same sexual selection processes that shaped birdsong.

wordless courtship songs predated our linguistic abilities, and that such singing provided the scaffolding upon which language itself evolved

DARWIN - 1871



human musicality as a fortuitous
byproduct of how our minds work

a “mere incidental peculiarity of the
nervous system... of no
teleological* significance.”

James - 1871

*teleology = study of ends and purposes



I suspect music is auditory cheesecake, an exquisite confection crafted to tickle the sensitive spots of... our mental faculties.

As far as biological cause and effect are concerned, music is useless

Steven Pinker (1997)

“music takes advantage of pre-evolved faculties for language, pattern recognition, and emotion, but that it is an evolutionary byproduct—a happy accident”



music constitutes a medium that is well suited to demonstrate the “protean,” unpredictable and creative, properties of an individual, properties that are selectively advantageous and hence desirable in the determination of mate-choice

Miller (1997)



Adaptationist theories

- the function of music was to attract sexual mates (Darwin)
 - However, unlike other sexually selected traits, music is not sexually dimorphic, meaning that there are no differences between the musical abilities of men and women
 - Signalling more general fitness?



Adaptationist theories (2)

- Music fosters group cohesion, cooperation and social bonding
 - In other primates, social bonds are formed and maintained through grooming, but around the emergence of *Homo erectus* social groups became too large for grooming to be viable
 - ➔ Language and music (or a common precursor of the two) evolved to perform this function (Dunbar, 1996; Huron, 2001)

Adaptationist theories



sexual selection



motherese
“baby talk”



group cohesion
“social glue”

Adaptationist theories



“sharing emotional states/intentionality”
“song and dance - release of endorphins and promote social bonding”

Patel, A (2010). Music, biological evolution, and the brain
Levander & C. Henry (Eds.), Emerging Disciplines, Rice University Press

Exceptions?



Tsimane (Bolivian tribe) - *little to no collective music-making*
- singing by shamans or other older adults whose songs
conveyed traditional knowledge, reinforced cultural norms, and
propitiated ancestors and the guardian spirits of forest animals

Patel, Rudden (2021). Where they sing solo: Accounting for cross-cultural variation in collective music-making in theories of music evolution

Exceptions?



- researchers played certain notes of different frequencies and asked them to match this to the same note in a different octave.

“One of the tasks they got was to sing back an interval an octave lower, for example. Whereas people who have been exposed to octave-based music could do this quite easily, it was much harder for the Tsimane. ”

Jacoby et al., (2019).Universal and Non-universal Features of Musical Pitch Perception Revealed by Singing. *Current Biology*

Exceptions?

youtube: Universal and Non-universal Features of Musical Pitch Perception Revealed by Singing

<https://www.youtube.com/watch?v=8SKa2cIVq3g&t=1s>

Musicality?

Music?

octave equivalence is a
culturally learned
construct!

Exceptions?



- researchers played certain notes of different frequencies and asked them to match this to the same note in a different octave.

“One of the tasks they got was to sing back an interval an octave lower, for example. Whereas people who have been exposed to octave-based music could do this quite easily, it was much harder for the Tsimane. ”

Jacoby et al., (2019).Universal and Non-universal Features of Musical Pitch Perception Revealed by Singing. *Current Biology*

Non-adaptationist view

“a human invention that can have lasting effects on such nonmusical brain functions as language, attention, and executive function, and is concerned with explaining the biological mechanisms underlying these effects”

“music resembles *control of fire* in being an ancient invention that has become universal because it provides things that are universally valued by humans”

“the valued things it provides are mental rather than physical: namely emotional power, ritual efficacy, and mnemonic efficacy ”

- *Aniruddh Patel (2010)*

Non-adaptationist view

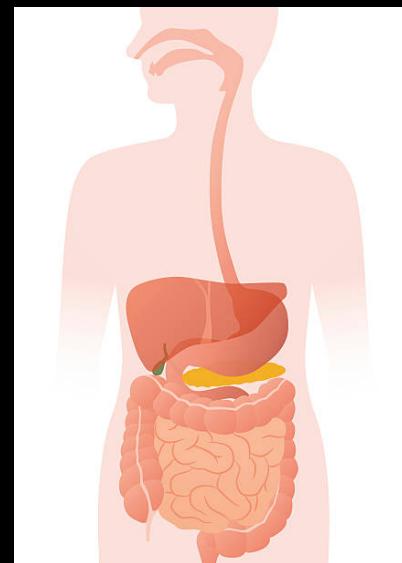


8605399670



Non-Adaptationist or Adaptationist view: Gene-culture coevolution

gene-culture coevolution entails the idea that purely cultural inventions can lead to heritable genetic changes



Non-Adaptationist or Adaptationist view: Gene-culture coevolution

While gene-culture coevolution is largely an adaptationist framework because it focuses on selection and fitness advantages, it also acknowledges non-adaptationist dynamics, especially when considering cultural transmission mechanisms that do not map directly onto genetic adaptation.

why music?

Non-Adaptationist or Adaptationist view: Gene-culture coevolution

engaging in musical activities provided pleasure and things
that are universally valued by humans

intrinsic reward for predicting (ex: beat perception &
synchronization - BPS)

intrinsic reward via synchronisation with others (ex:social
bonding, signalling coalition strength to other groups)

Patel, A (2021). Human musicality and gene-culture coevolution:
Ten concepts to guide productive exploration. In: E.H. Margulis, D. Loughridge, & P. Loui (Eds.) The
Science-Music Borderlands: Reckoning with the Past, Imagining the Future (MIT Press)



vocalisations = music?

musicality lies in listening or production?

music = organised sound

musicality - a natural, spontaneously developing set of traits that are based on and constrained by cognitive abilities and its underlying biology

music: a social and cultural construct that is based on **musicality**

music is in the mind of the listener/beholder”

musicality

eg: recognise and appreciate melodies (even when transposed) and rhythms. These rely on abilities to recognise **relative pitch** and perceiving beat or **beat induction**

relative pitch and **beat induction**

form the basis of music and musicality
(Honing, 2022)

are these abilities innate?
do other closely related species exhibit it?

Musical Aptitude/Ability - a biological trait

- new born babies have brain responses similar to adults if you omit the note on the down beat
- results strongly support the view that beat perception is innate
- infants (5-24 months) engage in significantly more rhythmic movement to music and other rhythmically regular sounds than to speech
- infants exhibit tempo flexibility to some extent (e.g., faster auditory tempo is associated with faster movement tempo)

Vocal Learning Hypothesis

—>***vocal learning hypothesis***: vocal learning prerequisite for beat perception



“Snowball most likely dances to the music for social reasons and is not motivated by food or mating behaviour” - Patel, 2019

But....?



—>sea lions are not vocal learners/cannot imitate - some may have limited vocal learning abilities?

what do humans share with cockatoos and sea lions that we do not share with monkeys?

Revised VL hypothesis

- parrots and humans are the only animals to do spontaneous beat processing to music, and share unusually complex vocal learning brain systems and abilities (Patel, 2021)
- this system provides intrinsic rewards for predicting patterns in sound sequences
- intrinsically motivated to predict what comes next : scaffold for *statistical learning*

Music, biological evolution, and the brain

“rather than a by-product of evolution, music or more precisely musicality is likely to be a characteristic that survived natural selection in order to stimulate and develop our mental faculties”

— Honing (2013)

Musical Aptitude/Ability or Musicality

- biologically based spontaneously developing skill (like language) constrained by our biological and cognitive systems
- need not be related to special musical talent
- widely shared human capability
- a multifaceted cognitive skill that encompasses aspects of implicit learning, temporal processing, sensorimotor synchronization, and the role of expectation in music perception

— Honing (2020)

Genes x Environment

Genes affecting inner ear development, dopaminergic systems, learning, and memory were found as candidate genes for musical aptitude, listening to and performing music

MOZART: THE GENETIC SECRET



Mozart is a typical example of a talented composer whose family was musical. There are a lot of families in our days that have several professional musicians, so part of the musical talent is explained by the genes but of course also to exposure to music.

It's like an allergy; the risk for an allergy is only expressed when the pollen is coming, so you need this environmental trigger. And music is an excellent environmental trigger. Children who have an ability for music have to be exposed to music, otherwise we don't know whether they can become musicians. So a rich musical environment is of course needed.

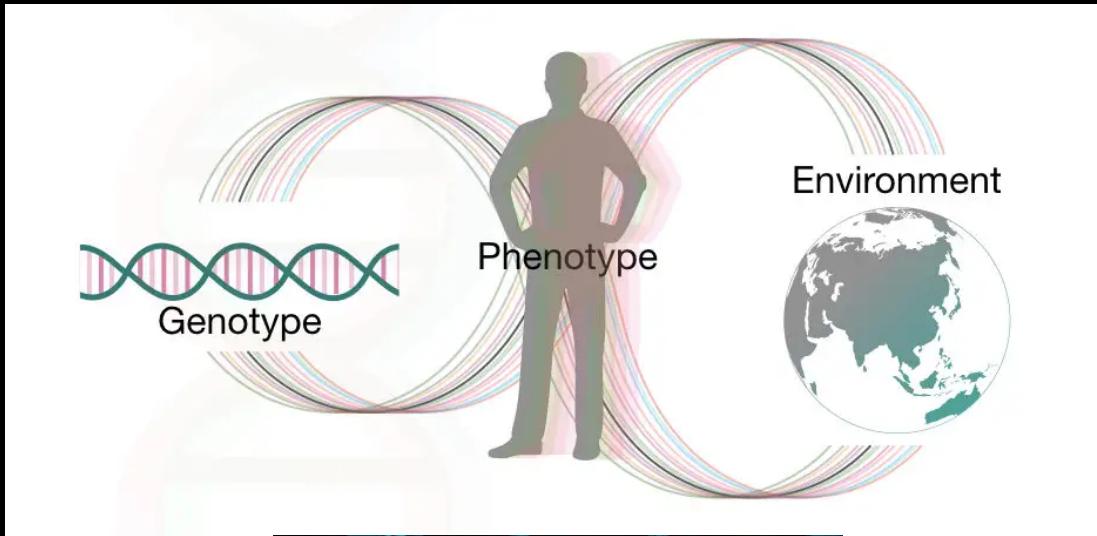
Beat Perception & Synchronization

BPS is a complex or “polygenic” trait, in which many common genetic variants weakly influence the trait, rather than a “Mendelian” trait strongly influenced by variation at a single gene

genetic variance explained only about 13-16% of phenotypic variance in the ability to clap in time to a musical beat, indicating that variance in BPS ability is genetically influenced but far from genetically determined

Niarchou et al., (2021); Patel (2021) Human musicality and gene-culture coevolution: Ten concepts to guide productive exploration. In: E.H. Margulis, D. Loughridge, & P. Loui (Eds.) The Science-Music Borderlands: Reckoning with the Past, Imagining the Future (MIT Press)

Musicality





E-CONFERENCES TO BRIDGE PHYSICAL & INTERDISCIPLINARY GAPS

SOCIAL BRIDGES

DO-RE-MI DNA:
THE BIOLOGICAL BASES OF MUSIC
19 - 20 January, 2022



Max Planck Institute
for Empirical Aesthetics



https://youtu.be/wAs8P_iZxLs?feature=shared

being unmusical?

amusia: tone-deafness, difficulty in processing pitch differences, eg: cannot differentiate between two different melodies
1-2% of American/Western population

prevalence in India?

being unmusical?

musical anhedonia: *neurological* condition characterised by an inability to derive pleasure from music

individuals have a low degree of neural coupling between auditory processing and reward regions of the brain (Martínez-Molina et al., 2016; Loui et al., 2017)

Musical Ability & Appreciation Only limited to humans?

"non-humans also have the potential to experience relaxation or stress in response to music" - Hargreaves & North, 2010



the effect of music versus no music on the cows' readiness to approach an automatic milking system

exposing rats to stress-inducing rock music could reduce their ability to heal wounds

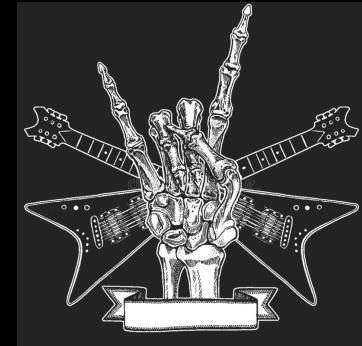


Musical Ability & Appreciation

Only limited to humans?



classical - most
soothing leading
to more time
resting, being
quiet, and less
time standing



heavy metal -
dogs spent more
time barking

Musical Ability & Appreciation

Only limited to humans?

non-humans also have the potential to discriminate between music/silence, musical genres and different versions of *Yesterday* - Hargreaves & North, 2008



But....?

does music improve animal welfare because it masks background noise (or has other second-order effects) or does it work simply because the animals concerned simply enjoy it?

to what extent can the effects of music on animal welfare be attributed to music only: would other (non-copyrighted and therefore cheaper) sounds provide a source of relaxation or stimulation that also improves welfare?

how much music has to be played for it to have a beneficial effect, how loud must this music be, how often does the music have to be changed, and so on? (Indeed, playing the 'wrong' types of music may well explain why Cloutier et al. (2000) and Hodgetts et al. (1998) found no welfare benefits of playing music to piglets and deer respectively.

But....?

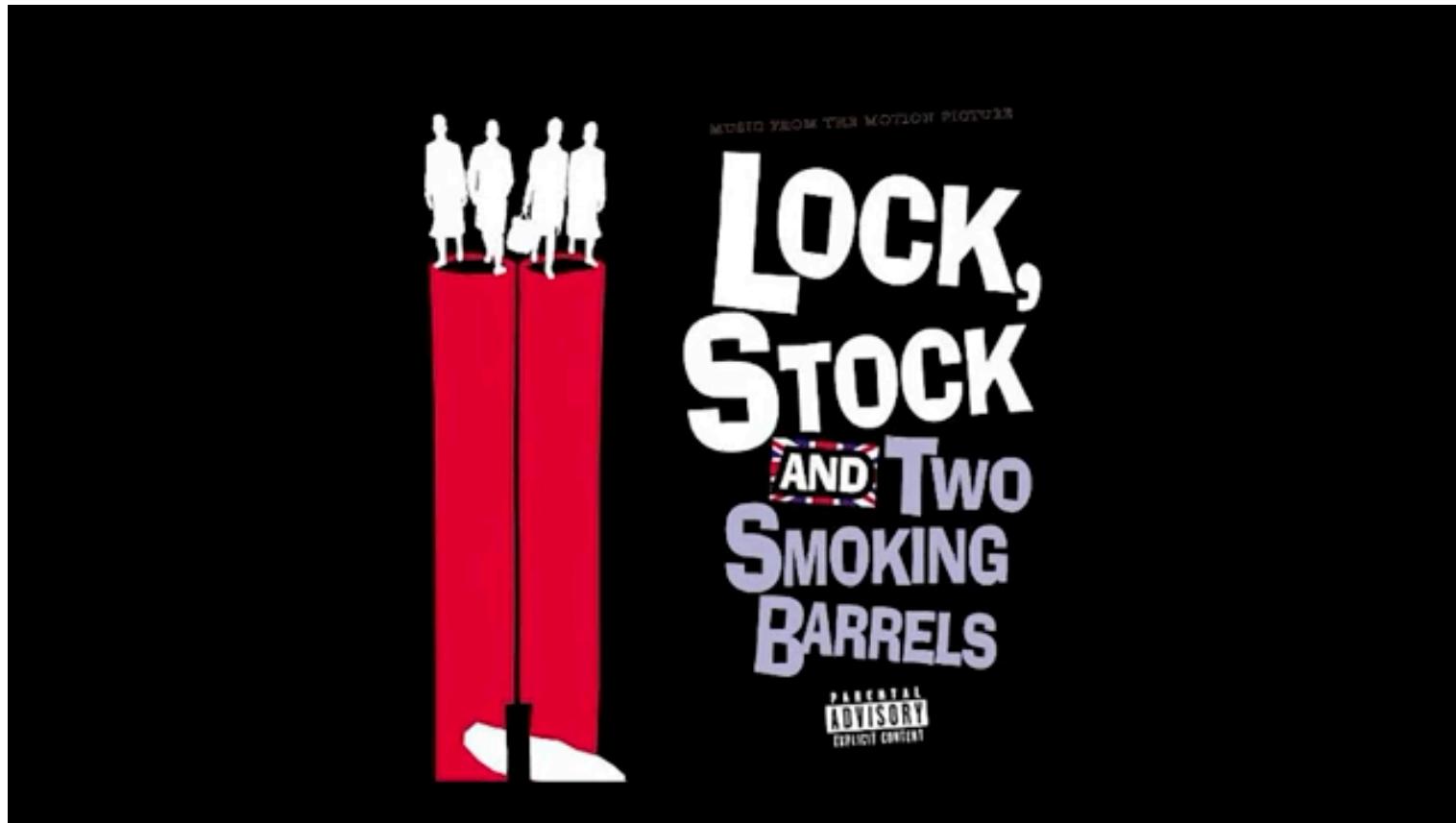
to what extent would research on specifically music support Newberry's (1995) claim that any attempt at environmental enrichment for captive animals must have functional relevance?

although the results are broadly consistent with the ideas concerning human preferences (Konecni).....

it may be a grave mistake to automatically assume that all species should necessarily react similarly to the same music.

eg: simple, repetitive melodies of new age music may relax a relatively unintelligent animal such as a camel, but bore the pants off a relatively intelligent one such as a chimpanzee!

Embodied Music Cognition



Embodied Music Cognition

- sensory-motor experiences shape human consciousness
- corporeal articulation plays an important role in music cognition
- the role of the human body in relation to all musical activities

Embodied Music Cognition



What sort of movements would you imagine for the following examples?



Musical Meter and Music Induced Movement



Rhythmic engagement with music in infancy

Marcel Zentner^{a,1} and Tuomas Eerola^b

^aDepartment of Psychology, University of York, York YO10 5DD, United Kingdom; and ^bFinnish Centre of Excellence in Interdisciplinary Music, University of Jyväskylä, Jyväskylä 40014, Finland

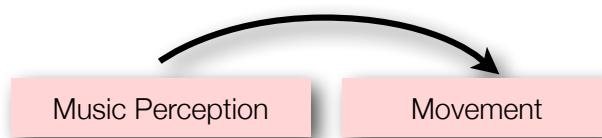
Edited by Dale Purves, Duke University Medical Center, Durham, NC, and approved February 10, 2010 (received for review January 7, 2010)
"Department of Psychology, University of York, York YO10 5DD, United Kingdom; and ^bFinnish Centre of Excellence in Interdisciplinary Music, University of Jyväskylä, Jyväskylä 40014, Finland

Humans have a unique ability to coordinate their motor movements or to an external auditory stimulus, as in music-induced foot tapping or dancing. This behavior currently engages the attention of scholars across a number of disciplines. However, very little is known about its earliest manifestations. The aim of the current research was to

of idiosyncratic factors may lead to striking yet otherwise *st* atypical behavior in single cases, as in a dancing chicken (*at*). The overarching aim of the current research was to examine whether preverbal infants engage actively and spontaneously with rhythmic behavior to music and, if so, how such behavior may be

Music and Movement

- music induces rhythmic movement in infants more efficiently than speech
- people walk faster to music than metronomes (Styns et al. 2007)





Beat? Tempo? Meter? Rhythm?

Beat is the basic rhythmic unit

The tempo is the speed of the **beat**

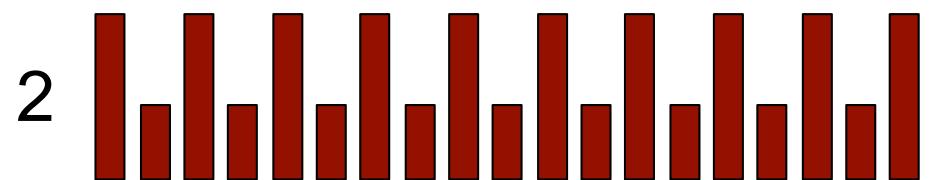
Meter refers to the grouping of both strong and weak **beats** into recurring patterns

Rhythm is music's systematic division in time which may have ever-changing combinations.

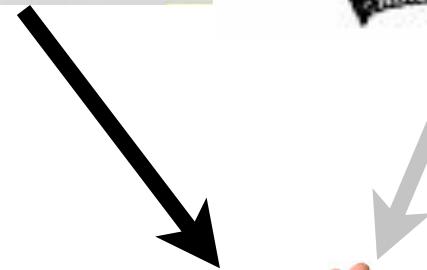
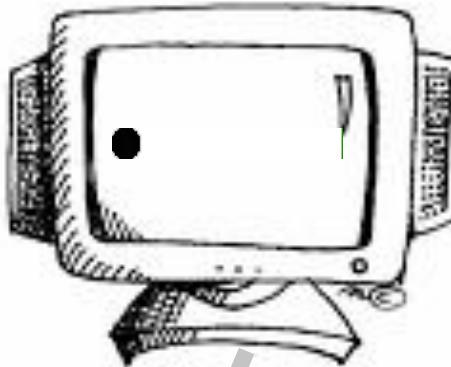
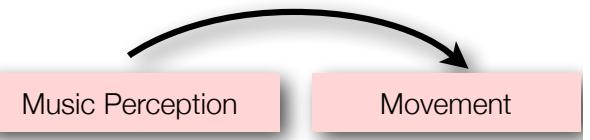


Musical Meter

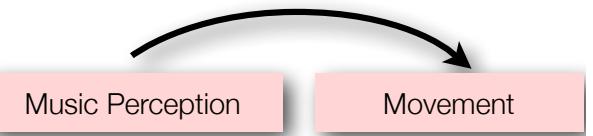
- Music often evokes several beat percepts
 - periods often have integer relationships
- Combination of beats produces meter (hierarchy of beats)



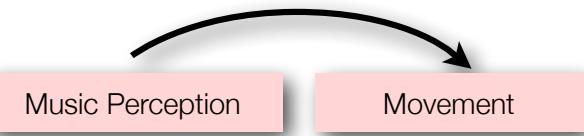
auditory-motor vs. visuo-motor coupling



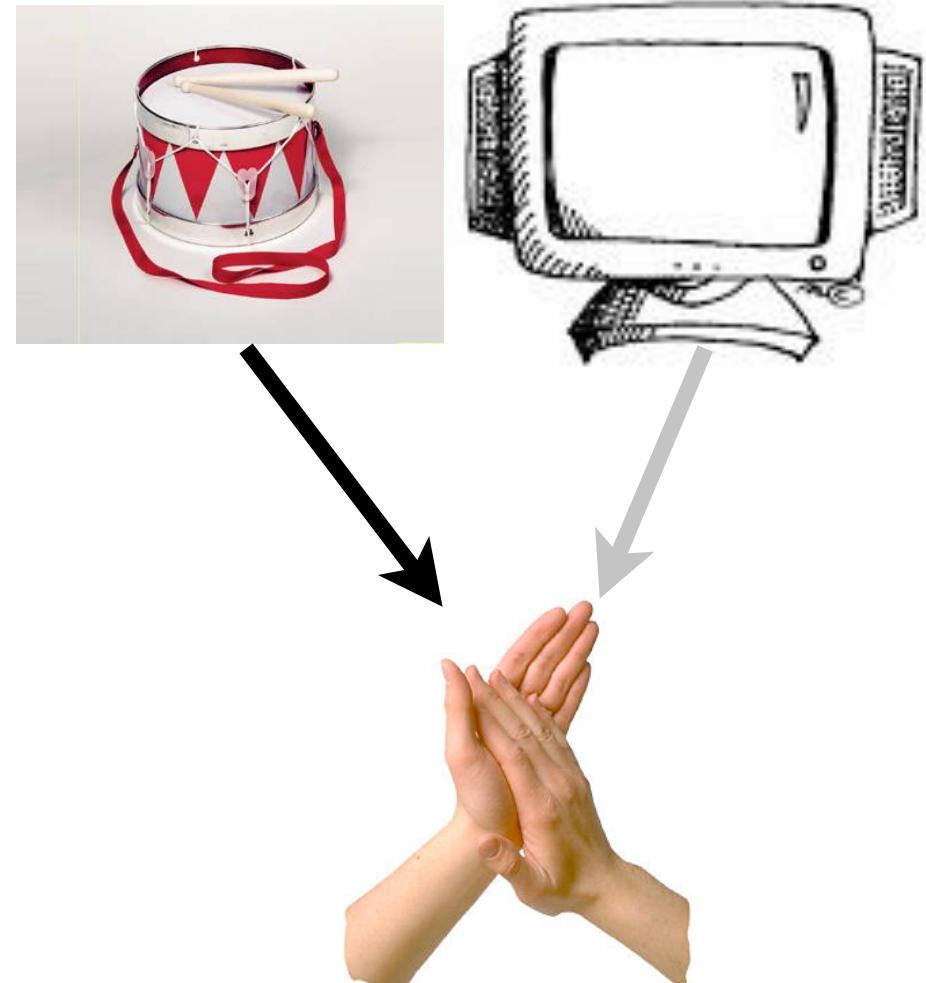
auditory-motor vs. visuo-motor coupling



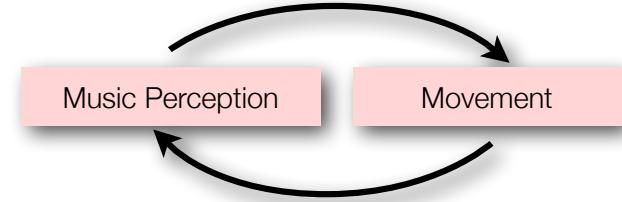
auditory-motor vs. visuo-motor coupling



- **auditory** rhythms evoke rhythmic bodily movement **more efficiently** than visual rhythms (Repp & Penel 2004, Patel et al. 2005)
- beat perception and synchronization have a **special affinity with the auditory system**



preferred tempo & body size



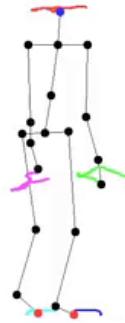
- Preferred tempo correlates with lengths of body segments (Todd et al. 2007)
- Taller people prefer slower tempi



Music and Movement



- moving to music enhances beat perception (Su & popped 2012; Manning & Schultz 2013)
- moving to the beat can alter meter perception (Phillips-Silver & Traitor 2005, 2007, 2008)



what factors determine the way you move to music?

can you predict those factors by analysing the way you move?

Physical Characteristics

- posture
- kinematics

Perceptual Characteristics

- skill
- attractiveness
- emotion

Music Characteristics

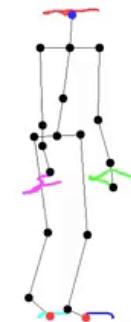
- tempo, metre
- timbre
- tonality
- lyrics

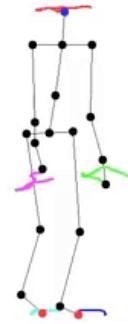
Listener Characteristics

- age
- personality
- mood
- preference
- gender

Cultural Conventions

- genre
- dancing styles





what factors determine the way you move to music?

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Physical Characteristics

- posture
- kinematics

Perceptual Characteristics

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- emotion

Music Characteristics

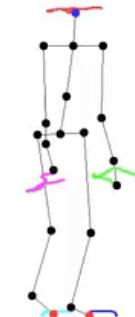
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Listener Characteristics

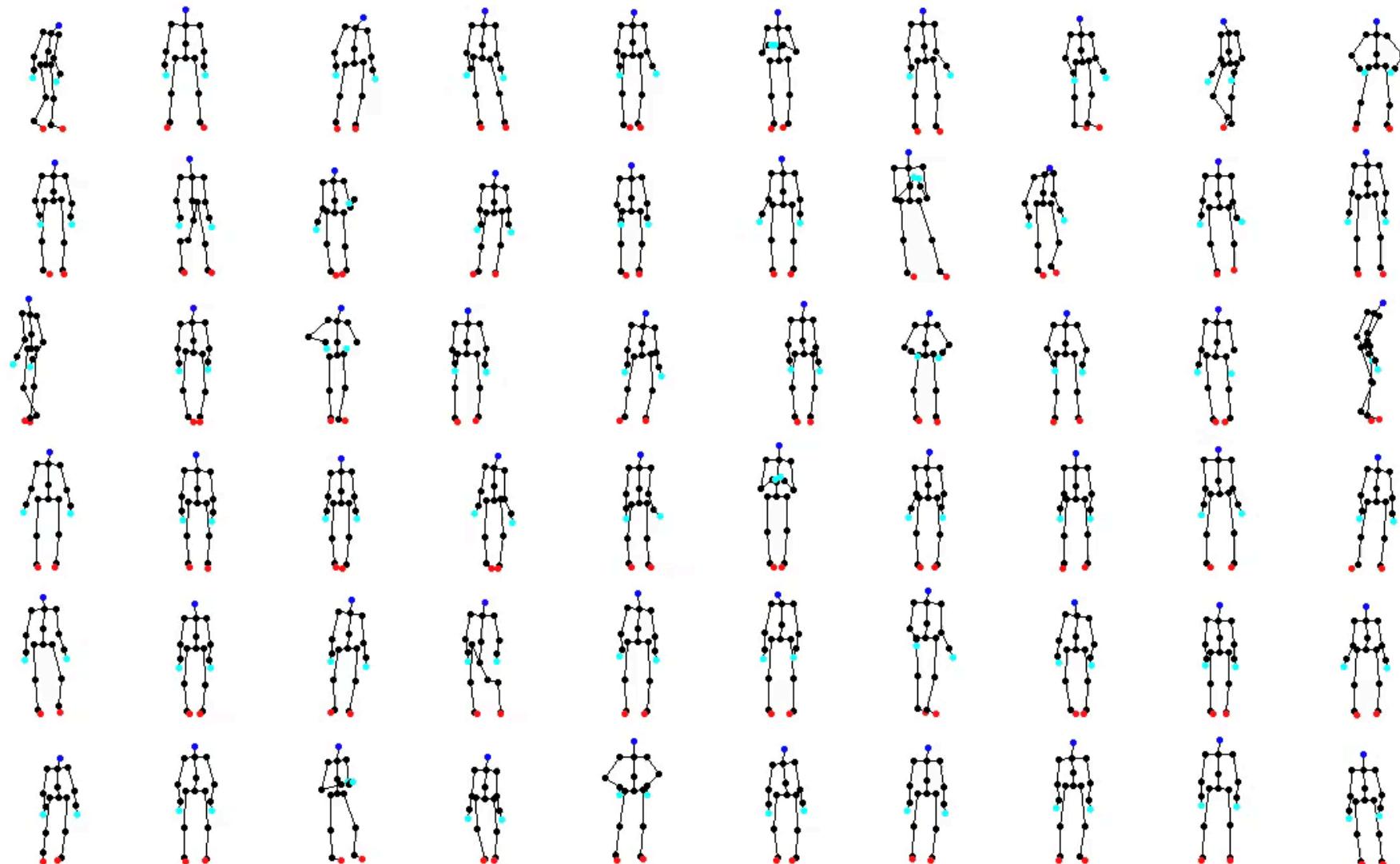
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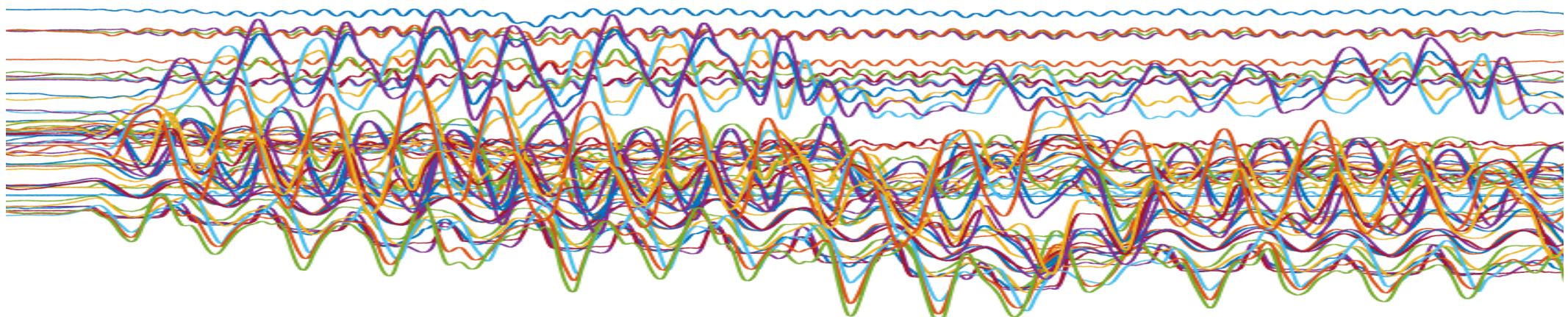


60 persons moving spontaneously to music

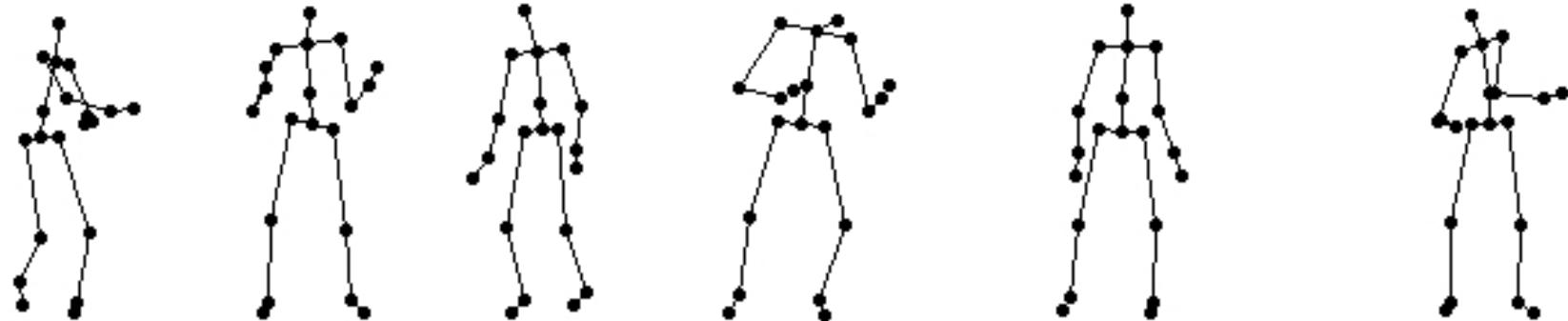


motion capture

- infrared cameras
- reflective markers
- 1 mm spatial resolution
- 1 ms temporal resolution



Moving to music in 4/4 meter



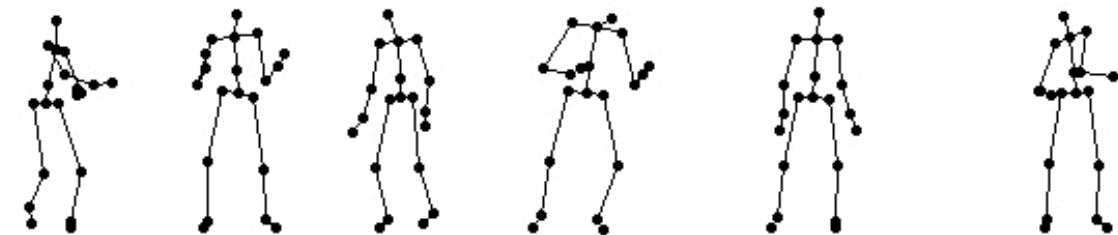
Are the metrical levels present in movement?

metrical levels in music and movement

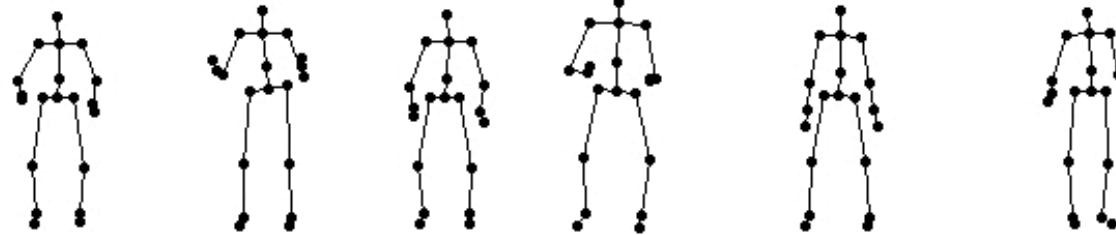
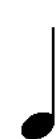
- we may use our bodily movements to help parse metrical structure of music.
- Aim:
 - investigate how pulsations on different metrical levels manifest in music-induced movement.

embodiments of metrical levels: decomposition by filtering

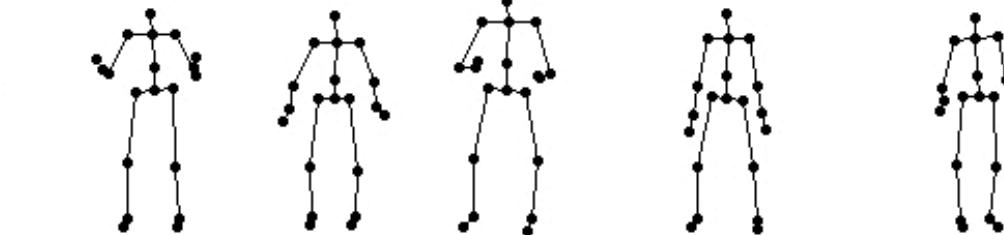
Original



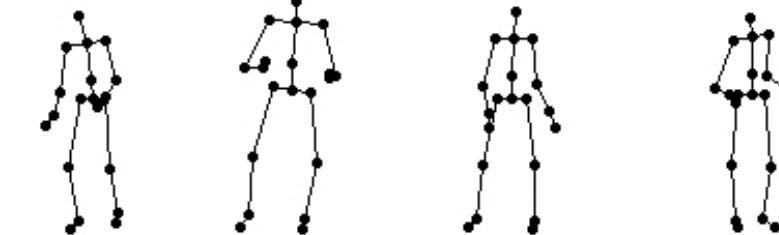
$f = 2 \text{ Hz}$



$f = 1 \text{ Hz}$

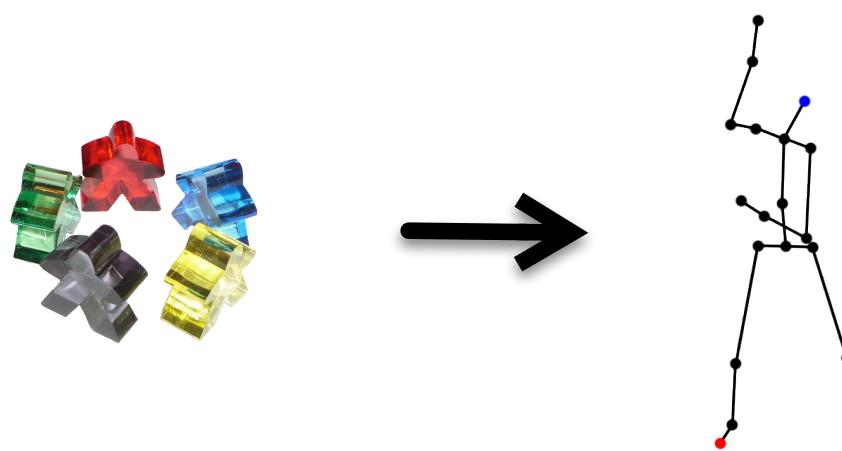


$f = 0.5 \text{ Hz}$



personality and movement

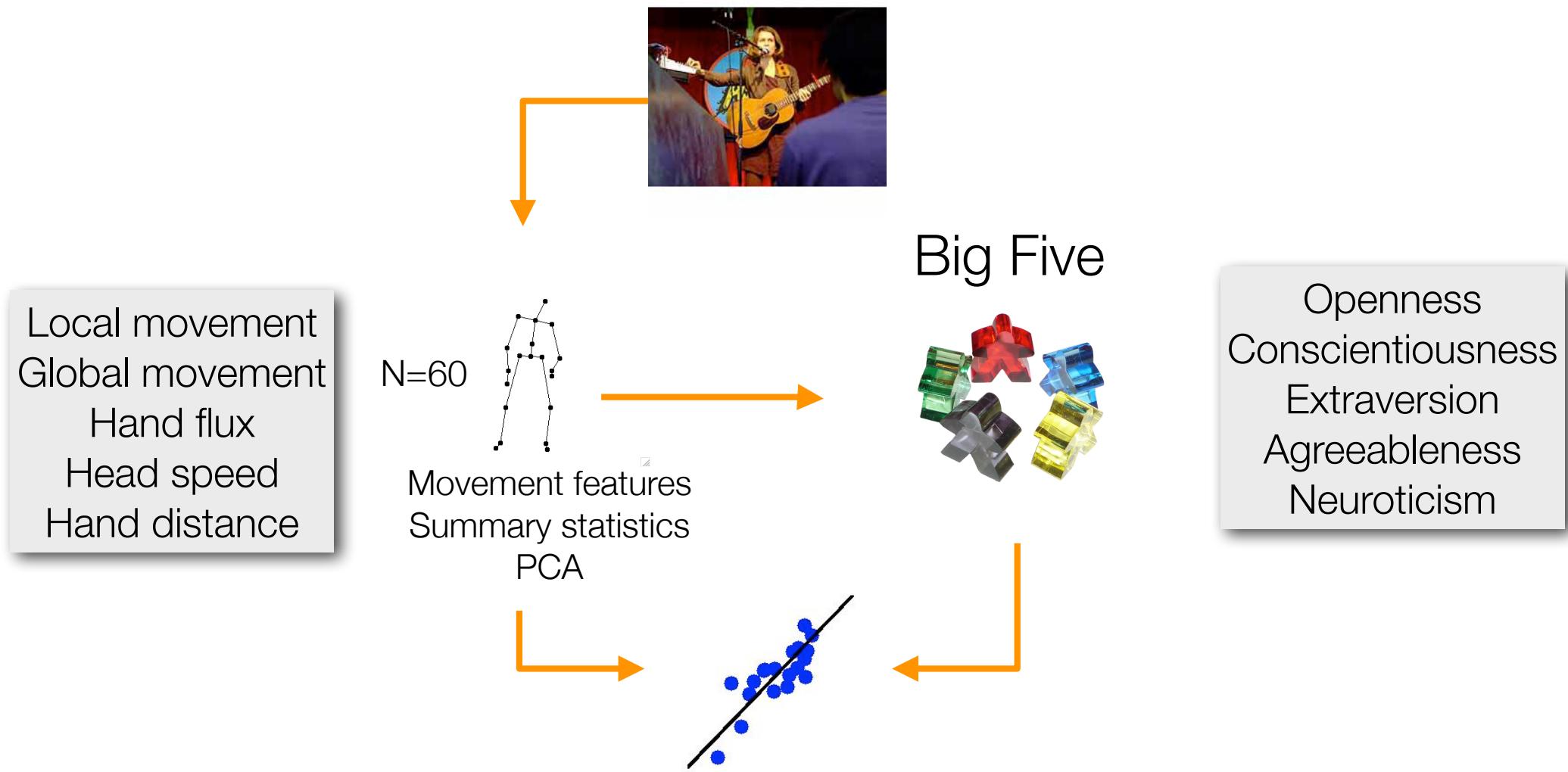
- individuals dance differently
- could that be related to their personality traits?



personality and movement

- **body motions** reliable indicators of personality type (Ball & Breese, 2000)
- relationships between **speakers'** movement patterns and perceptions of their personality (Koppensteiner & Grammer, 2010)
- personality **disorders** reflected in bodily movement (Kluft, Poteat, & Kluft, 1986)

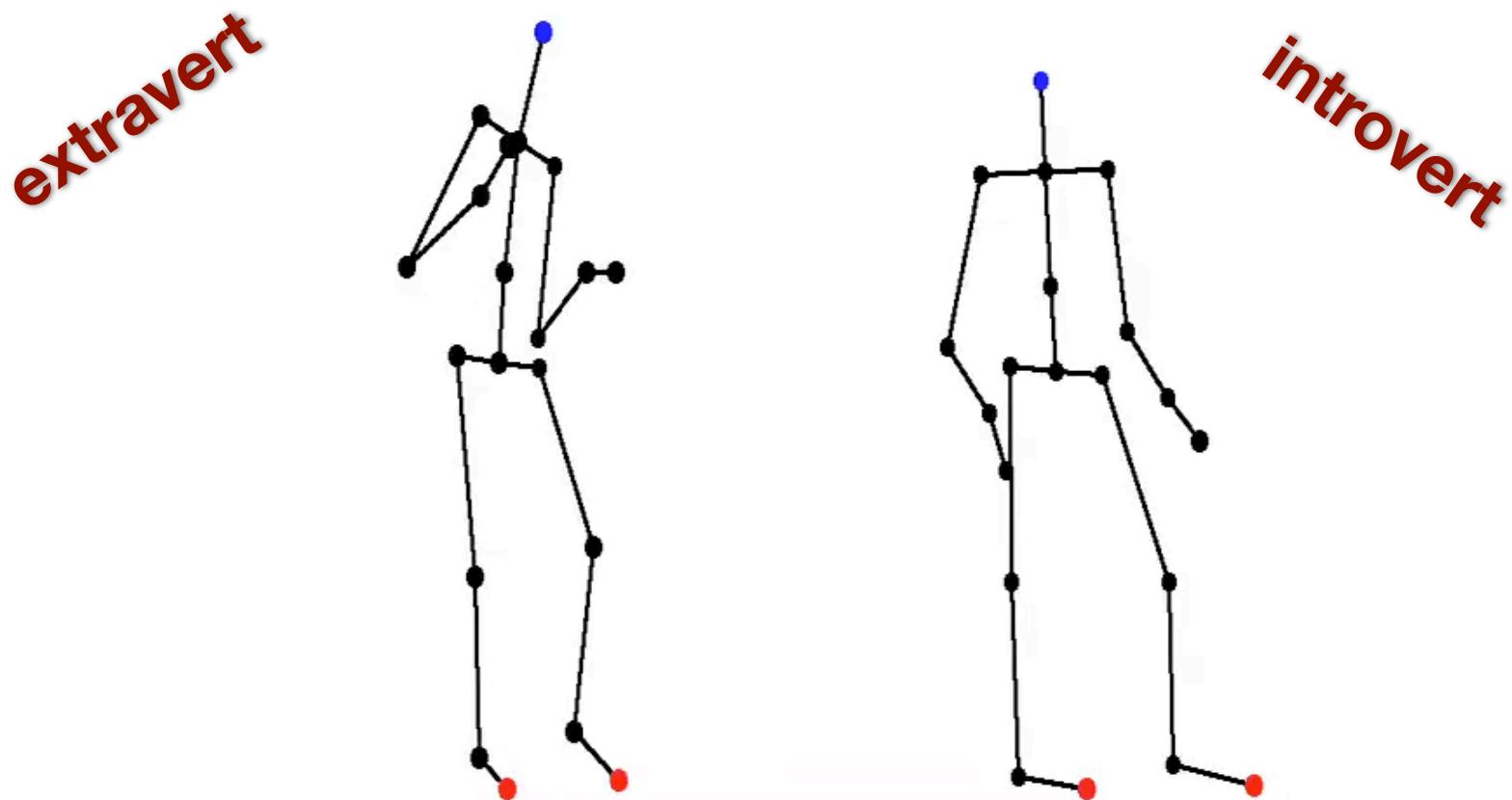
personality and music-induced movement



personality and music-induced movement

extraversion

energetic,
sociable,
talkative,
outgoing



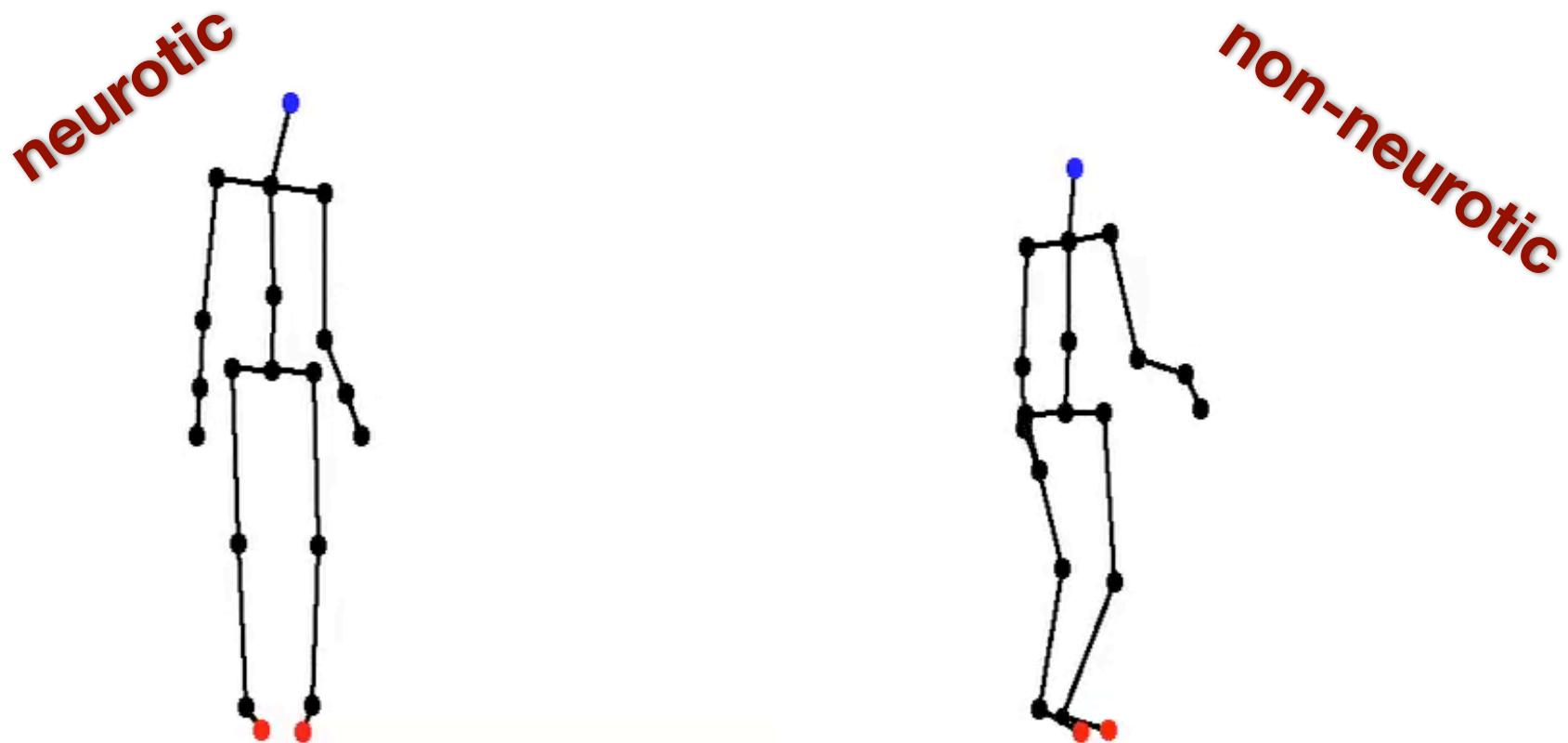
extraverts moved more than introverts
(esp. head, hands, feet)

personality and music-induced movement

neuroticism

emotionally unstable,
anxious,
stressed

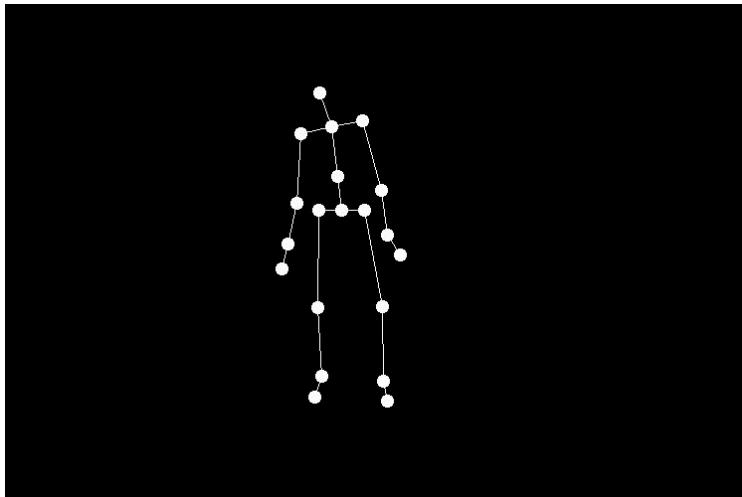
neurotics move more on the spot and
use less head and hands than non-
neurotics



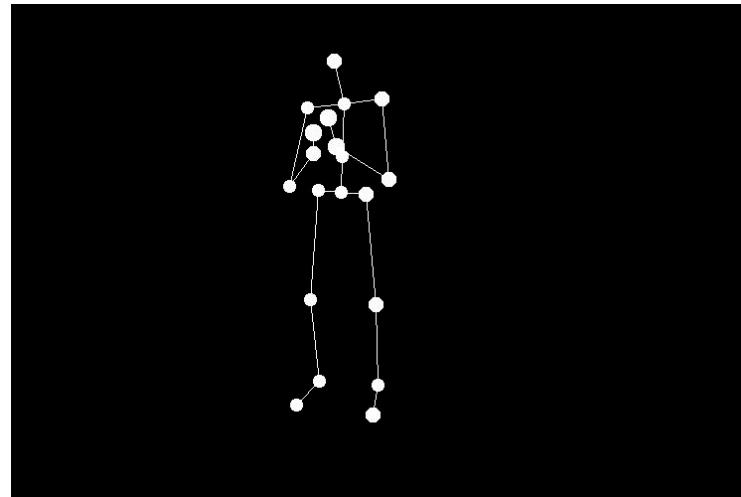
gender and movement

- point-light displays convey information about gender (Kozlowski & Cutting, 1978)
- gait kinematics can predict gender with 92.5% accuracy (Troje 2002)
- kinematic features predict women's perception of men's dancing ability (Neave et al 2010)
 - variability and amplitude of movements of the neck and trunk, and speed of movements of the right knee

1

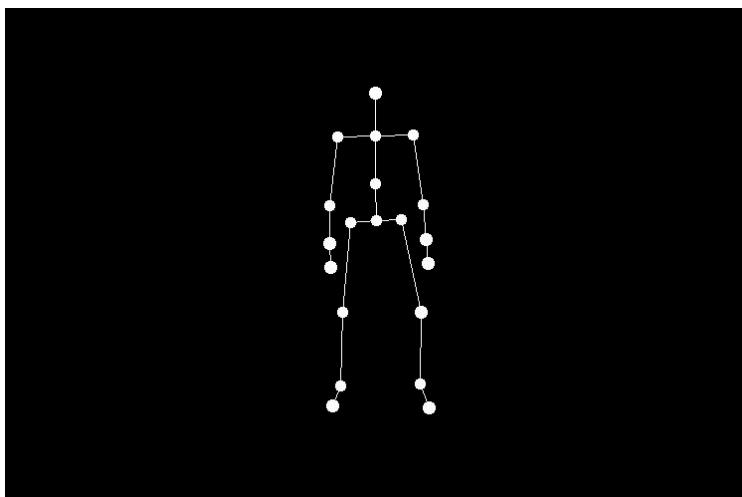


2

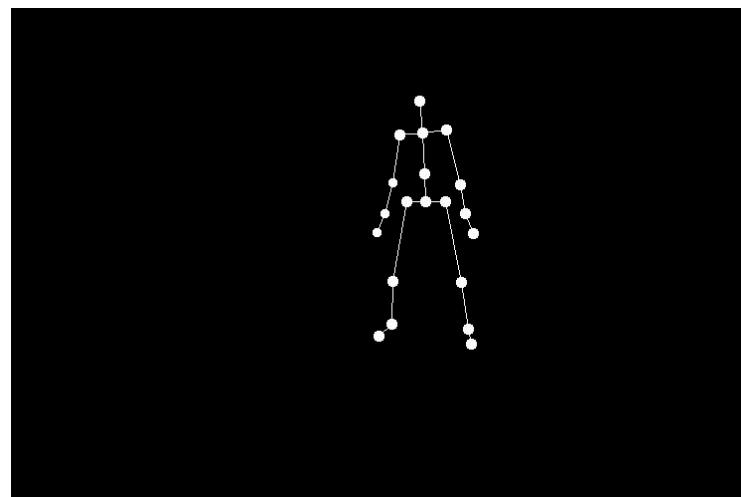


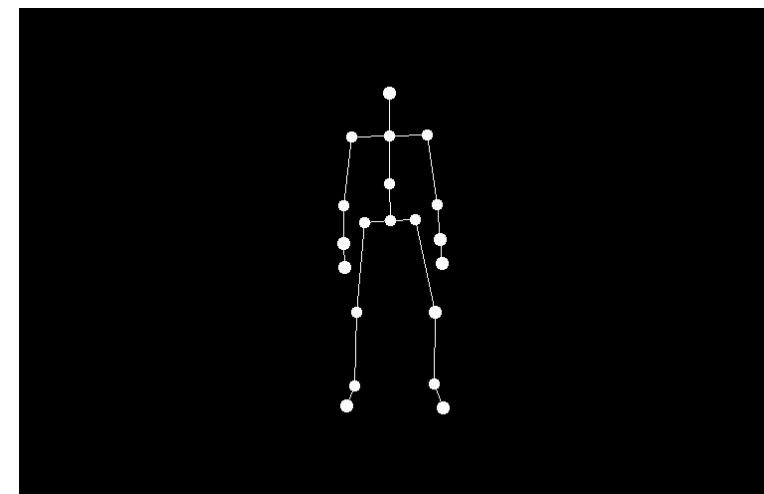
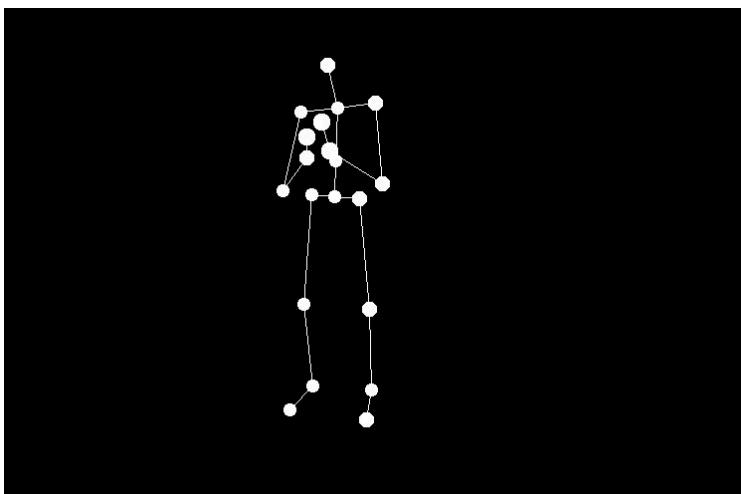
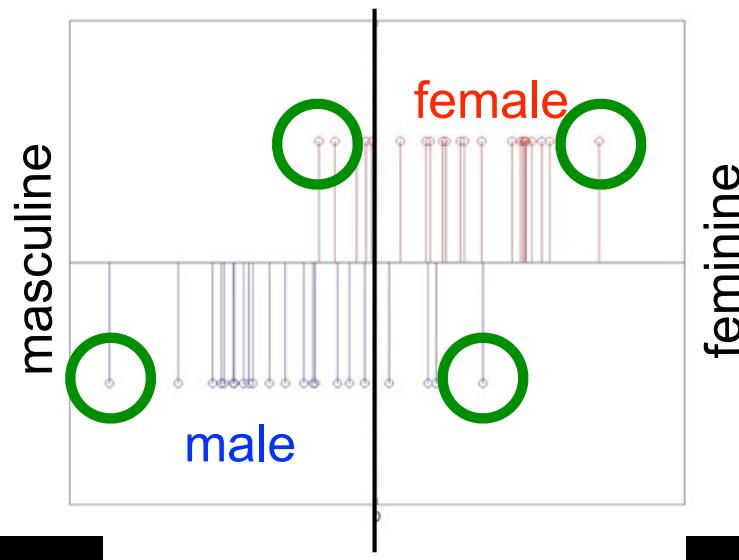
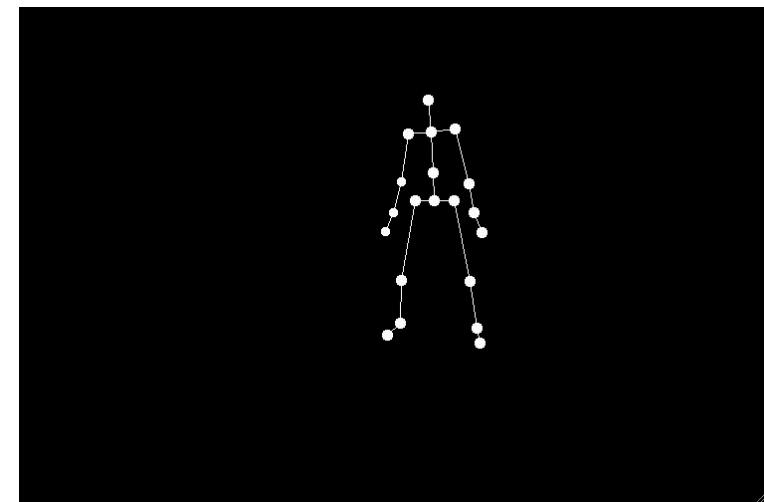
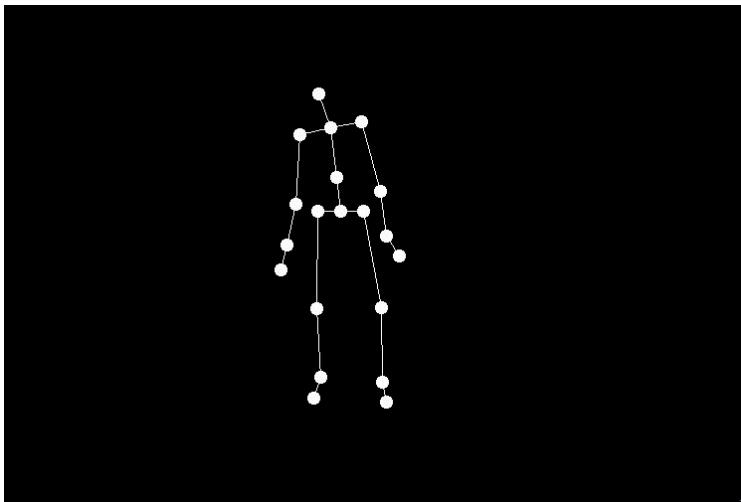
task: male or female?

3



4



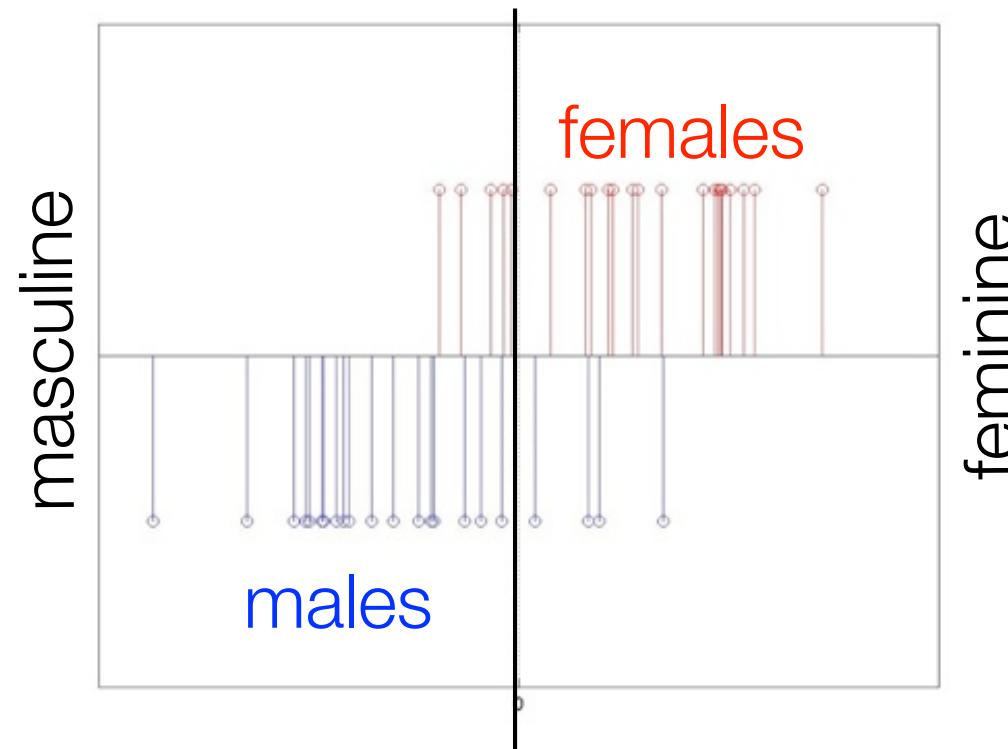


gender classification from movement kinematics

- 48 mocap recordings ($F=24$, $M=24$)
- kinematic feature extraction
 - linear & angular velocities, acceleration, jerks, kinetic energy, posture, ...
- machine learning
 - sequential backward elimination with variance inflation factor (VIF)
 - linear discriminant function (LDF)

discriminant function: "gender index"

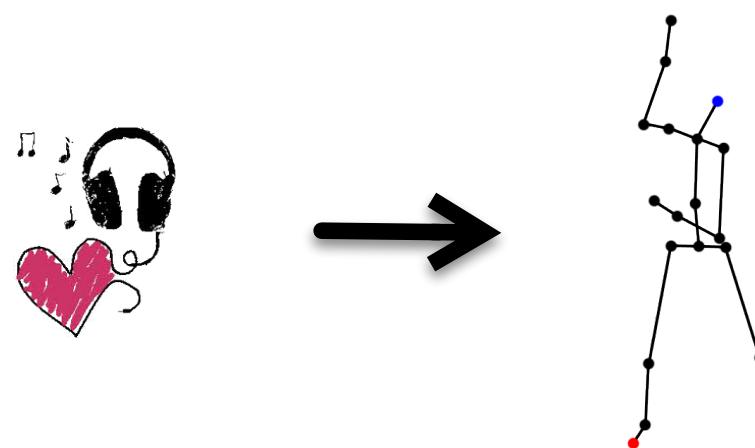
$0.93^* \text{HipWiggle} + 0.87^* \text{DistHands} + 0.38^* \text{SpeedFeetAP} + 0.24^* \text{BoundRec} + 0.07^* \text{AccHeadAP}$



80% correct
classification
rate

emotion and movement

- music can convey emotions
- moreover, music has emotional impacts on humans
- how would emotions expressed in the music be embodied by movement?



Physical Characteristics

- posture
- kinematics

Perceptual Characteristics

- skill
- attractiveness
- emotion

Music Characteristics

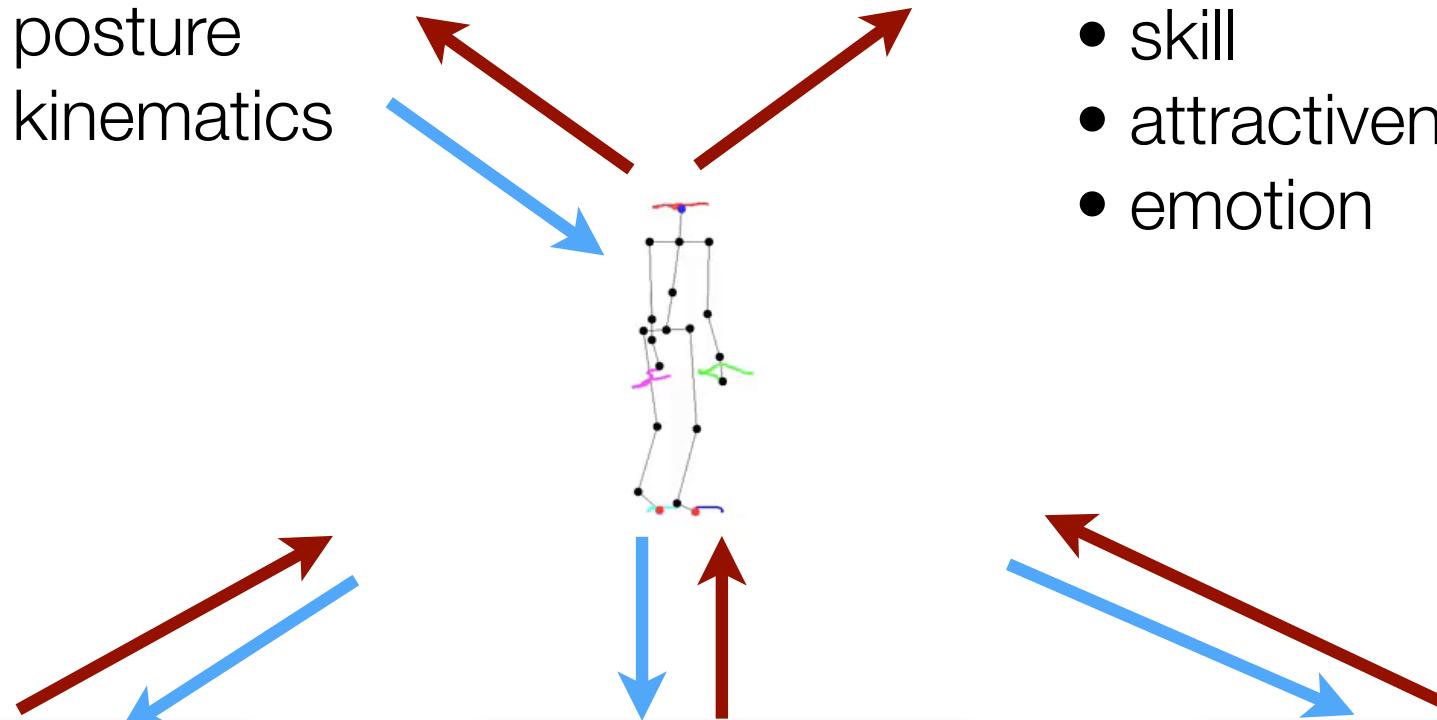
- tempo, metre
- timbre
- tonality
- lyrics

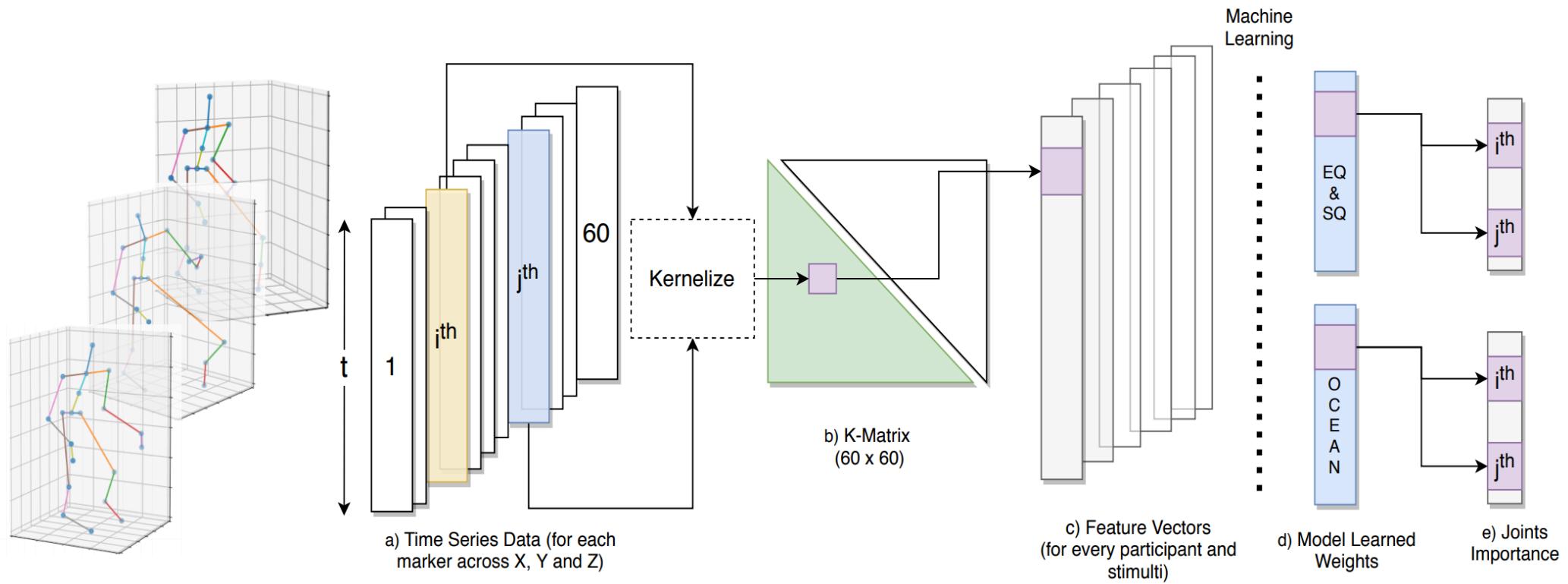
Listener Characteristics

- age
- personality
- mood
- preference
- gender

Cultural Conventions

- genre
 - dancing styles
- predictable?





Input	Openness		Conscientiousness		Extraversion		Agreeableness		Neuroticism	
	RMSE	R ²	RMSE	R ²	RMSE	R ²	RMSE	R ²	RMSE	R ²
Position	0.197	0.776	0.317	0.760	0.384	0.743	0.252	0.776	0.384	0.758
Position(N)	0.227	0.740	0.332	0.690	0.414	0.756	0.273	0.716	0.390	0.739
Velocity	0.332	0.464	0.487	0.415	0.556	0.523	0.440	0.335	0.557	0.483
Velocity(N)	0.304	0.527	0.426	0.543	0.501	0.623	0.408	0.442	0.461	0.654

Table 3: Prediction Results for Five Personality Traits using Bayesian Regression

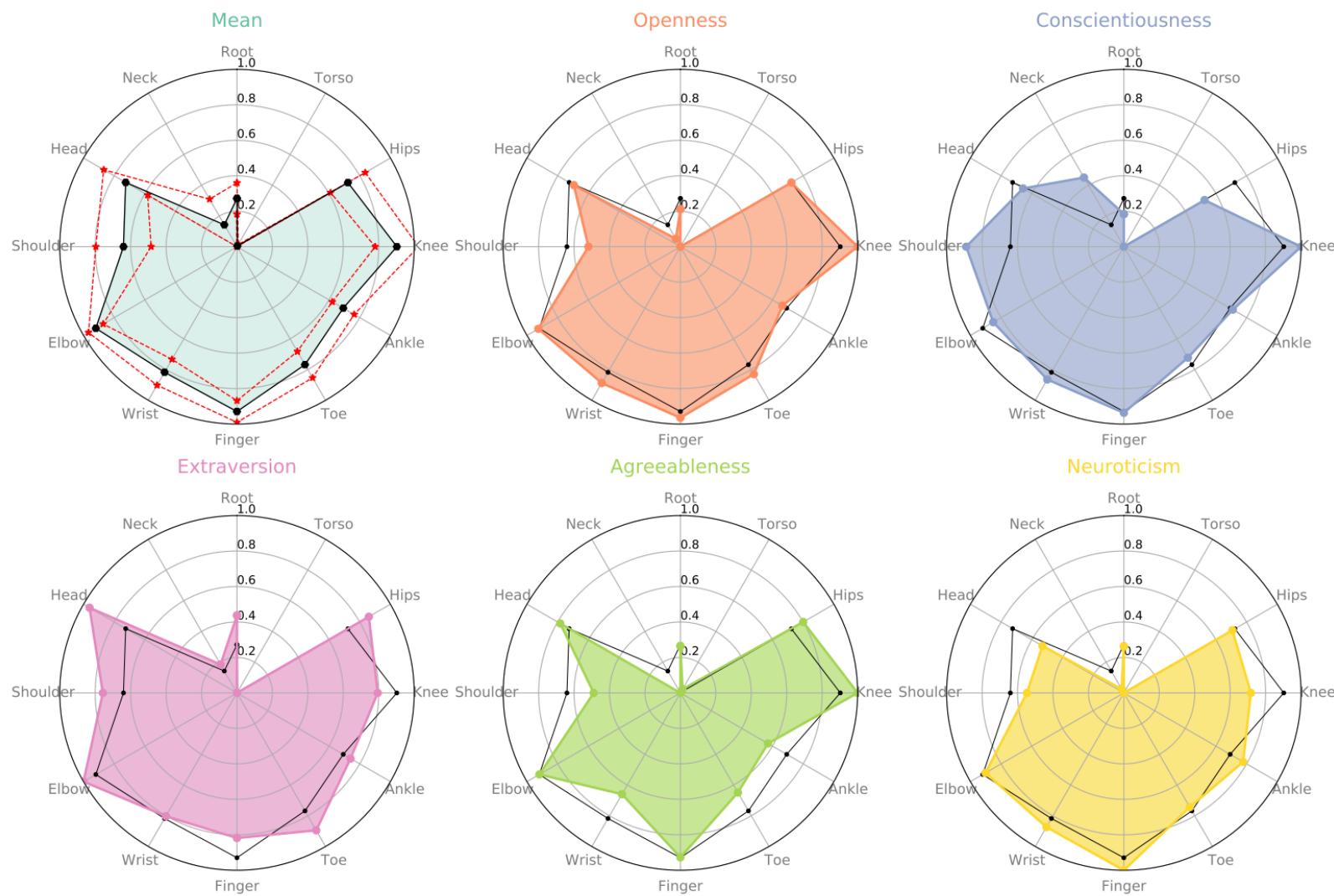
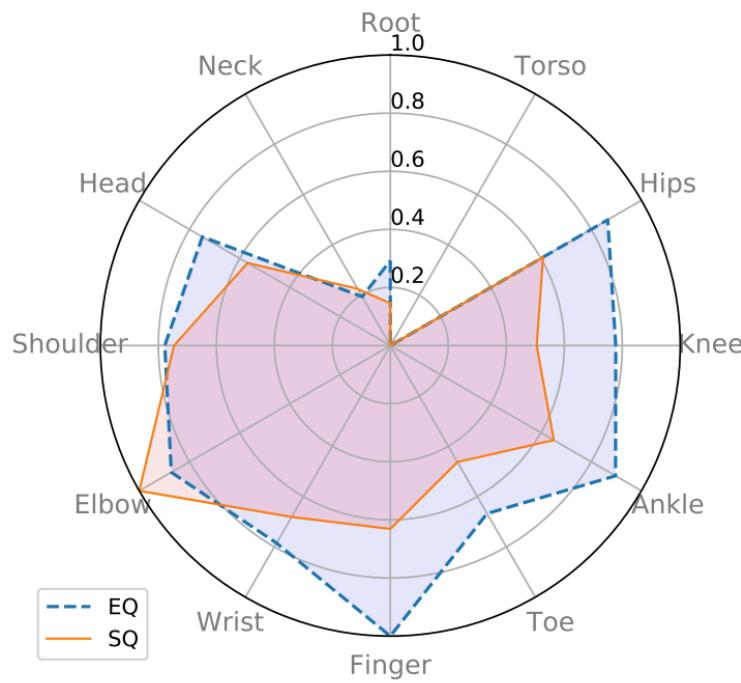


Figure 4: Relative importance of Joints of the five personality traits(Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism) using the Position Data. The black line indicates the mean importance of the corresponding joint marker. The red dotted line in the top left sub-figure indicates the standard deviation about the mean.



Input	PCR		Bayesian Ridge	
	RMSE	R^2	RMSE	R^2
Position	3.071	0.708	2.722	0.771
Position(N)	3.201	0.684	2.733	0.765
Velocity	4.938	0.249	4.343	0.423
Velocity(N)	4.583	0.353	4.015	0.503

Table 1: Prediction Results for Empathizing Quotient

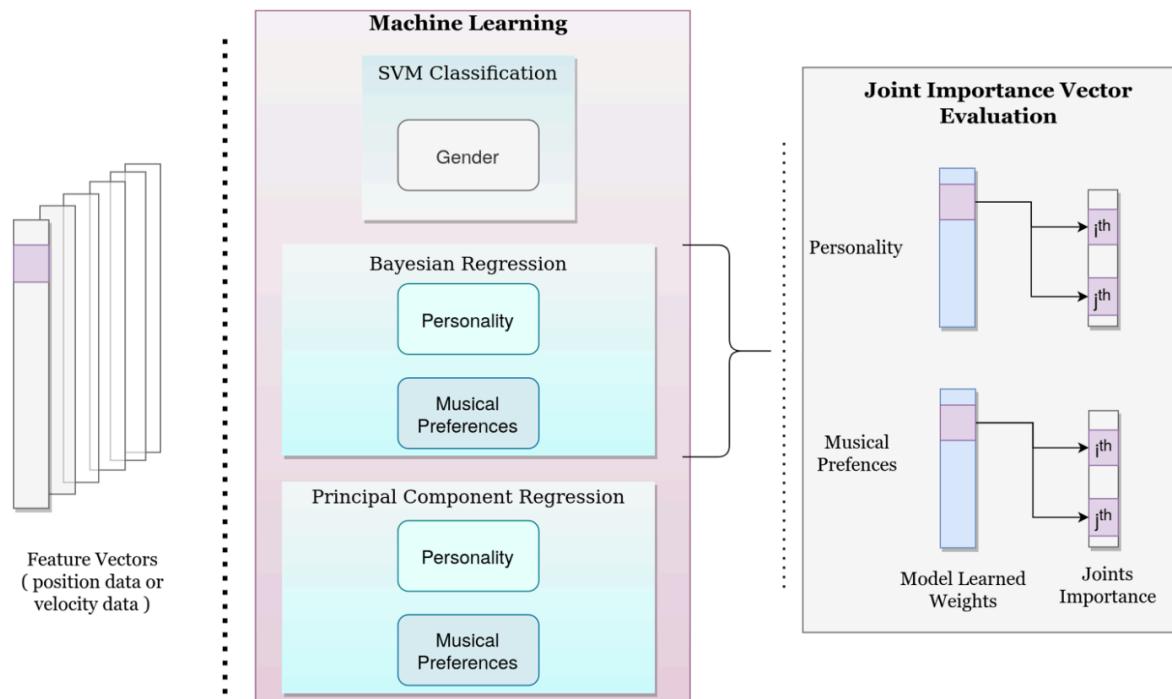
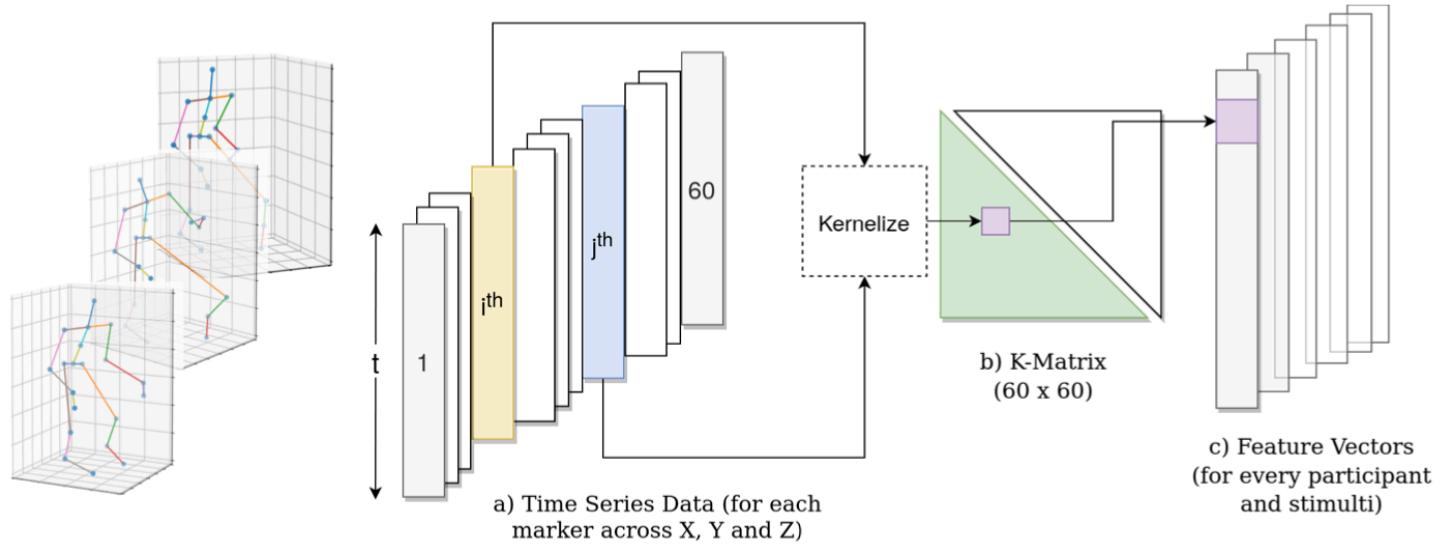
Input	PCR		Bayesian Ridge	
	RMSE	R^2	RMSE	R^2
Position	2.398	0.781	2.161	0.867
Position(N)	2.363	0.786	2.502	0.838
Velocity	4.448	0.252	3.832	0.469
Velocity(N)	4.211	0.329	3.714	0.552

Table 2: Prediction Results for Systemizing Quotient

Extended.....

	Dataset-1	Datataset-2
Participants	58	60
Gender	41 Females, 17 Males	43 Females, 17 Males
Age	Mean: 26.8 years, Std: 4.7 years	Mean: 24 years, Std: 3.3 years
Personality (BFI)	✓	✓
Music Preferences (STOMP-R)	✓	✗

Table 4. Dataset Comparison



Results

gender

Classification Accuracy (in %)	Dataset-1	Dataset-2
Position	96.53	98.76
Velocity	84.59	86.33

personality

	Openness		Conscientiousness		Extraversion		Agreeableness		Neuroticism	
	RMSE	R^2	RMSE	R^2	RMSE	R^2	RMSE	R^2	RMSE	R^2
Dataset-1	0.20	0.78	0.32	0.76	0.38	0.74	0.25	0.78	0.38	0.76
Dataset-2	0.19	0.90	0.22	0.90	0.25	0.88	0.17	0.89	0.24	0.88

preference

Metric	Blues	Country	Dance	Funk	Jazz	Metal	Oldies	Pop	Rap	Reggae	Rock	Soul
R^2	0.81	0.73	0.84	0.72	0.77	0.84	0.75	0.85	0.72	0.73	0.79	0.77
RMSE	0.58	0.96	0.63	0.65	0.72	0.85	0.63	0.53	0.94	0.81	0.49	0.72

identify individuals based on their movements?



motor fingerprint?

identify individuals based on their movements?

identify individuals based on their movements in dyadic settings?

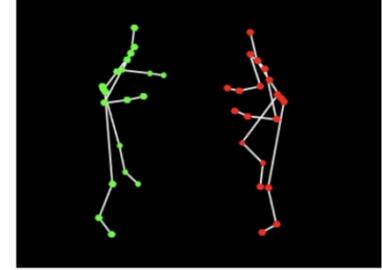
identify individuals based on their movements within a more constrained setting, where each performs the same routine?

individual identification from movement kinematics

- accuracy of 94% in identifying individuals from their motion-captured data using only movement features while doing free-form dance movements to the music of eight genres (Carlson et al. 2020)
- individuals in dyads tend to move their hands more than when dancing alone for the same music stimulus, and this difference is statistically significant (Carlson et al. 2018)
- same individual can move differently when dancing with different partners, and this happens particularly in individuals with high self-reported empathy scores (Carlson et al. 2018)

individual identification from movement kinematics

- 73 participants (54 females) aged 19–40 years ($M = 25.75$, $SD = 4.72$)
- 24 different nationalities and possessing diverse musical and dance training backgrounds
- mean classification accuracy of 96.75%
- why lower accuracy in metal and jazz?

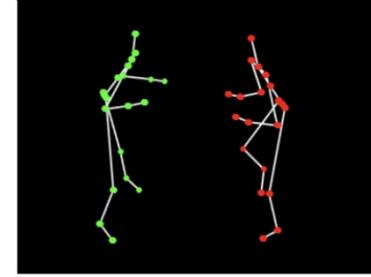
	
Dyads	27
Dancers	54
Musical Stimuli	16 (8 musical genres)

Musical Genre	Accuracy
Reggae	98.15
Pop	99.07
Metal	87.96
Jazz	95.37
Dance	100.00
Country	96.30
Blues	99.07
Rap	98.11

Table 3.1: Dancer Identification accuracy when that musical genre was held as test-set (Dyadic)

individual identification from movement kinematics

- model trained on individual's dyadic setting identified the individual based in an individual setting with an accuracy of 83.23%
- —>our movements retain unique characteristics even when dancing with a partner

	
Dyads	27
Dancers	54
Musical Stimuli	16 (8 musical genres)

individual identification from movement kinematics

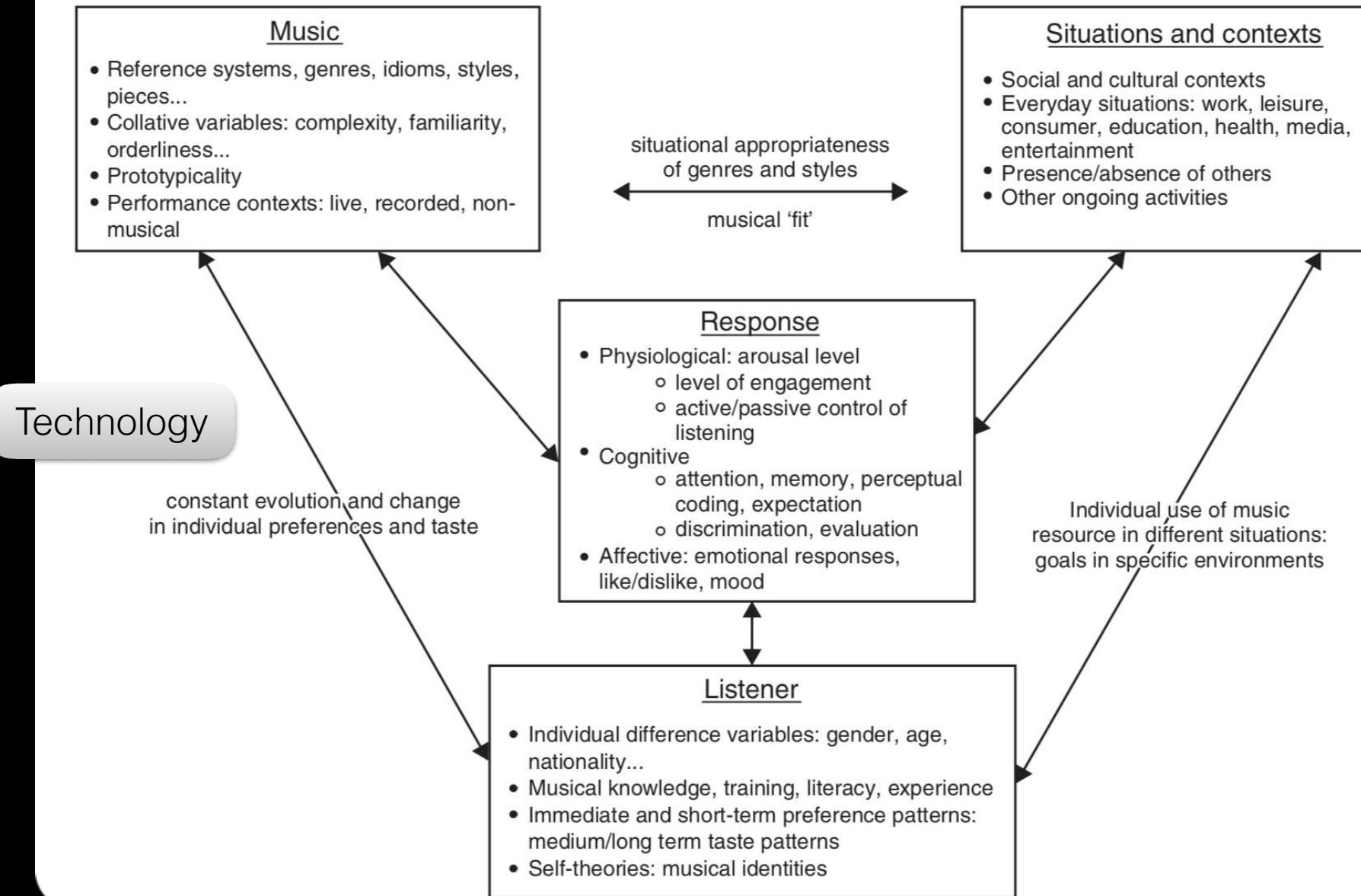
- accuracy of 47.6%, surpassing the chance level of 33.33% (Varshney et al. 2024)
- two step approach - identify genre, then identify individual - resulted in accuracy of 63.89%-91.67%
- > existence of a distinctive personal style for each dancer, further corroborating the efficacy and robustness of Carlson's methods in dancer identification

AIST++ DATASET			
	Dance Genres		
Basic Dance (10x3x10x4)	Dancers	3	ballet jazz
	Choreographies	10	street jazz
	Impressions	4	krump
Advanced Dance (10x3x7)	Dancers	3	house
	Choreographies	7	LA-Style hip hop
			middle hip hop
			waack
			lock
			pop
			break

Dance Genres	Mean	Std
Break	63.89	0.07
House	91.67	0.08
B Jazz	79.07	0.12
S Jazz	65.51	0.14
Krump	67.72	0.11
L Hip-hop	81.67	0.09
Lock	85.00	0.09
M Hip-hop	86.67	0.07
Pop	70.00	0.12
Waack	78.90	0.14

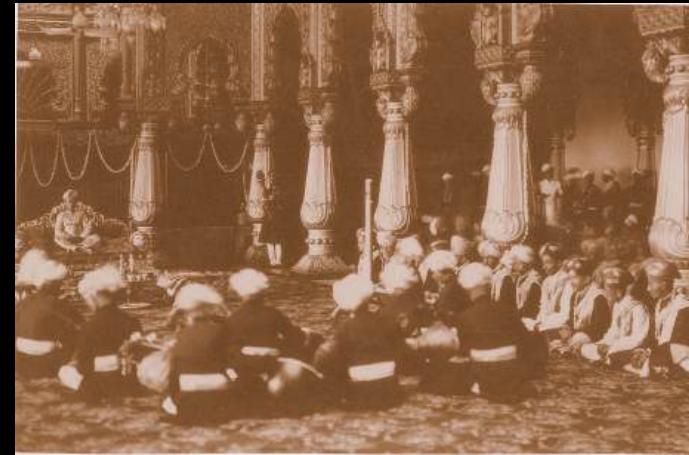
Music in everyday life

Musical Experience



Reciprocal feedback model of musical response

Musical Experience: Then



Musical Experience: Now



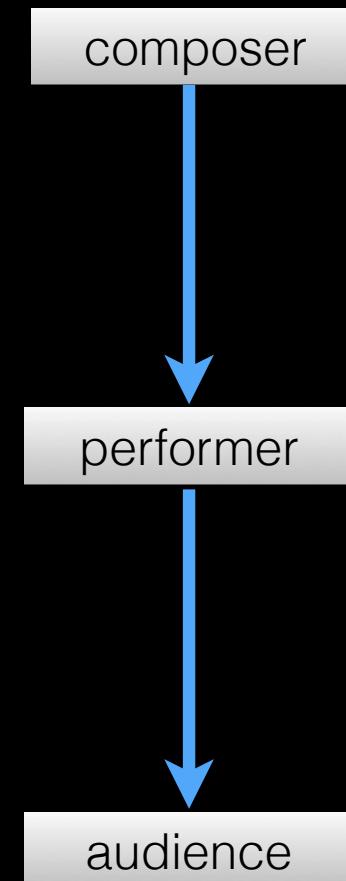
Musical Experience: Now

Virtual Reality Concerts: The Future of Live Music?

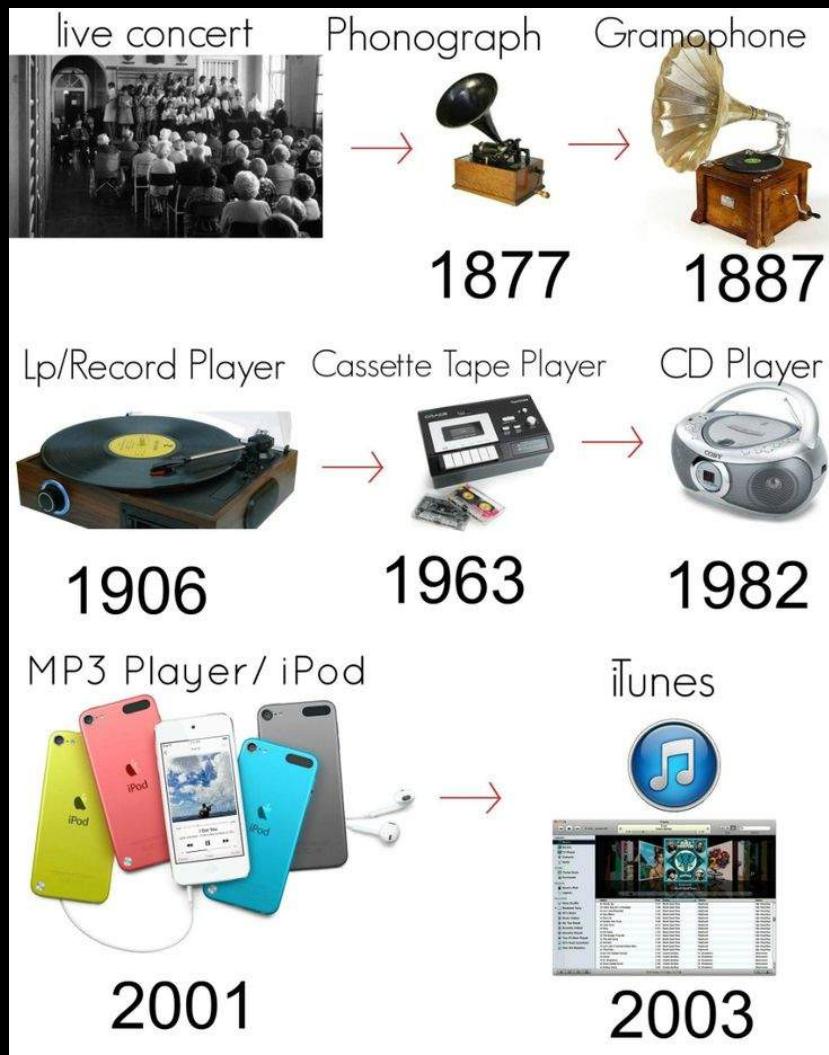
Virtual Reality Concerts: Where the Beat Never Stops—Even in Your Living Room



Musical Hierarchy: Then

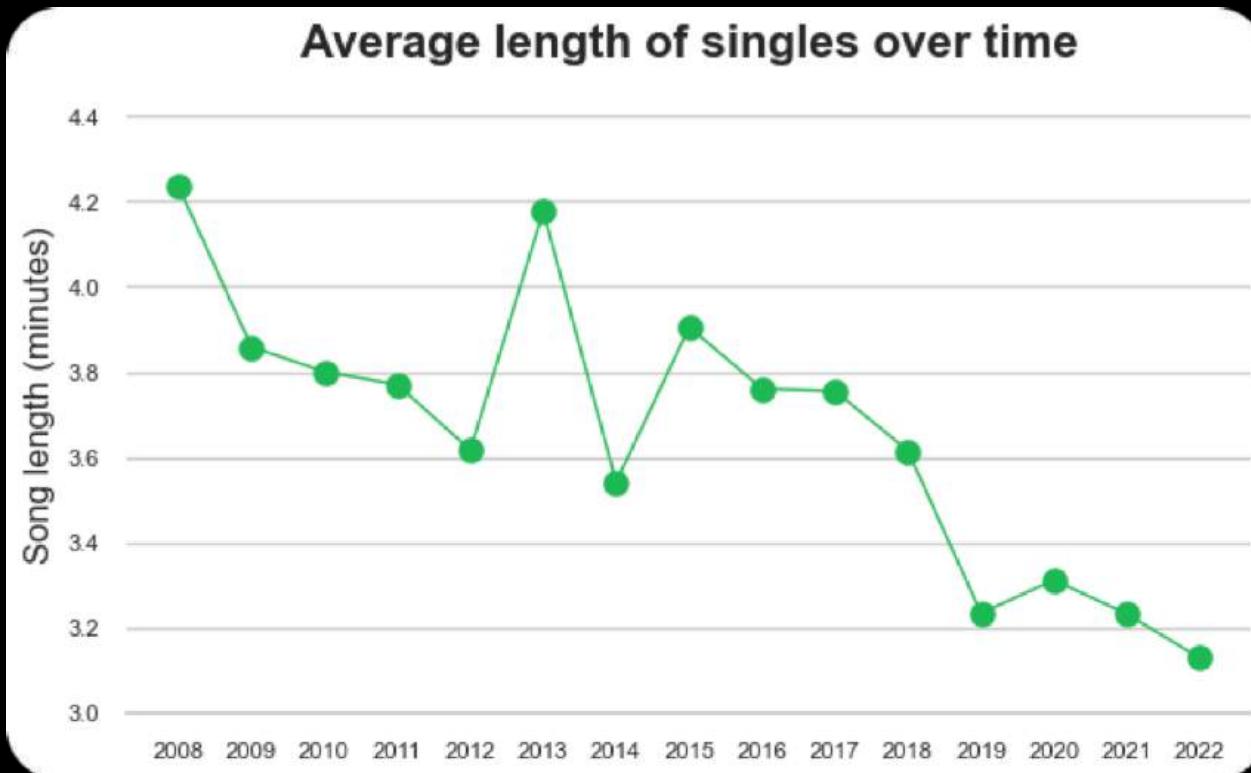


Musical Hierarchy: Now??



When do the performers and composers vanish?

Why are songs getting shorter?

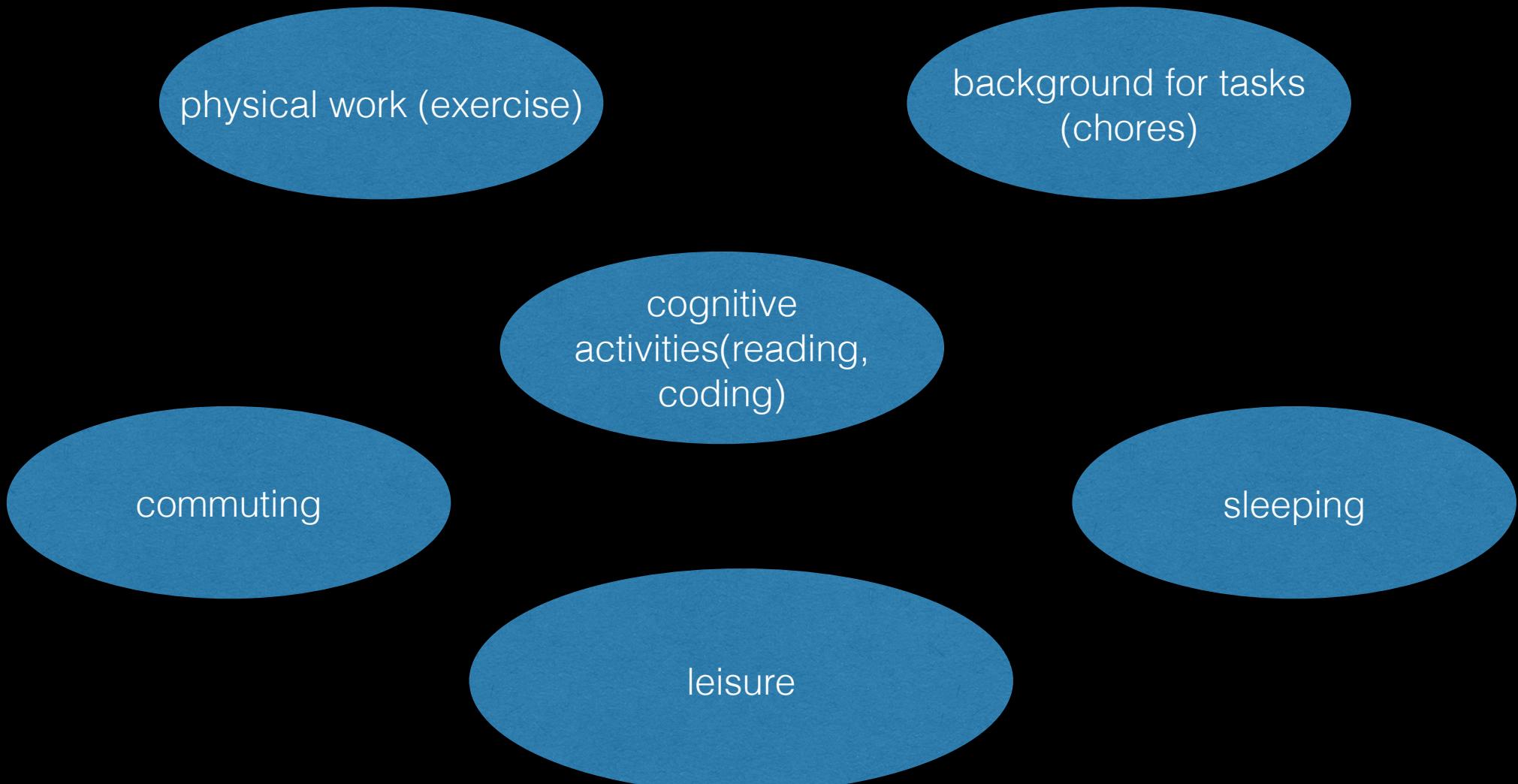




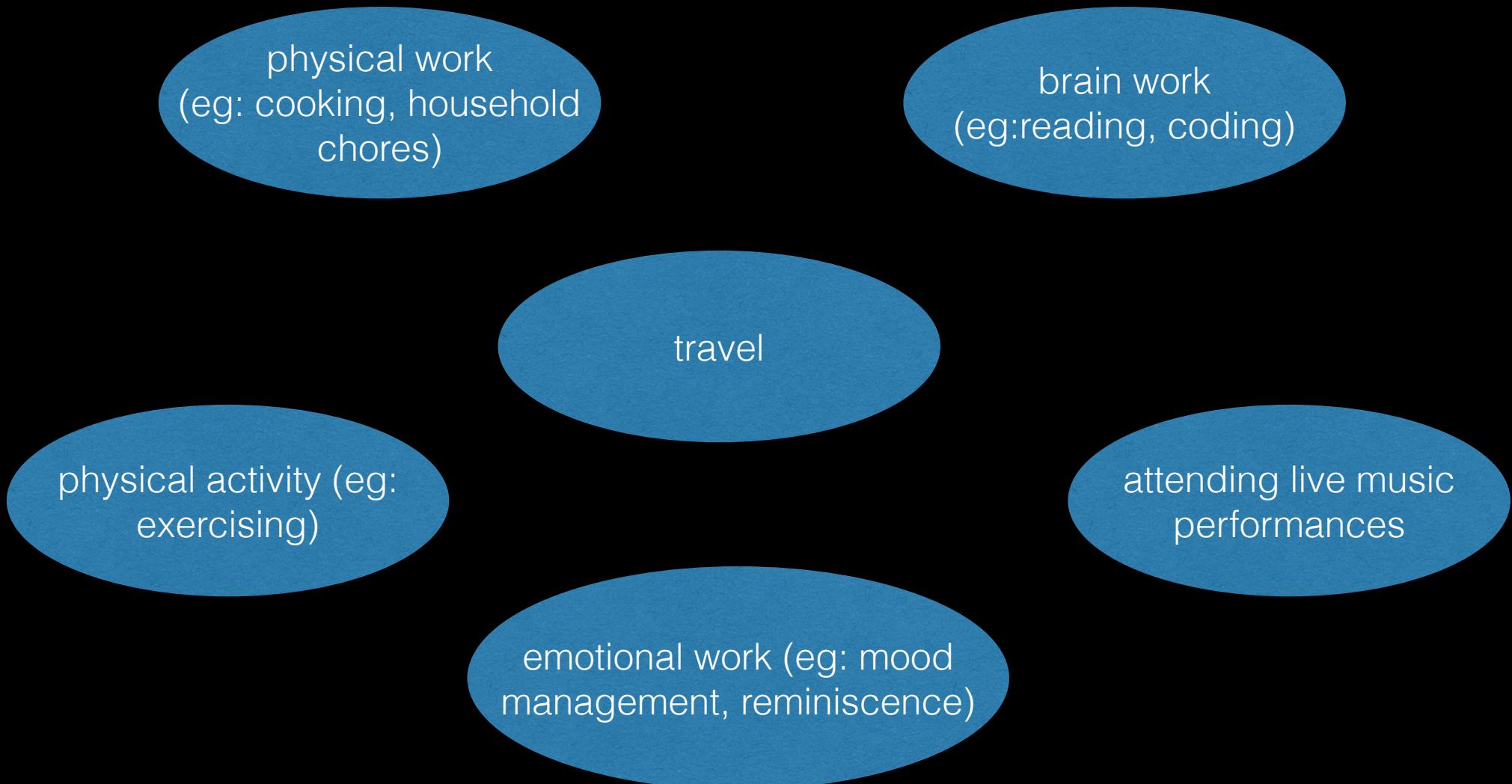
behaviour accompanying music
listening ?

functions of music?

behaviour accompanying of music?



behaviour accompanying of music?



function of music?

to relax

to energize

focus

as a distraction

social bonding

entertainment

function of music?

enhance other art forms

cross-cultural awareness

(Self)Mood Regulation

social bonding/group cohesion

motivation

concentration/work

escapism

background

memory prompt

Music in everyday life

Behaviors music accompanies:

- Travel (e.g. driving, walking, public transport)
- Physical work (e.g. cleaning, cooking)
- Brain work (e.g. study, reading, writing)
- Body work (e.g. exercise, yoga, relaxation, pain management)
- Emotional work (mood management, reminiscence, presentation of identity)
- Attendance at music performance as an audience member

Functions music serves:

- Distraction
- Energizing
- Entrainment
- Meaning enhancement



International Journal of Psychology

Publication details, including instructions for authors and subscription information:
<http://www.tandfonline.com/loi/pijp20>

The functions of music and their relationship to music preference in India and Germany

Thomas Schäfer ^a, Arun Tipandjan ^b & Peter Sedlmeier ^a

^a Department of Psychology, Chemnitz University of Technology, Chemnitz, Germany

^b International Centre for Psychological Counseling and Social Research, Pondicherry, India

Available online: 21 Jun 2012

Main function

Allocated items

Music listening

Background

My favorite music . . .

Memory prompt

Is what I like to listen to as background music

Diversion

Enables me to reminisce

Emotion regulation

Is what I like to listen to when I'm dancing

Self-regulation

Is music I can appreciate as art

Self-reflection

Is able to put me in a good mood

Social bonding

Can make me feel ecstatic

Can help me chill and tune out

Helps me forget my problems and worries

Supplies me with important or interesting information

Enables me to experiment with different sides of my personality

Enables me to better understand my thoughts and feelings

Expresses my values

Helps me express my identity

Helps me feel close to others

Can help me meet people

Enables me to identify with the artists



International Journal of Psychology

Publication details, including instructions for authors and subscription information:
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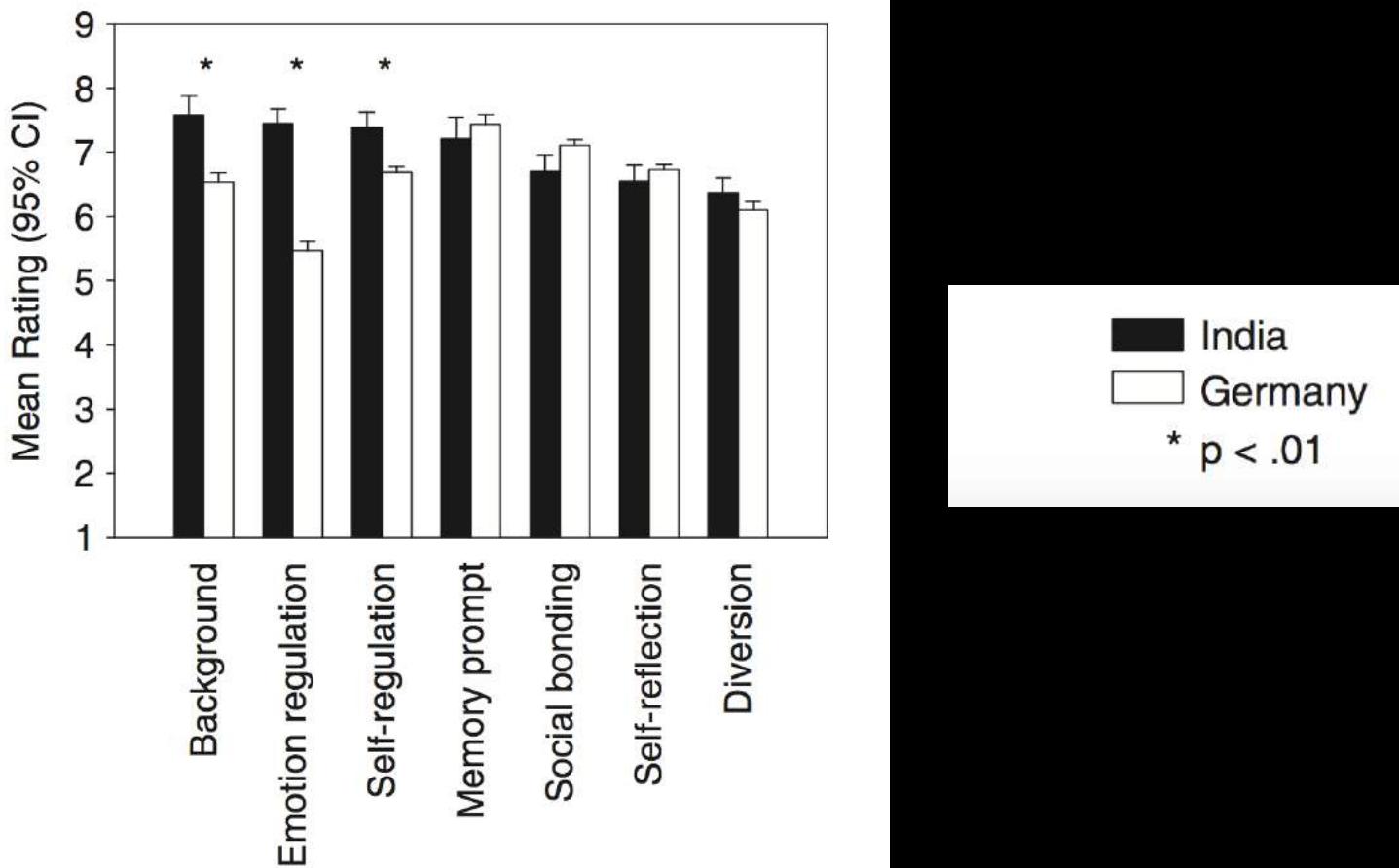
The functions of music and their relationship to music preference in India and Germany

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Music in everyday life

Slides from Amanda Krause©

How do we experience music in daily life?

- How the music was heard and the consequences of listening
- 3 types of consequences as a result of the music experienced
 - **Purposive** listening (helping concentration, motivation)
 - **Actively engaged** listening (bringing back memories, enjoying the music)
 - **Validation seeking** (aiding worship and appearance)

Krause, A. E., North, A. C., & Hewitt, L. Y. (2015). Music-listening in everyday life: Devices and choice. *Psychology of Music*, 43, 2, 155-170.

Krause, A. E., North, A. C., & Hewitt, L. Y. (2014). Music selection behaviors in everyday listening. *Journal of Broadcasting and Electronic Media*, 58, 2, 306-323.

How do we experience music in daily life?

Krause, et al.'s (2015) Experience Sampling Method Study

- 7 days x 2 texts each day = 14 responses
- Texts randomly sent between 8:00 and 23:00
- 177 individuals completed 12+ responses

	Yes	No
Did you hear music within the two hours prior to receiving the text?	46.3 %	53.7 %



Krause, A. E., North, A. C., & Hewitt, L. Y. (2015). Music-listening in everyday life: Devices and choice. *Psychology of Music*, 43, 2, 155-170.
<http://images.wisegeek.com/cell-phone-message.jpg>

How do we experience music in daily life?

■ How the music was heard and people's mood

Shift in feeling more lethargic	Shift in feeling more content
Recorded music in public; Radio, TV	Mobile phone, personal computer collection
Not having control	Personal playlist
Shift in feeling less lethargic	Shift in feeling less content
Cloud source	Recorded music in public; TV
Live performance; Random/Shuffle	Not having control; someone else chose

lethargy

content

How do we experience music in daily life?

■ How the music was heard and people's mood

Shift in feeling more lethargic	Shift in feeling more content
Recorded music in public; Radio, TV	Mobile phone, personal computer collection
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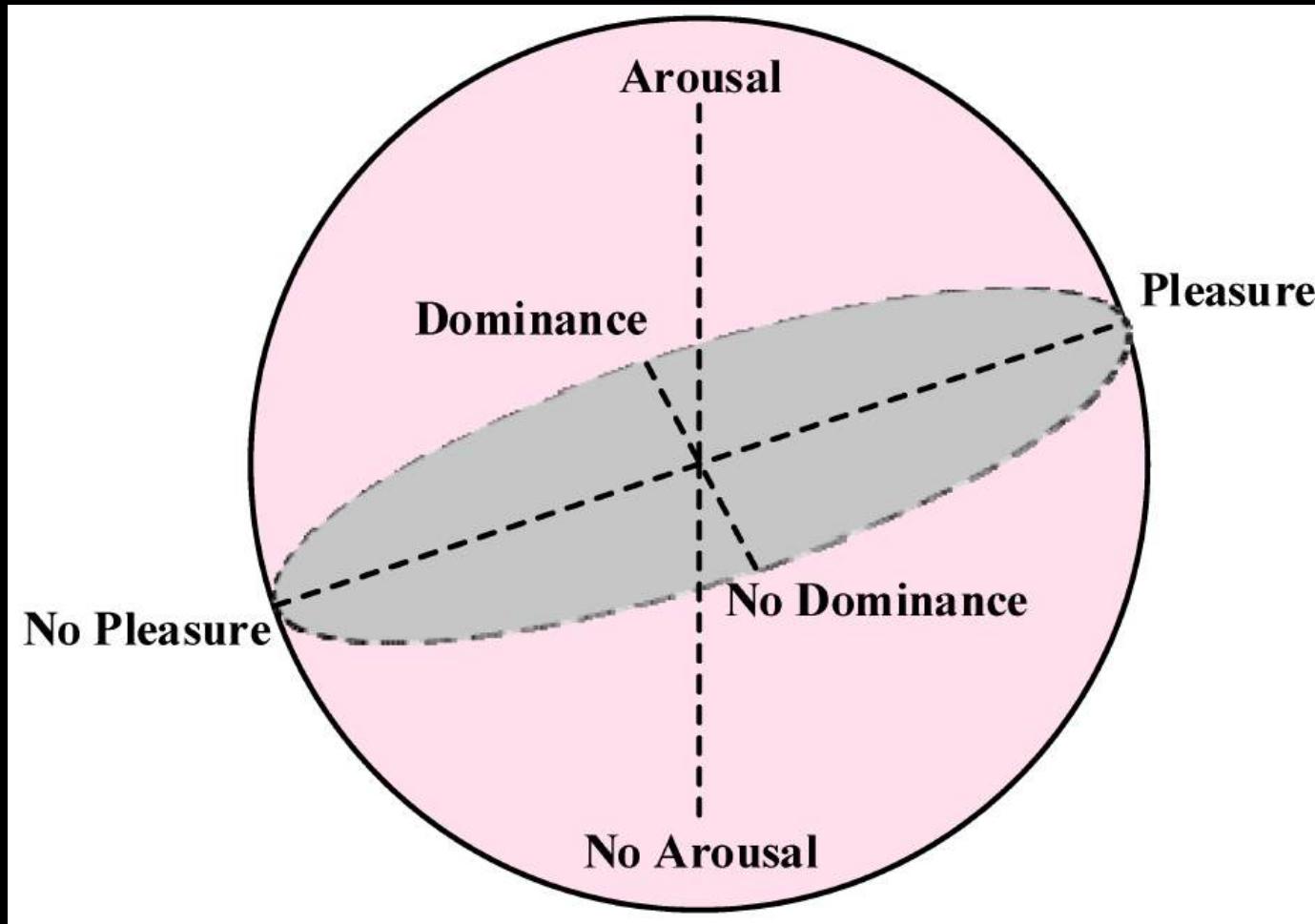
How do we experience music in daily life?

- Where the music was heard
 - Also asked participants about their engagement with the music
 - Four questions - rated their music episode (1-7 rating):

Choice	Liking	Attention	Arousal
At home, driving a car, public transportation ↑ ↓	At home, public transportation ↑ ↓	At home, public transportation, walking ↑ ↓	At the gym ↑ ↓
At a restaurant, pub/club	At a restaurant	At work, at a restaurant	At work, at a restaurant

Krause, A. E., North, A. C., & Hewitt, L. Y. (2016). The role of location in everyday experiences of music. *Psychology of Popular Media Culture*, 5, 3, 232-257.

most liked in public transportation



environmental psychology

physical environments influence people through their emotional impact

PAD model & the role of control

Krause and North (2017) → An explicit consideration of location and control over the music

An in-situ, ecologically valid 'experiment'

- Background questionnaire
- A 15-minute listening task (playlist)
- Questionnaire response
 - >response to the music
 - >response to the overall experience ("episode")

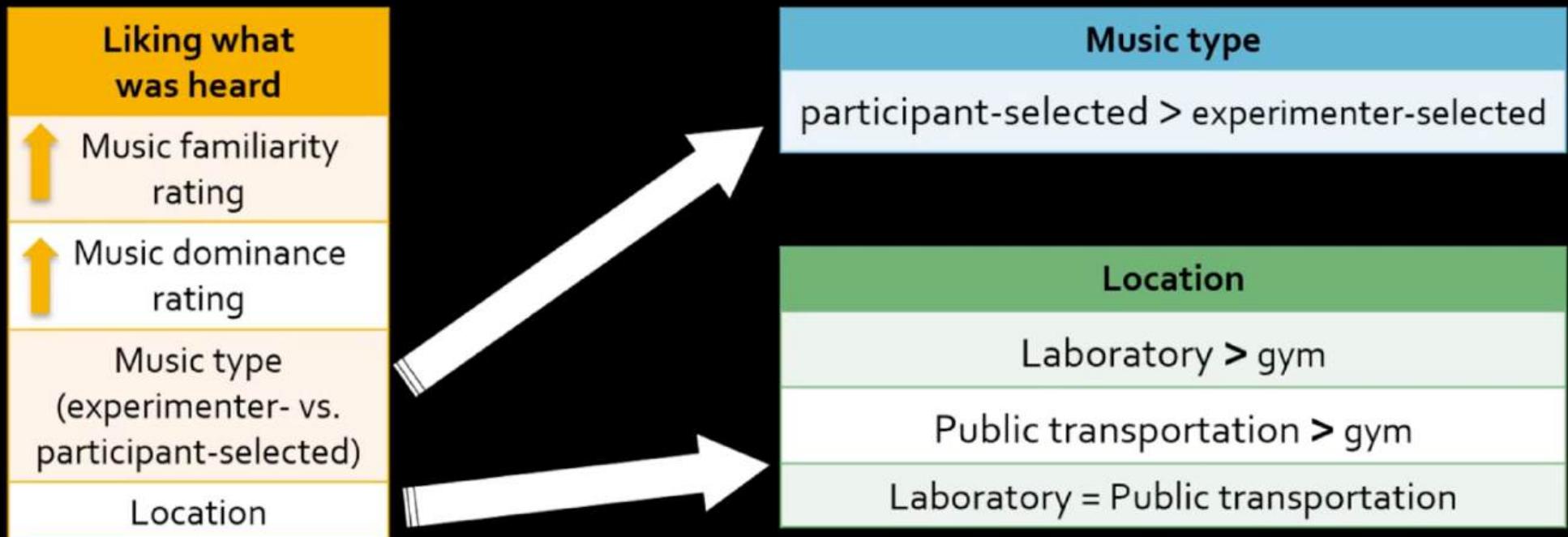
Experiment design	
3 (Location) x 2 (Music)	
At the gym	Experimenter-provided
On public transport	Participant-selected
In the laboratory	--

216 participants (17-51 years old, $M_{age} = 21.50$, $Mdn_{age} = 19$; 78.70% female)

Krause, A. E., & North, A. C. (2017). How do location and control over the music influence listeners' responses? *Scandinavian Journal of Psychology*, 58, 2, 114-122.

PAD model & the role of control

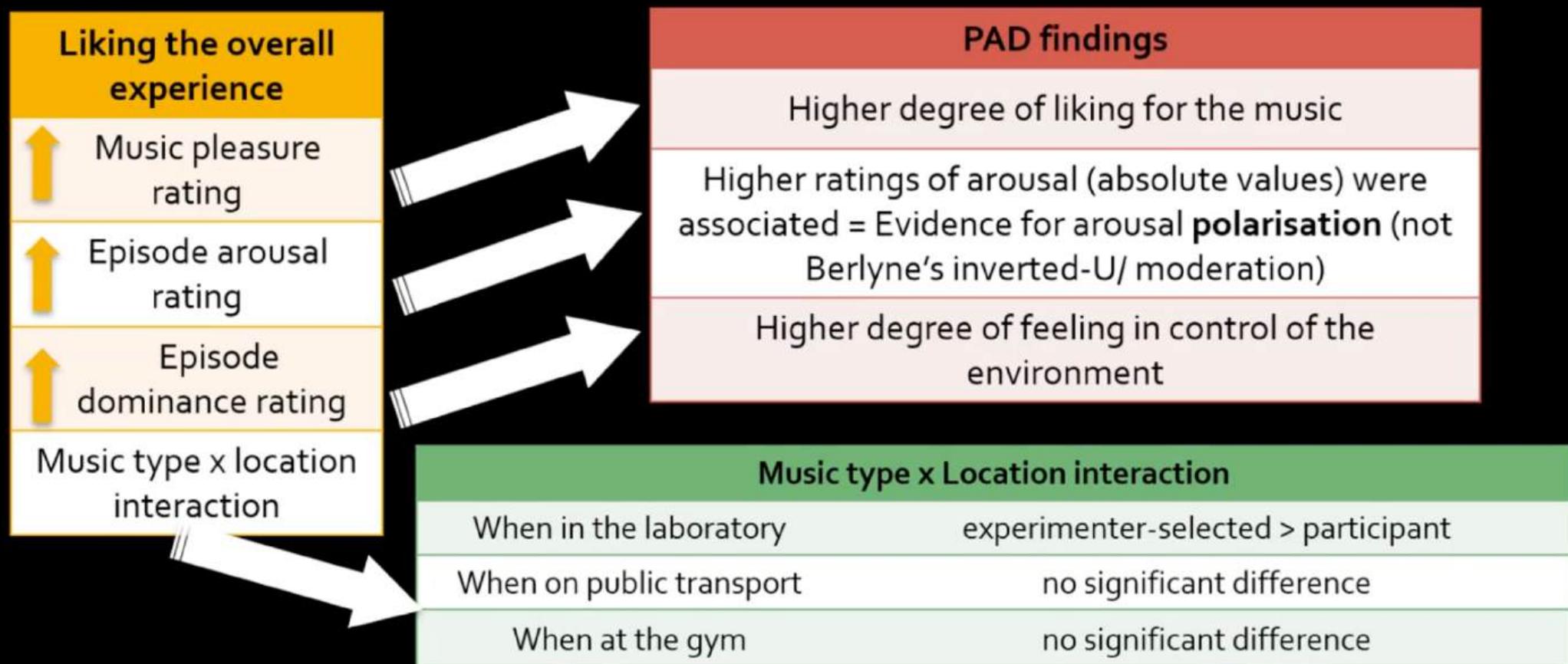
- Response rating regarding the music



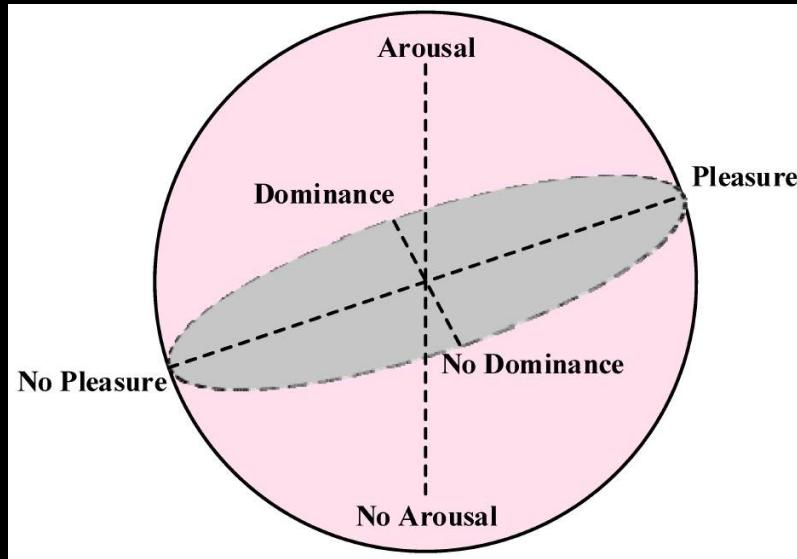
Krause, A. E., & North, A. C. (2017). How do location and control over the music influence listeners' responses? *Scandinavian Journal of Psychology*, 58, 2, 114-122.

PAD model & the role of control

- Response rating regarding the *whole experience*



Krause, A. E., & North, A. C. (2017). How do location and control over the music influence listeners' responses? *Scandinavian Journal of Psychology*, 58, 2, 114-122.



more control/dominance - more positive experience

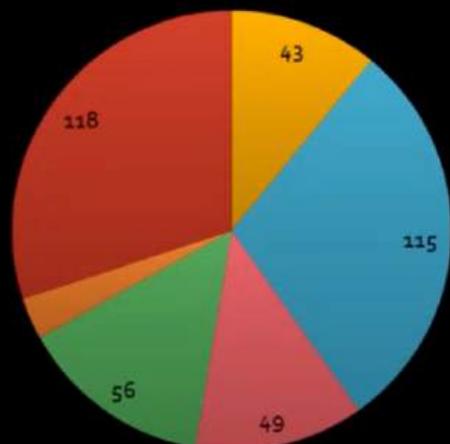
when we like music more - we enjoy what we are doing more

dominance in India??? listening to music itself appears to make you feel a sense of control

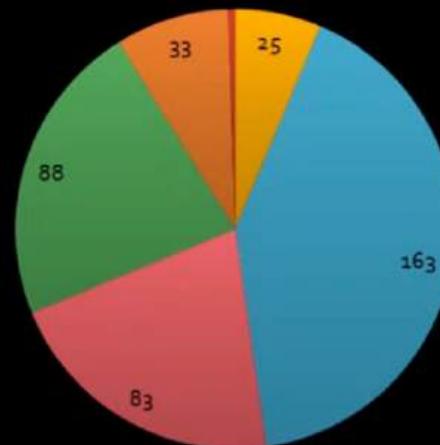
Preferred Devices

Brown and Krause (2016): Newer device use data ($N = 396$)

Favourite



Most often used



- Physical
- Digital file
- Free digital streaming
- Paid-for digital streaming
- Radio
- Live music

Brown, S. C., & Krause, A. E. (2016, July). *A psychological approach to understanding the varied functions that different music formats serve*. In the Proceedings of the 14th International Conference on Music Perception and Cognition, San Francisco, CA, USA.

what differences would we observe if this was done in India?

Preferred Devices

Krause & Brown (2021): Uses and Gratifications of device use

Dimension	Description	Example Items
Usability and intention to use	Continued use based on convenience	I intend to use this format to listen to music in the future; It is enjoyable; It is familiar.
Discovery	Aids discovery of music and broadens taste	It helps me to discover music I would not normally listen to; To sample music before I buy it.
Functional utility	Storage, ability to control selection	I can manage the music easily; It enables me to access the songs I want; It centralizes my music collection.
Flexibility	Portability, playback matches moment-to-moment demands	It is portable; It allows me to listen to music wherever I am; It allows me to listen to music when it best suits.
Connection	Allows user to connect emotionally with music	To connect with myself; I am able to use music to elicit particular moods or states.
Social norms	Others tend to listen to music in this way	Most people who are important to me would approve of me listening to music in this way.
Value for money	A financially viable way of listening to music	It is a financially viable way of listening to music; Using this format helps save me money.
Playback diversity	Format features (shuffle, playlists)	I enjoy creating compilations or playlists; I use shuffle features.

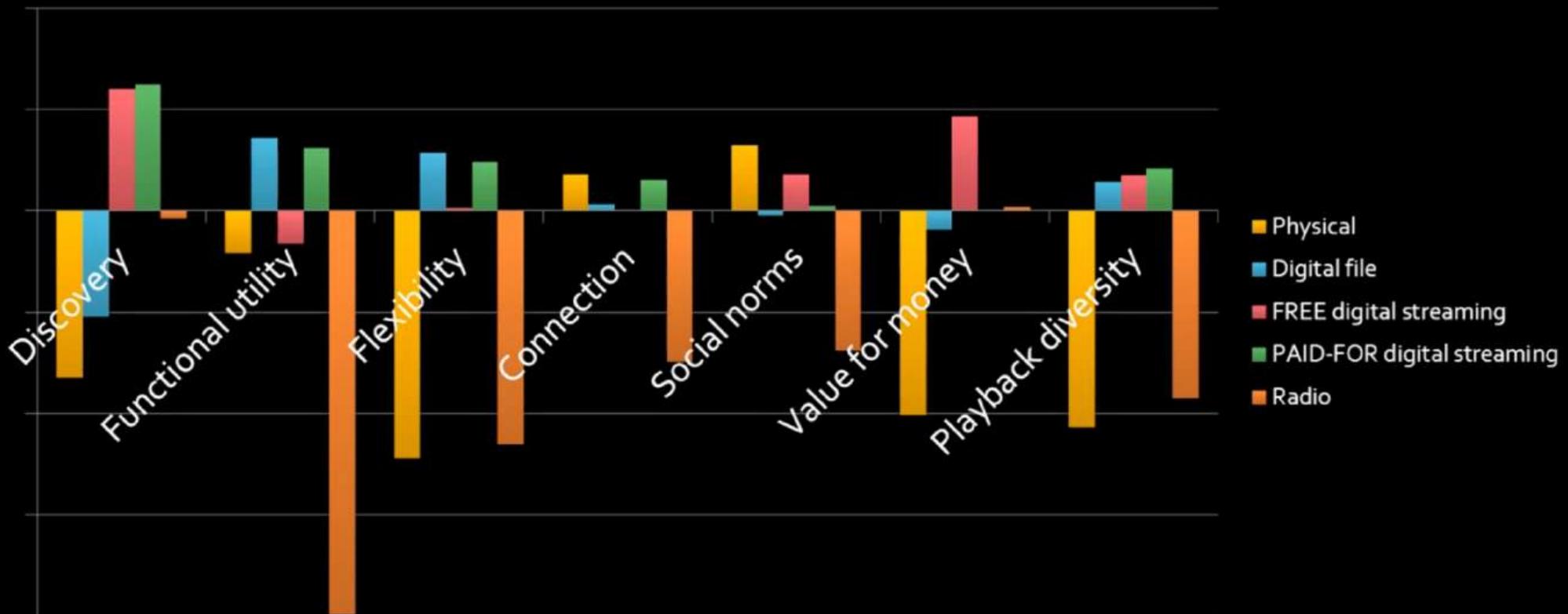
Krause, A. E., & Brown, S. C. (2021). A uses and gratifications approach to considering the music formats that people use most often. *Psychology of Music*, 49, 3, 547-566. <https://doi.org/10.1177/0305735619880608>

a communication theory that explains why people use media to fulfill their needs

project idea???

Preferred Devices

Brown and Krause (2016): Uses and Gratifications of device use
Estimated Marginal Means



Brown, S. C., & Krause, A. E. (2016, July). *A psychological approach to understanding the varied functions that different music formats serve*. In the Proceedings of the 14th International Conference on Music Perception and Cognition, San Francisco, CA, USA.

Preferred Devices

Brown and Krause (2020): Favourite format reasons

- Some themes were present across formats (e.g., unrestricted access; ease of use); others help define and distinguish people's choices

Format	Example of a unique theme	Participant quote(s)
Physical	Sound quality; richness	In terms of vinyl, its superior audio qualities were noted by many participants, including how it is "better" (Male, 19) "richer" (Male, 17), and that it has "warmth" (Male, 43).
Digital file	Private listening	Ability to "listen to whatever music you want without the fear of being judged" (Female, 20).
Free streaming	Affordable	"It's my favourite format because it's free" (Male, 19).
Paid-for streaming	User power	Practical benefits included "customizable options" (Female, 18) such as creating playlists and the "ability to save music to listen to offline" (Female, 18).
Radio	Serendipity; variety	The unpredictability of which songs will be played: how listening to the radio can result in "nice surprises" (Female, 37), and how it is good to "just turn it on and see what plays" (Female, 50).
Live music	Atmosphere, connecting with others, emotional	A concert "has a lot more to offer" (Male, 19), "being amongst other people and the music makers" (Female, 20), with concerts being "unpredictable" (Male, 45), in nature. "Being at a concert brings out a whole different emotion" (Female, 18).

Brown, S.C., & Krause, A.E. (2020). *Freedom of choice: Examining listening as a function of music format preference*. *Psychomusicology: Music, Mind, & Brain*, 30, 2, 88-102. <https://doi.org/10.1037/pmu0000254>

Spotlight on playlists

How are playlists made?

- Are there different types of playlists?
- Krause (2010)
 - Categorized 5 main types of playlists

Playlist types
Artist/ Group
Genre
Specific situation/Activity
Feeling/ Emotion/ Mood
Time (Holiday, Occasion, Season, etc.)

Krause, A. E. (2010). *myTunes: Digital music library users and their self images*. Masters Thesis, Roehampton University.

what would you expect to find in India?

Spotlight on playlists

Contextualized Listening

- A lot of playlists are made to accompany an activity/situation
- Krause and North's (2014) study
 - [Discussed in the lecture on taste]
 - Asked to create a playlist of 10-12 songs for a situation

Playlist situations:
House party with friends
Commuting on public transportation
To use while doing the washing up/ironing
To listen to before going to sleep
For a posh cocktail reception
To listen to after a long day of work
For a wedding
To use while jogging with an mp3 player

Krause, A. E., & North, A. C. (2014). Contextualized music listening: Playlists and the Mehrabian and Russell model. *Psychology of Well-Being: Theory Research and Practice*, 4: 22.

what would you expect to find in India?

Spotlight on playlists

Krause and North's (2014) study

- Analyses demonstrated that preferred playlist music varied by situation

Arousing = loud, invigorating, attention-grabbing	
↑	Jogging with an mp3 player At a house party
Overall mean	
↓	Before going to sleep At a cocktail party

Sophisticated = sophisticated/classy, sensual, beautiful	
↑	At a wedding At a cocktail party
Overall mean	
↓	After a long day At a house party
	Jogging with an mp3 player While commuting on public transportation

Krause, A. E., & North, A. C. (2014). Contextualized music listening: Playlists and the Mehrabian and Russell model. *Psychology of Well-Being: Theory Research and Practice*, 4: 22.

Everyday listening and well-being

Music engagement and well-being

- More than 500 benefits reported in published work
(Krause, et al. 2018)



- Social, emotional, cognitive, spiritual, physical, quality of life

Krause, A. E., Davidson, J. W., & North, A. C. (2018). Musical activity and well-being: A new quantitative measurement instrument. *Music Perception*, 35, 4, 454-474.
<https://doi.org/10.1525/MP/2018.35.4.454>

Everyday listening and well-being

Social

- Gives you opportunities to make and keep friends
(e.g., Jutras, 2011)
- Helps you feel connected + involved in a community
(e.g., Creech, et al., 2013)

Emotional

- A big **reason** for listening is to **manage mood** (Lonsdale & North, 2011)
- Positive emotions (Bungay & Skingley, 2008)
- Stress release, relaxation (Jutras, 2011) & catharsis (Garrido, 2017)
- Processing & expressing emotions
(e.g., Bailey & Davidson, 2005)

Jutras, P. J. (2011). The benefits of new horizons band participation as self-reported by selected New Horizons band members. *Bulletin of the Council for Research in Music Education*, 187, 65-84.

Creech, A., Hallam, S., Gaunt, H., McQueen, H., Pincas, A., & Varvarigou, M. (2013). The power of music in the lives of older adults. *Research Studies in Music Education*, 35, 1, 87-102.

Lonsdale, A.J., & North, A.C. (2011). Why do we listen to music? A uses and gratifications analysis. *British Journal of Psychology*, 102, 1, 108-134.

Bungay, H., & Skingley, A. (2008). The silver song club project: Summary of a formative evaluation. Canterbury: Canterbury Christ Church University.

Jutras, P. J. (2011). The benefits of new horizons band participation as self-reported by selected New Horizons band members. *Bulletin of the Council for Research in Music Education*, 187, 65-84.

Bailey, B. A., & Davidson, J. W. (2005). Effects of group singing and performance for marginalized and middle-class singers. *Psychology of Music*, 33(3), 269-303.

Garrido, S. (2017). *Why Are We Attracted to Sad Music?* Palgrave MacMillan.

Everyday listening and well-being

Cognitive (Music & Memory)

- Supports QoL in PWD (Särkämö, et al., 2016)
- Alzheimer's and autobiographical recall (El Haj, et al., 2015)
- Benefits for 'healthy' folks, too (e.g., Thompson, et al., 2005)
 - e.g., higher intelligence (Schellenberg, 2005) and supporting creativity/ imagination (Kokotsaki & Hallam, 2011)

Physical (Cue to move)

- Improvements after stroke (van Wijck, et al., 2011)
- Improves walking with Parkinson's disease (Hove & Keller, 2015)
- Children walk farther when listening (Reychler, et al., 2017)
- Improves sports performance (Karageorghis, et al., 2013)

Särkämö, T., Laitinen, S., Numminen, A., Kurki, M., Johnson, J. K., & Rantanen, P. (2016). Clinical and demographic factors associated with the cognitive and emotional efficacy of regular musical activities in dementia. *Journal of Alzheimers Disease*, 49, 3, 767-781.

El Haj, M., Antoine, P., Nandrino, J. L., Gély-Nargeot, M.-C., & Raffard, S. (2015). Self-defining memories during exposure to music in Alzheimer's disease. *International Psychogeriatrics*, 27, 10, 1719-1730.

Thompson, R.G., Moulin, C.J.A., Hayre, S., & Jones, R.W. (2005). Music enhances category fluency in older adults and Alzheimer's disease patients. *Experimental Aging Research*, 31, 91-99.

Schellenberg, G. (2005). Music and cognitive abilities. *Current Directions in Psychological Science*, 14, 6, 317-320.

Kokotsaki, D., & Hallam, S. (2011). The perceived benefits of participative music making for non-music university students: a comparison with music students. *Music Education Research*, 13(2), 149-172.

van Wijck, F., Knox, D., Dodds, C., Cassidy, G., Alexander, G., & MacDonald, R. A. R. (2011). Making music after stroke: Using musical activities to enhance arm function. *Annals of The New York Academy of Sciences*, 305-311.

Hove, M. J., & Keller, P. E. (2015). Impaired movement timing in neurological disorders: Rehabilitation and treatment strategies. *Annals Of The New York Academy Of Sciences*, 1337, 111-117.

Reychler, G., Fabre, J., Lux, A., Caty, G., Pieters, T., & Liistro, G. (2017). Influence of different kinds of music on walking in children. *Rehabilitation Nursing*, 42, 1, 33-38.

Karageorghis, C. I., Hutchinson, J. C., Jones, L., Farmer, H. L., Ayhan, M. S., Wilson, R. C., . . . Bailey, S. G. (2013). Psychological, psychophysical, and ergogenic effects of music in swimming. *Psychology of Sport and Exercise*, 14, 560-568.

Everyday listening and COVID19

Music listening time has typically increased during the pandemic

(Cabedo-Mas et al., 2021; Carlson et al., 2021; Fink et al., 2021)

- increase may be related to another common finding that people listen to music more frequently to cope with stress, regulate moods and emotions, and connect with others during the pandemic than under usual circumstances
(Cabedo-Mas et al., 2021; Fink et al., 2021; Granot et al., 2021; Henry et al., 2021; Ribeiro et al., 2021b; Vidas et al., 2021)
- Krause, et al. (2021) study with uni students: at the within-person level, life satisfaction was positively associated with music listening and negatively associated with watching TV/videos/movies

Krause, A. E., Dimmock, J., Rebar, A., & Jackson, B. (2021). Music listening predicted improved life satisfaction in university students during early stages of the COVID-19 pandemic. *Frontiers in Psychology*, 11: 631033. <https://doi.org/10.3389/fpsyg.2020.631033>
Terasawa, H., Matsubara, M., Goudarzi, V., & Sadakata, M. (2021). Music in quarantine: Connections between changes in lifestyle,

Final Thoughts



- Consuming music is not “simply about listening but involves the ways it becomes integrated into our personal and social lives. This is very much determined by the technologies through which we experience it: how music is distributed, rendered, purchased, organized, shared, chosen, listened to, interacted with and repurposed”
(O’Hara & Brown, 2006, p. 3)
- Technologies still evolving – future music technologies are yet to come
 - But vital for research on music behaviors “to keep in touch with these technological developments in order to maintain its ecological validity”
(Krause & Hargreaves, 2013)

O’Hara, K., & Brown, B. (2006). Consuming music together: Introduction and overview. In K. O’Hara & B. Brown (Eds.), *Consuming music together: Social and collaborative aspects of music consumption technologies* (pp. 3-18). Dordrecht, The Netherlands: Springer.

Krause, A. E., & Hargreaves, D. J. (2013). myTunes: Digital music library users and their self images. *Psychology of Music*, 41, 5, 531-544.



Music as a mirror of
the self

Musical Preferences & Individual Differences

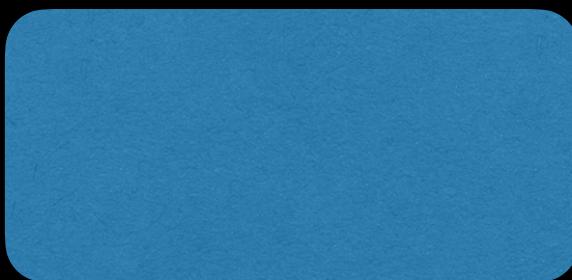
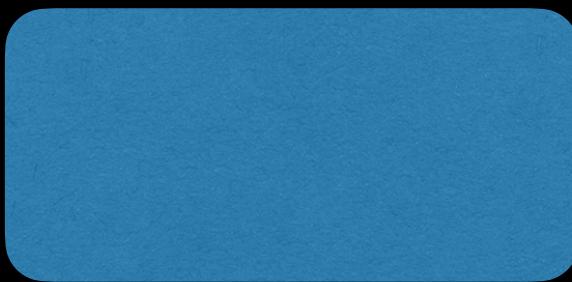
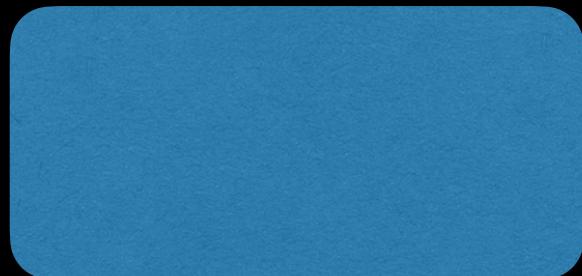


measure preferences?

measure individual differences?

what do we know so far?

Music Preferences ?



Music Preferences ?

Emotion
(Felt vs Perceived)

Musical Genre

Dance form
(eg: salsa)
Movement Genre

Mood

Artist

Perceptual attributes
(eg: loud, soft, intense)

Lyrical Aspects
(Topics, emotion)

Psychological attributes
(eg: complex, inspiring,
sophisticated)

Social Aspects
(Popularity, Identity,
Bonding)

Your musical preference: responses

- Lyrical content (way of using language as part of music, way of verbal expression)
- Changes & dynamics (genre change in middle of song)
- Playing myself, reminds of specific time, memory of listening to the composer
- Beauty, balance, music encompassing life from beginning to end
- Jealousy for the wonderful experience music is describing, composer envy/admiration
- The way of reproducing a cover song from original
- Visual connotation music evokes, the atmosphere music creates
- Timbre & instrumentation of the music
- Developing melody or theme in the song – music grows / goes forward
- Personal connection, feeling something for the performer
- Images that lyrics evoke (even though meaning is not completely clear)

Individual Differences ?

Age

Gender

Current State

Mental Health

Traits (personality,
empathy)

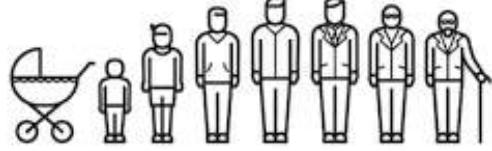
Culture

Physical Dysfunction

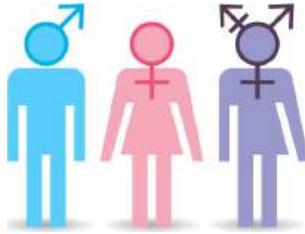
Musical Expertise

SES

Individual Differences



age



gender



traits



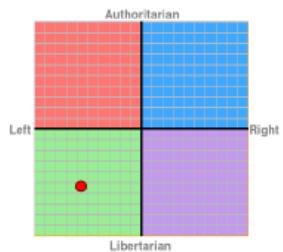
skills



states/arousal level



cognitive styles

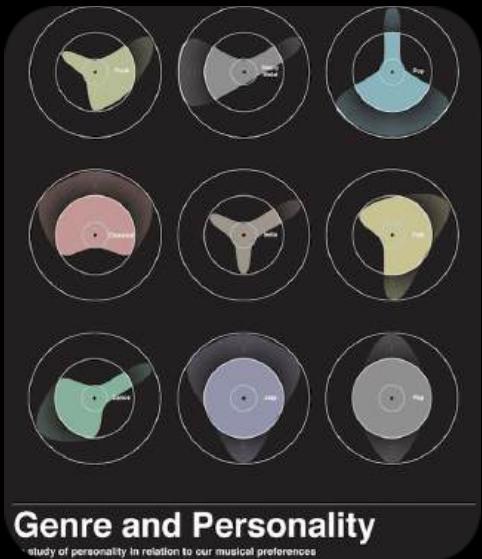


political leanings



disease/brain disorders

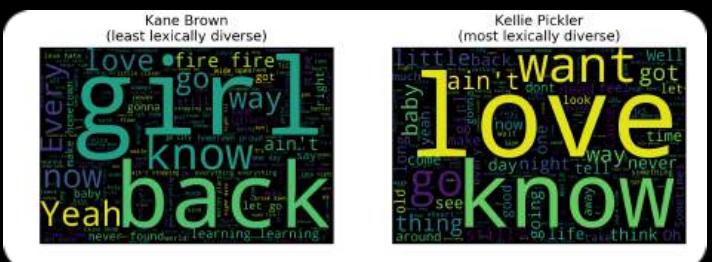
Musical Preferences & Individual Differences



“individuals are drawn to the social and cultural meanings in music that match their personal characteristics and concerns”

Rentfrow, P. J., & Gosling, S. D. (2003).

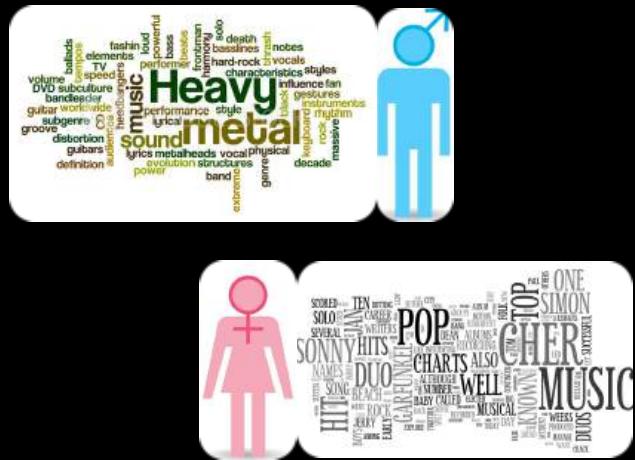
The do re mi's of everyday life: The structure and personality correlates of music preferences. Journal of Personality and Social Psychology, 84(6), 1236-1256.
<http://dx.doi.org/10.1037/0022-3514.84.6.1236>



“people use linguistic cues in lyrics as stimuli to fulfill their individual needs”

Qiu, L., Chen, J., Ramsay, J., & Lu, J. (2019). **Personality predicts words in favorite songs**
Journal of Research in Personality 78 (2019) 25–35

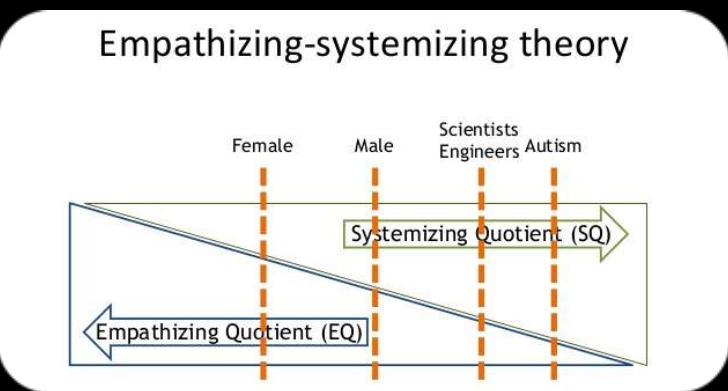
Musical Preferences & Individual Differences



“greater preference for heavier contemporary music among men and of chart pop music among women”

Colley (2008), *J. Appl. Social Psychol.*, vol. 38, no. 8, pp. 2039–2055; Hargreaves et al. (1995) *J. Res. Music Educ.*, vol. 43, no. 3, pp. 242–250.

Empathizing-systemizing theory



empathisers - mellow
systemizers - intense

Musical Preferences & Individual Differences



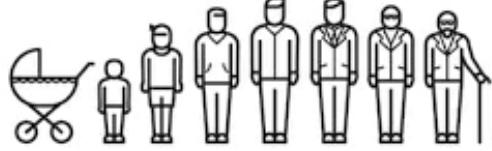
“people who feel the pain of sad songs may be better at feeling the pain of other human beings”

Vuoskoski, J. K., Thompson, B., McIlwain, D., and Eerola, T. (2012). **Who enjoys listening to sad music and why?** *Music Percept.* 29, 311–317

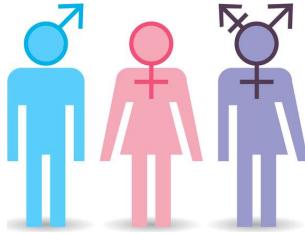
“musical preferences are an expression of who we are **emotionally, socially, and cognitively**”



Individual Differences



age



gender



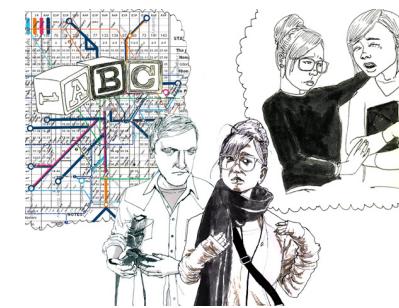
traits



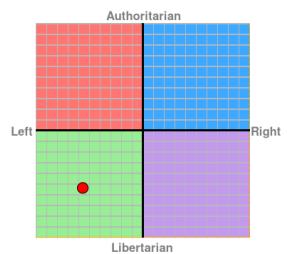
skills



states/arousal level



cognitive styles



political leanings



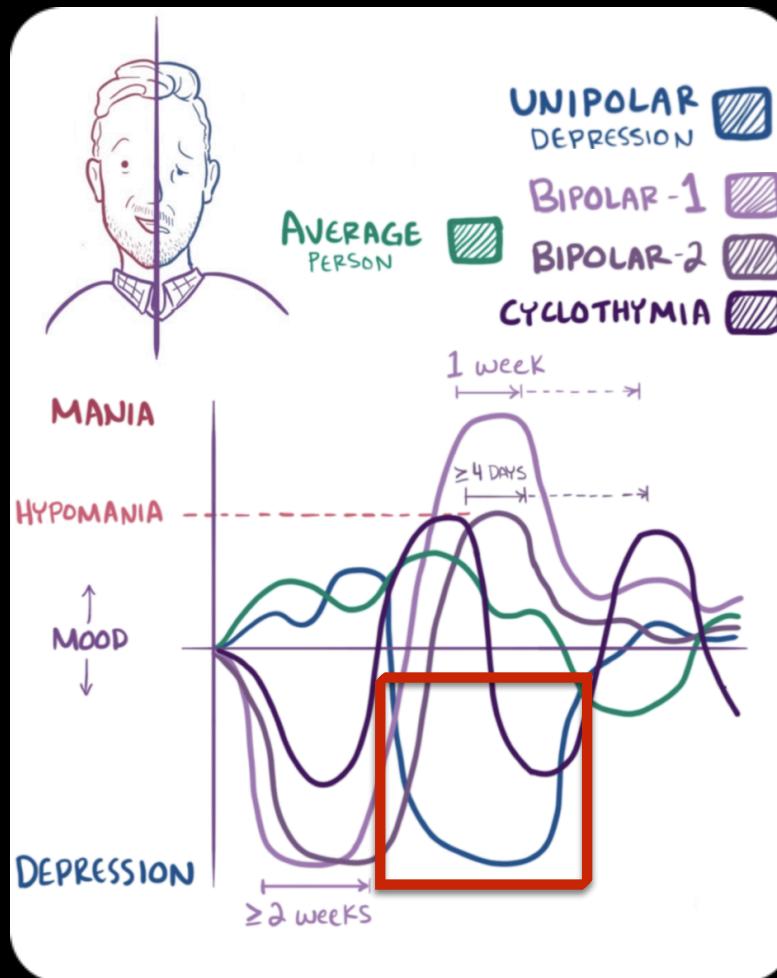
disease/brain disorders



Individual Traits, States & Well-Being

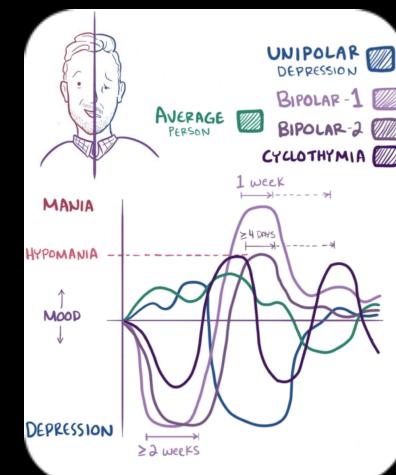
- **neuroticism** related to risk of depression (Paulus et al., 2016)
- rumination on cause of sadness associated with more symptoms of depression and anxiety (Roelofs et al., 2008)
- higher musical engagement for emotion focused-coping especially during periods of depression (Stewart et al., 2019; Miranda et al., 2012)

Individual Traits, States & Well-Being



Individual Traits, States & Well-Being

- high emotional variability and emotional inertia are indicators of ill-being and forms of psychopathology such as depression, bipolar disorder, and borderline personality disorder (Kuppens, 2017)



Musical Preferences & Depression



"people with a tendency for depression demonstrate a liking for sad music"

Garrido, S and Schubert, E (2015). Music and people with tendencies of depression. *Music Perception*, 32, 4, pp. 313–321,

why?

induce consolation (Huron, 2011)

safe place/space to accept sadness (Van Den Told et al, 2016)

Musical Preferences & Depression

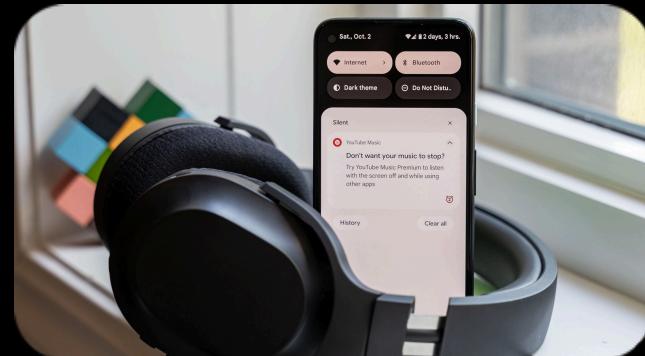


“people with a tendency for depression demonstrate a liking for sad music”

Garrido, S and Schubert, E (2015). Music and people with tendencies of depression. *Music Perception*, 32, 4, pp. 313–321,

depression group chose

- more sad and less happy music excerpts
- chose less energetic music excerpts
- “sad music is calming”



Yoon, S., & Rottenberg, J. (2021). Listening to the blues: An ecological momentary assessment of music choice in depression. *Emotion*, 21(6), 1177.

Musical Preferences & Depression



"people with a tendency for depression demonstrate a liking for sad music"

Garrido, S and Schubert, E (2015). Music and people with tendencies of depression. *Music Perception*, 32, 4, pp. 313–321,



"an instrument to detect a risk for depression and potentially other mental health problems in a nonintrusive way"

Saarikallio S, Gold C, Mcferran K. 2015. Development and validation of the Healthy-Unhealthy Music Scale. *Child Adolesc Ment Health*. 20:210–217.



HEALTHY-UNHEALTHY MUSIC SCALE



Saarikallio S, Gold C, Mcferran K. 2015. **Development and validation of the Healthy-Unhealthy Music Scale**. Child Adolesc Ment Health. 20:210–217.



HEALTHY-UNHEALTHY MUSIC SCALE



Kessler Psychological Distress Scale (K10)



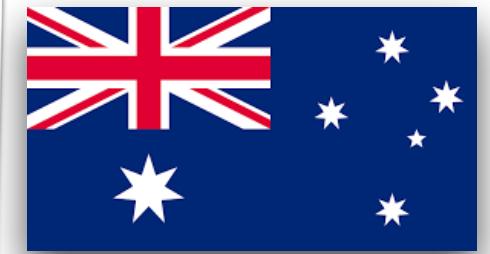
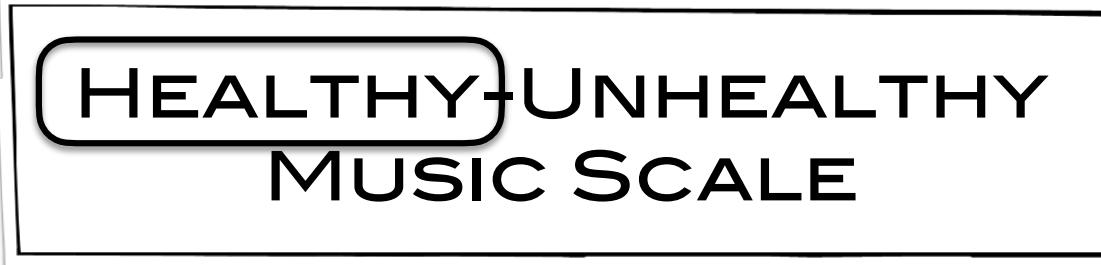
Saarikallio S, Gold C, Mcferran K. 2015. **Development and validation of the Healthy-Unhealthy Music Scale**. Child Adolesc Ment Health. 20:210–217.



HEALTHY-UNHEALTHY MUSIC SCALE



	Never	Rarely	Sometimes	Often	Always
1. When I listen to music I get stuck in bad memories	<input type="checkbox"/>				
2. I hide in my music because nobody understands me, and it blocks people out	<input type="checkbox"/>				
3. Music helps me to relax	<input type="checkbox"/>				
4. When I try to use music to feel better I actually end up feeling worse	<input type="checkbox"/>				
5. I feel happier after playing or listening to music	<input type="checkbox"/>				
6. Music gives me the energy to get going	<input type="checkbox"/>				
7. I like to listen to songs over and over even though it makes me feel worse	<input type="checkbox"/>				
8. Music makes me feel bad about who I am	<input type="checkbox"/>				
9. Music helps me to connect with other people who are like me	<input type="checkbox"/>				
10. Music gives me an excuse not to face up to the real world	<input type="checkbox"/>				
11. It can be hard to stop listening to music that connects me to bad memories	<input type="checkbox"/>				
12. Music leads me to do things I shouldn't do	<input type="checkbox"/>				
13. When I'm feeling tense or tired in my body music helps me to relax	<input type="checkbox"/>				



“Music helps me relax”

“I feel happier after playing or
listening to music”

“Music helps me connect with
other people who are like me”



HEALTHY-UNHEALTHY MUSIC SCALE



“I hide in my music because nobody
understands me, and it blocks people out” **avoidance**

rumination

“I like to listen to songs over and over
even though it makes me feel worse”

“It can be hard to stop listening to music that
connects me to bad memories”



HEALTHY-UNHEALTHY MUSIC SCALE



UNHEALTHY
SCORE



Kessler
Psychological
Distress Scale
(K10)



Saarikallio S, Gold C, Mcferran K. 2015. **Development and validation of the Healthy-Unhealthy Music Scale**. Child Adolesc Ment Health. 20:210–217.



HEALTHY-UNHEALTHY MUSIC SCALE



“HUMS is **not a direct measure of depression** but

.....an instrument to detect **a risk for depression** and potentially other mental health problems in a **nonintrusive** way.”

“a **high HUMS Unhealthy score** could be followed up with a screening measure for **depression and suicide risk.**”



HEALTHY-UNHEALTHY MUSIC SCALE



n = 141

(mean age = 24.32, sd = 3.83 years, 80 males)

Subramaniam, S., Mittal, A., Alluri, V. (2018). **Indian Validation of Healthy-Unhealthy Music Scale (HUMS)**. International Conference on Music Perception and Cognition. Poster.



HEALTHY-UNHEALTHY MUSIC SCALE



n = 151

(mean age = 29.3, sd = 6.7 years, 91 males)

HEALTHY-UNHEALTHY MUSIC SCALE

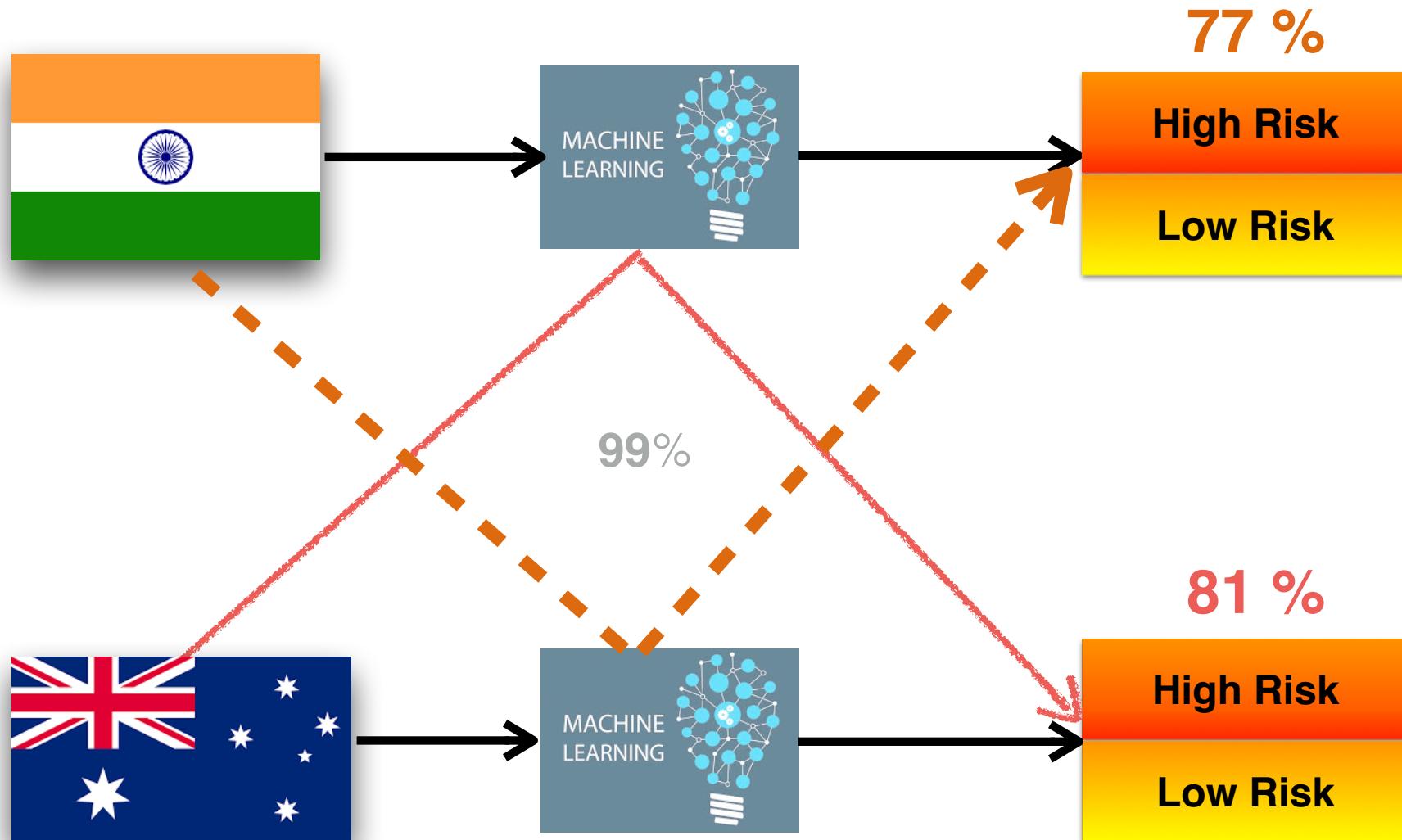


Scales	Original Study		Current Study	
	Healthy	Unhealthy	Healthy	Unhealthy
Healthy	1		1	
Unhealthy	0.14*	1	0.21*	1
K10	0.18**	0.67**	0.01	0.54**
MHCSF	0.09	-0.48**	0.18*	-0.22*
Rumination	0.21**	0.50**	-0.06*	0.44**
Reflection	0.24**	0.01	0.01	0.03

*p < .05; **p < .01

Partial correlations (controlling gender) between various scales

Predicting Risk from Listening Strategies



HEALTHY-UNHEALTHY MUSIC SCALE



n = 65

(mean age = 27, sd = 8.3 years, 35 males)



n = 285

(mean age = 29, sd = 9.8 years, 136 males)

HEALTHY-UNHEALTHY MUSIC SCALE



Kessler Psychological
Distress Scale (K10)



UNHEALTHY
SCORE

$r = 0.17$

UNHEALTHY
SCORE

$r = -0.17$

Healthy and **Unhealthy**

$r = 0.23$

GROOVE

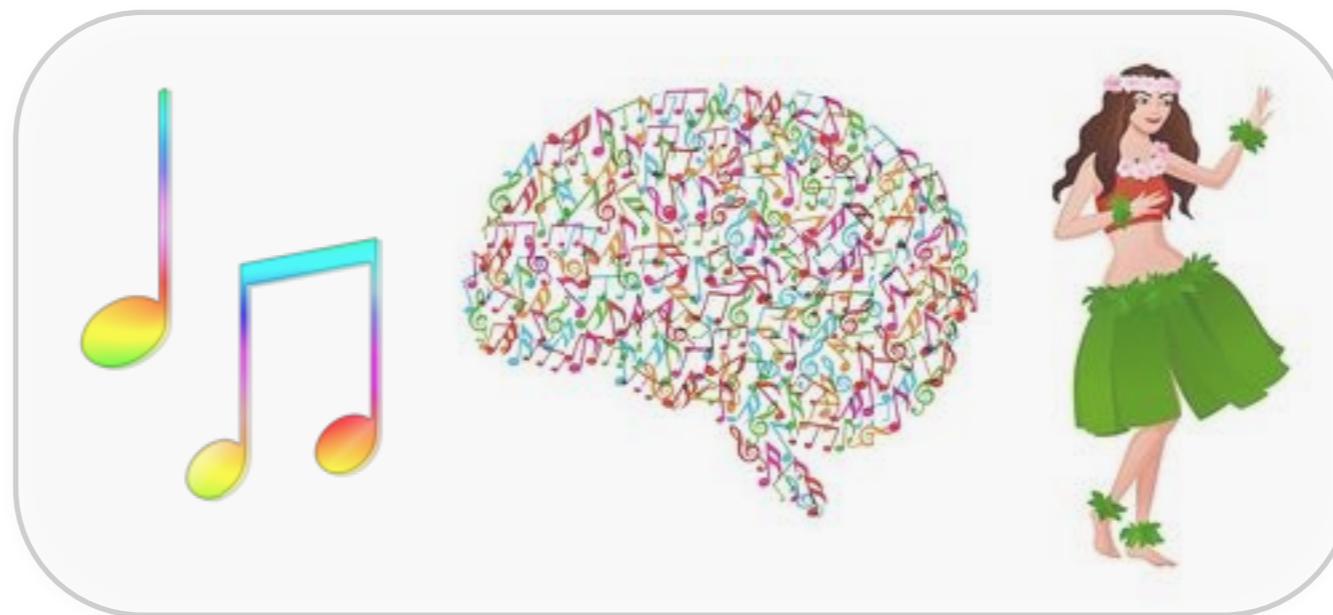
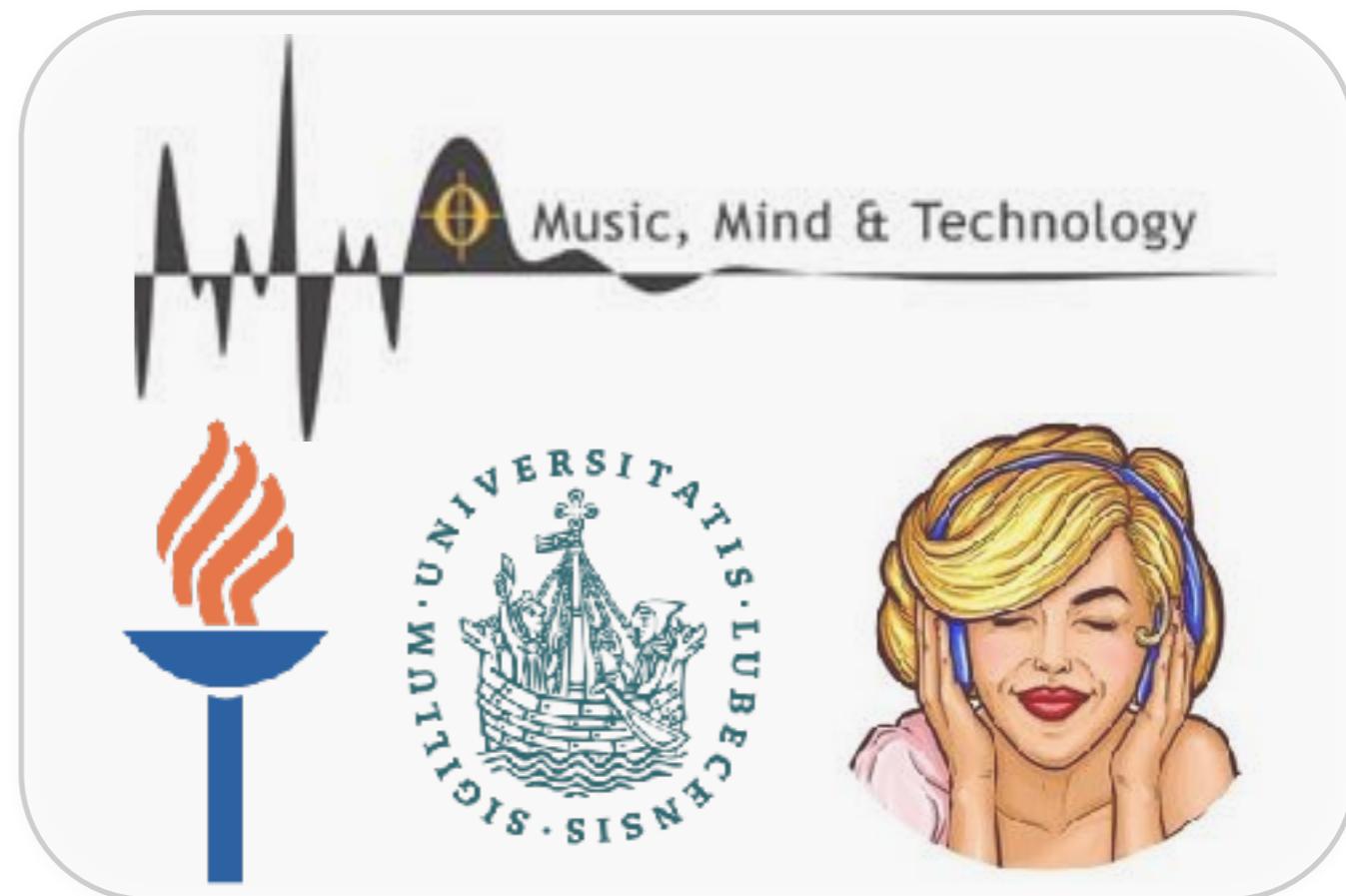


Dr. Deniz Duman

International Institute of Information Technology, Hyderabad

17 January 2025

Ψ



How can groove research be applied
in real life to make an impact on
today's society?

Origin of Music & Dance...



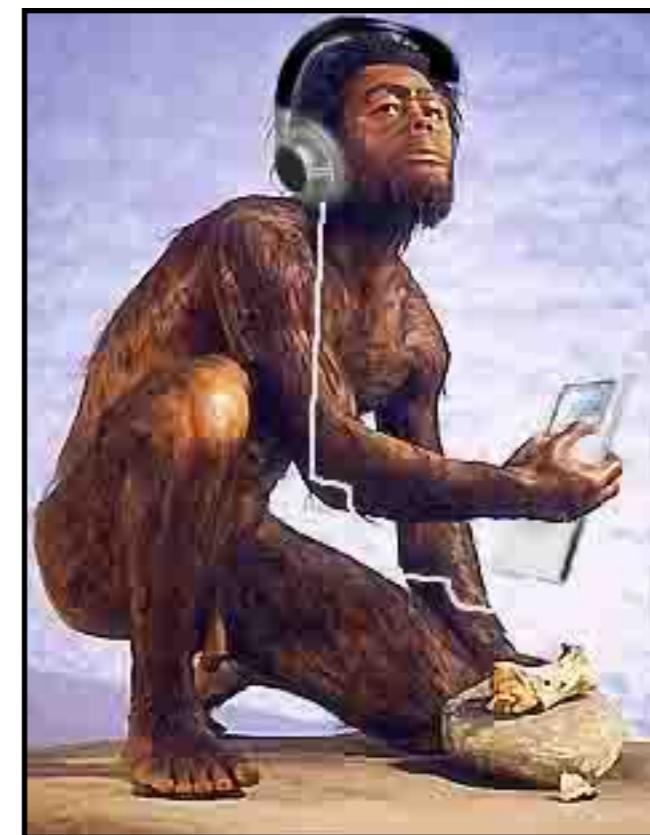
- **Ritual activities** - (eg. - agriculture, hunting, dry season)
- **Transmits knowledge across generations** (eg. - In Vietnam, guidance for planting and harvesting crops)
- **Management of social relationships** (eg. - lament for the dead, birthday songs)

Origin of Music & Dance...



(Laland, Wilkins, & Clayton, 2016; Patel, 2014)

MUSIC = DANCE



(Trehub, Becker, & Morley, 2015)

MUSIC = DANCE



<https://www.youtube.com/watch?v=MOsZhZIQ-6Q>

What is Groove ?

What is Groove?

- Familiar term in the field of music:
 - ‘I am in the groove.’
 - ‘This band plays groovy.’
 - ‘This song grooves.’
- “Like catching water in a net” (Hosken, 2020, p182)
- Various descriptions depending on the descriptor, the context, and the era.

What is Groove?

changing connotations over history...

- **Returning to one's old self** - “He was very ill but now he's back in the groove.”
- **Being immersed in a task smoothly and efficiently** - “If I'm in the groove, I can clean for hours.”
- **Experiencing a particularly successful period** – “Three championship titles in a row? Wow, that team is really in the groove.”
- **Performance / playing style** - “The jazz musicians gave no grandstand performances; they simply got a great burn from playing in the groove.”
- **Good / cool / hip (slang)** - “There are a lot of guys going round with groovy hair-styles.”

(The Oxford English Dictionary, n.d.)

What is Groove?

changing connotations over history...

- **1940s** - swing and jazz era - ‘in the groove’ ==> a specific musical routine, preference, or style, indicating its aesthetic properties (Kernfeld, 2002)
- **1970s** - associated with funk and soul (Hale, 2014)
 - used as a phrase to say ‘cool’ (Hein, 2011; Runyan et al., 2013)

What is Groove?

various perspectives from branches of musicology...

- **Ethnomusicology:** “unspecifiable but ordered sense of something that is sustained in a distinctive, regular and attractive way, working to draw a listener in” (Feld, 1988, p.76)
- The power of music lies in the **participatory discrepancies** , and there are basically of two kinds:
 - **Processual:** groove, beat, vital drive, swing, pulse, push
 - **Textural:** timbre, sound, tone qualities
- Music to be *personally* involving and *socially* valuable, must be “*out of time*” and “*out of tune*”. (Keil, 2010)

What is Groove?

various perspectives from branches of musicology...

Like driving a car on snow...

“As you change lanes you slide just a bit, then you feel your tires settle into grooves made by the tires of other cars. You have some sense of the firmness and path of these grooves – less by actually seeing them, more through your body. [...] In a musical groove, a musician, dancer, or an engaged listener has a similar feeling of being pulled-into a musical ‘notch’, guided-onto a musical ‘track’, buoyed by a rhythm, being lifted up and carried along. [...] Loosely speaking, a groove is the feel of a rhythm.”

(Roholt, 2014, p.1)

What is Groove?

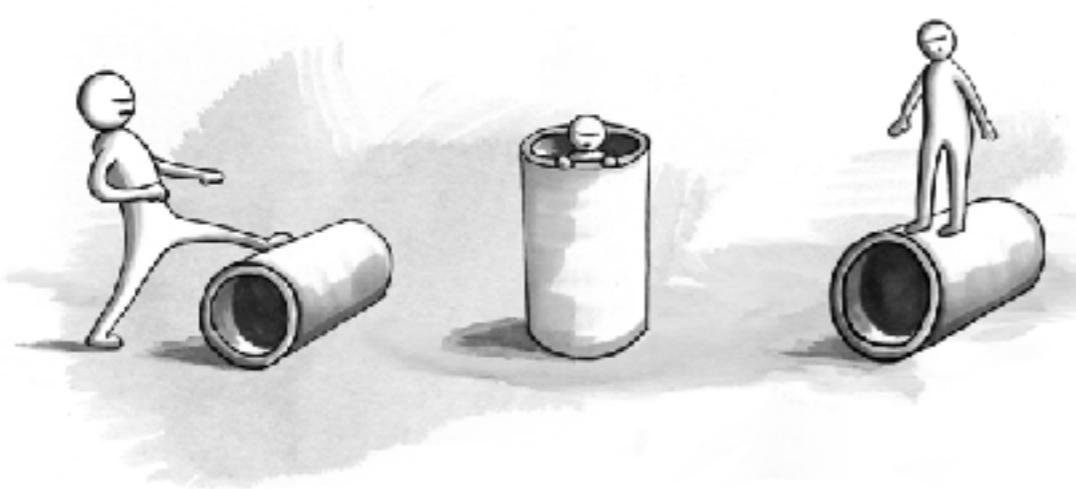
various perspectives from branches of musicology...

- **Music Psychology:** “pleasurable desire to move to music”

(Janata et al., 2012, Kowalewski et al., 2020; Matthews et al., 2020; Lustig & Tan, 2020; Senn et al., 2020; Haugen & Danielsen, 2020)



Prof. Eric Clarke



LISTENING ENVIRONMENT

Locational aspect

indoors, outdoors, club, commute, festival, YouTube, Spotify...

Social aspect

alone, with others, close circle, strangers...

Temporal aspect

Season, day of the week, period of the day

Musical aspect

performance; artists, instruments, styles, musical features; time- & pitch-related

LISTENER

Fixed personal factors

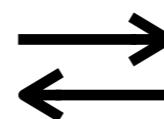
age, gender, genes, nationality, culture, personality traits, capacity for empathy, proneness to dance

Skills, habits, preferences

musical expertise, dance expertise, familiarity, exposure, memories

Temporary individual factors

current mood, goals and reasons for listening, substance use



ACTION (POSSIBILITIES) (affordances)

Immersion

Movement

Positive Affect

Social Connection

What makes groove groove ?

What makes some songs more groovy than the others?

On Performance of Groove...



On Performance of Groove...

<https://www.youtube.com/watch?v=uLQW4jI3j2Q&t=328s>



Groove from Listeners' Perspective

The groove depends on the extent to which the music makes you want to move. ($N=152/152$)

I like to listen to music that "grooves." ($N=76/76$)

The groove depends on the extent to which you feel you are a part of the music. ($N=148/149$)

The groove depends on the presence of a strong underlying beat. ($N=148/152$)

The groove depends on the emphasis or accent of certain beats over others (i.e. downbeats vs. offbeats). ($N=137/151$)

The groove depends on the tempo of the music. ($N=149/152$)

The groove depends on the precision of timing (i.e., how well the musical events "line up" in time). ($N=76/78$)

The music I most enjoy listening to "grooves." ($N=77/78$)

The groove depends on the specific rhythmic patterns that are employed (LONG-short-short, LONG-short-short). ($N=72/79$)

The groove is more readily experienced when you are in a good mood or a positive emotional state. ($N=151/152$)

Most of the music I choose to listen to "grooves." ($N=74/76$)

The groove depends on how "catchy" the tune is. ($N=73/74$)

The groove depends on the specific instruments that are sounding ($N=14$)

The groove depends on how much you like the music. ($N=74/74$)

The groove depends on the contrast or interplay of rhythmic patterns across different instruments/drum sounds. ($N=75/78$)

The groove depends on the repetition of a given rhythmic pattern. ($N=14$)

Fast music grooves. ($N=147/151$)

Table 1
Word Frequencies Across 153 Definitions of the Term Groove

Word	Frequency
music	140
groove	85
move	53
beat	49
rhythm	46
dance	43
feel	36
with	36
make	30
your	25
want	22
flow	19
listen	19
song	19
body	18
enjoy	15

Note. Articles, pronouns, prepositions, common verbs, and words occurring less than 10 times have been excluded.

Musical Features of Groove

- Rhythmicity (relates to temporal predictability)
- Sonic factors (relate to beat density and salience)
- Syncopation
- Tempo
- Pitch

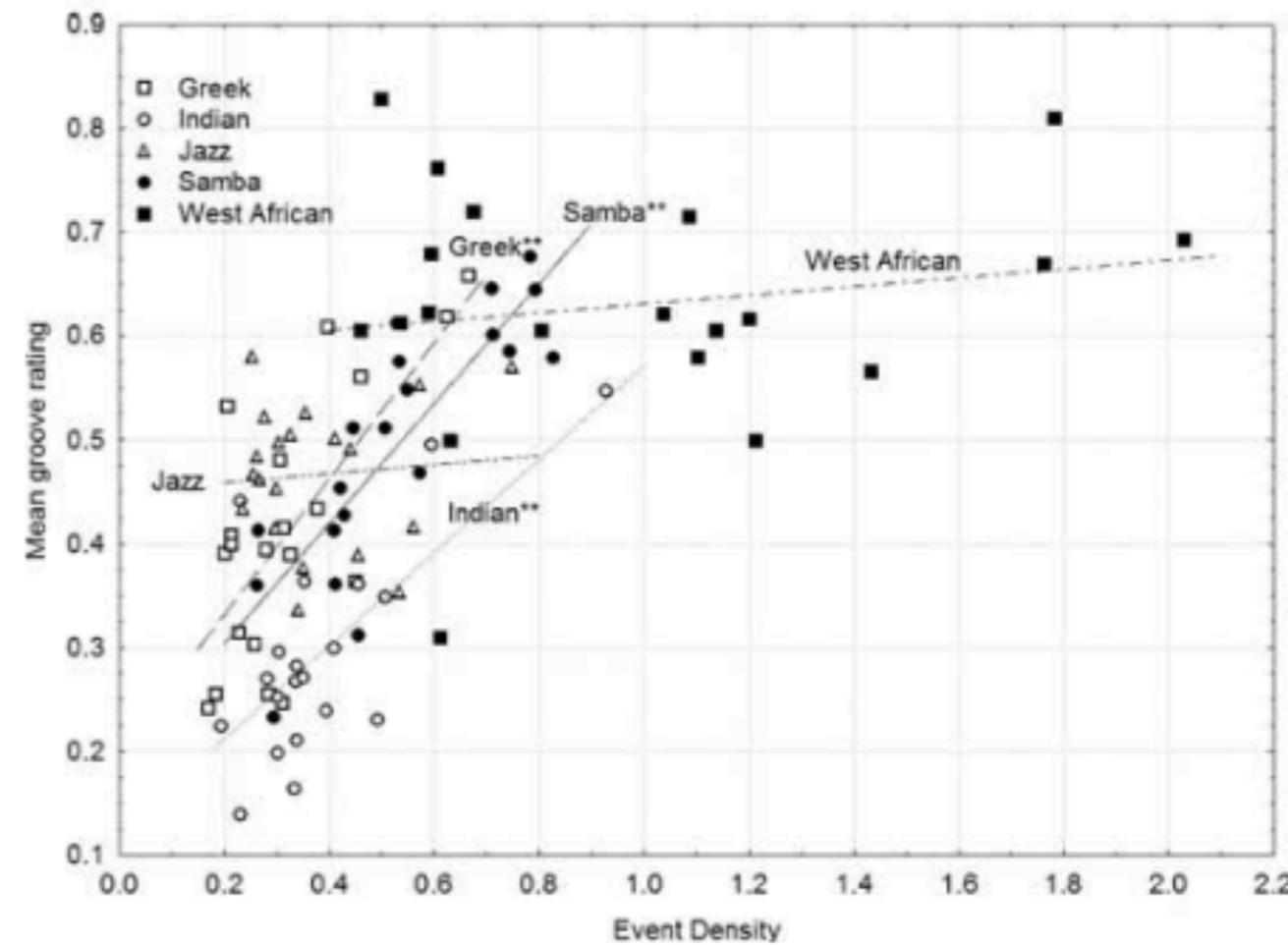
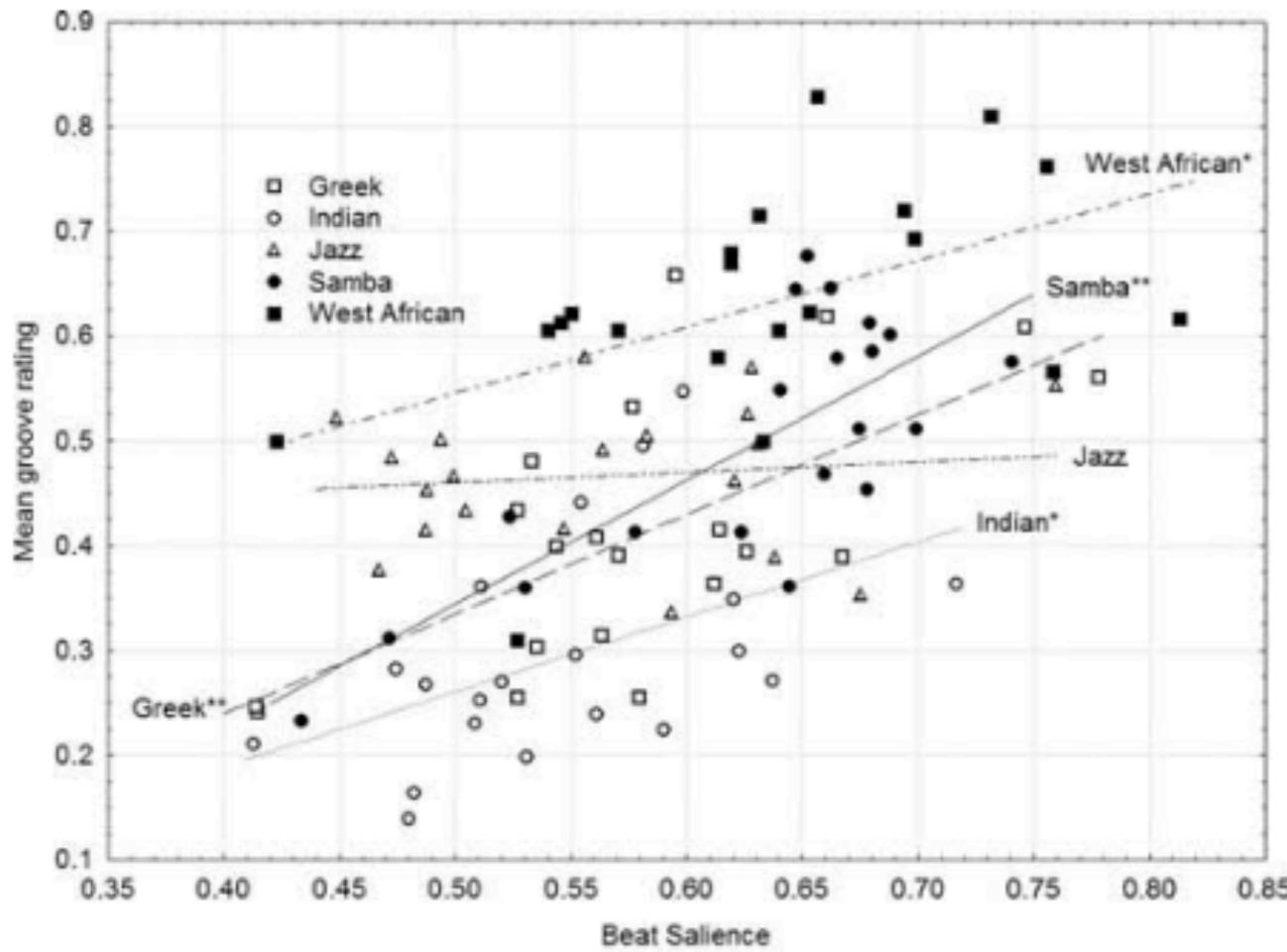
Temporal Regularity: Clear Meter & Pulse

First prerequisite of a grooving rhythm is establishing a clear and consistent meter.



(Fitch, 2016)

Temporal Regularity: Beat Density & Salience



Syncopation

(Witek et al., 2014)

Supplementary Material: Witek et al. 'Syncopation affects free body-movement in musical groove'

1. Hihat
Snare-Drum
Bass-Drum

2. -//

3. -//

4. -//

5. -//

6. -//

7. -//

8. -//

9. -//

10. -//

11. -//

12. -//

13. -//

14. -//

15. -//

Experimenter-Composed Low no. 4
S: 0

Experimenter-Composed Low no. 9
S: 0

Experimenter-Composed Low no. 1
S: 6

Honeydrippers: 'Impeach the President'
S: 9

Annette Peacock: 'Survival'
S: 12

Ike and Tina Turner: 'Cussin' and Cryin'
and Carryin' On'
S: 32

Garage Band Template no. 2
S: 34

Funkadelic: 'Good Old Music'
S: 43

Lou Donaldson: 'Ode to Billy Joe'
S: 45

Monk Higgins: 'One Man Band
(Plays All Alone)'
S: 46

Experimenter-Composed High no. 3
S: 58

Experimenter-Composed High no. 8
S: 64

Experimenter-Composed High no. 6
S: 65

Experimenter-Composed High no. 9
S: 66

Experimenter-Composed High no. 5
S: 78

LOW SYNCOPATION

1. MEDIUM SYNCOPATION

HIGH SYNCOPATION

1. Hihat
Snare-Drum
Bass-Drum

2. -//

3. -//

4. -//

5. -//

6. -//

7. -//

8. -//

9. -//

10. -//

11. -//

12. -//

13. -//

14. -//

15. -//

Experimenter-Composed Low no. 4
S: 0

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S: 66

Experimenter-Composed High no. 5
S: 78

LOW SYNCOPATION

1. MEDIUM SYNCOPATION

HIGH SYNCOPATION

Tempo

- Optimal tempo for groove is reported to be **100-120 beats per minute (BPM)** (Etani, Marui, Kawase, & Keller, 2018)
- This aligns with the typical speed of human movement (**2 Hz**) (MacDougall, & Moore, 2005)



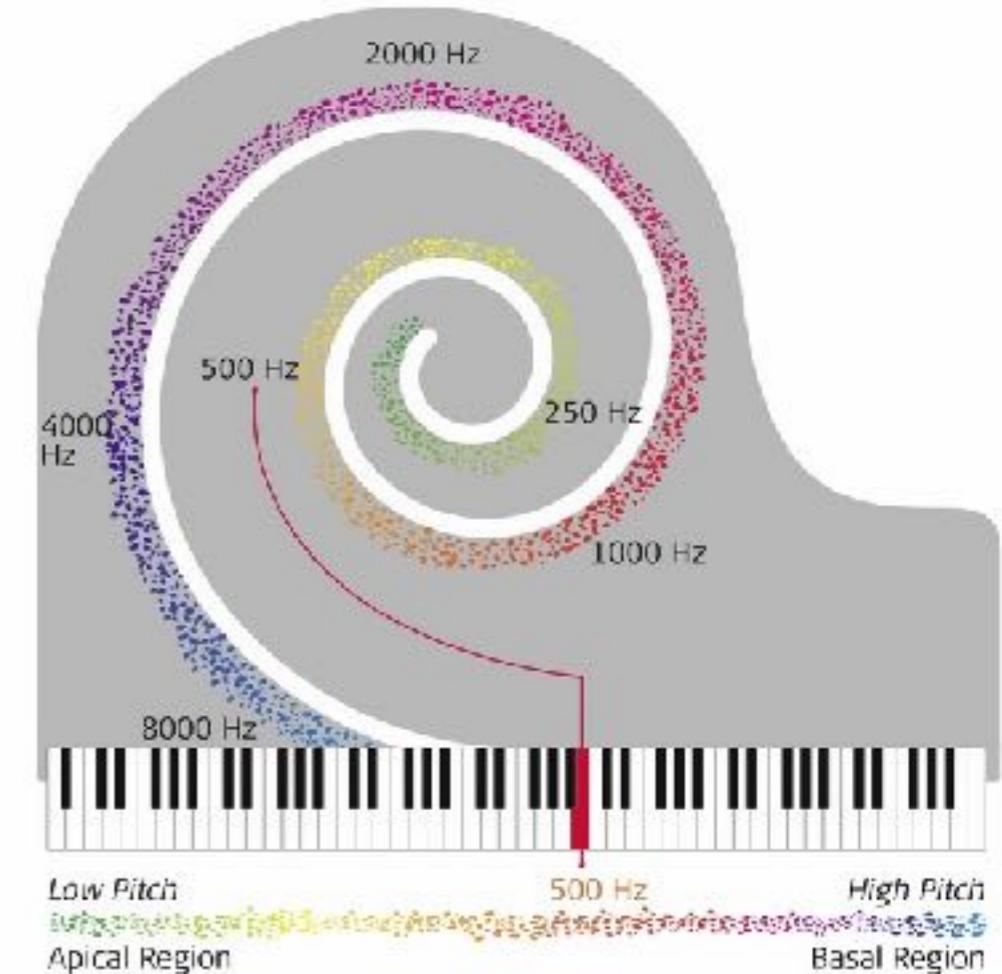
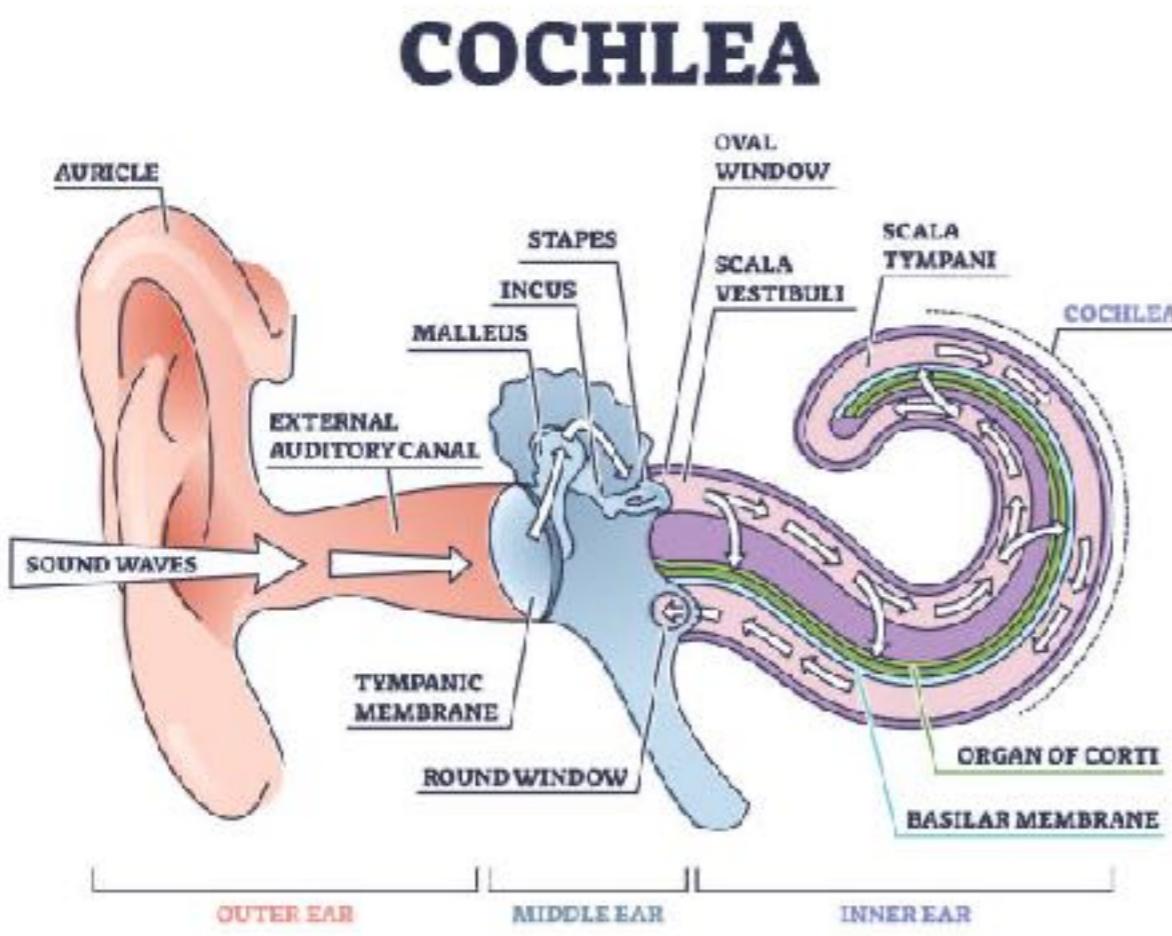
**... instrument creates the feeling of groove?
-more groovy than the others?-**

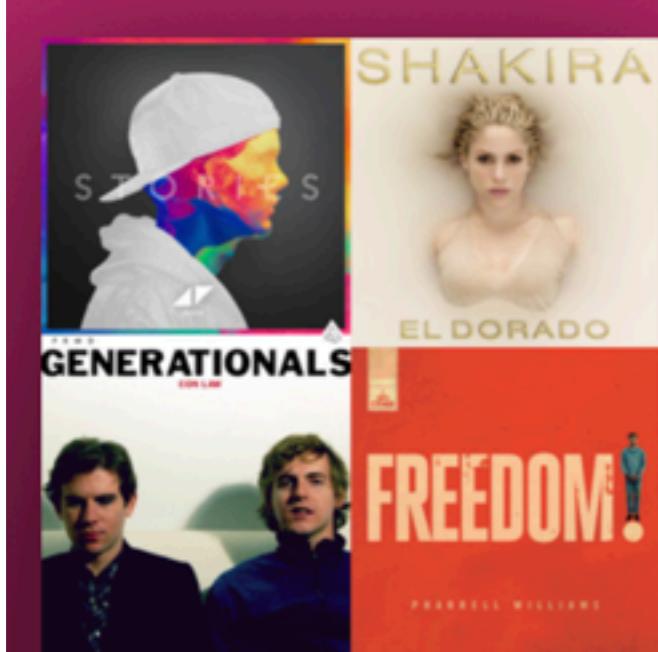




Pitch -Low Frequencies-

- The cochlea in the inner ear is sensitive for lower frequencies in detecting changes such as timing deviations.
- low frequencies are strongly linked to groove ratings and negatively correlate with tapping variability (Stupacher, Hove & Janata, 2016).



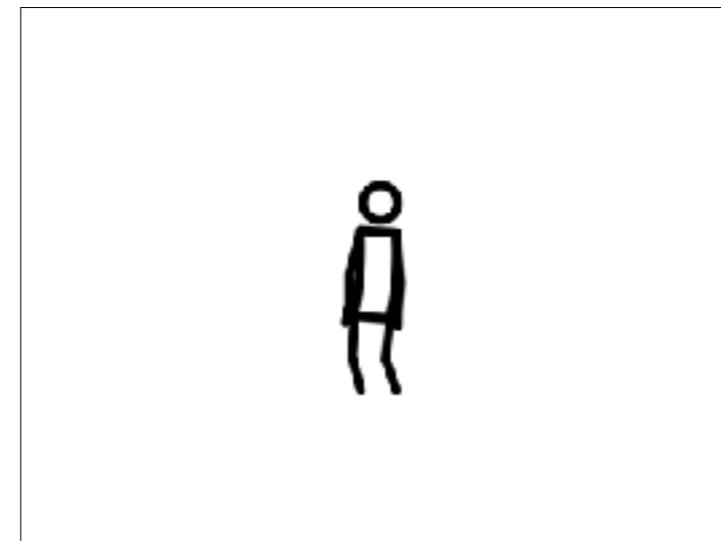


PUBLIC PLAYLIST

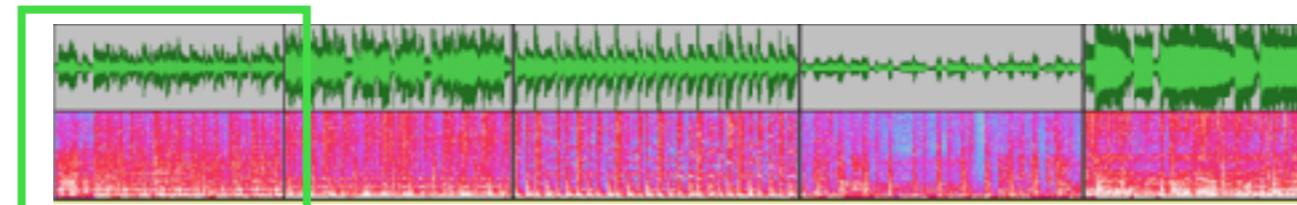
Music We Move To

This playlist include 278 tracks that people move to.

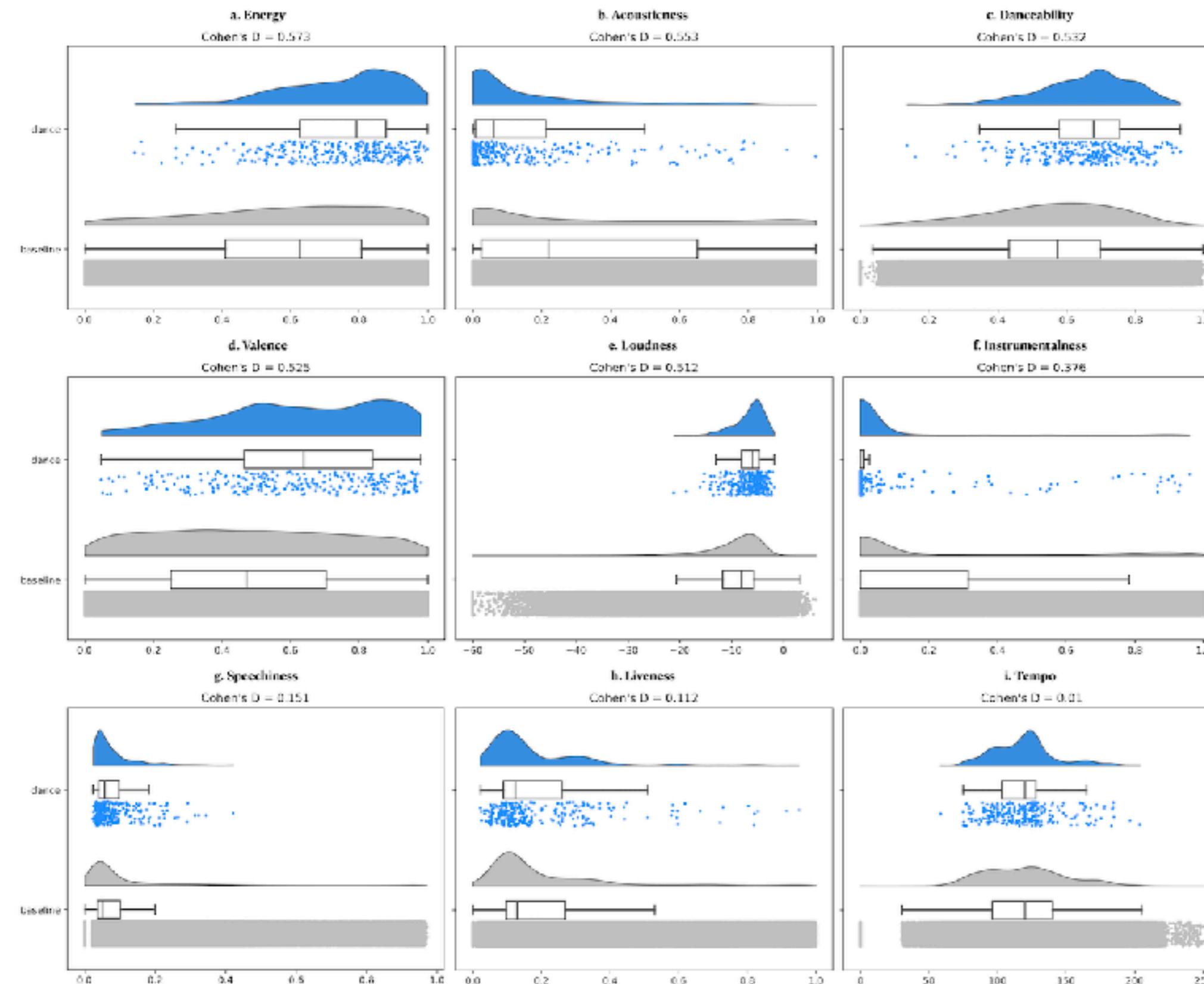
Deniz Duman • 278 songs, 18 hr 38 min



The 75+ Best Books of All Time (According to Readers)



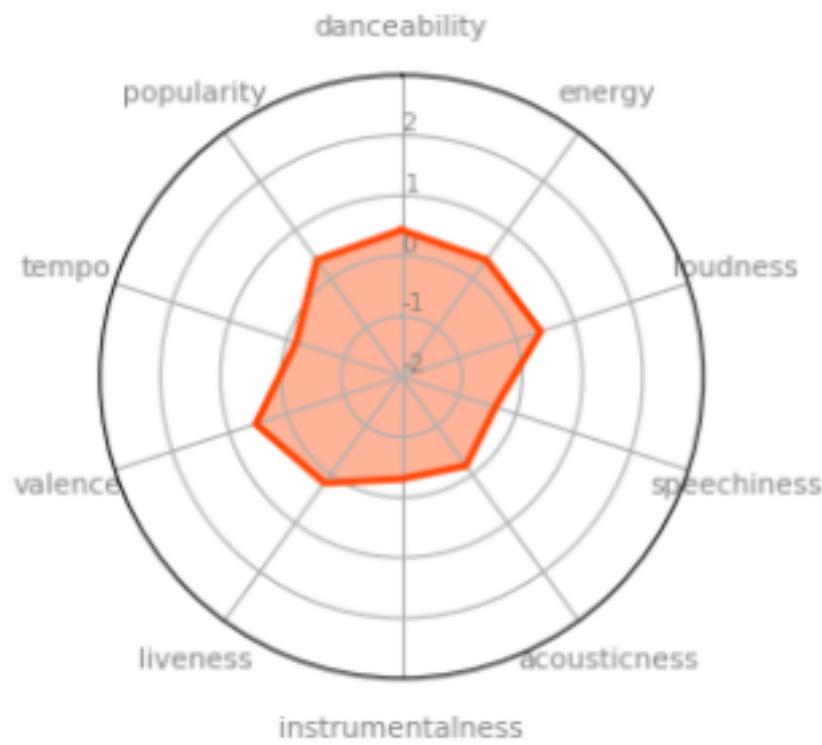
(Duman et al., 2022)



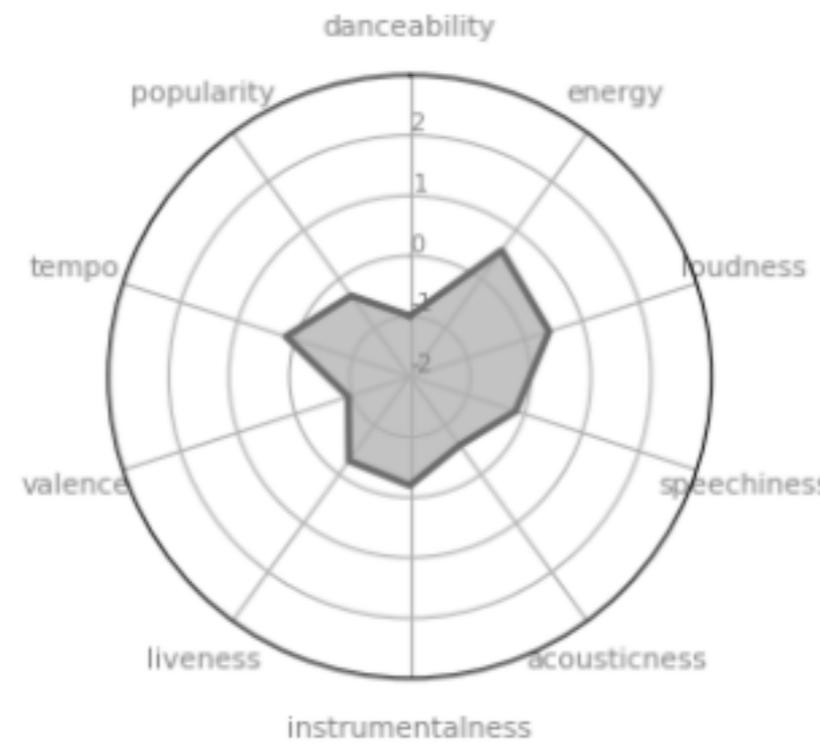
Dance songs are...

- ▣ louder
- ▣ energetic
- ▣ happy
- ▣ danceable
- ▣ non-acoustic
- ▣ 120 BpM

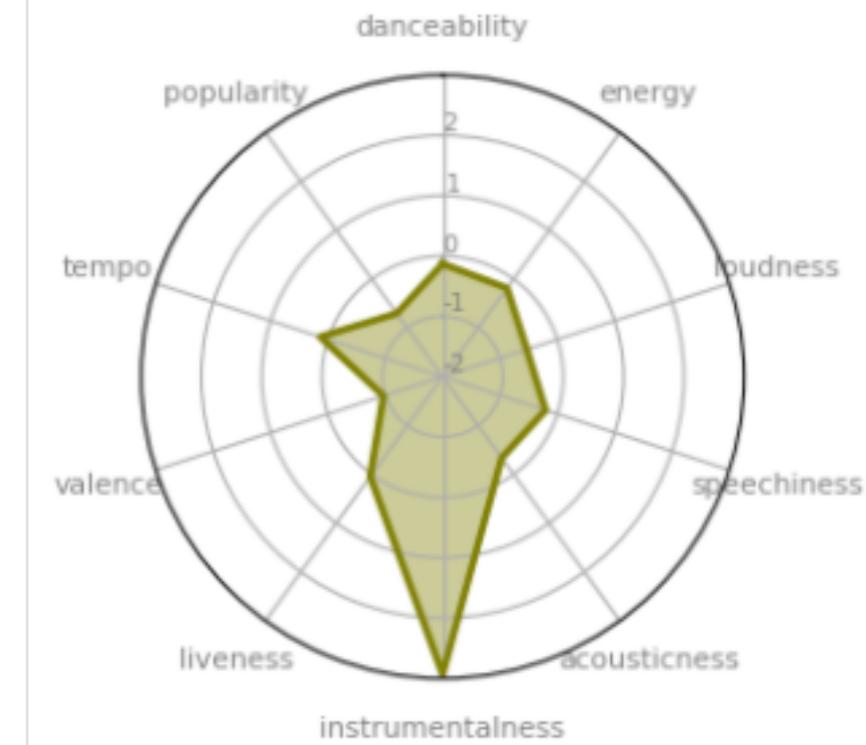
C1:happy-dance



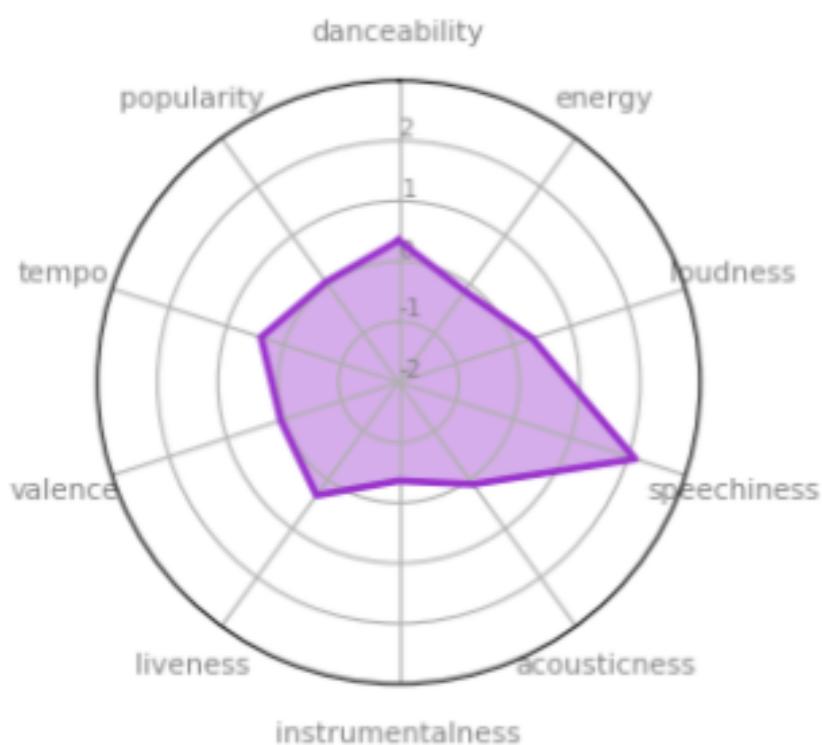
C2:sad-energy



C3:sad-instrumental



C4:fast-lyrical



C5:soft-acoustic



Subgroups of Dance Music

C1 (N=101): various genres

C2 (N=60): rock, metal

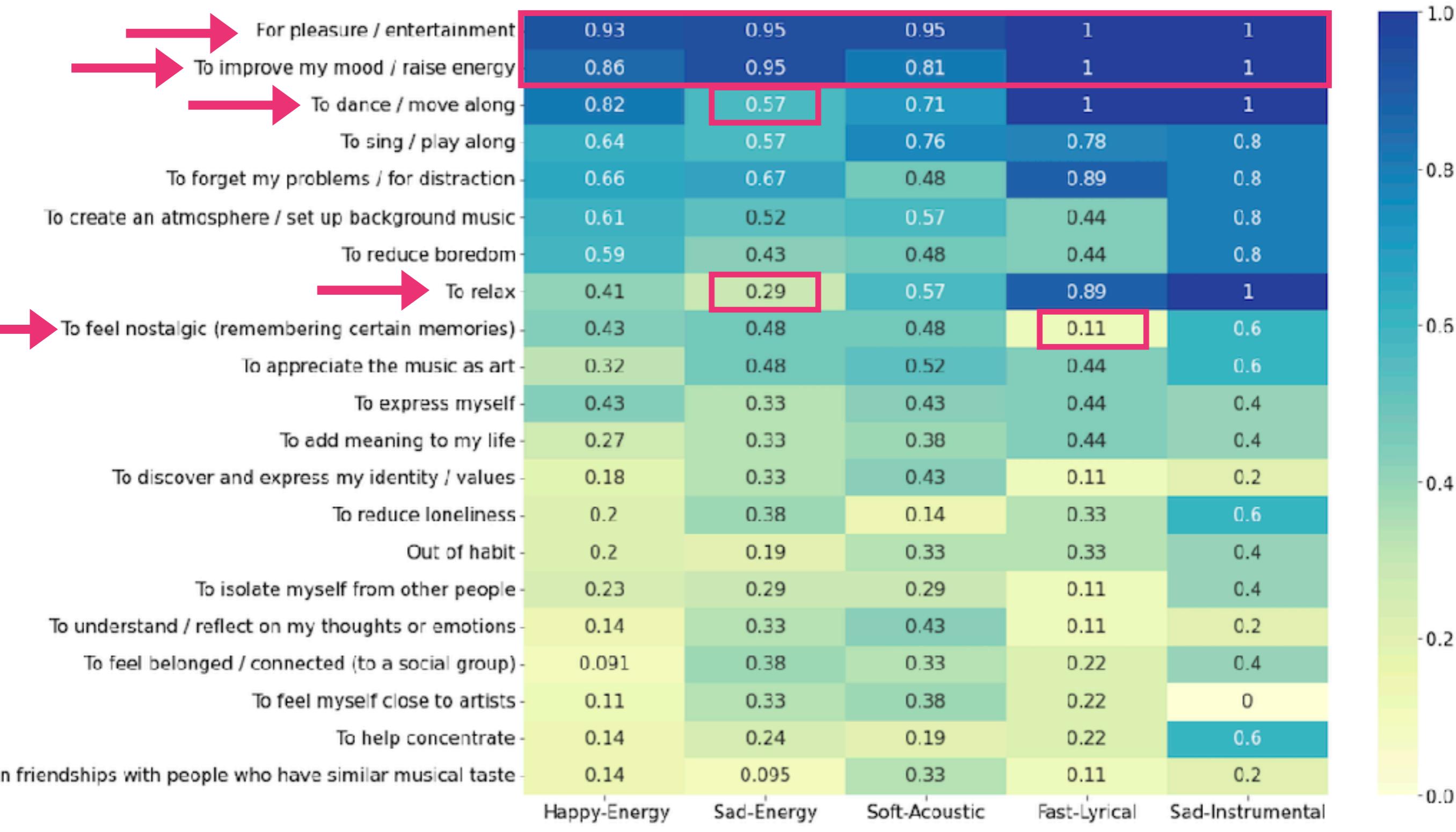
C3 (N=23): house, trance

C4 (N=35): rock, hip-hop

C5 (N=59): jazz, soul

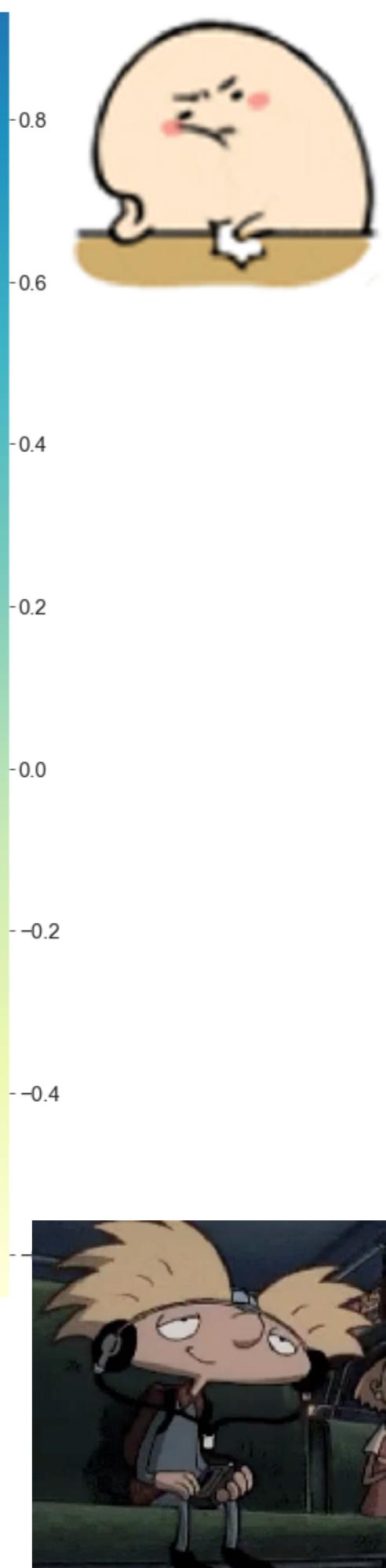
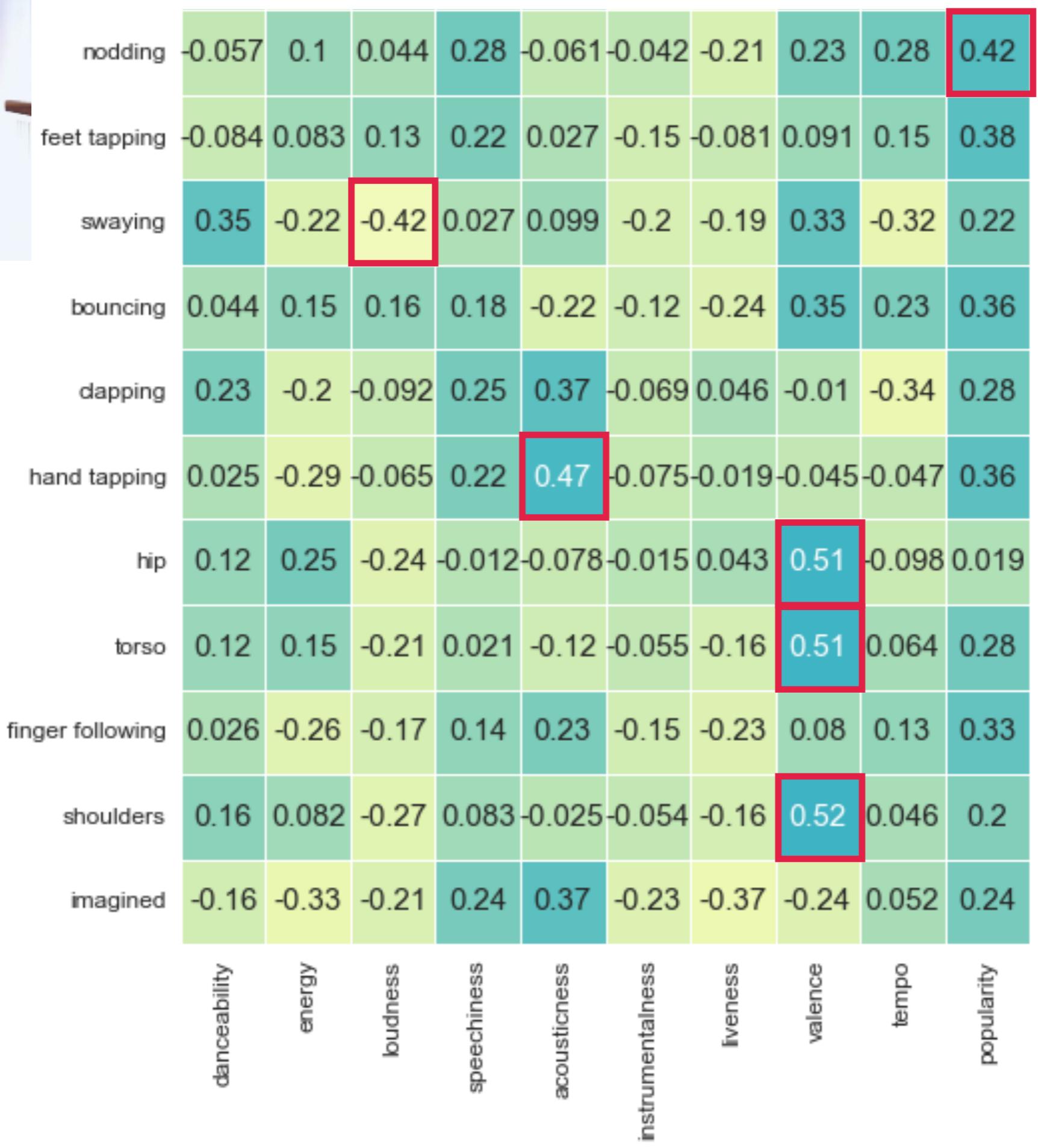
Subgroups vs RL dance

“Regulation of Mood and Arousal” and “Expression of Social Relatedness”
As the main functions of listening to music associated with dance





(Duman et al., 2023)



**Does variation in musical features
explain everything about groove
experience?**

Repetition, Prediction & Pleasure



(Huron, 2006; Witek, 2009)

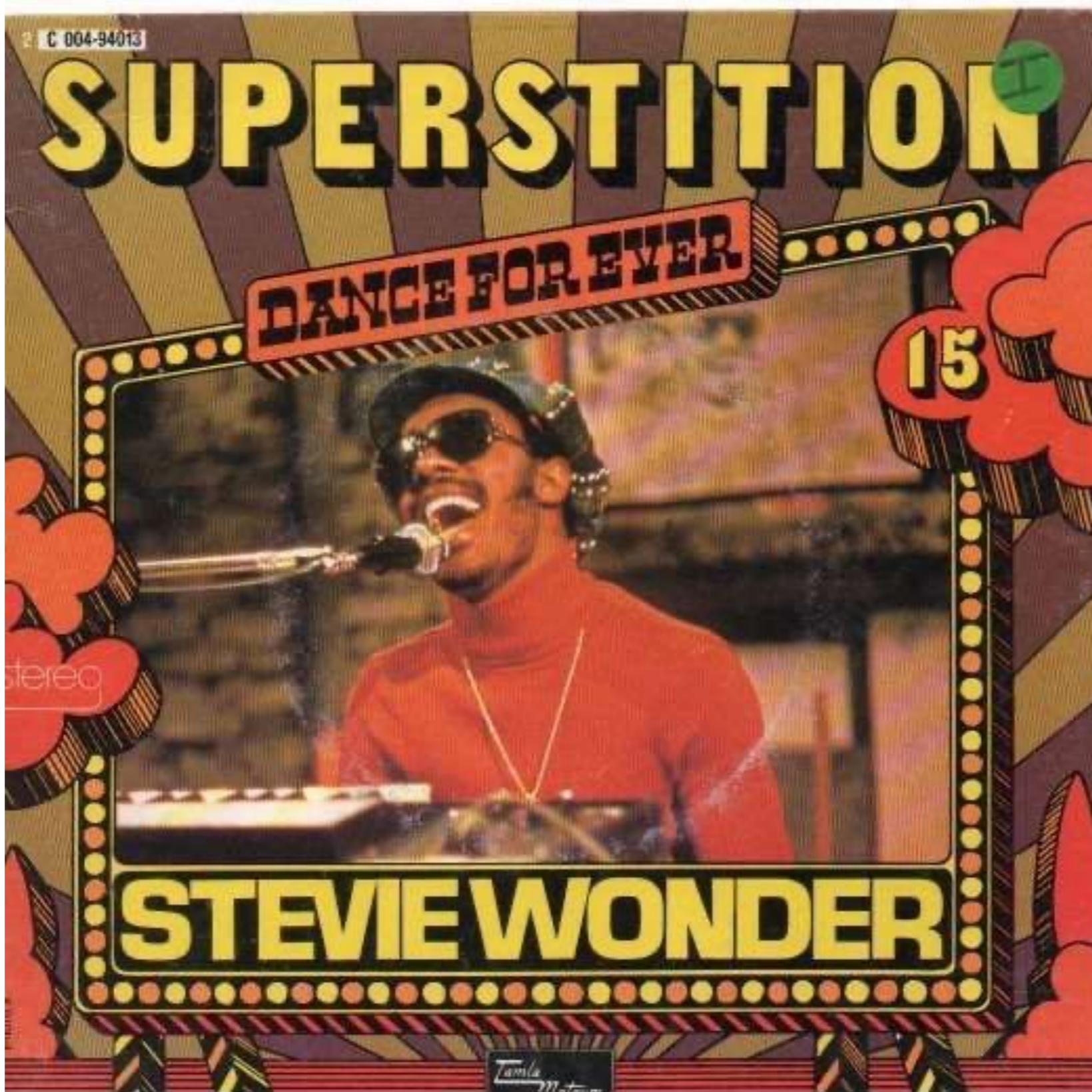
Groove is mostly associated with genres, such as funk, soul, hiphop, triphop, drum'n bass, house, jazz and world music.

Does metal music groove?



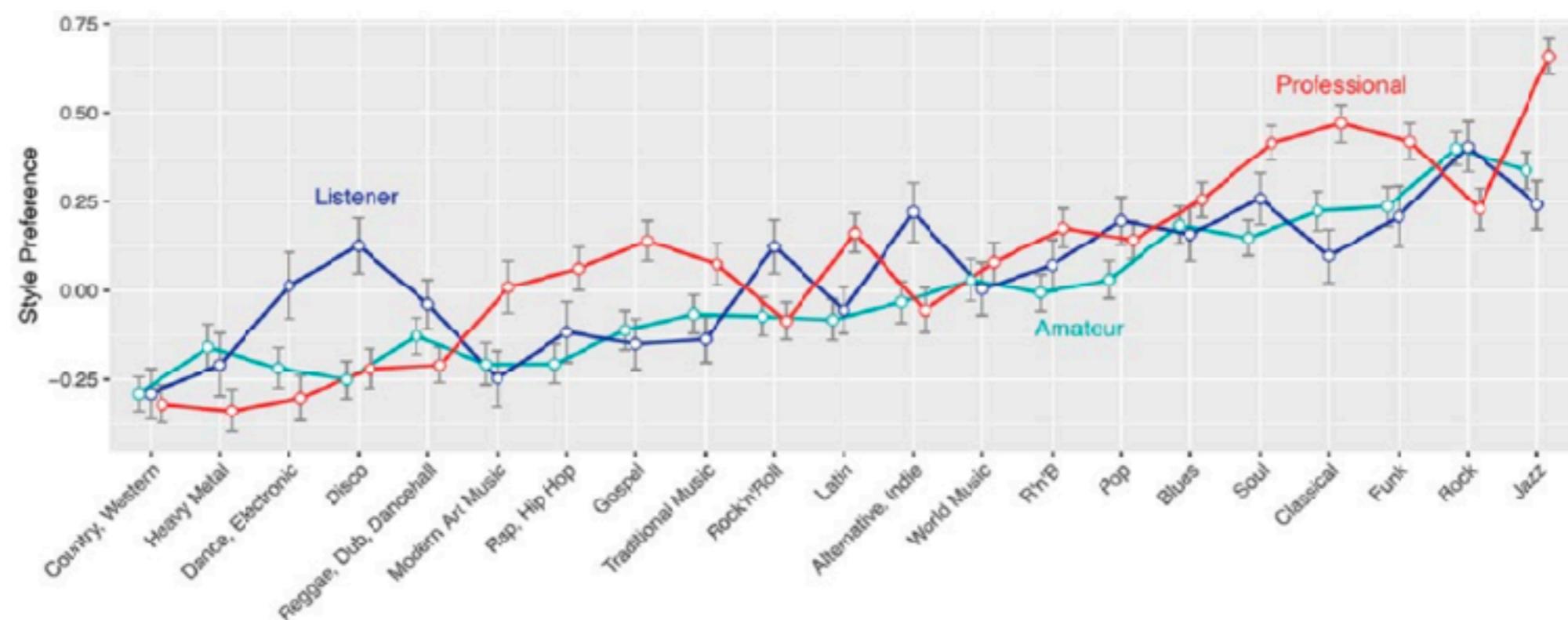
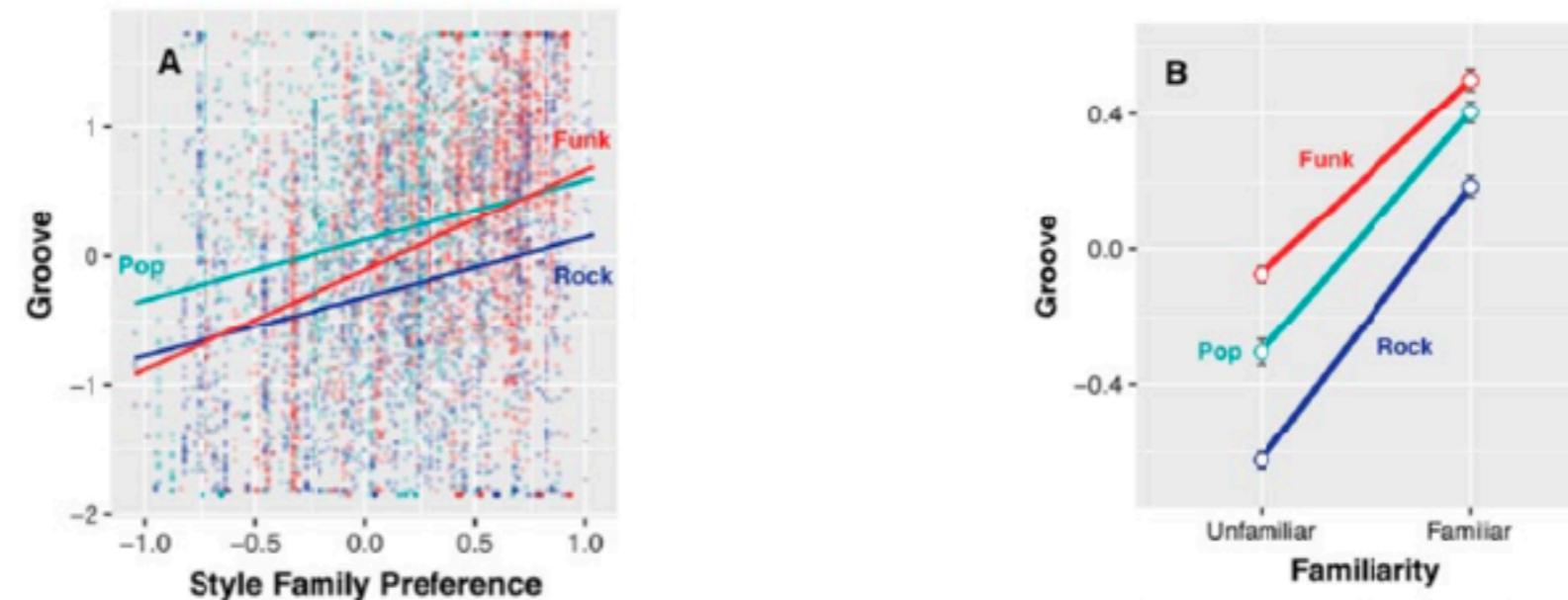
How about the most groovy song?

“A piece of music that makes me experience groove might not do the same for someone else.” (Madison, 2006)

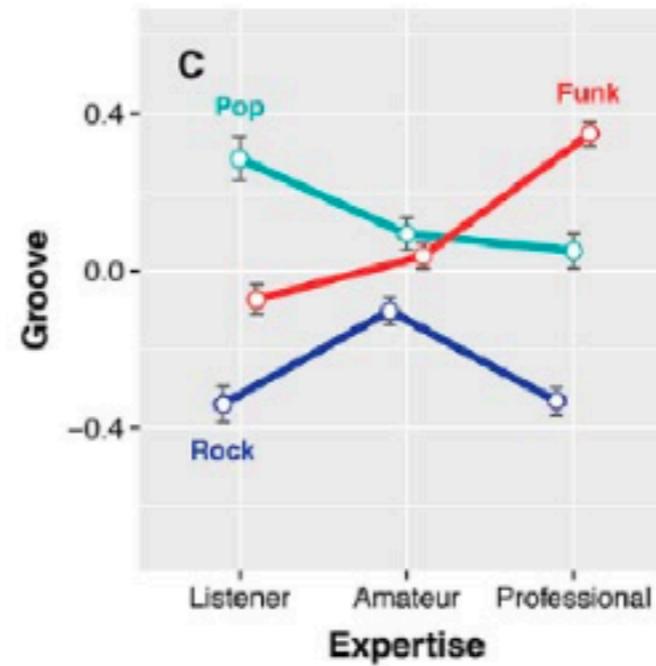


<https://open.spotify.com/track/1h2xVEoJORqrg71HocgqXd?si=KL6J-QX0TvSjU0VZs5KWCA>

Familiarity & Genre Preference

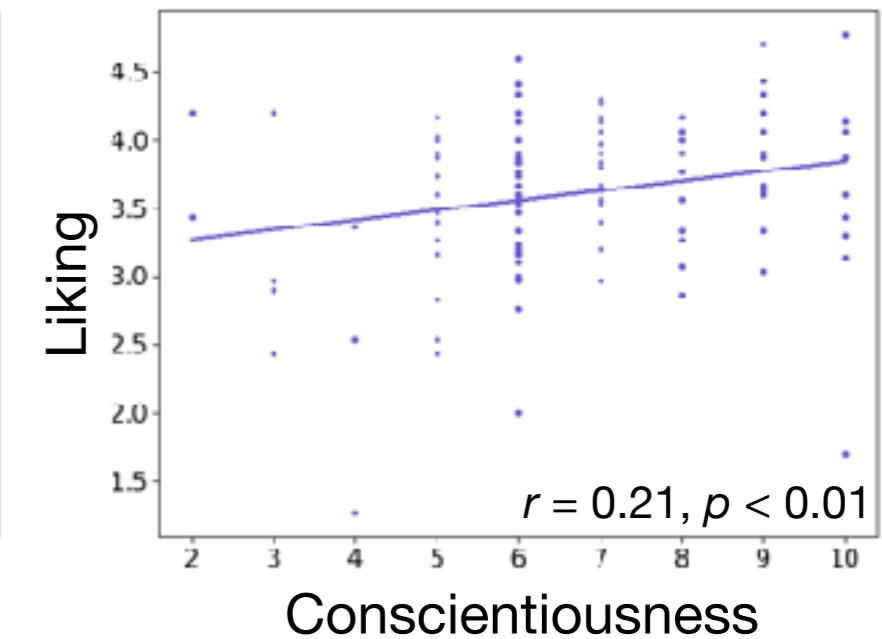
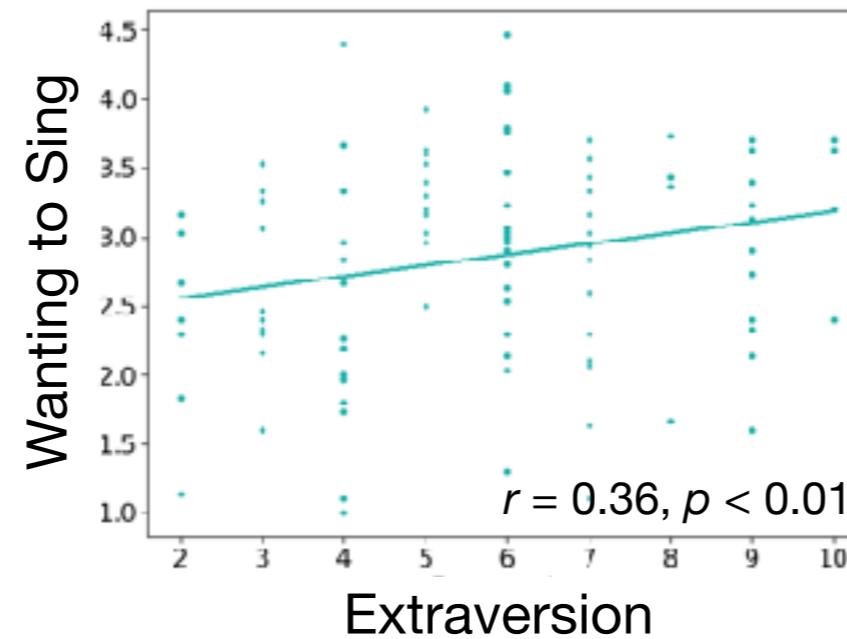
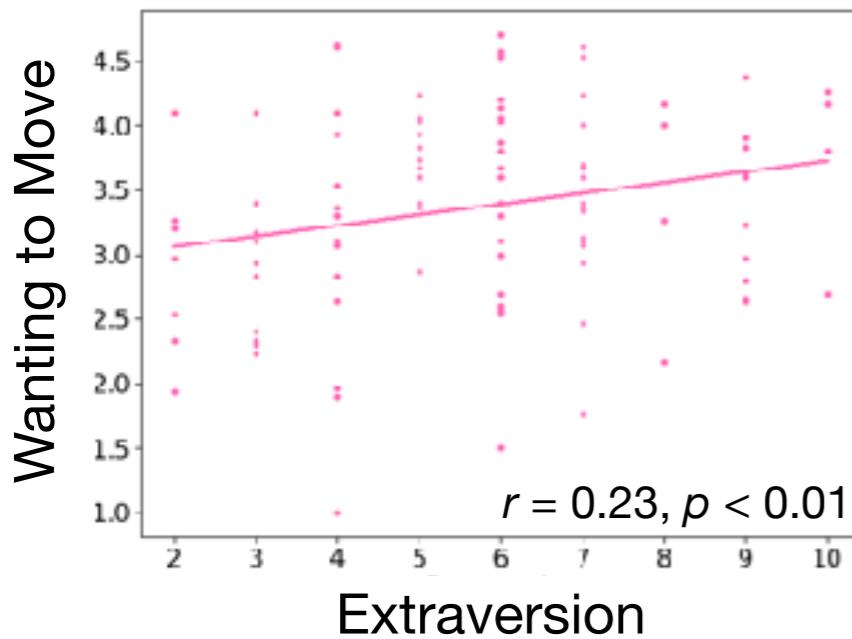


Expertise

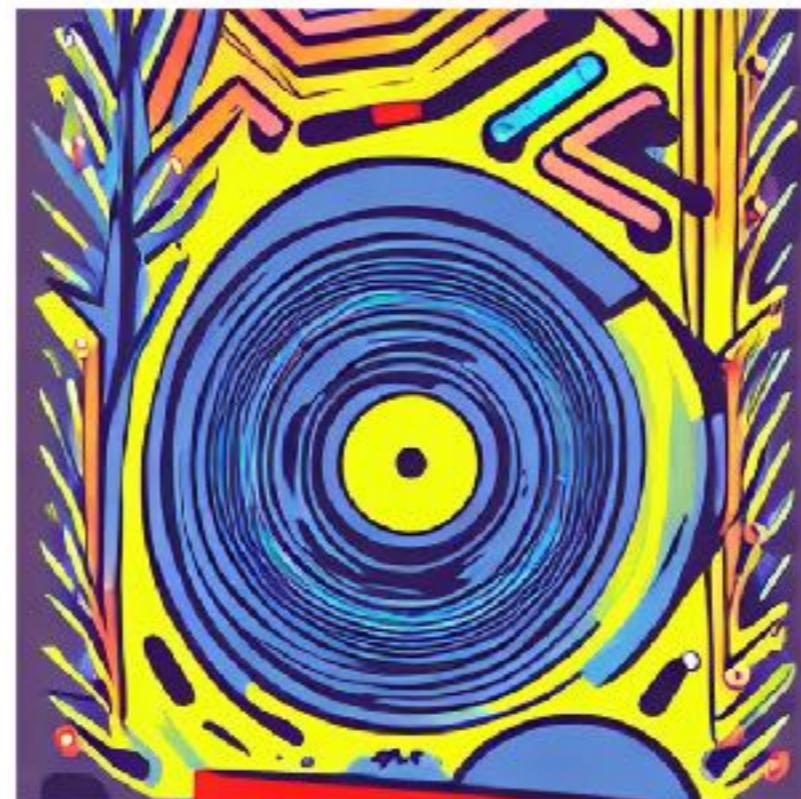


Groove is not only about the music itself, but depends on the listeners as well!!!

What is the role of personality traits in people's groove experiences?



What is Groove ?



(Duman et al., 2024)

MUSICAL ASPECT

Performance

Artists

Instruments

Styles

Musical Features

Time- & Pitch-
Related Features



Individual-related Factors

Musical
Preferences
Current State



EXPERIENTIAL ASPECT

Participatory Experiences

Immersion

Desire to Move

Positive Affect

Social Connection

Groove is...

“a participatory experience

(related to immersion, movement, positive affect, and social connection)

resulting from subtle interaction of specific **music-**

(such as time- and pitch-related features),

performance- and/or individual differences-related factors.”

LISTENING ENVIRONMENT

Locational aspect

indoors, outdoors, club, commute, festival, YouTube, Spotify...

Social aspect

alone, with others, close circle, strangers...

Temporal aspect

Season, day of the week, period of the day

Musical aspect

performance; artists, instruments, styles, musical features; time- & pitch-related

LISTENER

Fixed personal factors

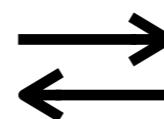
age, gender, genes, nationality, culture, personality traits, capacity for empathy, proneness to dance

Skills, habits, preferences

musical expertise, dance expertise, familiarity, exposure, memories

Temporary individual factors

current mood, goals and reasons for listening, substance use



ACTION (POSSIBILITIES) (affordances)

Immersion

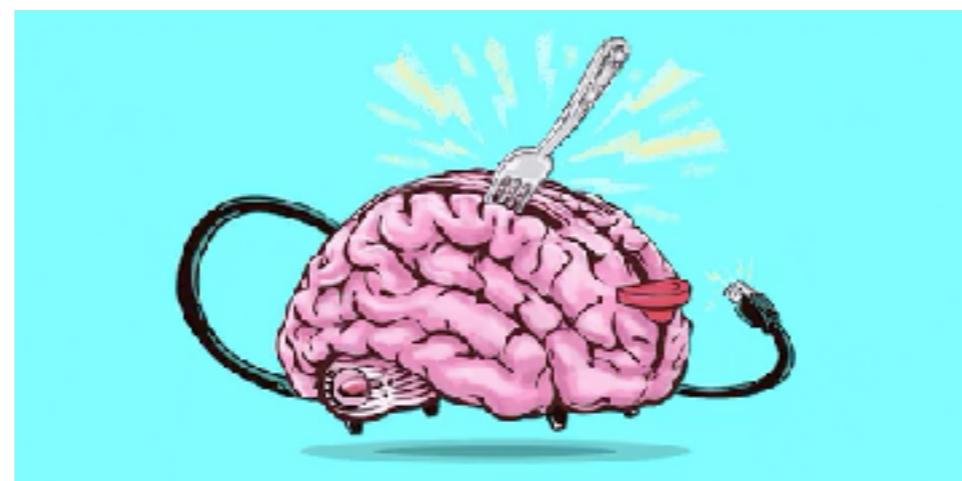
Movement

Positive Affect

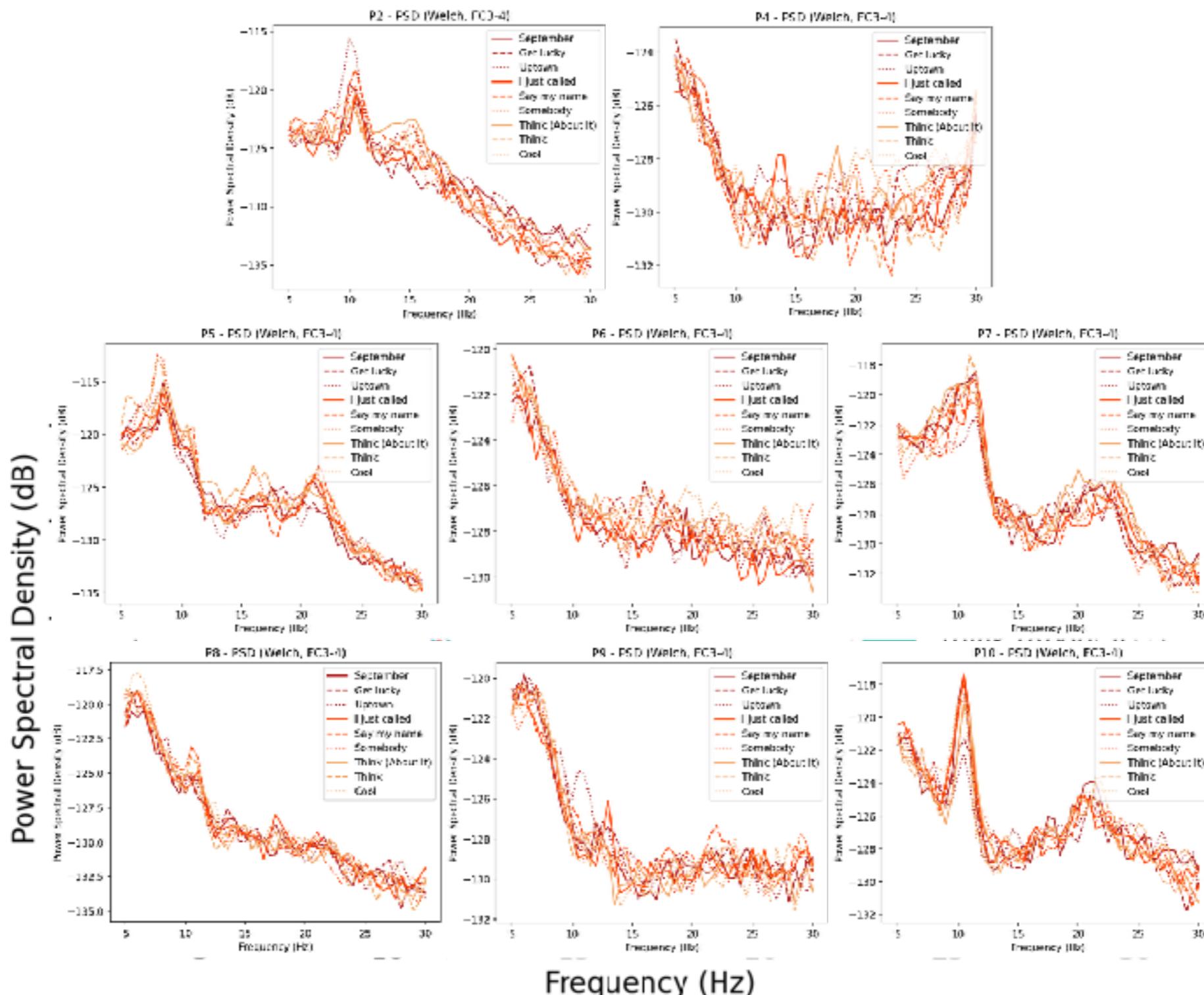
Social Connection

Brain on Groove

- Attending to rhythmic aspects of music activates motor areas of the brain even in the absence of movement (Fitch, 2016).
- **High-groove** music increase motor cortex excitability (Stupacher, et. al., 2013) whereas no difference occurred between low-groove music and noise



Investigation of Mu Oscillations to Naturalistic Groove Music





Localisation Task (11 min total)

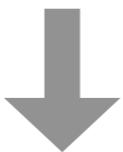
Rest (eyes open)
(2 min)

Rest (eyes closed)
(2 min)

Hand tapping
(2 min)

Foot tapping
(2 min)

Just listen
(2 min)



Passive & Active Blocks (9 - 11 min each)

Blocks 1-2 Passive / Active

9 + 9 audio (17-21 sec)
Groove ratings after every stimuli
Interval between trials: 4 sec

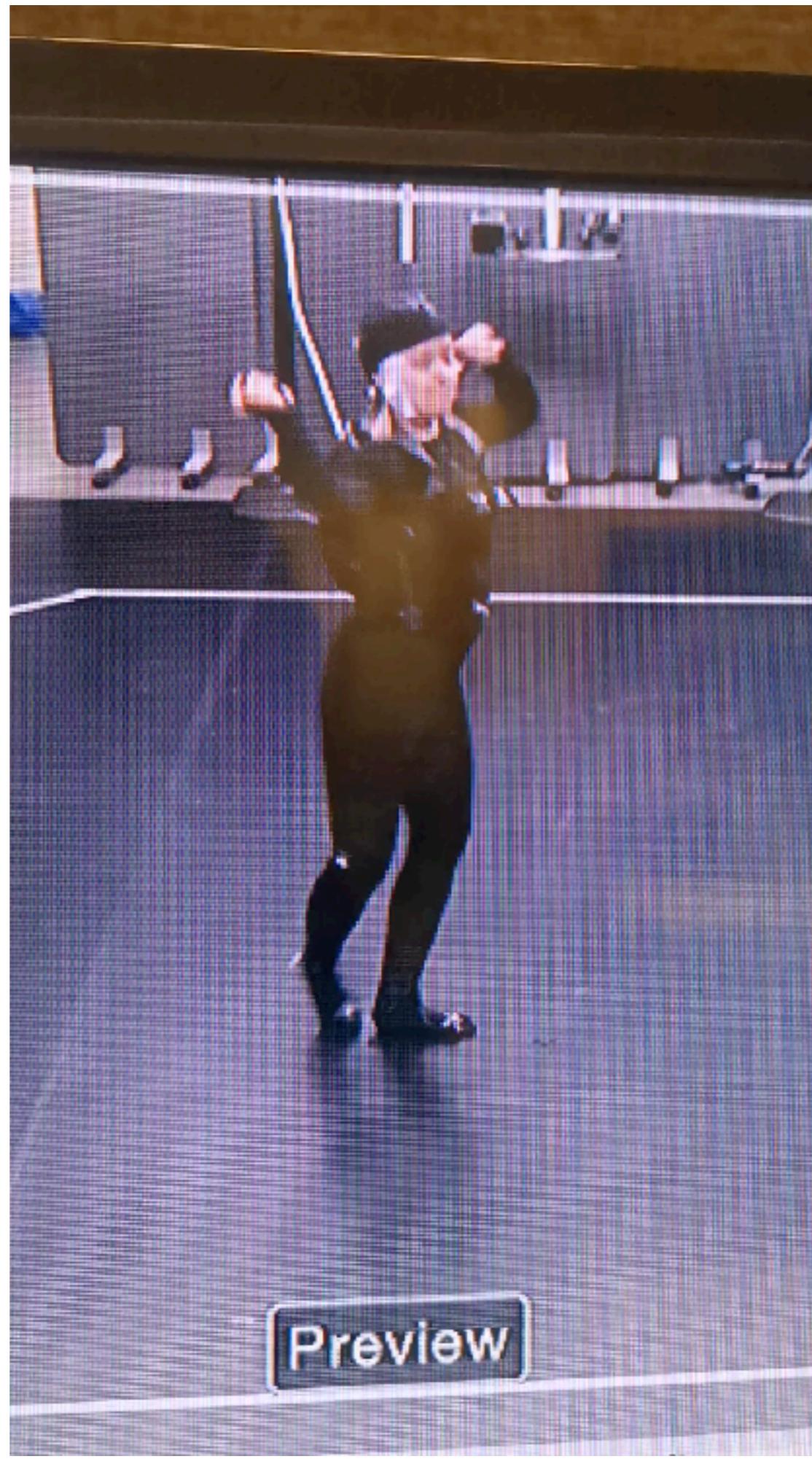
5 min
break

Blocks 3-6 Passive / Active

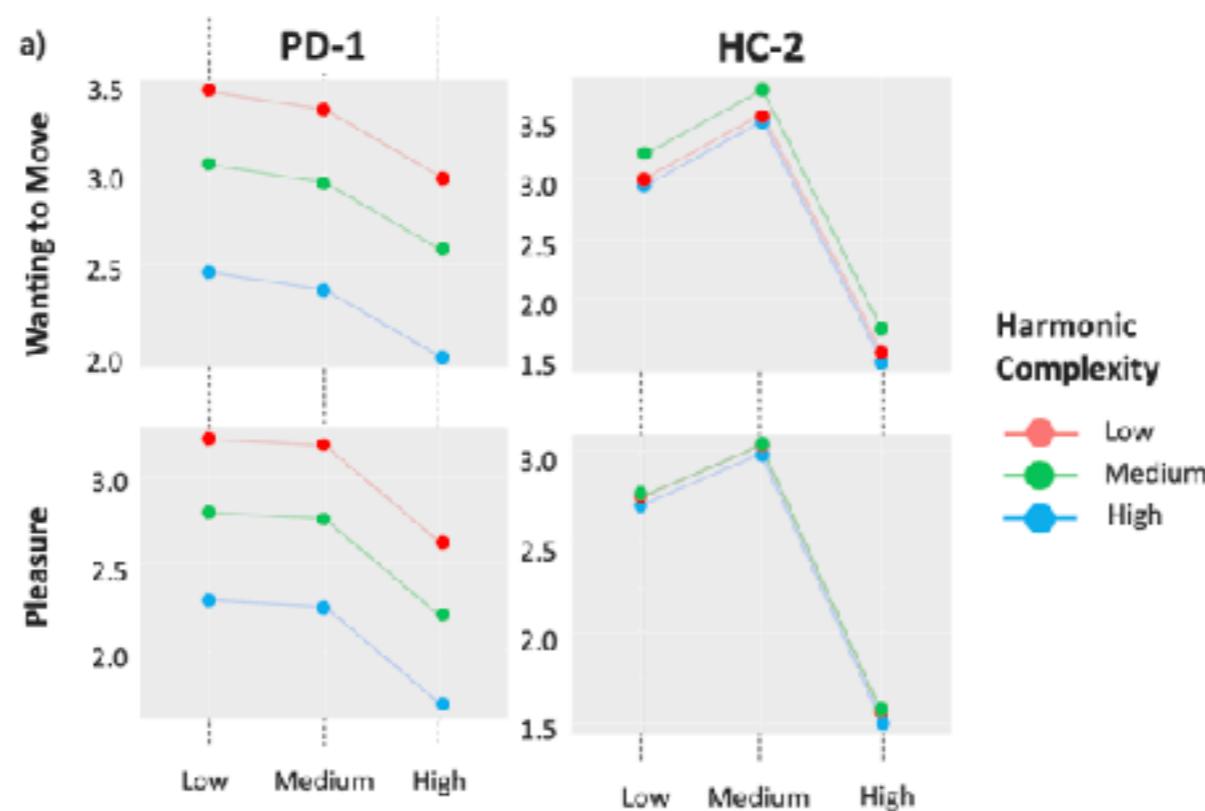
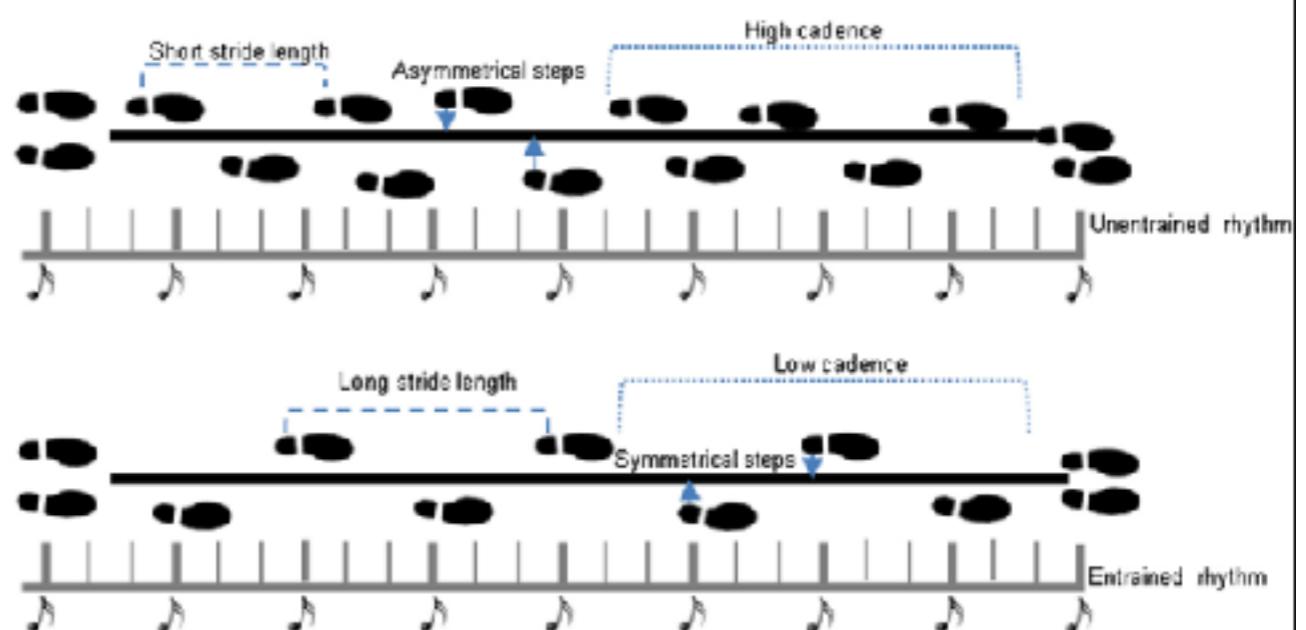
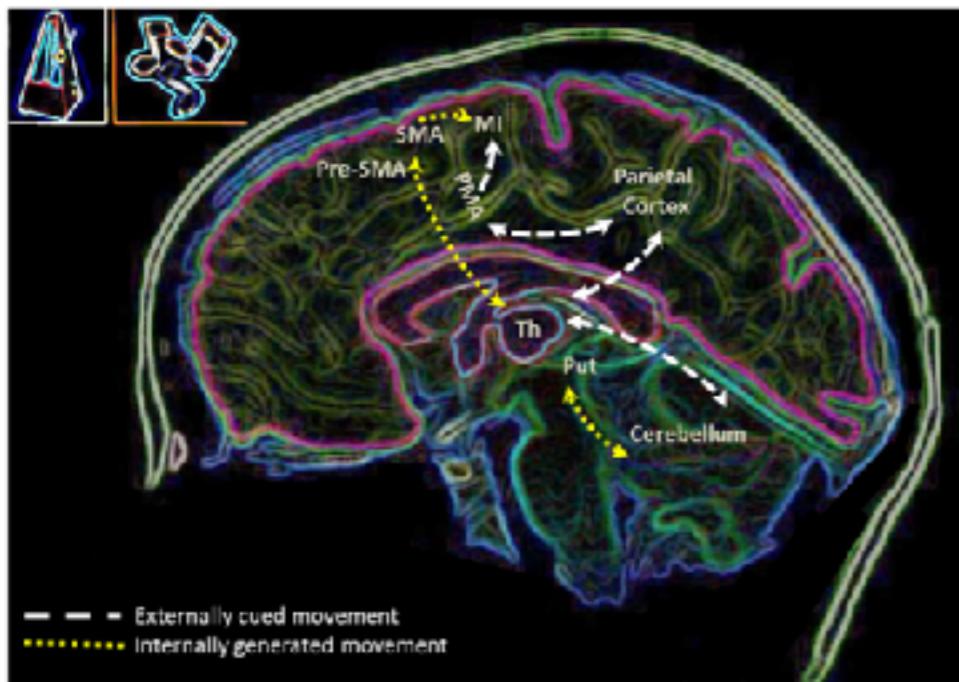
9 + 9 audio (17-21 sec)
No groove rating
Interval between trials: 4 sec

Wrap Up

1. Removing the equipments
2. Survey: Background Information, Questionnaires, Further Comments



Application of Groove Research



(Hove & Keller, 2015; Pando-Naude, Witek, Højlund, Johnsen, Garza-Villarreal, & Vuust)

DO YOU EVER FEEL STRONG CONNECTION TO MUSIC?

we would like to know more about your musical experiences

more info:



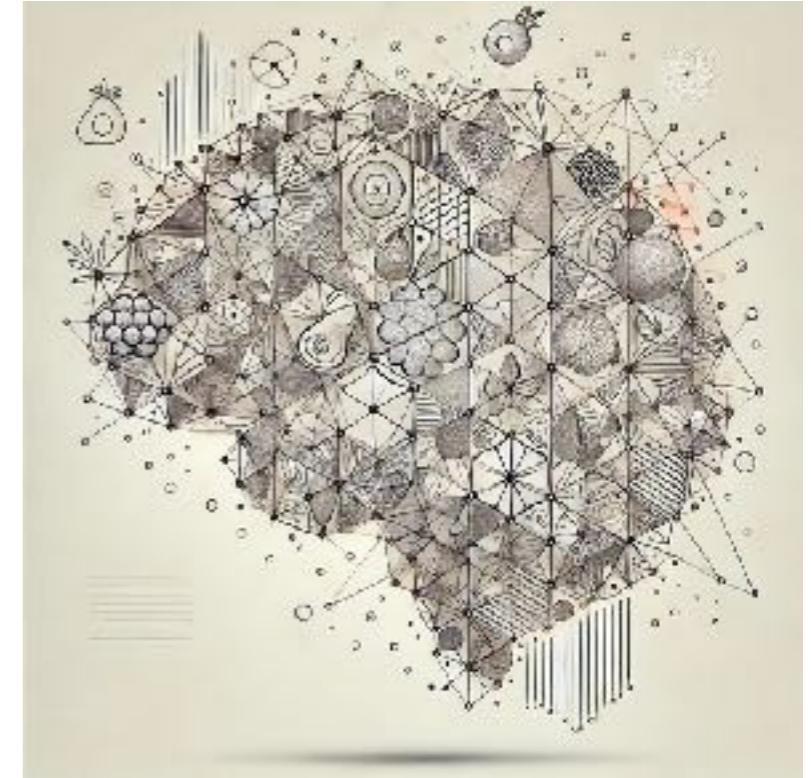
or contact: deniz.d.duman@jyu.fi

Researchers' Wellbeing Survey and Webinar Series



<https://link.webropolsurveys.com/S/A47ED0DE1BA58F22>

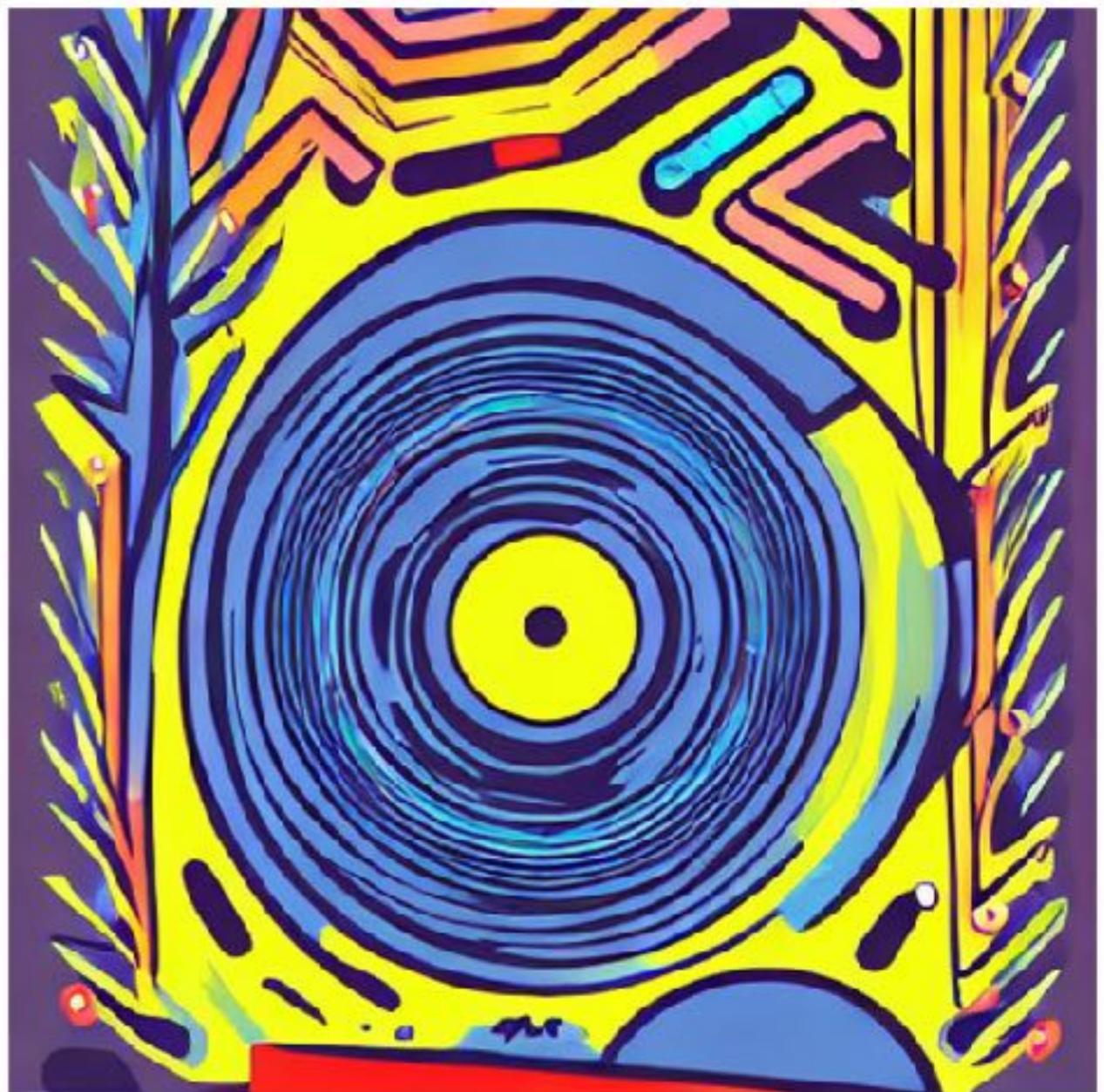
Food for Thought...



1. Which songs **groove for you the most**, which ones do not?
2. Do you experience **different kinds** of groove? (Such as more body- or emotion-related)
3. What is the influence of the **environment** (such as activity, people around...) on your groove experience?

How can groove research be applied
in real life to make an impact on
today's society?

thank you



Contact: deniz.d.duman@jyu.fi