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Nordic Music Therapy Student Conference
Aalborg

MUSIC THERAPY AND NEUROSCIENCE

Relationships and Differences

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Overview

MT= Music Therapy TwM = Therapy with Music

MUSIC THERAPY AND NEUROSCIENCE: Relationships

WHOLE BRAIN ACTIVATION: Slides 6-9

(1) Neurorehabilitation: Attention and Memory TwM

PERCEPTION-ACTION LOOPS: 10-15

(2) Neurorehabilitation: Arm Training TwM

MUSIC WITH PULSE: ENTRAINMENT: 16-19

(3) Rhythmic Auditory Stimulation, (4) Gait Training TwM

MUSIC IN FREE FLOW: 20-22

(5) Palliative Care (6) Premature infants MT

Overview

PLEASURE, REWARD, EMOTION / PET, fMRI: 23-29

(6) Premature infants MT

THE AUTONOMOUS NERVOUS SYSTEM: 30-33

MEMORY: 34-36

(7) Dementia TwM, (8) GIM Therapy MT

EEG & MEG: Neurophysiological measurements: 37-41

(9) Vegetative State and Minimally Conscious State MT

(10) Effects of neurorehabilitation TwM

Overview

MUSIC THERAPY and NEUROSCIENCE: Differences 42-44

MUSIC THERAPY can
EXPAND THE SCOPE of NEUROSCIENCE: 45-49

(11) Active improvisation with piano MT
(12) Active improvisation with percussion MT
(13) Active improvisation with voices in free flow MT
(14) Active improvisation with digital instruments and Djembe drum MT

INTERACTIVE WIRELESS EEG: 50-56
THE WHOLE BRAIN: 57-60

Relationships

NEUROSCIENCE CAN INFORM MUSIC THERAPY

- describing music's impact on body and mind
- documenting the effects of music-supported therapy and music therapy
- providing methods for systematic research, in particular Randomized Controlled Trials (RCT)

MUSIC THERAPY CAN INFORM NEUROSCIENCE

- providing unexplored material from improvisations, including music in free flow
- focusing on rich sounds and timbres of percussion
- focusing on the integration of body movement and music

MUSIC ACTIVATES (almost) THE WHOLE BRAIN

Perception
Motor functions
Multisensory functions

Memory
Attention
Emotion

Altenmüller & Schlaug 2012

Playing an instrument influences your brain

http://ed.ted.com/lessons/how-playing-an-instrument-benefits-your-brain-anita-collins

or

https://www.youtube.com/watch?feature=player_embedded&v=R0JKCYZ8hng

WHOLE BRAIN ACTIVATION

(1) Neurorehabilitation after stroke TwM
Teppo Särkämö et al. (2008)

RCT- study (Randomized Controlled Trial)

Three groups, 20 patients each
1. Treatment as usual
2. Treatment as usual + audio books
3. Treatment as usual + preferred music

RCT-study

Effects of music listening,
minimum one hour per day for 2 months:

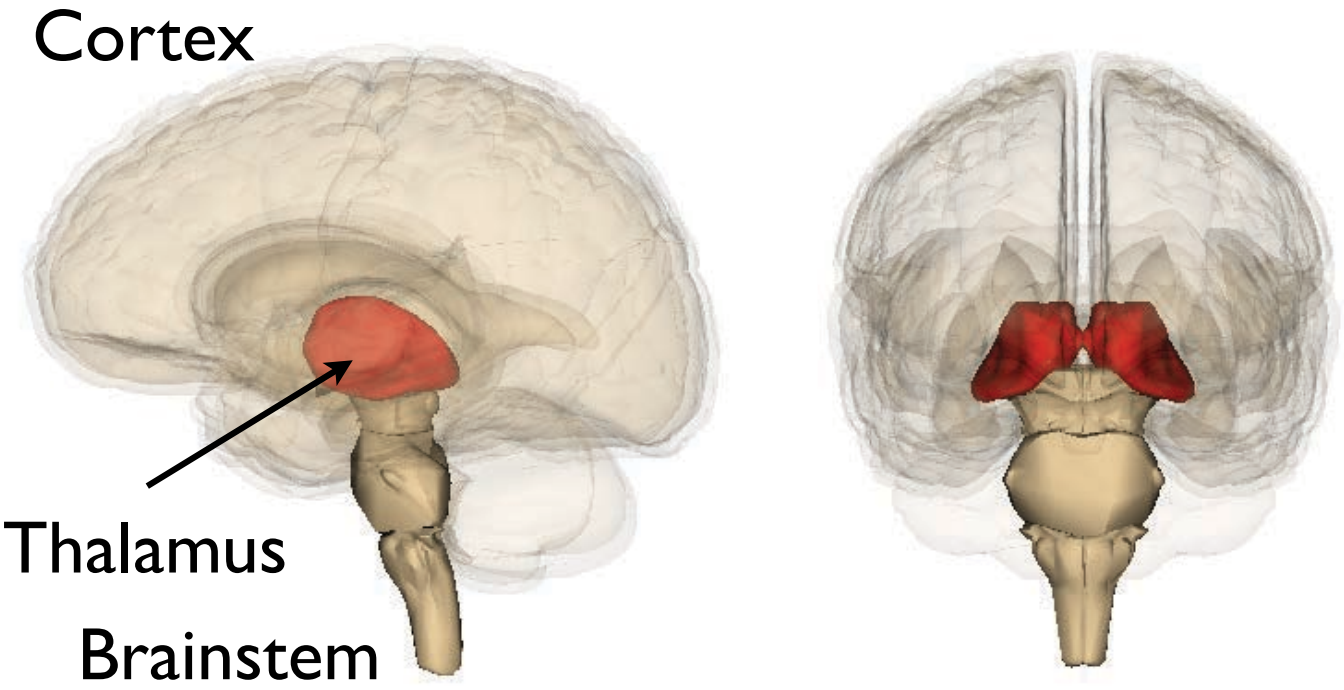
1) Improvement of ATTENTION and MEMORY

2) Less DEPRESSION and CONFUSION

Särkämö et al. (2008). Music listening enhances cognitive recovery and mood after middle cerebral artery stroke

PERCEPTION - ACTION LOOPS

MUSIC PERCEPTION: Three levels



Intensity, pitch, timbre and timing is encoded in the BRAINSTEM

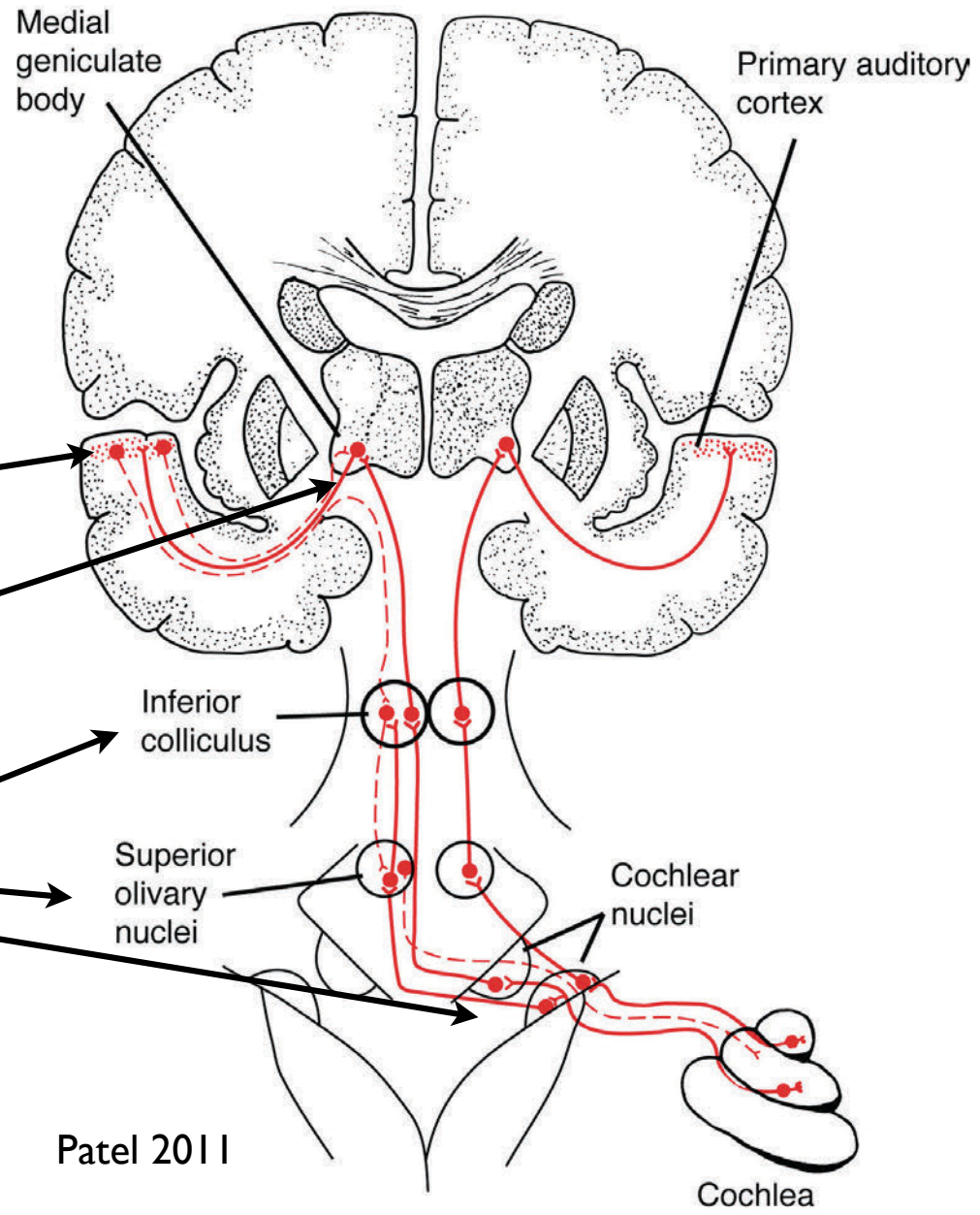
Kraus et al. 2011
Music - John Cage: Amores 3

MUSIC PERCEPTION PATHWAYS UP and DOWN

Auditory Cortex

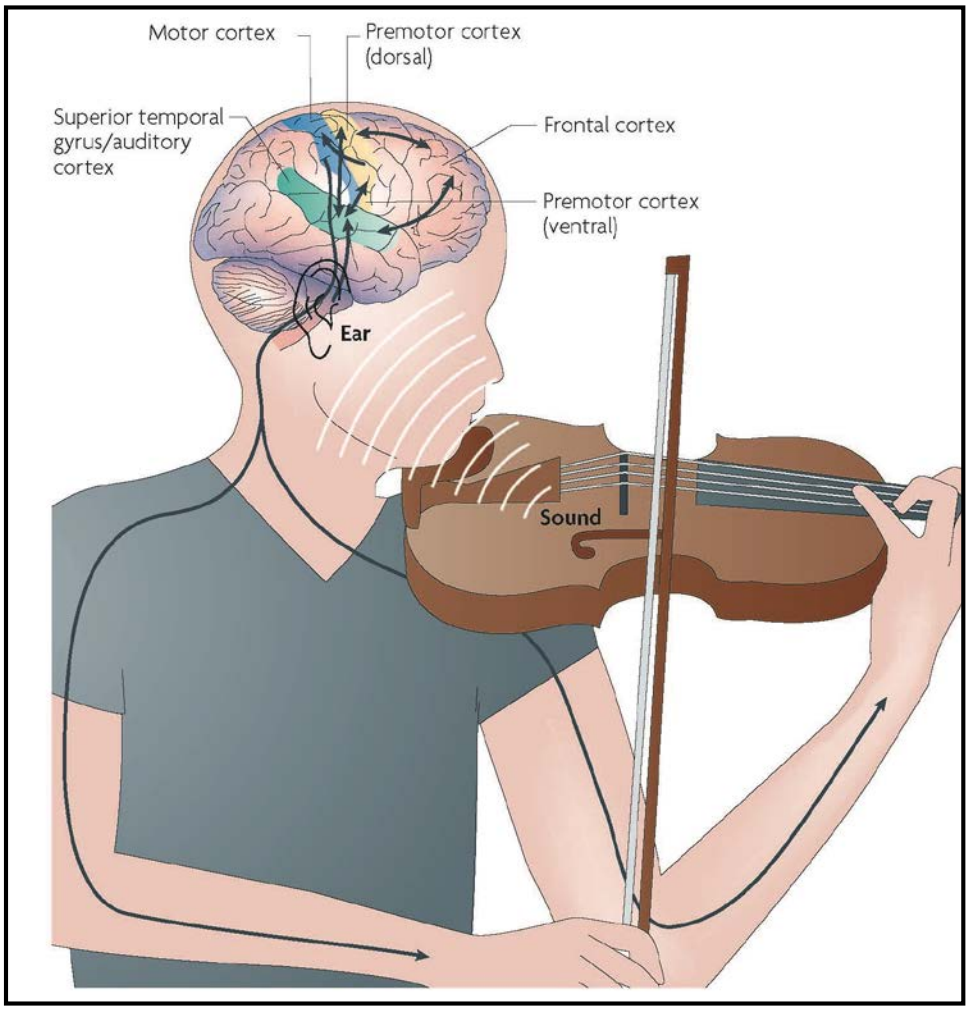
Thalamus

Brainstem



Patel 2011

PERCEPTION-ACTION LOOP



Music - Paganini: Caprice no. 16

Zatorre et al. 2007

PERCEPTION-ACTION LOOP:
(2) Neurorehabilittion after stroke TwM

Training of arm movements - Music Supported Therapy

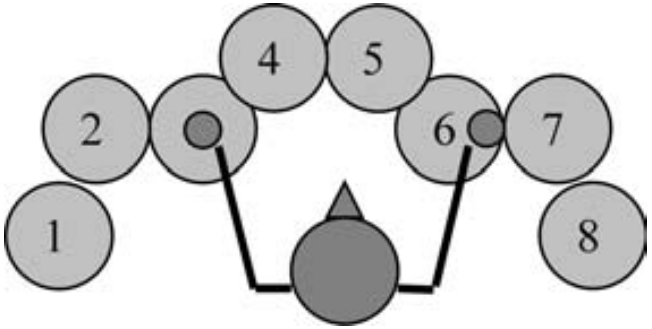
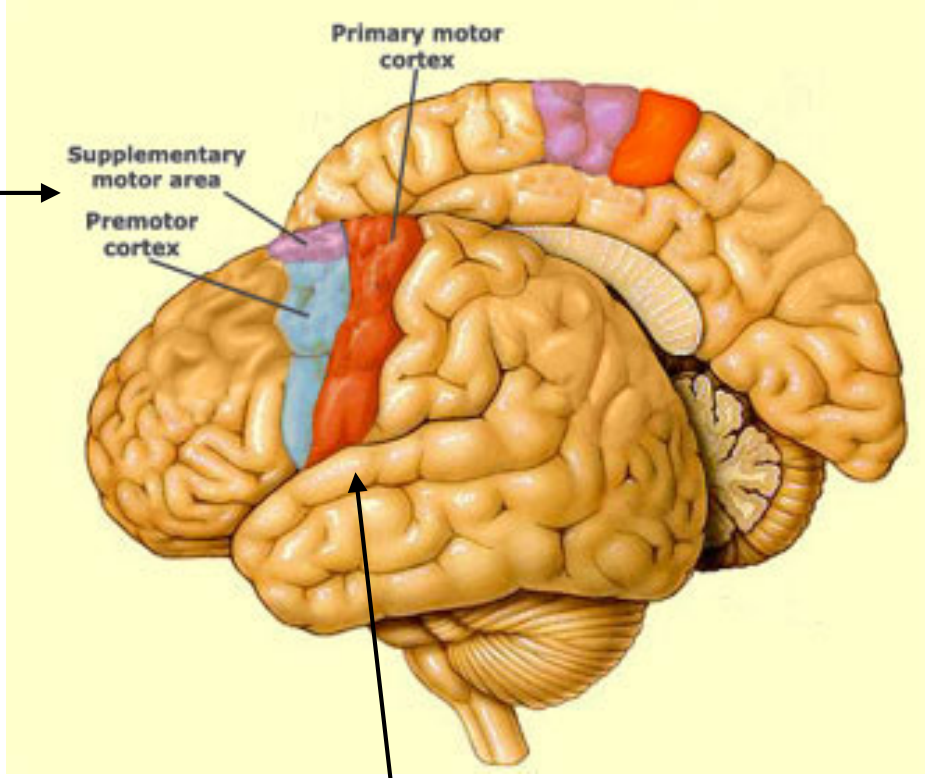


Fig. 1 Illustration of the set-up. Eight drum pads, four for each arm, were placed in a semi circle, all within reach of the patient

Sabine Schneider et al. (2010)

PERCEPTION-ACTION: MUSIC LISTENING ACTIVATES MOTOR PLANNING

Motor planning areas



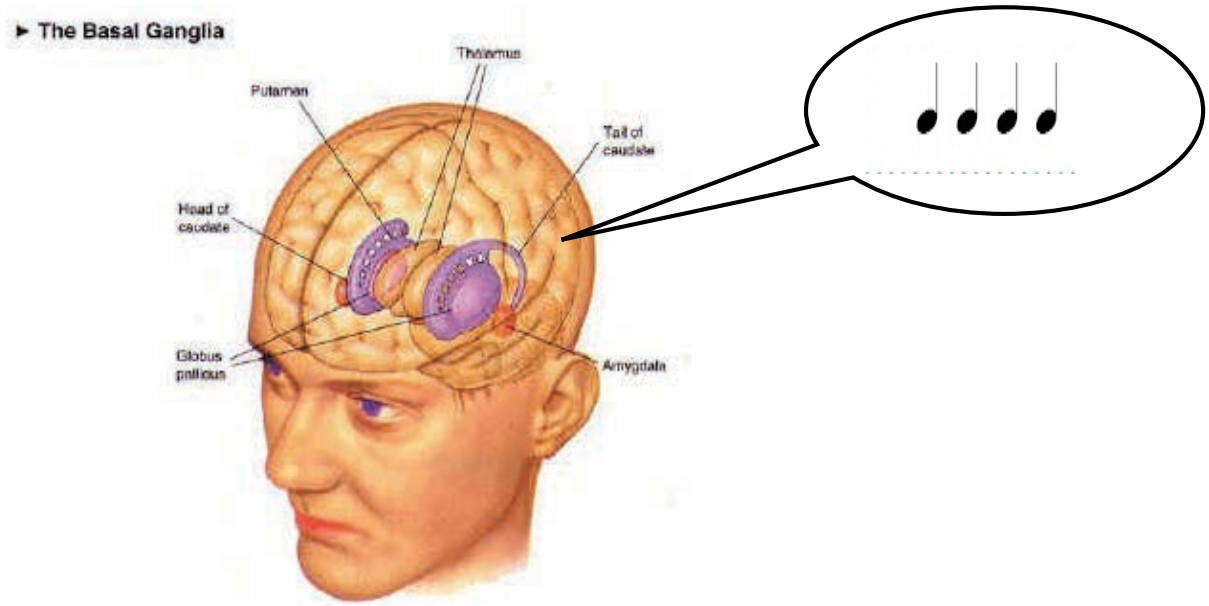
Auditory Cortex

Zatorre et al. 2007

ENTRAINMENT - MUSIC WITH PULSE

https://www.youtube.com/watch?v=to7uIG8KYhg

ENTRAINMENT: Perception catches the music's pulse, and The BASAL GANGLIA maintain it as an "inner pulse"



Grahn & Brett 2007

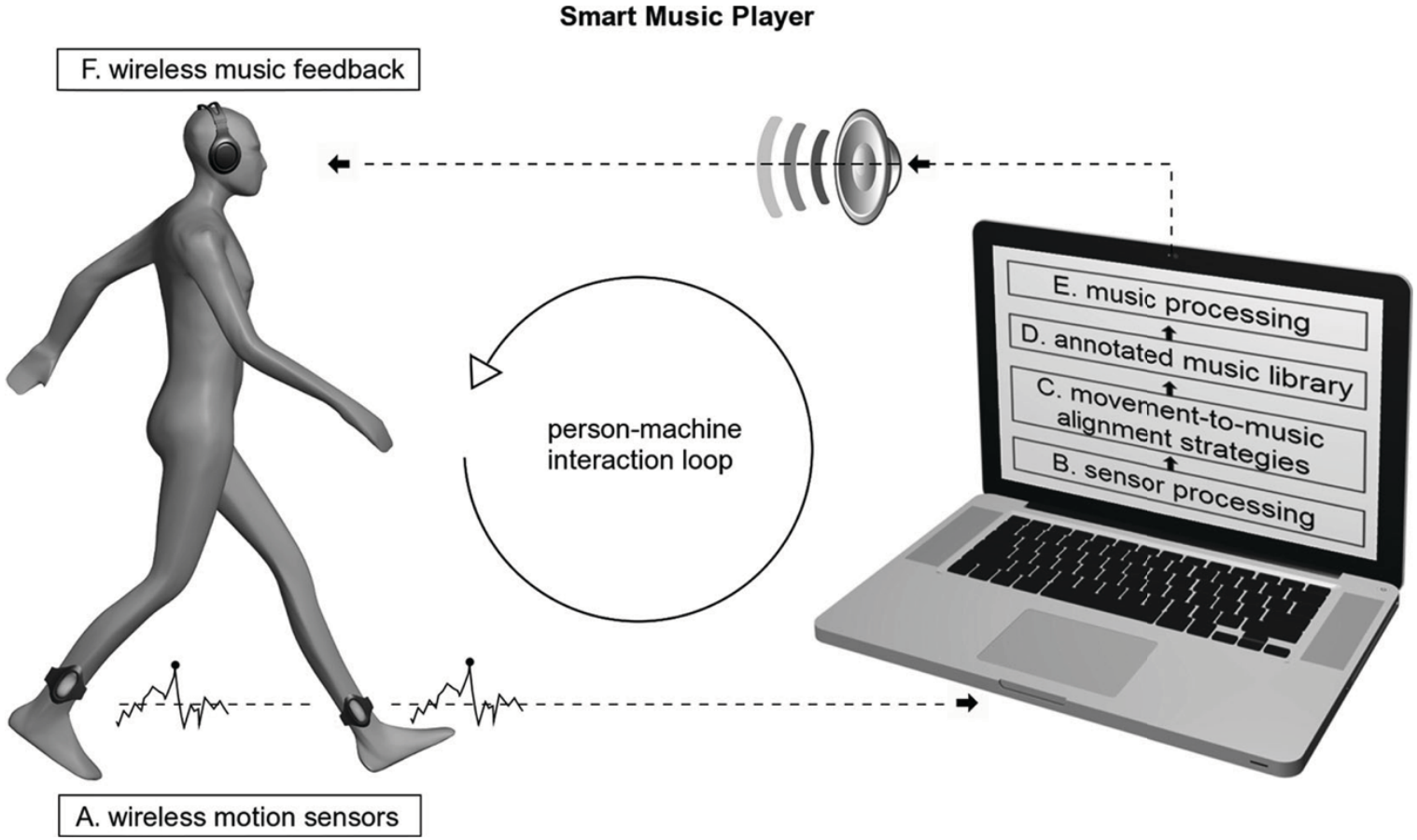
Music - Jelly Roll Morton: Black Bottom Stomp

ENTRAINMENT
(3) Rhythmic Auditory Stimulation (RAS) TwM

Gait training for rehabilitation: synchronizing gait with metronome or musical pulse

Thaut & Abiru (2010)

ENTRAINMENT (4) Smart Gait Training TwM



Moens & Leman (2015)

Music - Stevie Wonder: Superstition

MUSIC IN FREE FLOW
can be followed by a Cerebellum-related network

Teki et al. 2011

MUSIC IN FREE FLOW

Music - Gloria in excelsis Deo

MUSIC IN FREE FLOW

The Ocean drum is used in
(5) MT for Pain reduction in palliative care
RCT Gutgsell et al. 2013

and

(6) MT for premature infants
RCT Loewy et al. 2013

https://www.youtube.com/watch?v=ajhKWGWZu64

Music can evoke

PLEASURE
REWARD
EMOTION

which can be measured in the body and brain

Method: Measurement of "chill" response in the body

Respiration

Electrodermal
skin response

Temperature

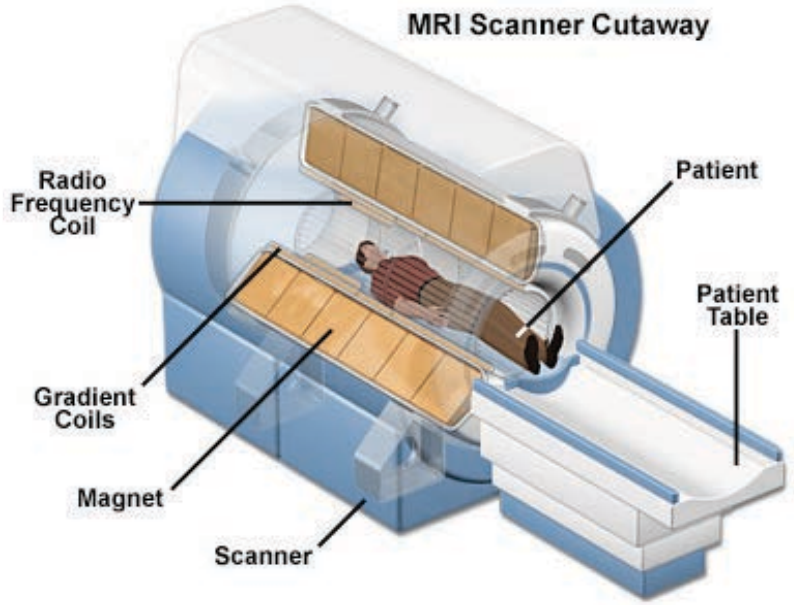
Blood volume
pulse amplitude

Heart rate

Method: PET SCANNING
Positron Emission Tomography:
Creation of images during music listening

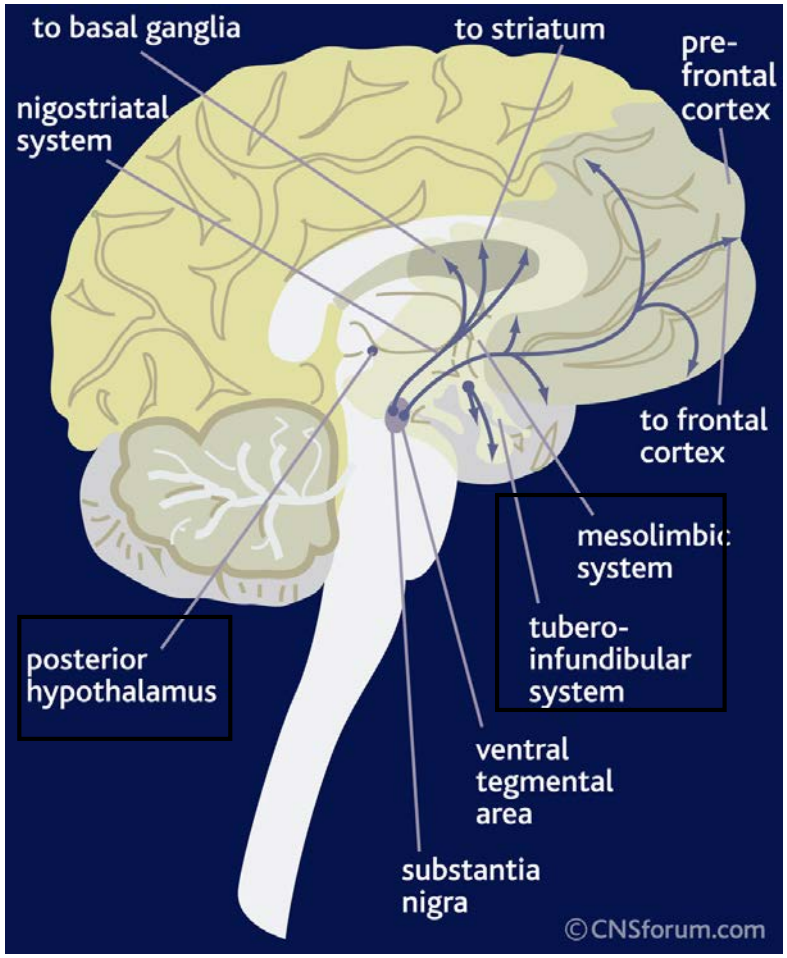
Images created by measuring the blood flow
to different parts of the brain reflect neural activity

Method: fMRI SCANNING: functional Magnetic Resonance Imaging during music listening



Images created by measuring magnetic differences between oxygenated and deoxygenated blood reflect neural activity

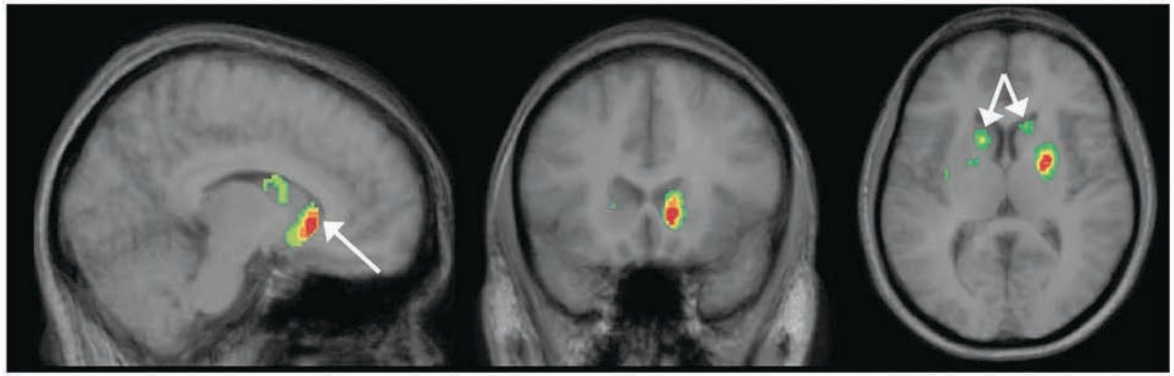
Music-induced EXPECTATION and PEAK EMOTION release DOPAMIN in the brain



Mozart: Lacrimosa from Requiem

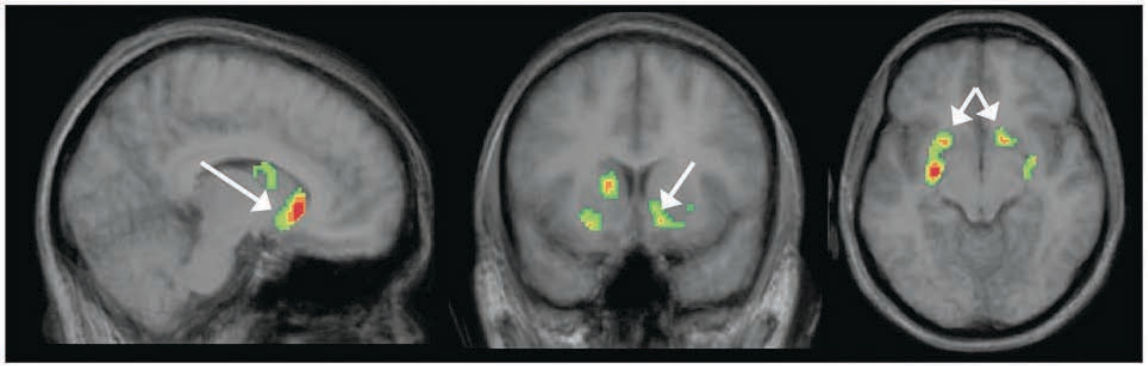
Salimpoor et al. 2011

Salimpoor et al. (2011) fMRI-scanning images



Nucleus caudatus

Dopamin release during EXPECTATION



Nucleus accumbens

Dopamin release during PEAK EMOTION

EMOTION ATTENTION ENTRAINMENT

(6) MT for stabilizing
premature infants

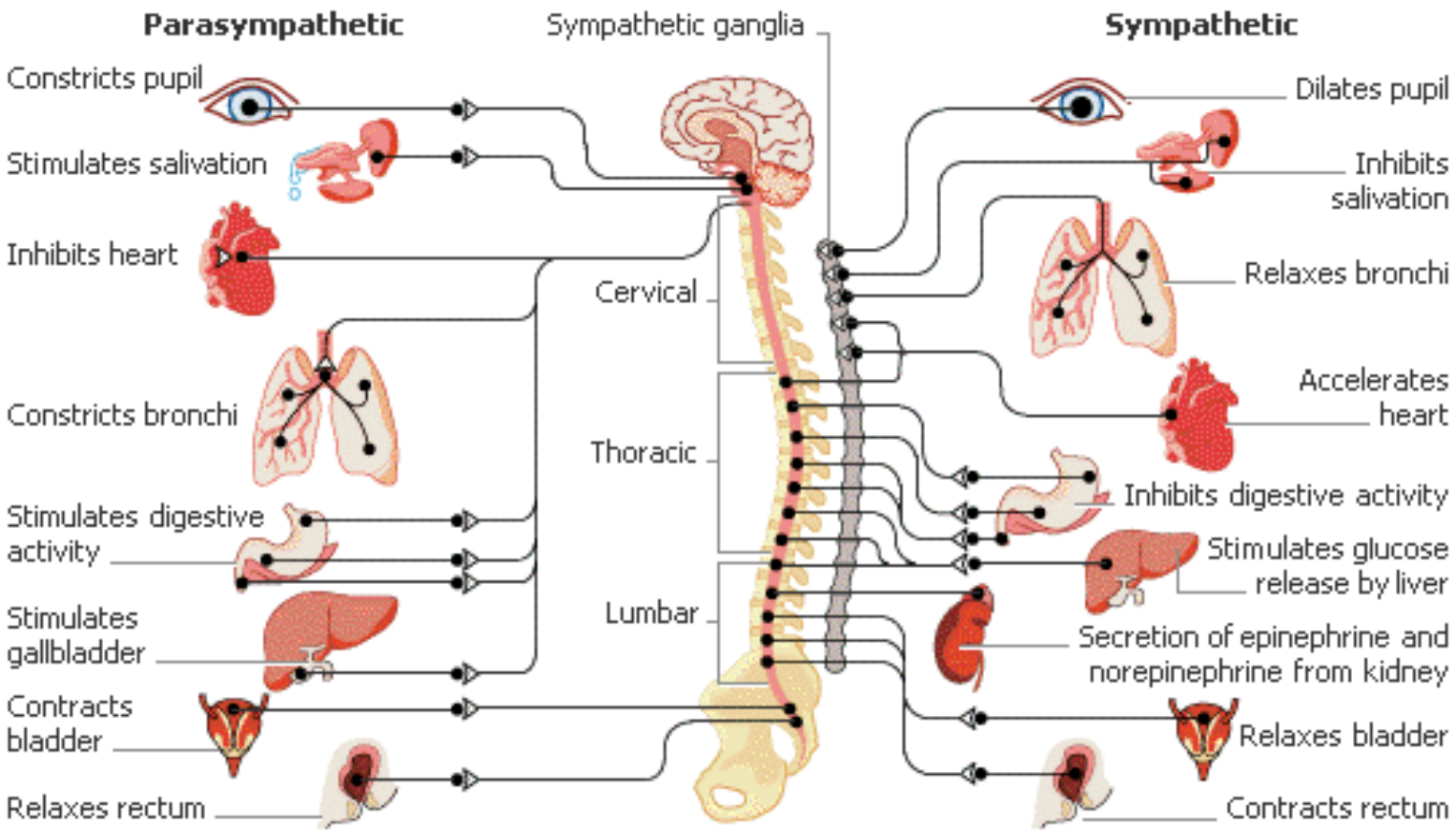
Music regulates
heart rate, breathing, movement, tension, sleep

Music: Veljo Tormis: LULLABY

Regulation of body and emotions: Autonomous Nervous System

Parasympathetic

Sympathetic



AUTONOMOUS NERVOUS SYSTEM response: TEMPO

Blood pressure, respiration, heart rate

Music: Vivaldi: Summer

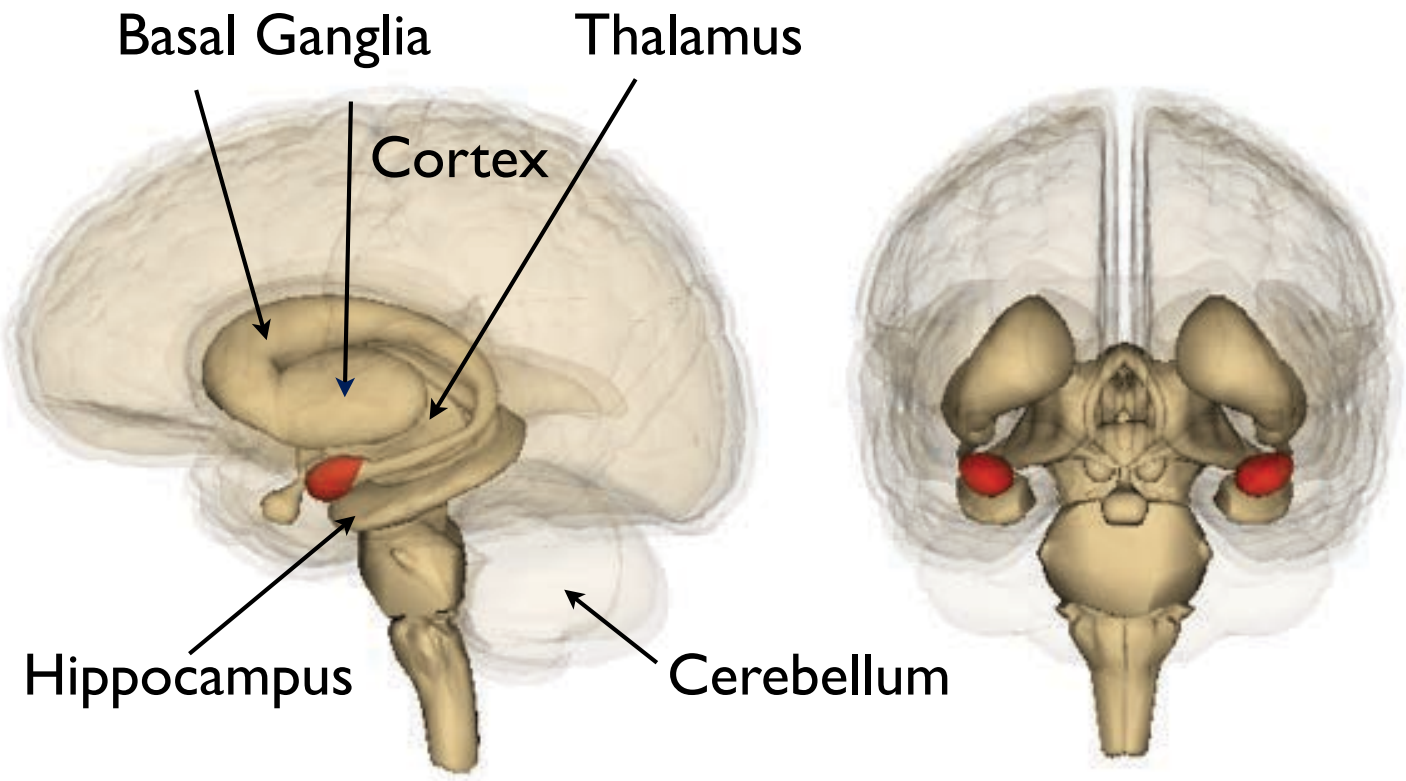
AUTONOMOUS NERVOUS SYSTEM response: CRESCENDO

Va, pensiero from Verdi: Nabucco

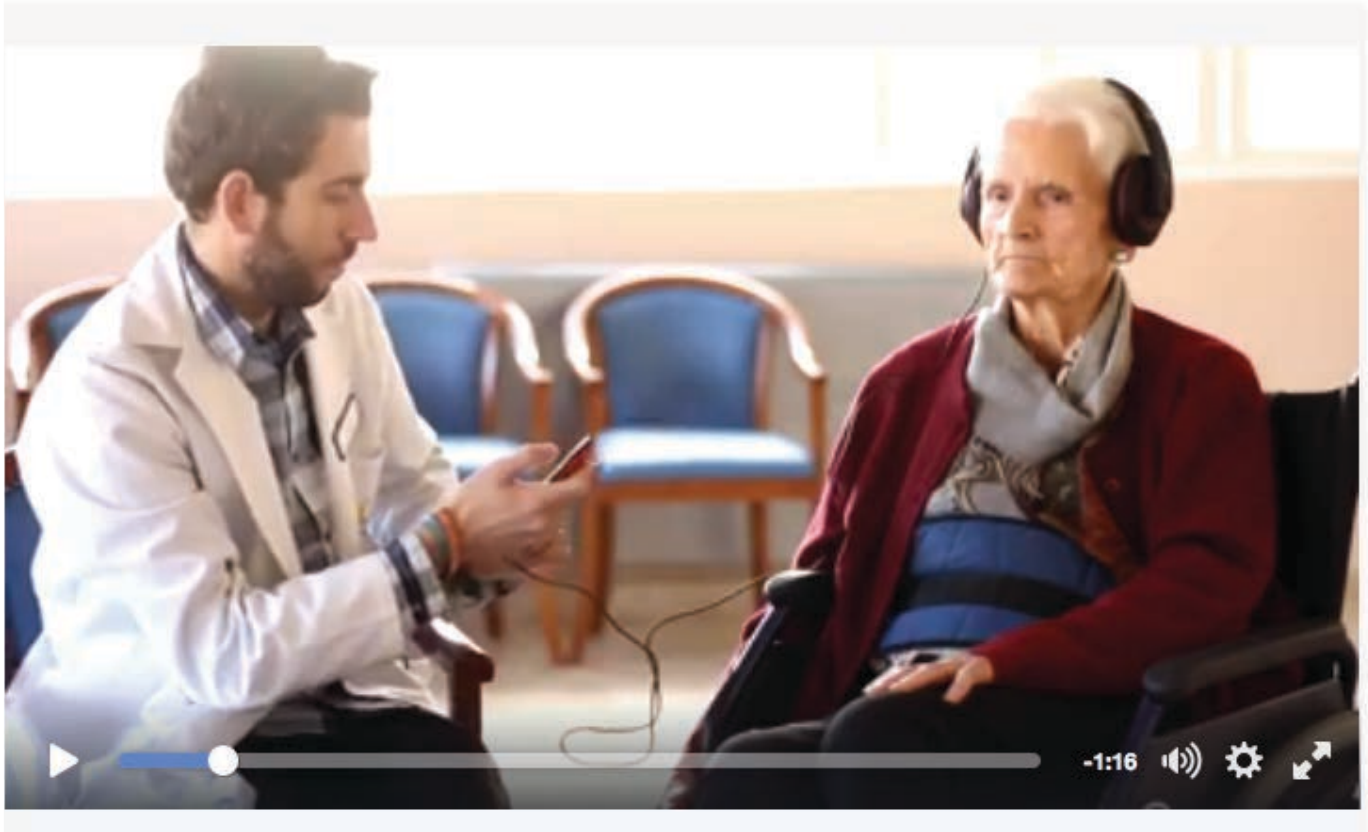
The AUTONOMOUS NERVOUS SYSTEM regulates AROUSAL

Music - Pentecostal Gospel: Holding on

MEMORY:
Hippocampus - Cortex loops



MEMORY Attention Emotion Movement
(7) Music for Dementia patients TwM



https://www.facebook.com/617837718278580/videos/843813975680952

MEMORY Attention Emotion Movement preparation
(8) Guided Imagery and Music (GIM) MT

Music - Arvo Pärt: Spiegel im Spiegel

EEG & MEG: Neurophysiological measurements

Method - EEG: Electroencephalography

measures differences in electric voltage correlated with neural activity

(9) MT with patients in Vegetative State (VS) and Minimally Conscious State (MCS)

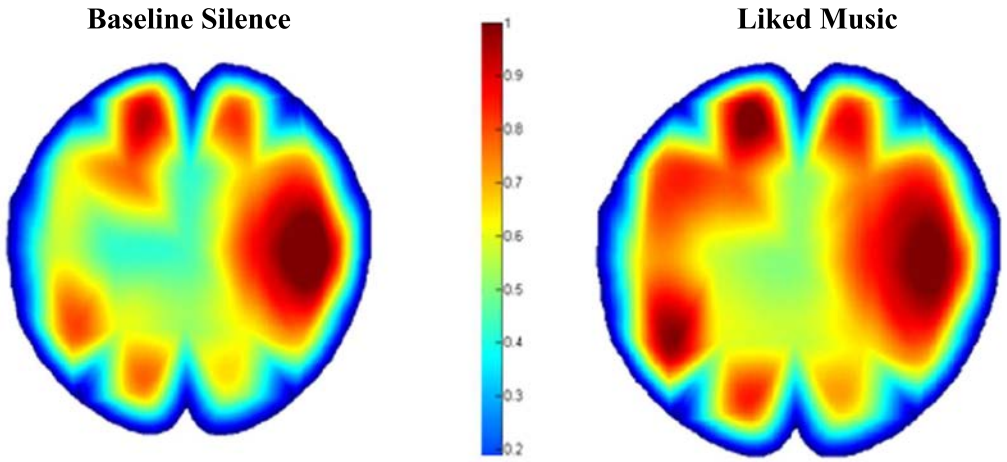


FIGURE 9 | Case "C" alpha 1 (8–10.5 Hz) EEG topography.

EEG measurements indicate response to live preferred music

O'Kelly et al. 2013

Method - MEG: Magnetoencephalography measures differences in magnetic fields correlated with neural activity

(10) MEG measurements show enhanced auditory sensory memory after treatment for stroke Särkämö et al. 2010 TwM

Documentation of music therapy effects in Cochrane reviews and systematic reviews:

Schizophrenia	Mössler et al. 2011
Autism Spectrum Disorder	Geretsegger et al. 2014
Depression	Maratos et al. 2009
Anxiety	Gold et al. 2009
Dementia	Kverno et al. 2009

DIFFERENCES NEUROSCIENCE	MUSIC THERAPY
Technology	Personal relationships
Measurements Quantitative methods	Clinical studies Qualitative and quantitative methods
Listening and training interventions	Listening, improvisation and creative interactions
Evidence	Benefit for the client

DIFFERENCES

"Primarily, music therapists deliver music-based interventions on a daily basis with numerous populations;

neuroscientists measure clinical changes in ways that provide an evidence base for progressing clinical care.

Although recent developments suggest that partnerships between the two can produce positive outcomes for both fields, these collaborations are not considered mainstream."

Wendy Magee and Lauren Stewart (2015): The challenges and benefits of a genuine partnership between Music Therapy and Neuroscience: a dialog between scientist and therapist

ONE BIG DIFFERENCE:
IMPROVISATION in MUSIC THERAPY

MUSICAL IMPROVISATION has been defined as

"Any combination of sound and silence
spontaneously created within a framework
of beginning and ending"

The British Association of Professional Music Therapists 1985
Darnley-Smith & Patey 2003:40; Wigram 2004:37

MUSIC THERAPY can
EXPAND THE SCOPE of NEUROSCIENCE

- providing unexplored material from improvisations

- focusing on music in free flow

- focusing on rich sounds and timbres of percussion

- focusing on the integration of body movement and music

- contributing to inter-brain research

(11) Active improvisation with piano MT
Music Therapist Tony Wigram and autistic boy

Therapist: low piano
Boy: high piano

Bonde (ed. 2014): 452-455

(12) Active improvisation with PERCUSSION MT
Music Therapist Tony Wigram and autistic boy

Therapist: drums
Boy : cymbal

Bonde (ed. 2014): 452-455

(13) Active improvisation
Voices in free flow

Music Therapist
Inge Nygaard Pedersen
and client suffering from
personality disorder

Bonde (ed. 2014): 262-268

(14) Individual MT for depression

Free improvisation
Instruments:
Digital mallet instrument
Digital percussion
Acoustic djembe drum

RCT study:
20 sessions of individual MT is effective for depression
Erkkilä et al. 2011

INTERACTIVE WIRELESS EEG:

REALISTIC UTOPIA

NECESSITY OF INTER-BRAIN RESEARCH

We believe that hyperscanning is necessary in future exploration of the underlying mechanisms of social interaction.

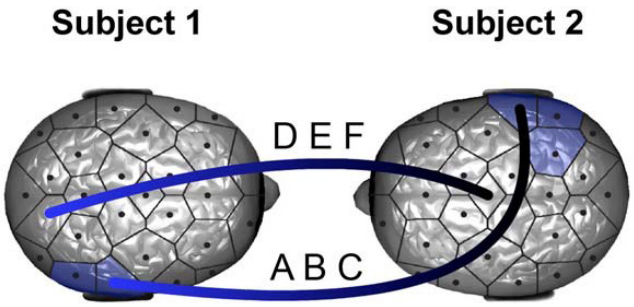
It is the only way to tap into inter-brain processes, which we still know so little about.

⇨ Konvalinka and Roepstorff (2012): The two-brain approach

⇨ http://interactingminds.au.dk

BASIC QUESTION

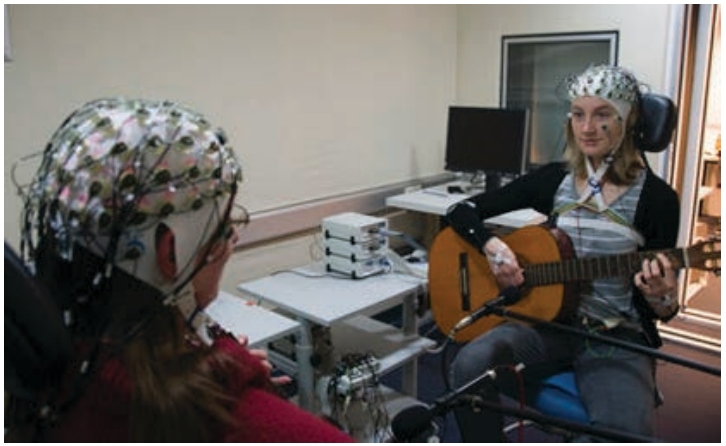
What goes on in two interacting minds?



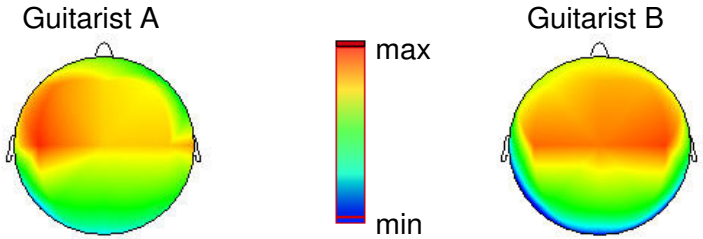
Dumas et al. 2010

POSSIBILITY

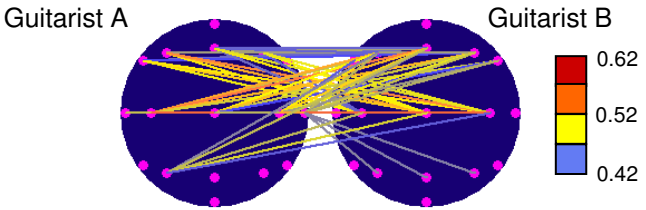
EEG Laboratory recording of interacting brains: Guitar duo playing a melody in unison



Synchronization within the brains



Synchronization between the brains



⇨ Max-Planck-Institute Berlin
Lindenberger et al. 2009

NEAR FUTURE: WIRELESS EEG CAPS

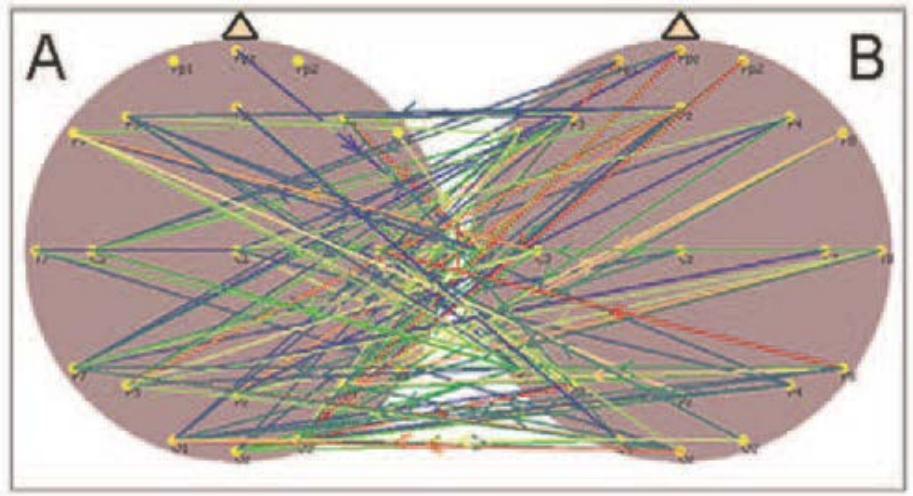
DeVos et al. 2014

FUTURE QUESTION:
What kinds of measurements can we expect?

synchronization

connectivity

and...



https://www.mpib-berlin.mpg.de/en/research/lifespan-psychology/projects/interactive-brains-social-minds ⇒ Max-Planck-Institut Berlin

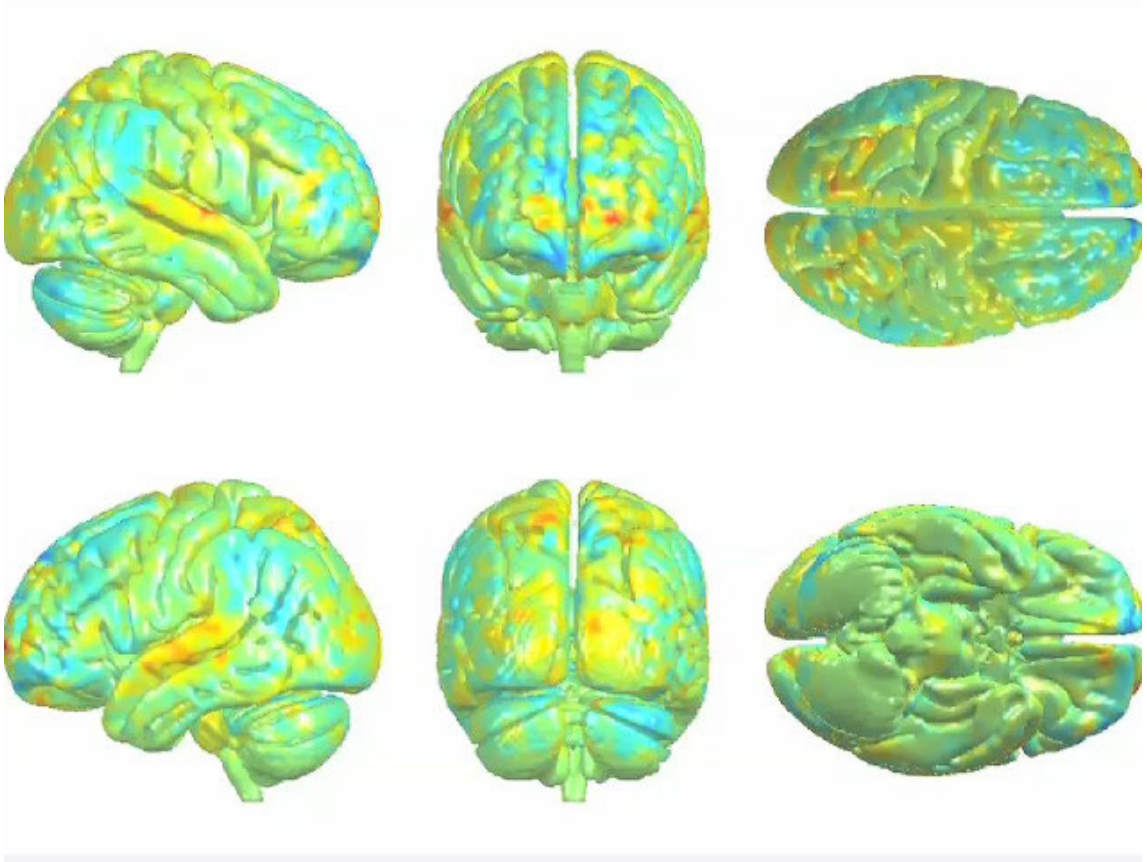
FUTURE QUESTION:
How can a music therapist interpret the interactive EEG measurements?

WHOLE BRAIN:
THE TANGO BRAIN

BRAIN ANIMATION

Front

Right side



From above

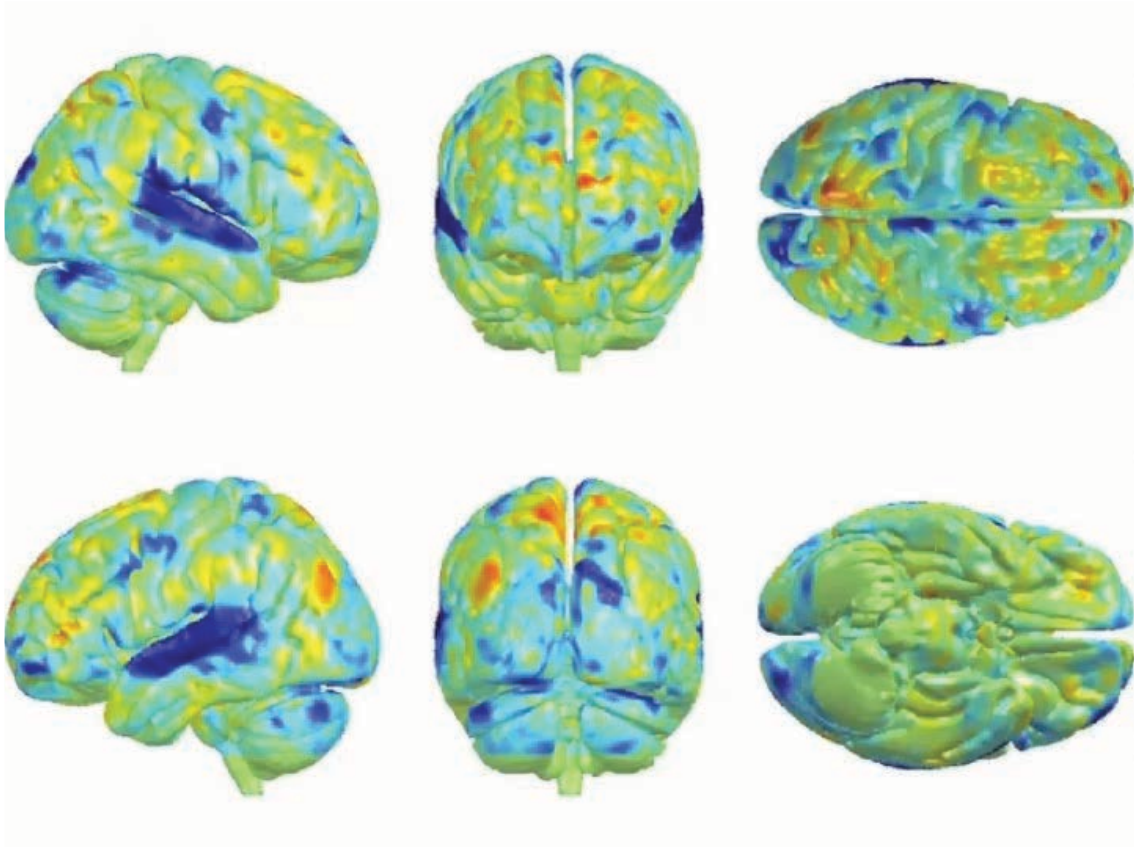
Left side

From below

Back

THE TANGO BRAIN ANIMATION

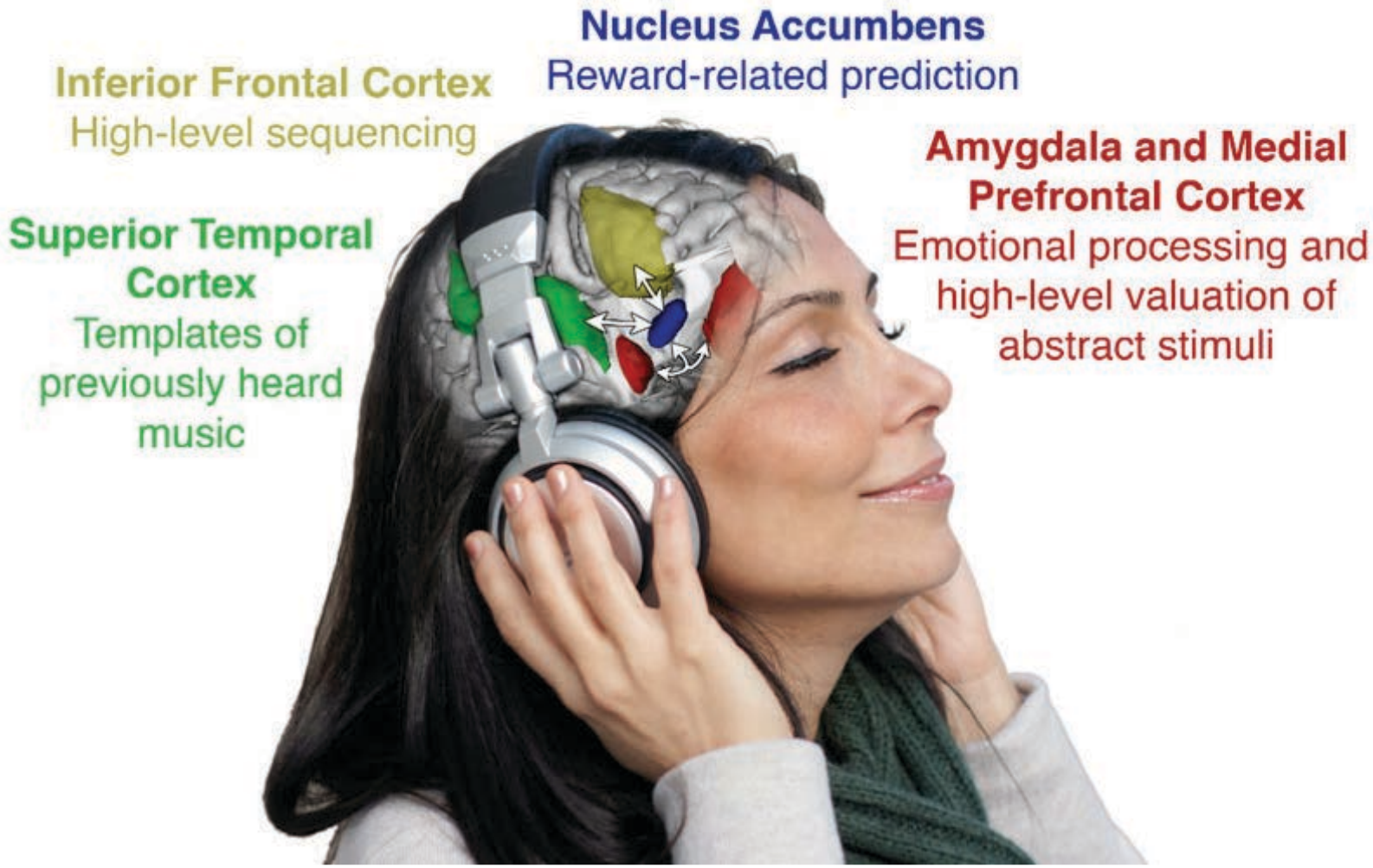
Music - Astor Piazzolla: Tango Adios Nonino



Alluri, Toiviainen et al. (2012)

http://vimeo.com/32859237

HAPPY NEW EARS!



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LINKS

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Playing an instrument
http://ed.ted.com/lessons/how-playing-an-instrument-benefits-your-brain-anita-collins

https://www.youtube.com/watch?feature=player_embedded&v=R0JKCYZ8hng

Entrainment - Twin babies
https://www.youtube.com/watch?v=to7uIG8KYhg

Ocean drum
https://www.youtube.com/watch?v=ajhKWGWZu64

Dementia patients in Spain
https://www.facebook.com/617837718278580/videos/843813975680952

Interactive brains, Social minds
https://www.mpib-berlin.mpg.de/en/research/lifespan-psychology/projects/interactive-brains-social-minds

Tango Brain
vimeo.com/32859237