UCSF School of Medicine

The Neuroscience of Cre

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Sound and Music Perce

UCSF

PI: Dr. Charles Limb, M.D.

Welcome!

Course Objectives

- How do we hear?
- How can we use neural imaging to study musical creativity?
- What are the neural areas involved in musical improvisation?
- Where can I find information about music and he

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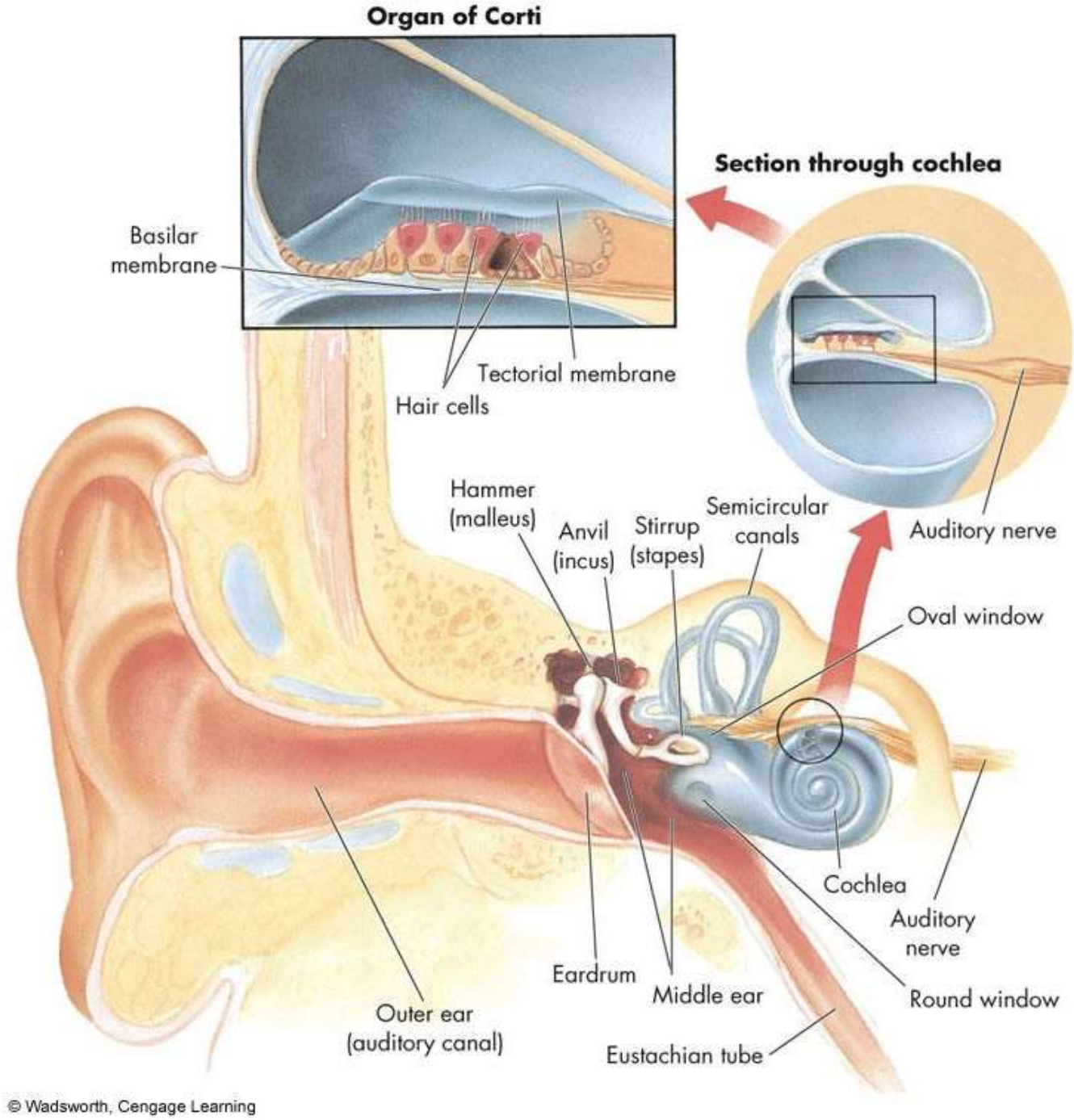
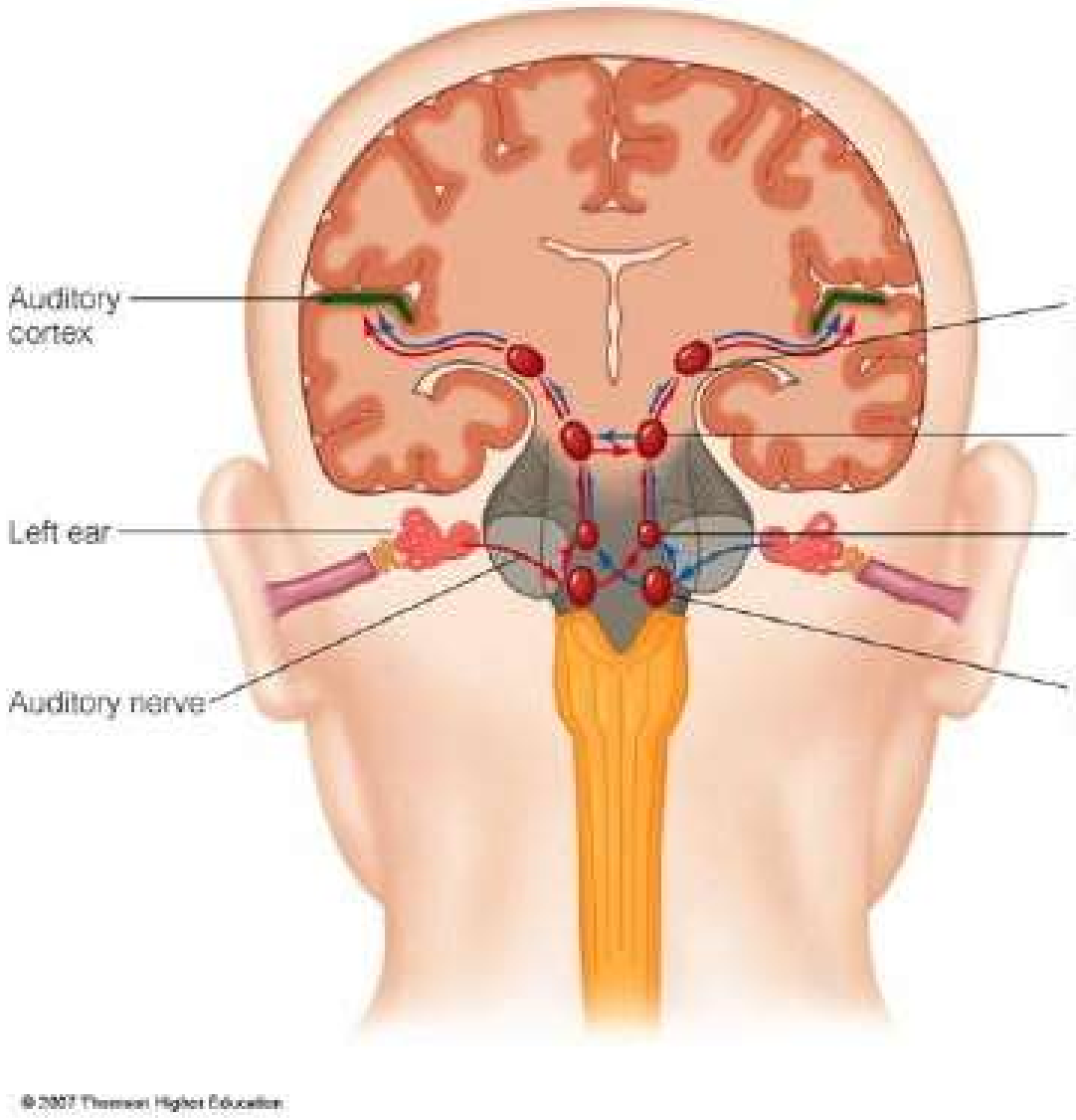
The Human Ear



A quick hearing overview

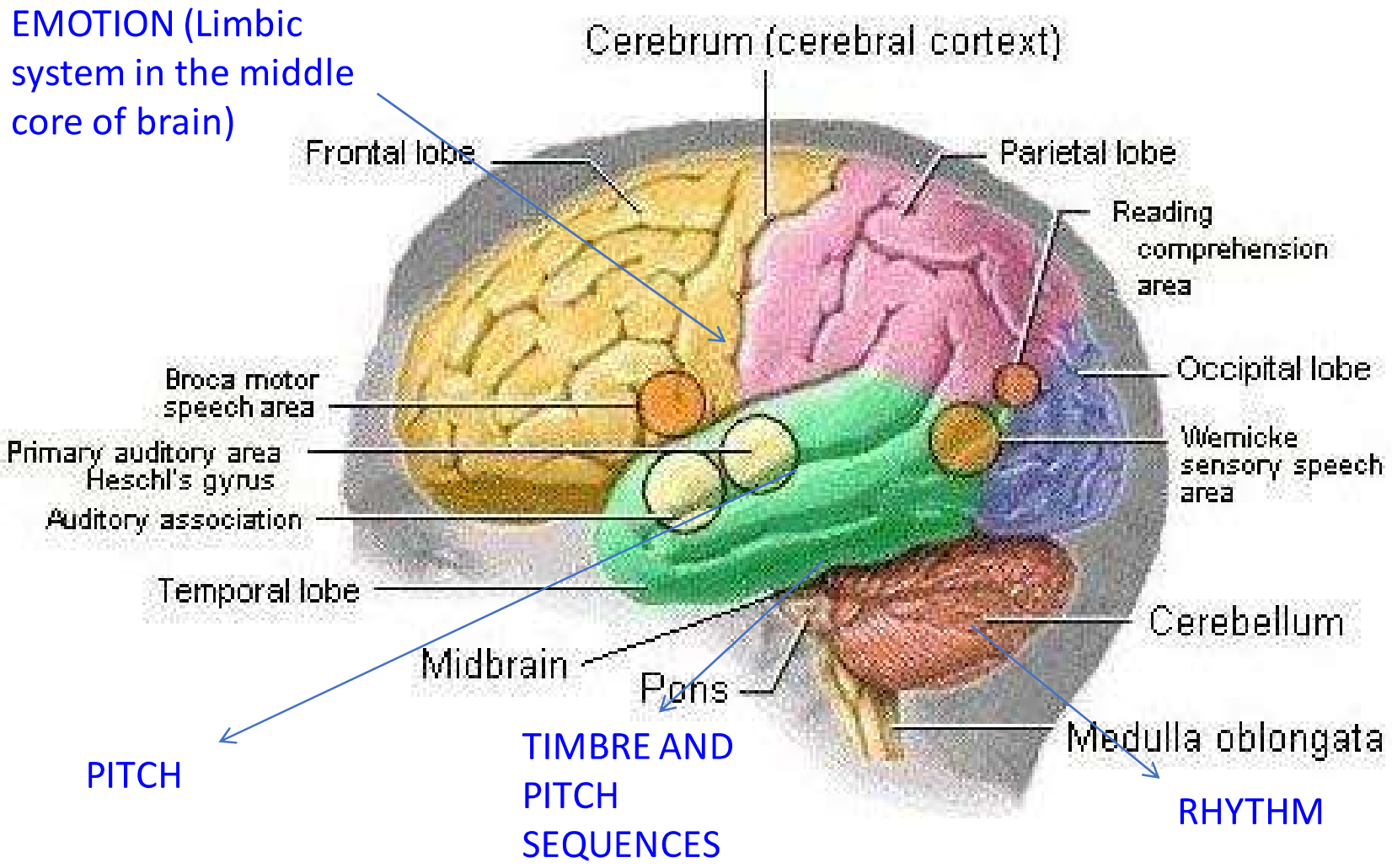
Auditory Pathways in the Brain

- Music processed in ascending pathway from ear all the way up to the auditory cortex
- Sound processed at each “station”

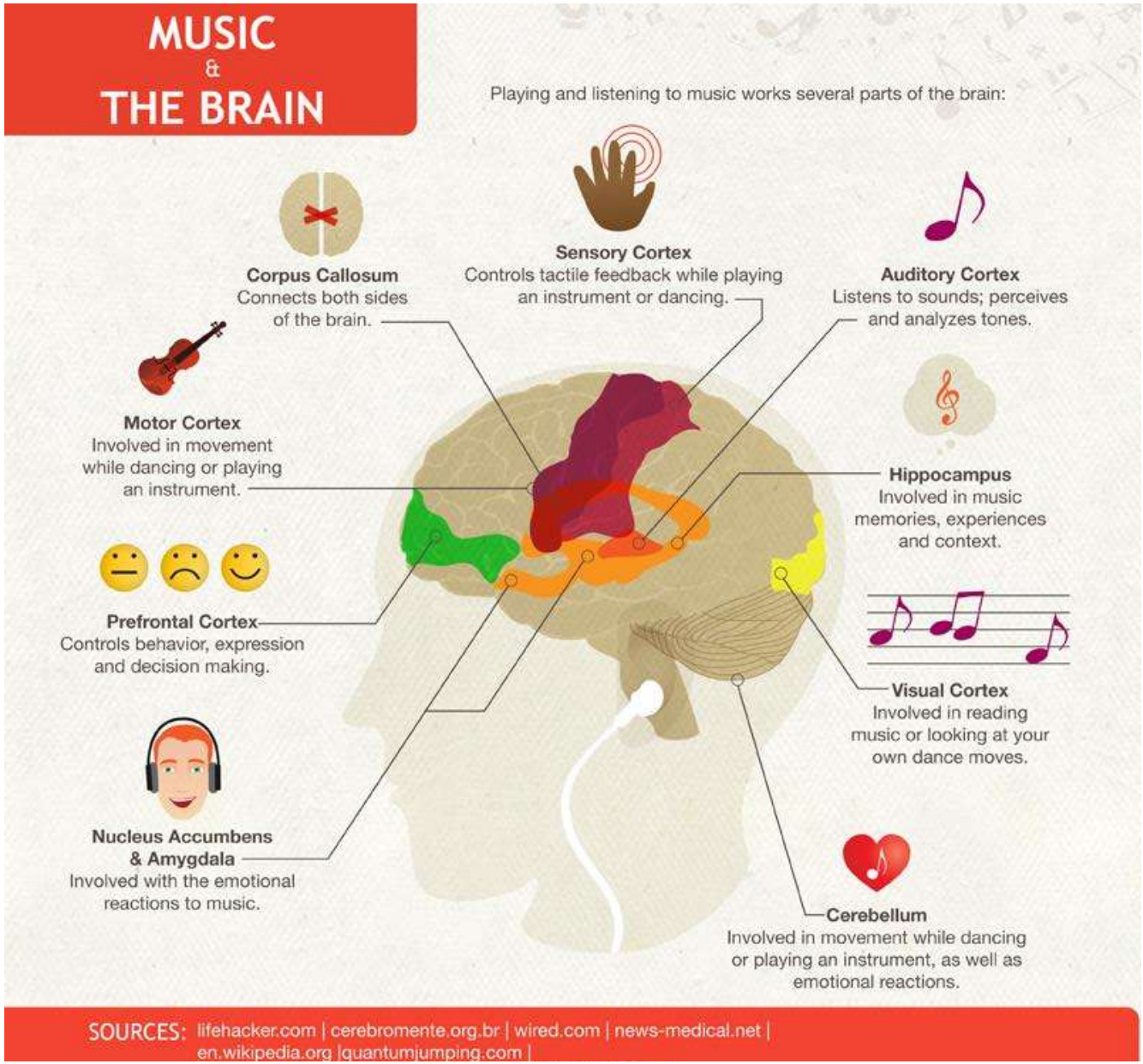


Music and the Brain

- There is no single "music center" in the brain, aspects of music are processed in various areas



Popular Media has recently been focused on how the multidimensional aspects of music listening



News Sources like NYTimes, BBC ne pick up stories ab and the Brain

This is not a real a figure but it helps the findings from news format

Introduction to our lab's research

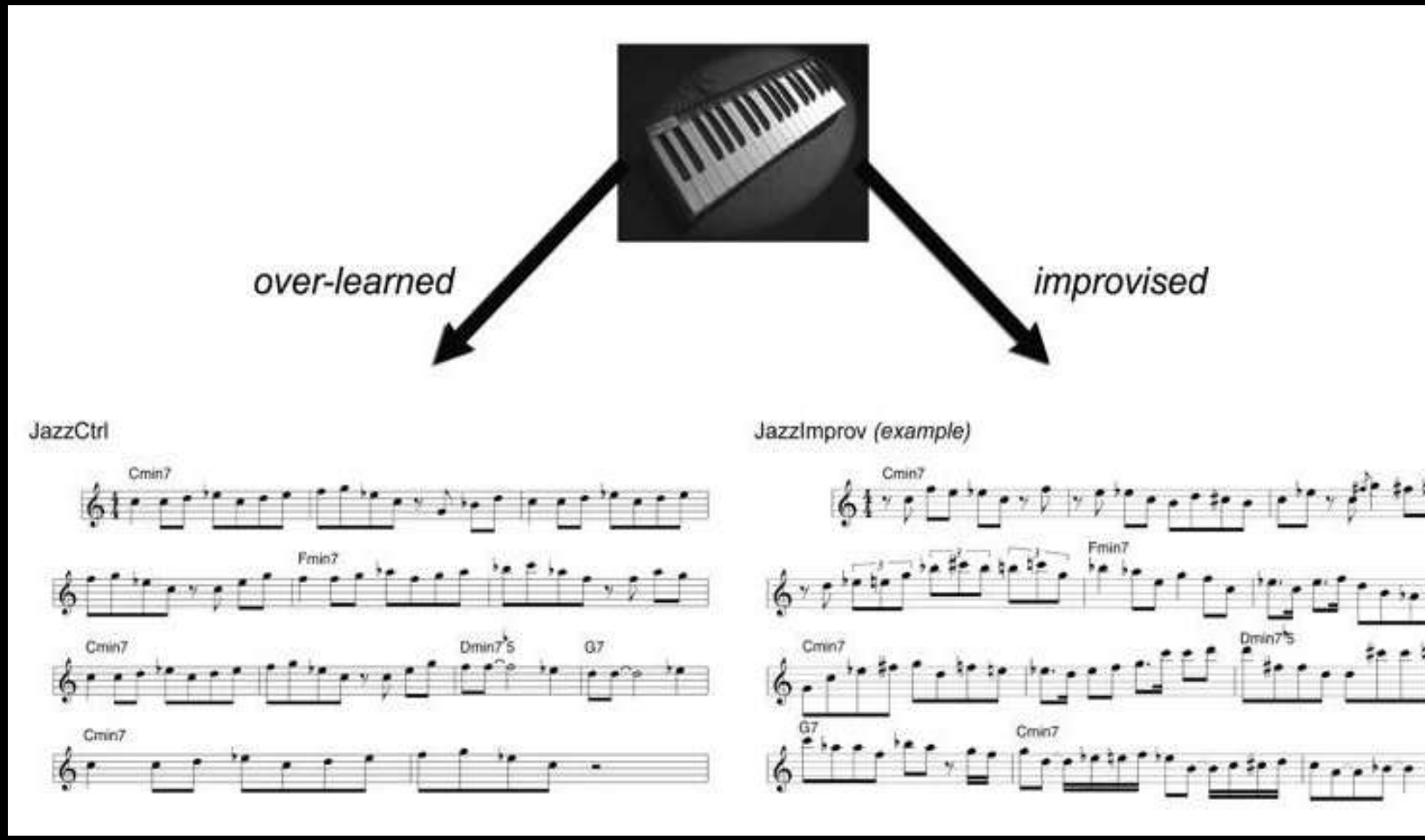
- Musical improvisation = spontaneous creation of music; real-time creativity
- Artistic creativity is a neural process that can be examined using r scientific methods
- fMRI studies of Creativity
  - Professional Jazz Musicians
  - Collaborative Improvisation
  - Musically-untrained Children
  - NEA Project: Improvisation Across Art Forms

Functional Magnetic Resonance Imaging

- Uses Blood Oxygen Level-Dependent imaging (BOLD)
  - Change in neurons' oxygen consumption = indicator of neural activity
- Scanner is noisy, magnetic, spatially-restricted and ergonomically-challenging

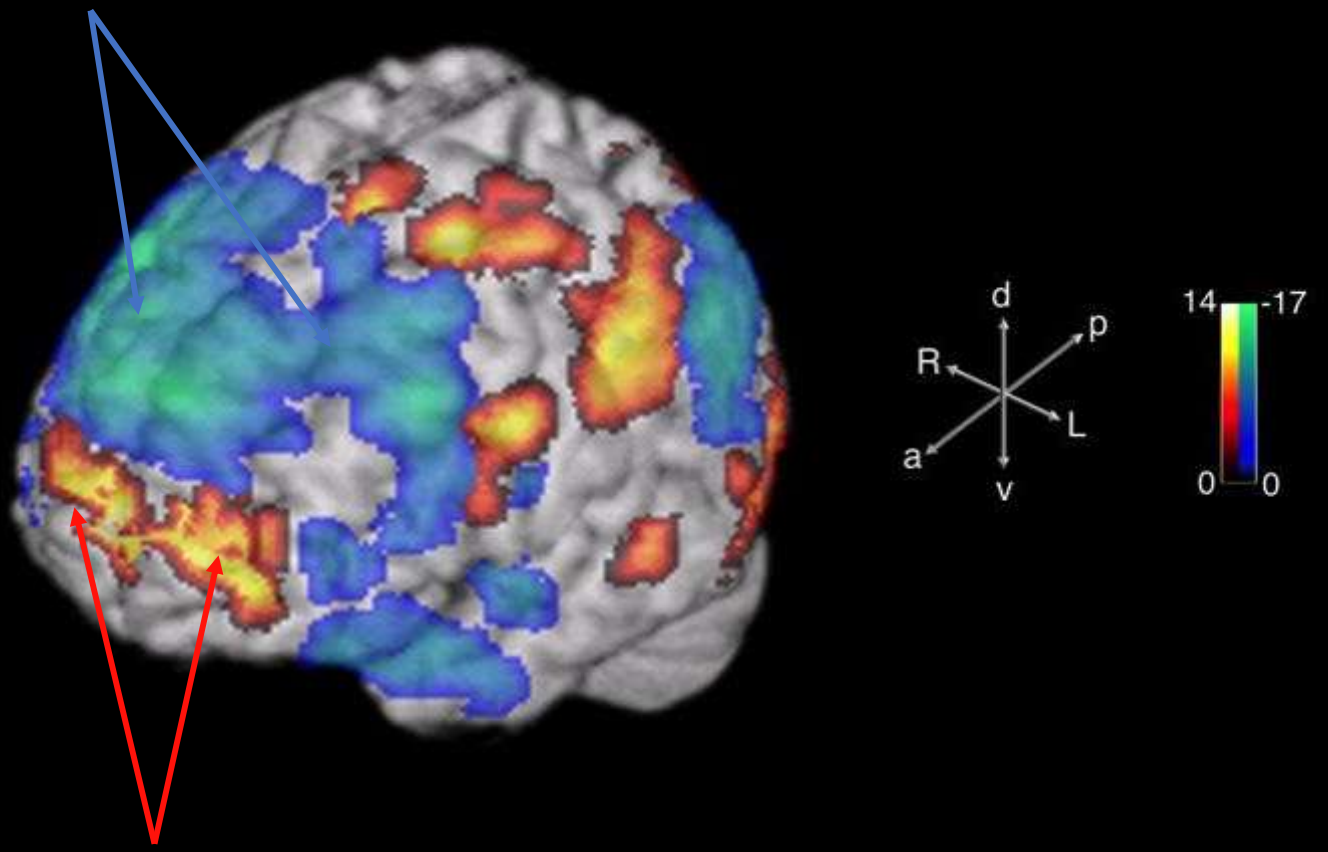
Studying Jazz in an fMRI Scanner

Limb and Braun, 2008, *PLOS ONE*



Experimental
Setup

lateral prefrontal deactivation: ***self-monitoring***



medial prefrontal activation: ***self-expression***

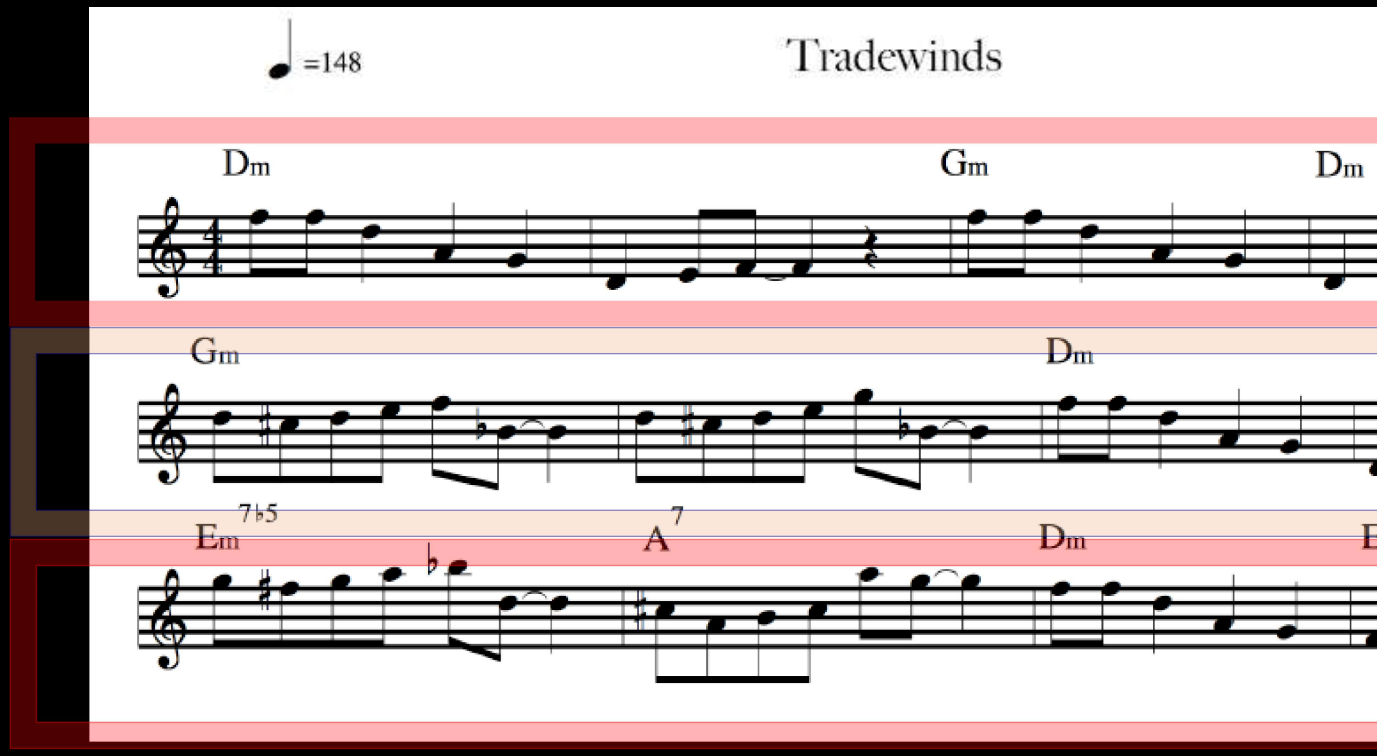
In jazz, solo improvisation is a goal-directed behavior (medial PFC) that may occur in the absence of the context normally provided (lateral prefrontal regions), leading to a defocused form of attention that may encourage spontaneous associations and sudden insights.

"FLOW" (Csikszentmihalyi, 2008)

What about Collaborative Improvisatio

Donnay et al., 2014, *PLOS ONE*

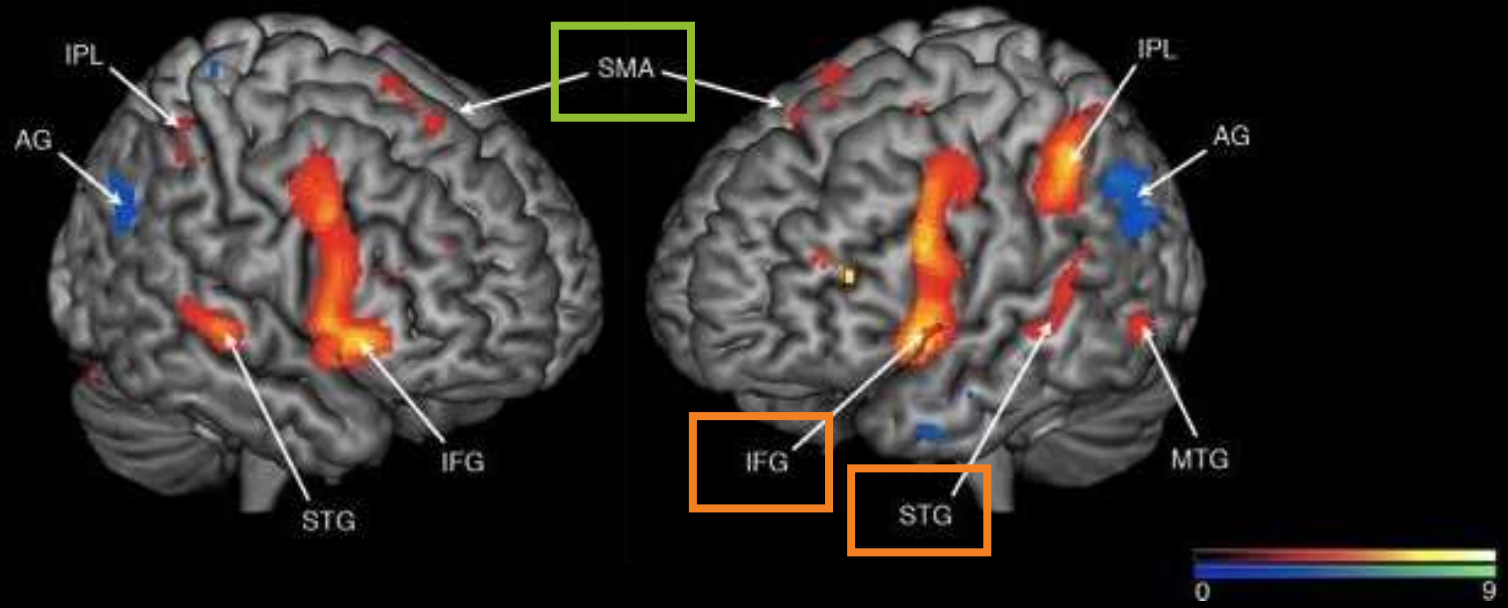
- What are the neural correlates of musical exchanges of improvis material?
- Trading Fours



Jamming
With
Mike
Pope

Improvisation is associated with activation in:

Sensorimotor areas

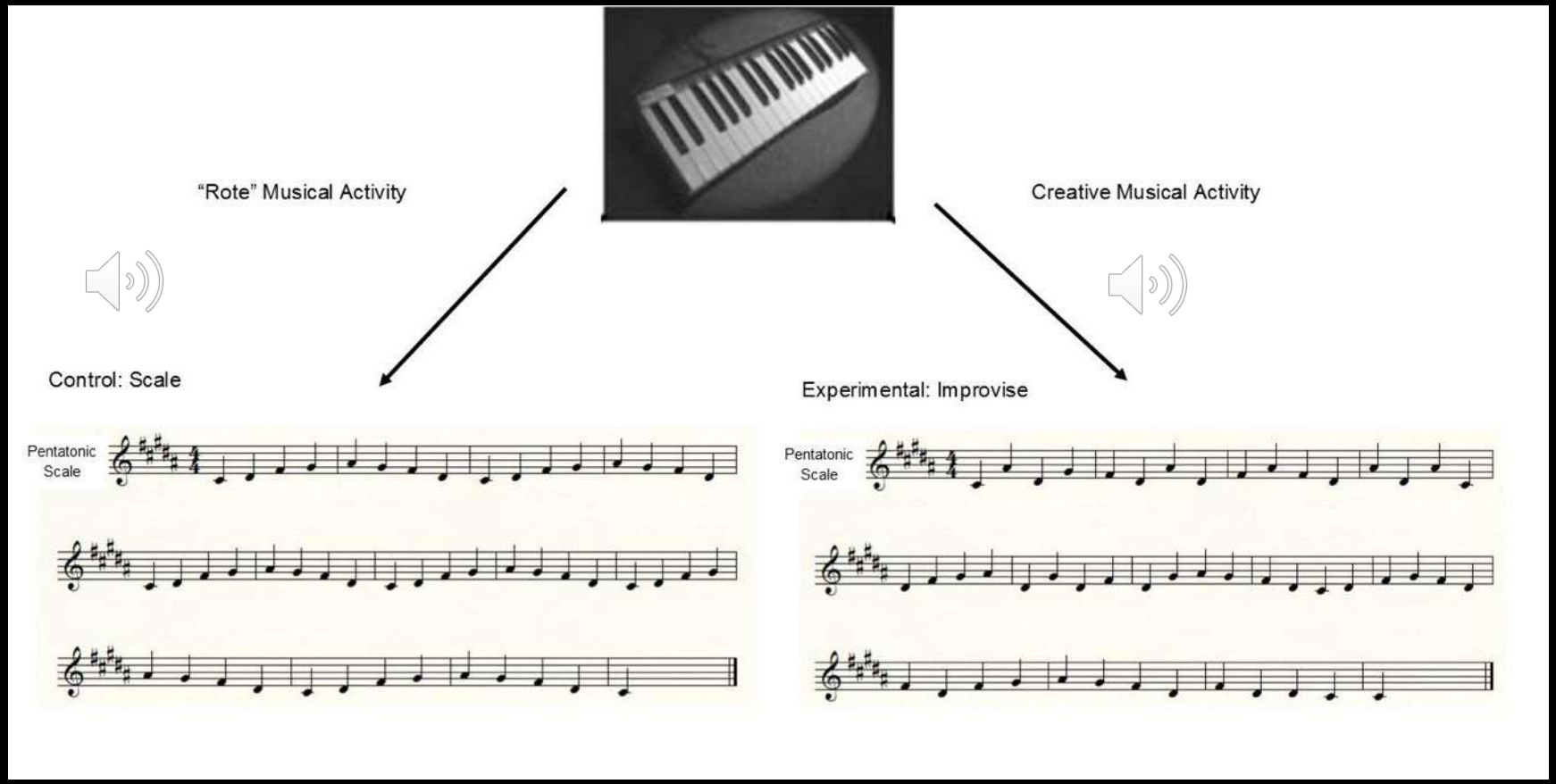


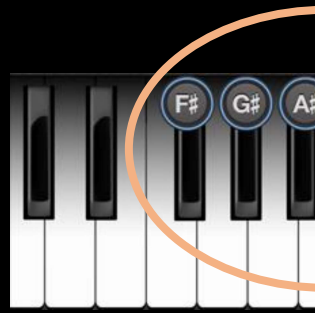
Language Areas

Collaborative Improvisation: a language-like musical exchan

Musically-untrained, school-aged childre

(in preparation)





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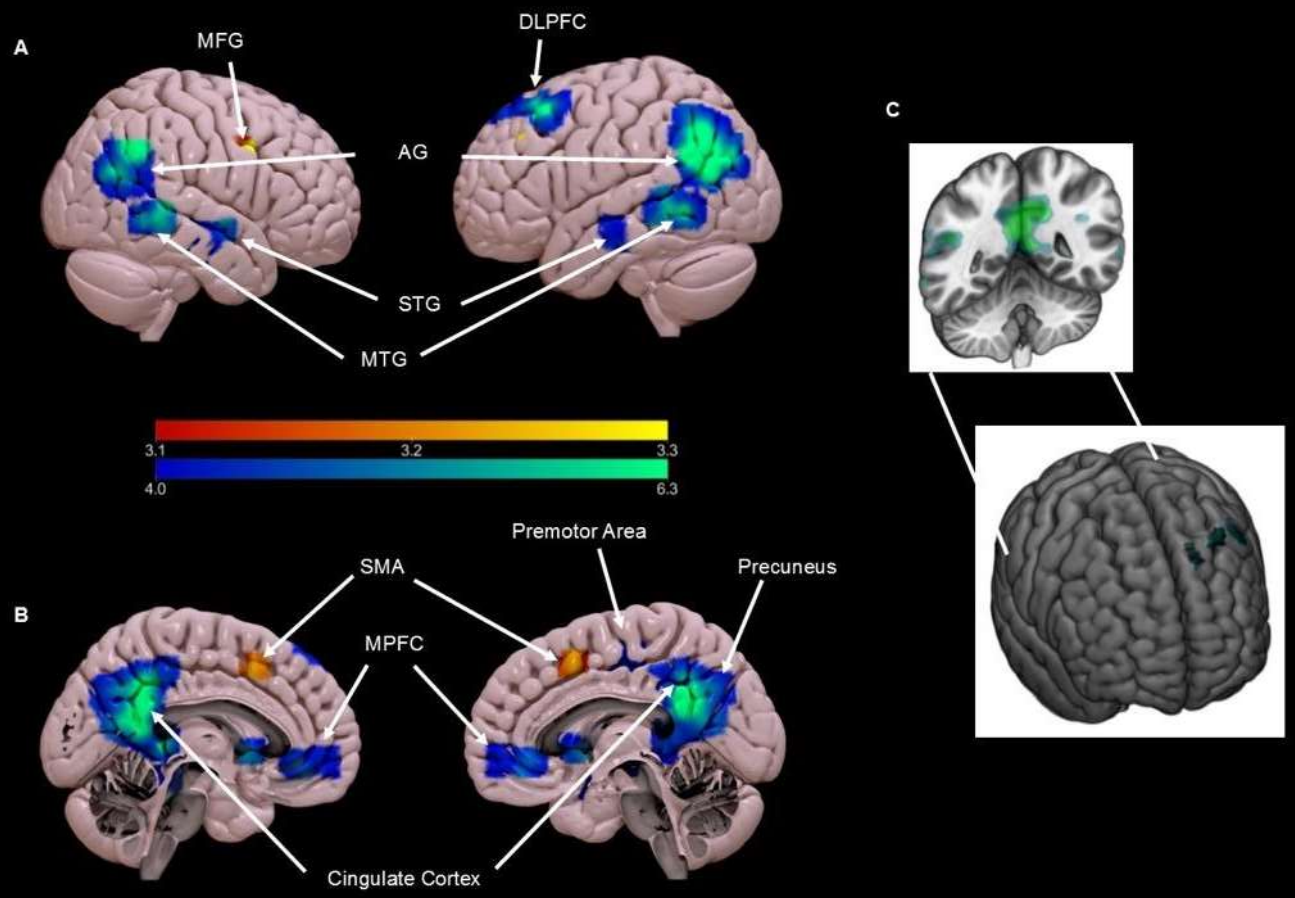
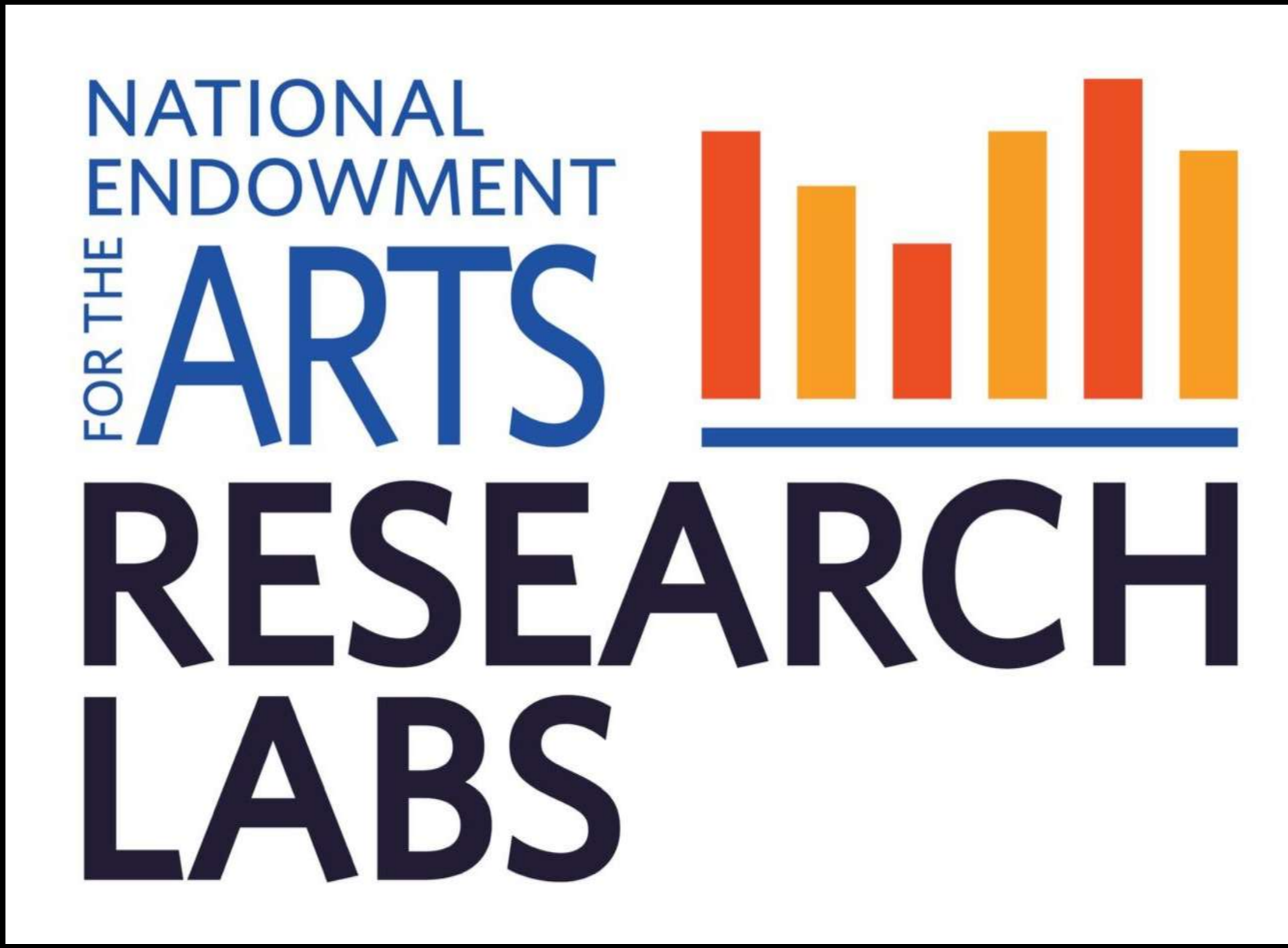
Musically-untrained Children: Preliminary Data Analysis



Deactivation of:
-limbic areas
-parietal areas

Less prefrontal de
than adult jazz m


NATIONAL
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RESEARCH
LABS

Improvisation Across Art Forms

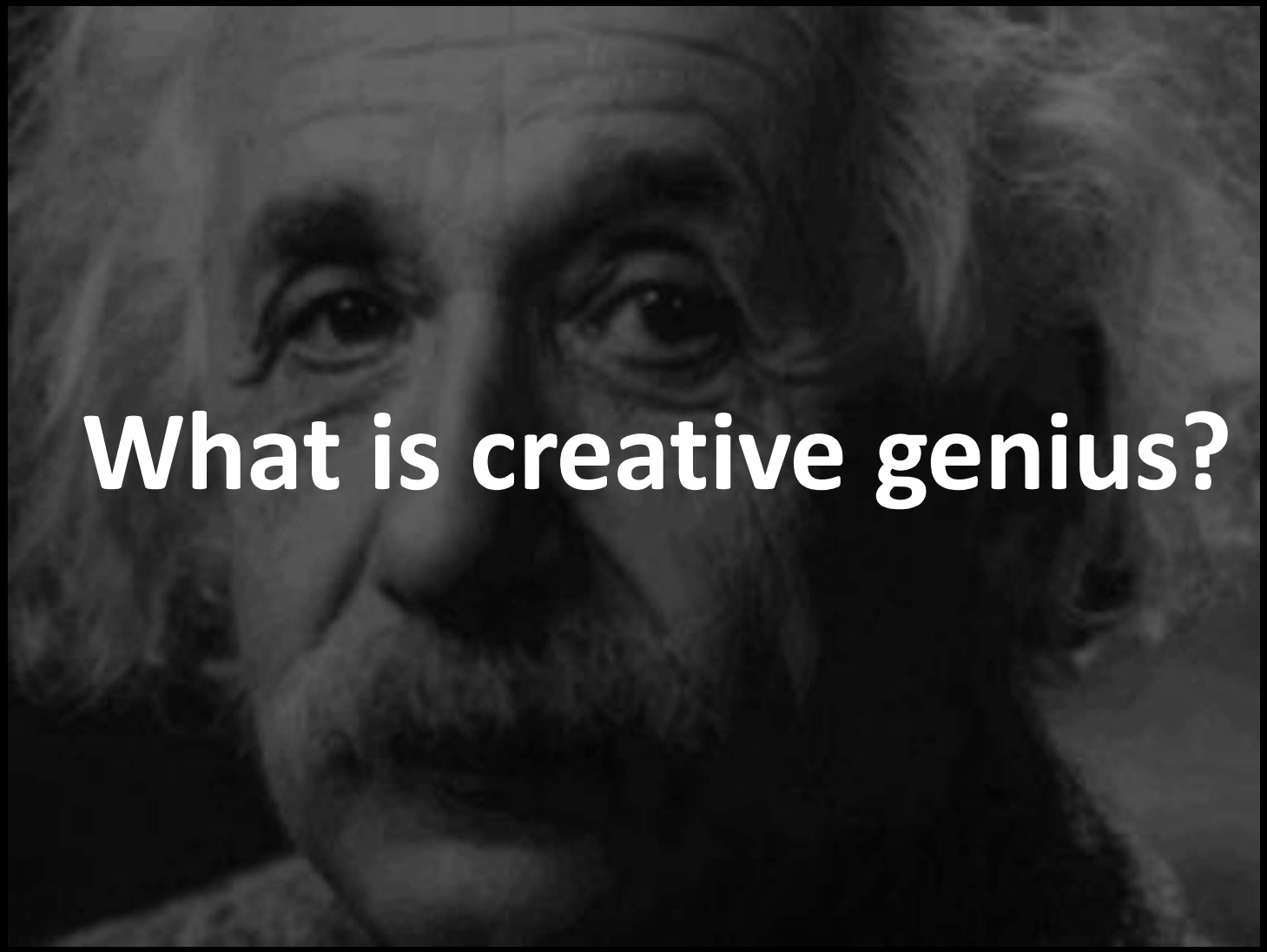
- Research questions:
  - What are the neural correlates of improvisation across art forms (mus
    comedy, visual arts)?
  - Are there cognitive differences among expert improvisers of different a

Paradigm

- Neural imaging (fMRI): Block design experiment comparing control blocks (“rote” artistic activity) vs experimental (improvisation) blocks

- Cognitive test battery: Assessments of creativity, cognitive skills and personality

- **Test Battery** refined with aid of our technical working gro
  - Working Memory and Attention
  - Crystallized IQ
  - Fluid Intelligence
  - Personality
  - Creativity: Divergent Thinking, Convergent Thinking, & Imagination
  - Artistic Achievement and Demographic Questionnaire


What is creative genius?

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Keystone Project: Eminent Musicians

- Testing world-class musicians as **case studies**
  - Case studies: experimental tasks tailored specifically to the talents of the artist
  - Case series: each artist also completes a common improvisation task
- Opportunities and Challenges

Eminent Musicians as Case Studies

Gabriela Montero
Barrett et al., 2020
Neuroimage

Matthew Whitaker

Fantastic Negrito

Esperan

Zakir Hussain

Solomon Howard

Shockwave

Gabriela Montero


GYROSCAN
ACS-NT
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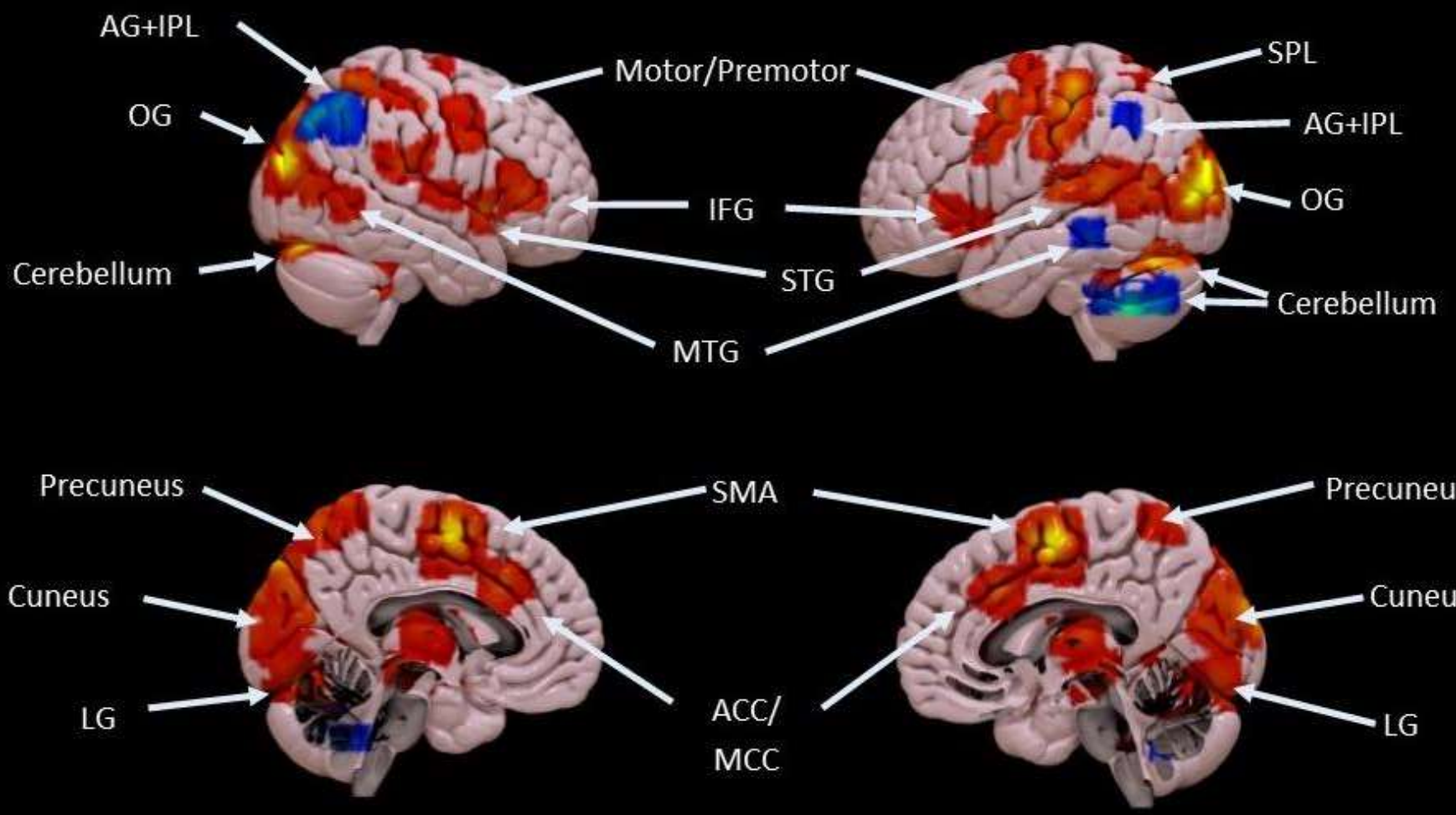
AG+IPL
OG
Motor/Premotor
IFG
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AG+IPL
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ACC/
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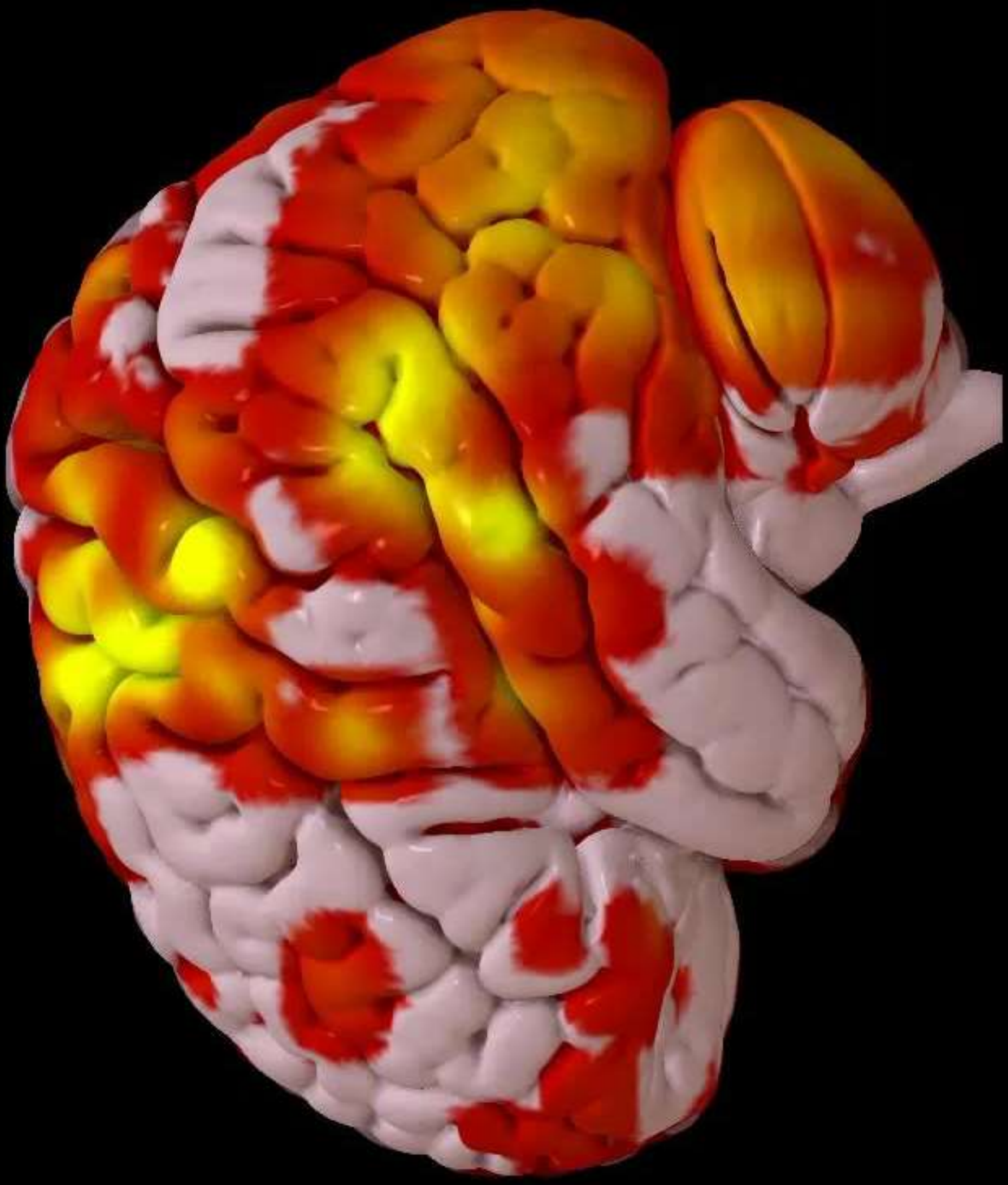
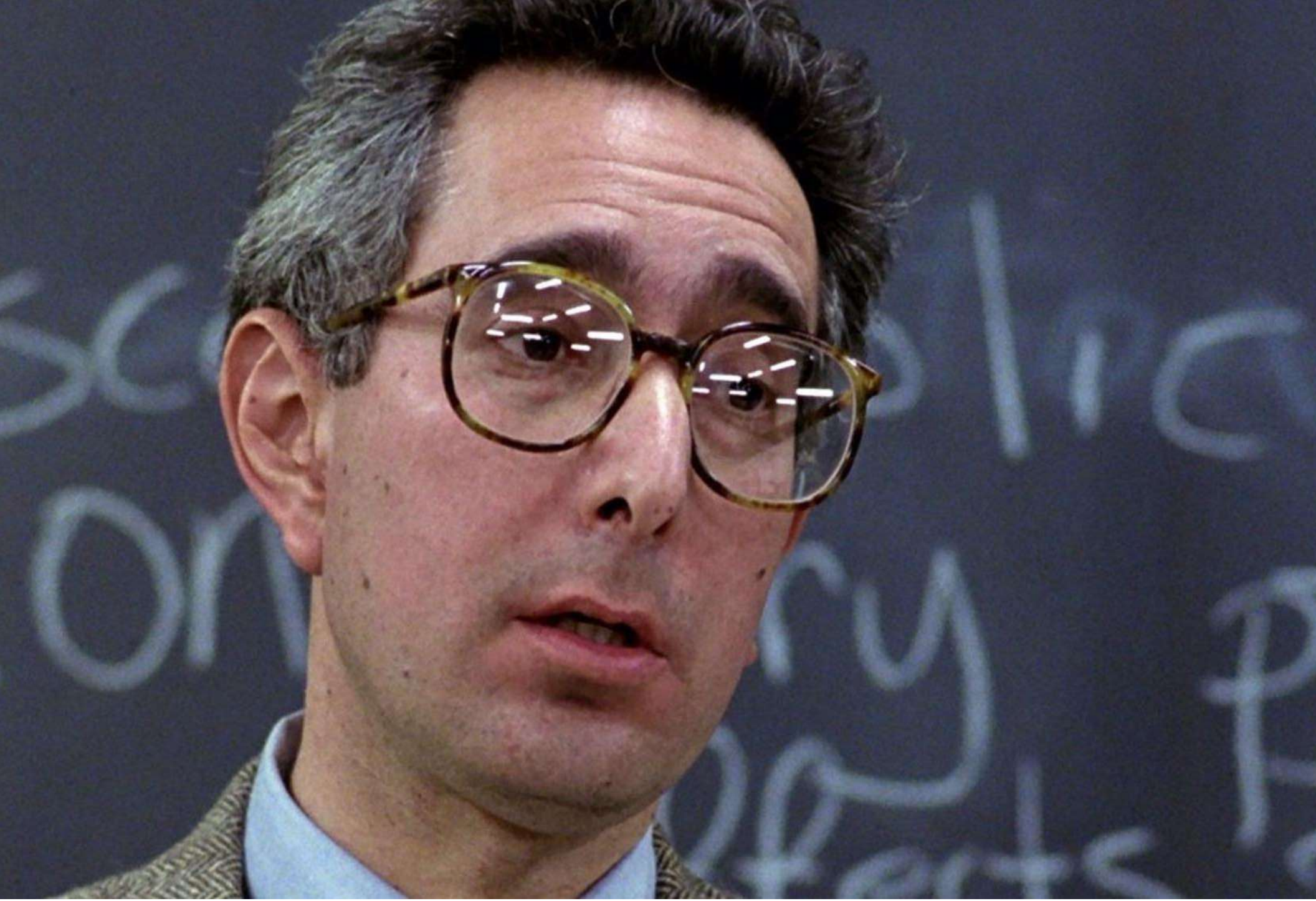
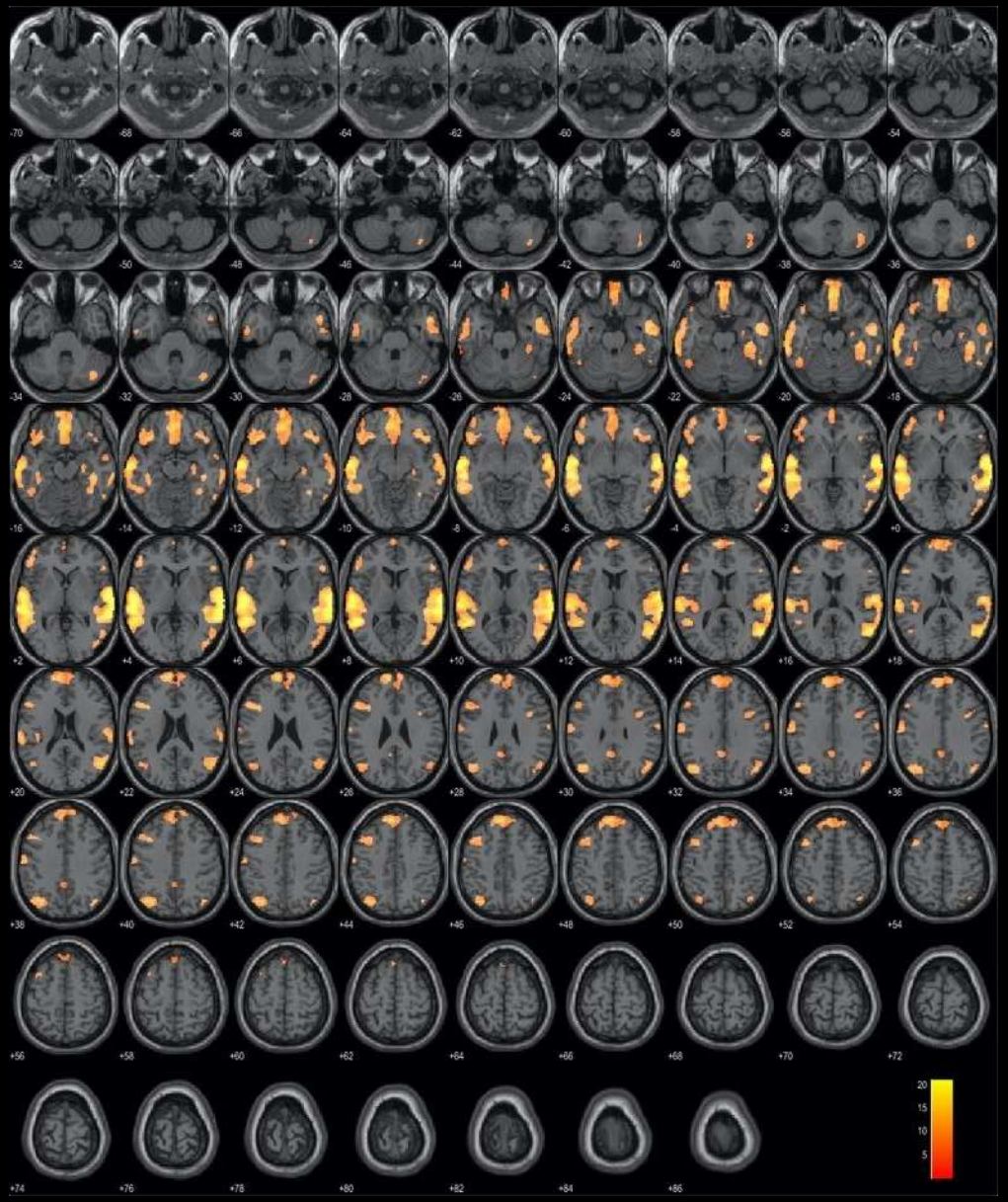
Barrett e

Matthew Whitaker

Matthew Whitaker at UCSF



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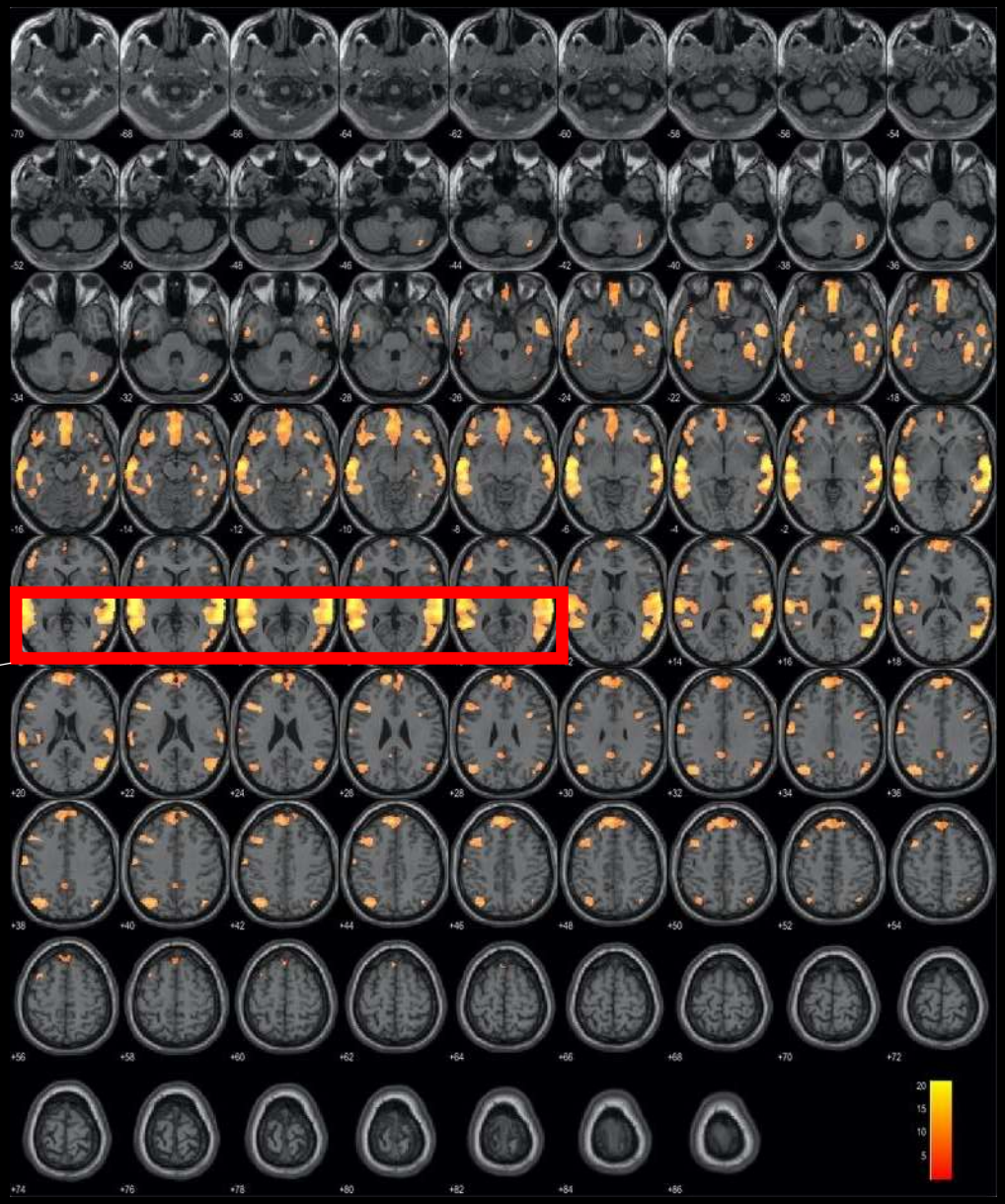
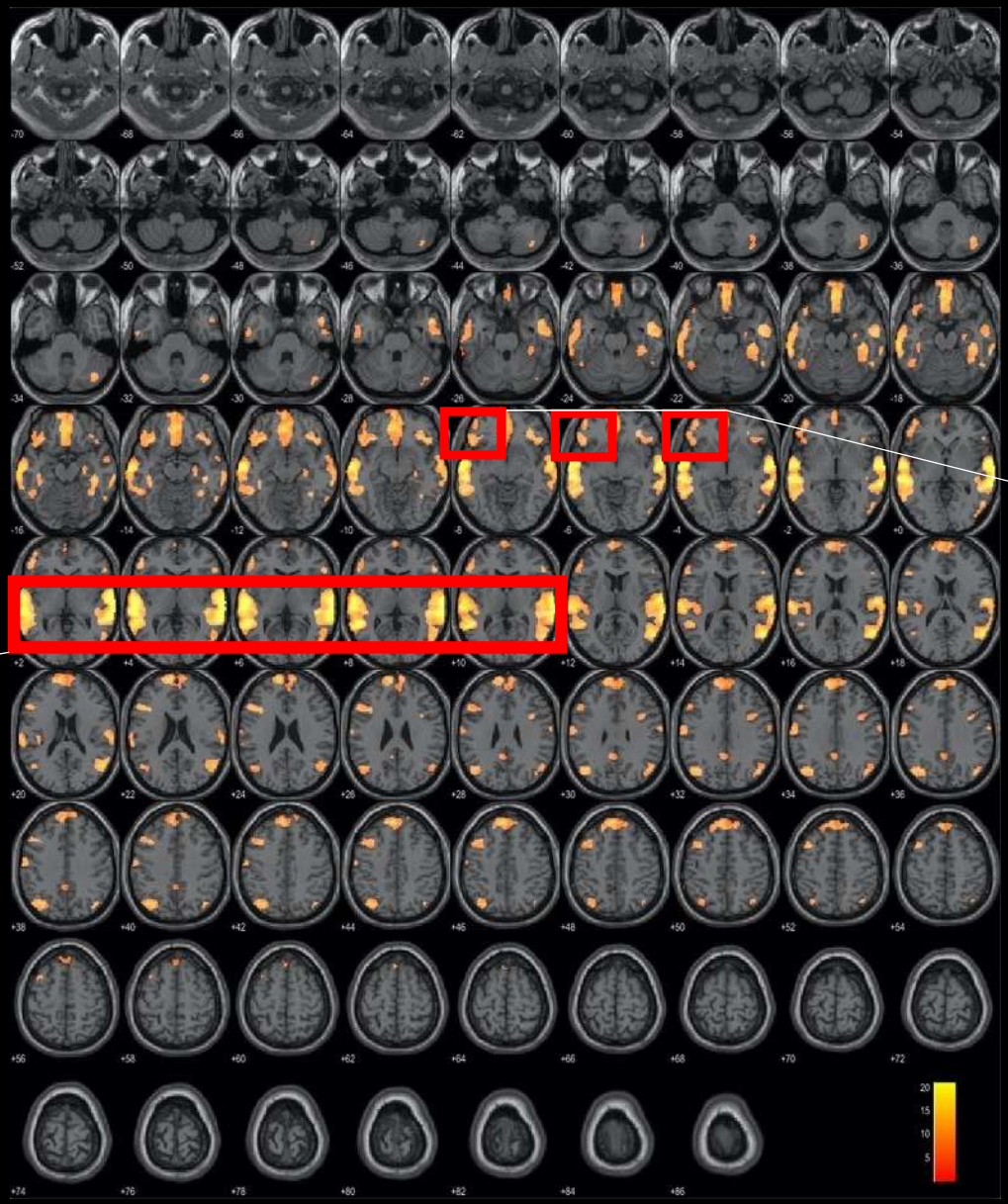


Auditory Cortex *sound*



Auditory Cortex *sound*

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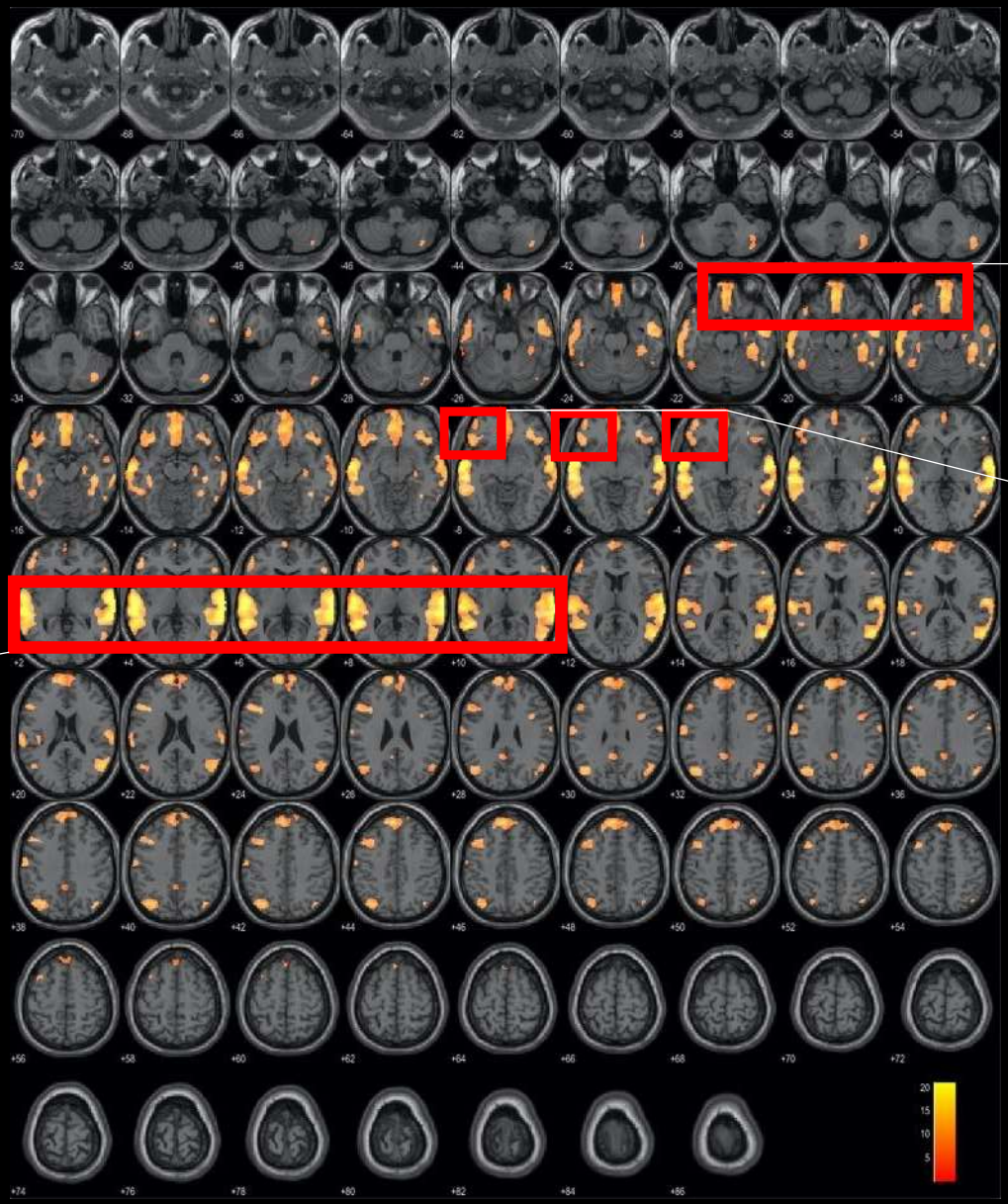

Auditory Cortex *sound*

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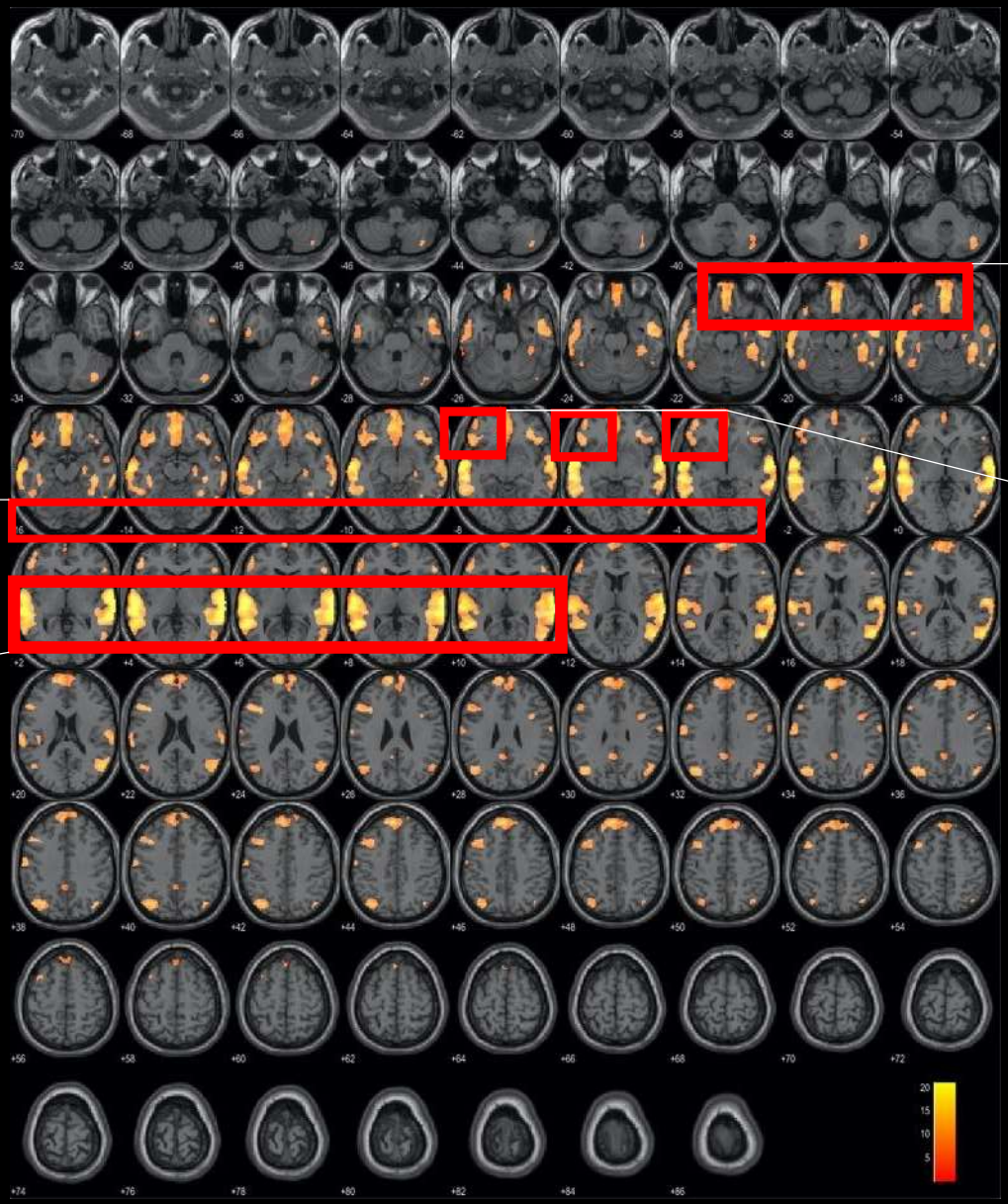

Visual Cortex *sight*

Auditory Cortex *sound*

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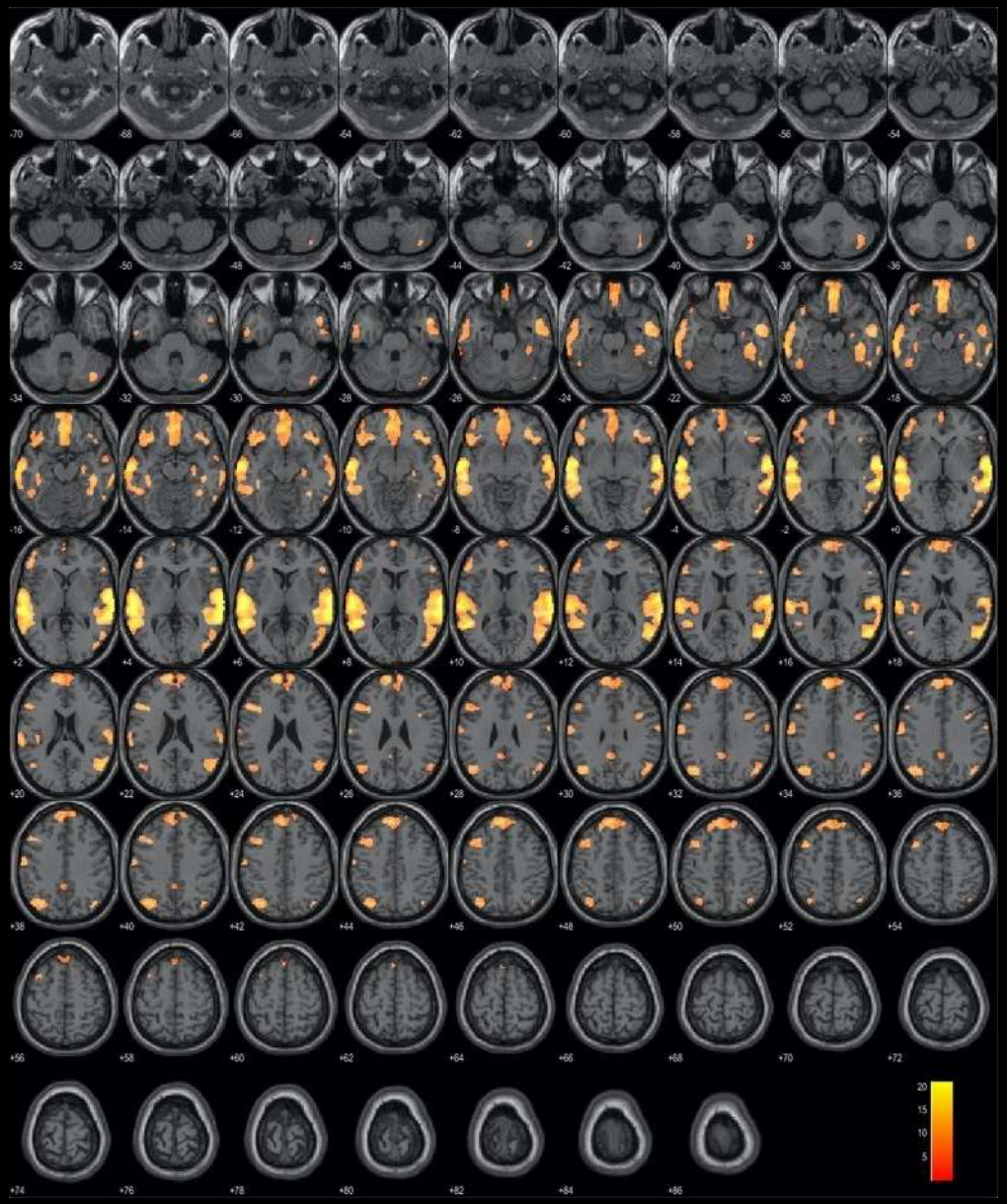
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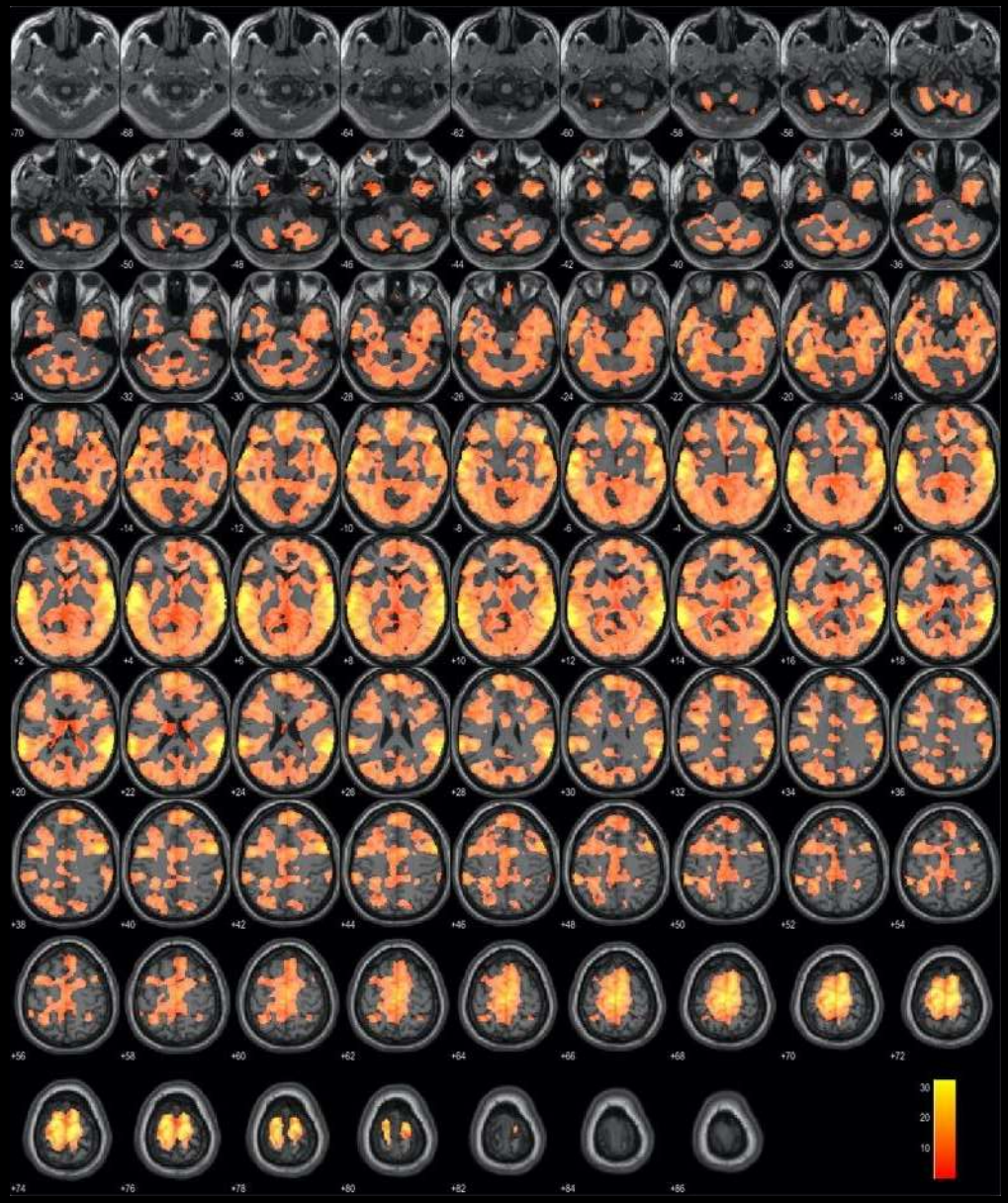
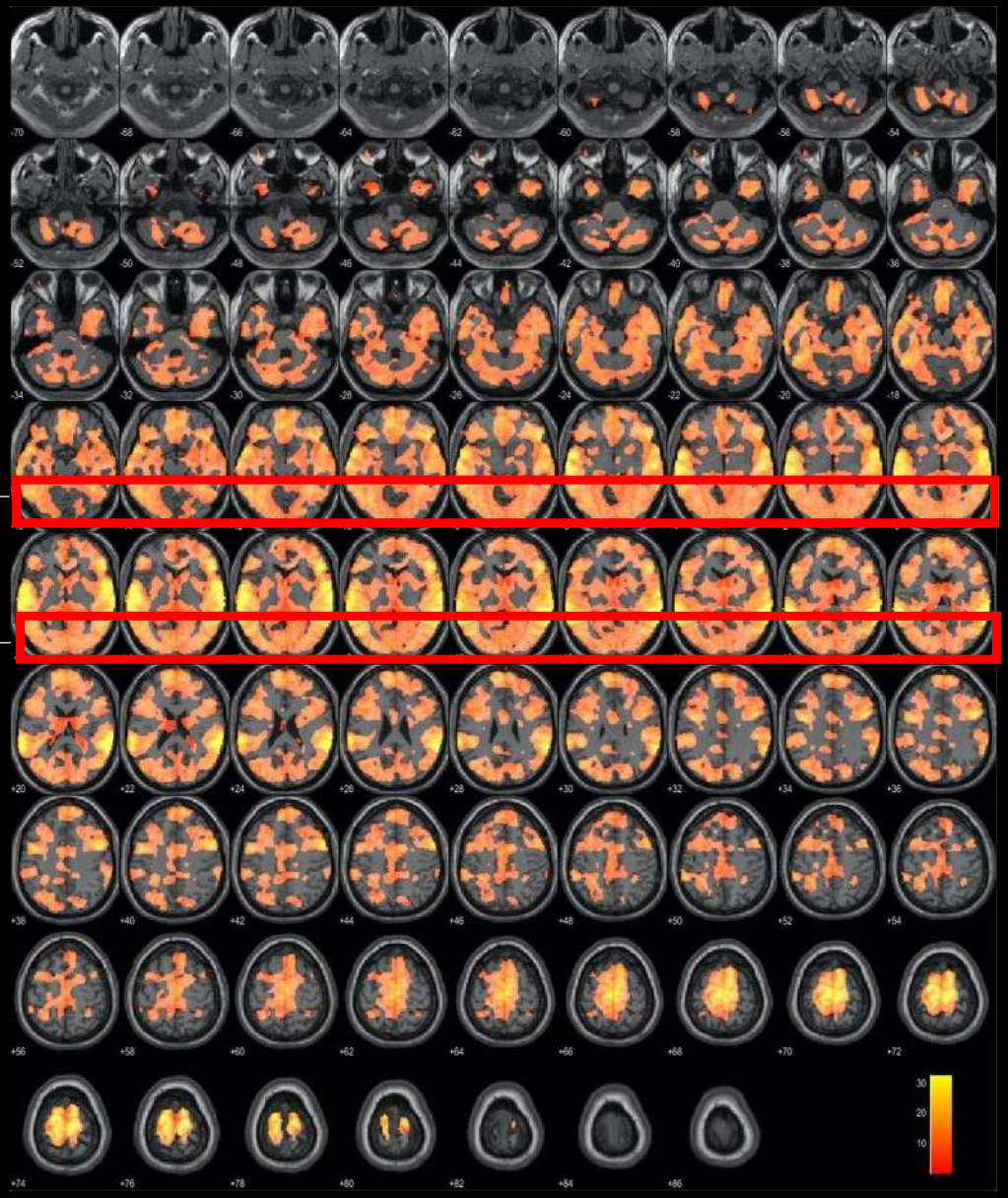
Music stimulates Matthew's entire brain!



Music stimulates Matthew's entire brain!

Visual Cortex is used for music!



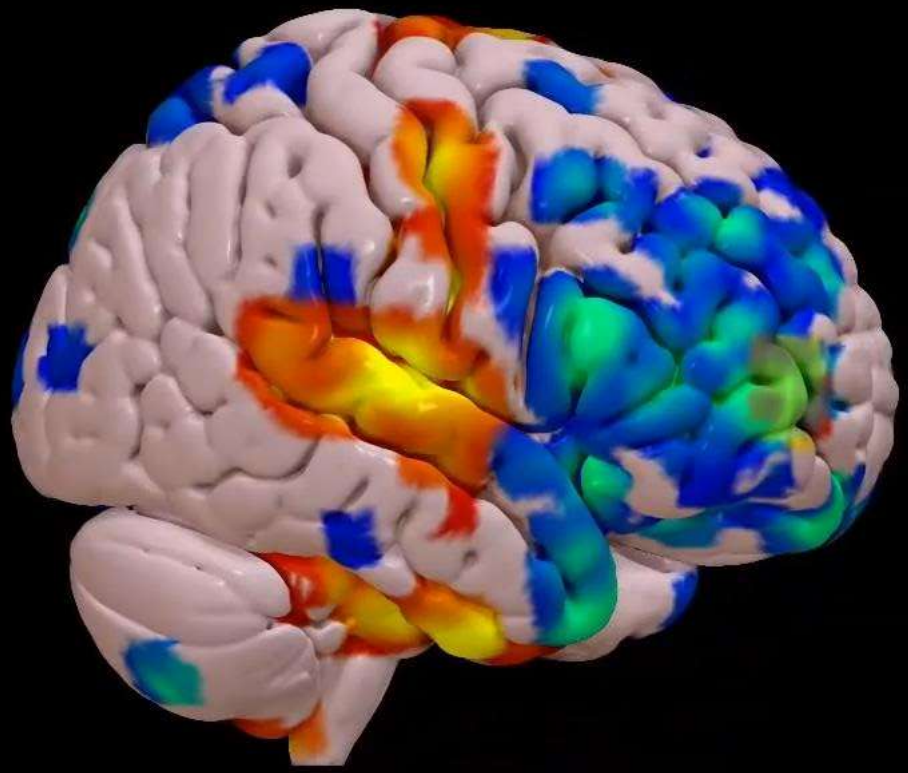
CONTROL ROOM

UeSF

Fantastic Negrito


SIEMENS

MEMORIZATION



Take-Away Messages

- **We can measure the creative brain in real time!**
- **Improvisation = rich model for studying the neural correlates o creativity**
- **You do not need to be a professional artist to be creative**
- Scientific rigor and Improvisation
- **With creativity from researchers, neural imaging is a useful tec to understand the biological basis of artistic creativity**

SOUND HE
NETWORK

The Sound Health Network aims to pron
research and public awareness about t
impact of music on health and wellnes

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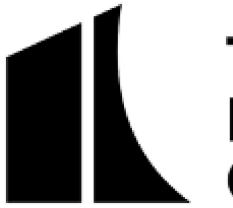
University of California
San Francisco

NATIONAL ENDOWMENT for the ARTS
arts.gov

NIH
National Institutes
of Health

RENÉE FLEMING



Julene Johnson, PhD
Network Co-Director

Dr. Julene K Johnson is a UCSF professor of cognitive neuroscience with an undergraduate degree in music.
Read more...

Charles J. Limb, MD
Network Co-Director

Dr. Charles Limb, is the Francis A. Sooy Professor of Otolaryngology-Head and Neck Surgery and the Chief of the
Read more...

Sheri L. Robb, PhD, MT-BC
Music Therapy Co-Investigator

Dr. Sheri L Robb is an Indiana University School of Nursing professor with international recognition for her
Read more...

Indre Vis
Communicatio

Dr. Indre Visko
opera stage di
communicator
Read more...

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Sound Health Network Manager

Stephanie Purnell is a Junior Specialist in Dr. Limb's Sound and Music Perception lab at UCSF where she
Read more...

Karen Barrett, PhD
Scientific Analyst

Dr. Karen Chan Barrett is a postdoctoral scholar in the lab of Dr. Charles Limb as well as a faculty member at San
Read more...

Patpong Jiradejvong, MS
Programmer Analyst

Patpong Jiradejvong is a data systems analyst in the Sound and Music Perception Lab at UCSF. Currently he is
Read more...

Ka
Social

Katy Lindhart i
freelancer spec
podcast manag
Read more...


The Sound Health Netw
Launch
January 26th 2
5pm EST / 2pm
On

Resources

SOUND H
NETWORK

- Sound Health Network website: soundhealth.ucsf.edu
  - Directory of Network participants*** new!
  - Consultation and logistical support
  - News and Events
  - Clearinghouse
  - Funding Opportunities
  - Newsletter
  - Virtual Networking Platform (in progress)
- Webinar and journal club series
- Social Media – Facebook, Twitter, Instagram, YouTube

Thank You!

Sound and Music Perception Lab

UCSF

NATIONAL ENDOWMENT FOR THE ARTS RESEARCH LABS

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