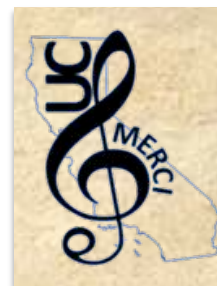




**UC MERCI**

# Encouraging the Scientific Study of Musical Experience & Communication



**Scott Makeig**

Institute for Neural Computation  
University of California San Diego

1<sup>st</sup> UC MERCI Colloquium  
UCSD Faculty Club  
March 17, 2015



# The UC Music Experience Research Community Initiative UC MERCI

- 24-month Planning Grant (2015-16)
- Proposed activities
  - 6 Colloquia (multi-campus, webcast)
  - 2 Workshops (Workshop I @ UCLA, July)
  - Web portal (music research @ UC and beyond)
  - Multi-campus research (**student opportunities!**)

Sponsor

UC Multicampus Research Programs and Initiatives (MRPI)



# *President's Research Catalyst Award*

University of California  
Office of the President



*For the multicampus collaborative research project:*

*Network for Research on Music Experience and Communication*

*Scott Makeig, Ph.D.*

*Lead Investigator*

*UC San Diego*

  
Janet Napolitano, President

  
Aimee Dorz, Provost  
Executive Vice President for Academic Affairs





# The UC Music Experience Research Community Initiative



In the west or most Californians, music is a seldom examined, little understood but omnipresent force shaping our thoughts, moods, aspirations, and even our purchasing behavior. Whether speeding or creeping on the I-5 freeway at rush hour, attending a social or religious function, or watching a movie or television show, Californians use music to intensify or communicate feelings, to enhance their sense of community. For many Californians, music lifts their mood as they perform uninviting tasks or face difficulties. Evidence is also steadily increasing that musical experience and training in childhood has general cognitive benefits and that music therapy can help those struggling with senility, recovering from brain injury, or attempting to walk normally while living with Parkinsons. Yet much basic research is needed to understand what aspects of musical experience convey these benefits remains to be accomplished.

## News

A research group from four University of California (UC) campuses have won a \$300,000 **President's Research Catalyst Award**, one of five such awards across the UC system announced by President Janet Napolitano. The group's research uses music to understand the human brain by "bringing together UC experts on music listening, performance, neuroscience, brain imaging, and data science to understand the transformative potential of music for health and cognition," says Napolitano's announcement.

The winning project is The UC Music Experience Research Community Initiative (UC MERC), "an American center for the scientific study of musical experience, communication, and behavior," that will allow UC researchers to share cutting-edge



# The UC Music Experience Research Community Initiative UC MERCI

## Aim

*“To develop a multi-campus University of California initiative for collaborative research on **human musical experience and communication** using new tools for brain/body imaging and data mining.”*

- Musical **experience**
- Musical **communication**



# The UC Music Experience Research Community Initiative UC MERCI

## Music Science as Interdiscipline

In the present work **an attempt will be made to connect the boundaries of two sciences**, which, although drawn towards each other by many natural affinities, have hitherto remained practically distinct — **I mean the boundaries of physical and physiological acoustics on the one side, and of musical science and aesthetics on the other**. The class of readers addressed will, consequently, have had very different cultivation, and will be affected by very different interests.

- Helmholtz (1862)

*On the Sensations of Tone*

# INDIVIDUAL DIFFERENCES IN LISTENING TO MUSIC



BY CHARLES S. MYERS. (1922)

*(From the Cambridge Psychological Laboratory.)*

1. Plan of the Investigation
2. Comparison with the results of Bullough's previous investigation
3. Comparison with the results of Bullough's previous investigation

# Musical

# Experience

4. The subjective aspect in the technique. His suppression of other
5. The absence of a goal in the music
6. The occurrence of associations among the musical
7. The relation of the character to the intra-subjective aspect
8. Symbolization of the art material
9. The aesthetic value of the pragmatic and objective aspects
10. The aesthetic value of the intra-subjective aspect
11. The aesthetic value of the meaning of music
12. The importance of 'distance'
13. The importance of the 'mystic' feeling





## Not only humans like music ...



<https://www.youtube.com/watch?v=darQyopeUEA>





But nearly all humans love music ...





# The UC Music Experience Research Community Initiative UC MERCI

## Why Do We Love Music?

... **The love of music is essentially an unanalyzed feeling.** Countless people fell the esthetic appeal in music without understanding anything about it. It may be like the notorious puppy love, which is frequently blind, but nevertheless a deep love.

Carl Seashore (1941)  
*Why We Love Music*



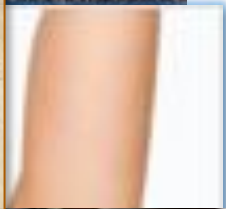
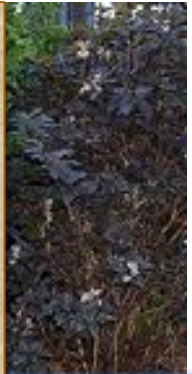
# The UC Music Experience Research Community Initiative UC MERCI

... **Why then do we love music?** Among other things, we love it because:

- It creates a physiological well-being in our organism.
- It is built from materials that are beautiful objects in themselves.
- It carries us through the realms of creative imagination, thought, actions and feelings in limitless art forms.
- It is self-propelling through natural impulses such as rhythm.
- It is the language of emotion.
- It is a generator of social fellowship.
- It takes us out of the humdrum of life and makes us live in play with the ideal.
- It satisfies our cravings for intellectual conquest,  
for isolation in the artistic attitude of emotion,  
and for self-expression for the joy of expression.

Carl Seashore (1941)  
*Why We Love Music*

**Music  
Experience  
as Embodied  
Experience**







MOVE TO THE MUSIC





# The UC Music Experience Research Community Initiative UC MERCI

Music as Emotional Communication

## Music as

The successful performance comes in an inspirational attitude, the semi-ecstatic feeling of the beauty one seeks to convey, a state of forgetfulness of self and concrete facts. Thus *music is a language of emotion*. Through **it the composer and the performer convey an invitation to the listener**. It is a message and a means of communication *that enables the performer and the listener to live, for moments, in the same tonal world of pleasure.*

## Communication

Carl Seashore (1941)  
*Why We Love Music*





ROMANTIC

GS





# Cultural communication ...



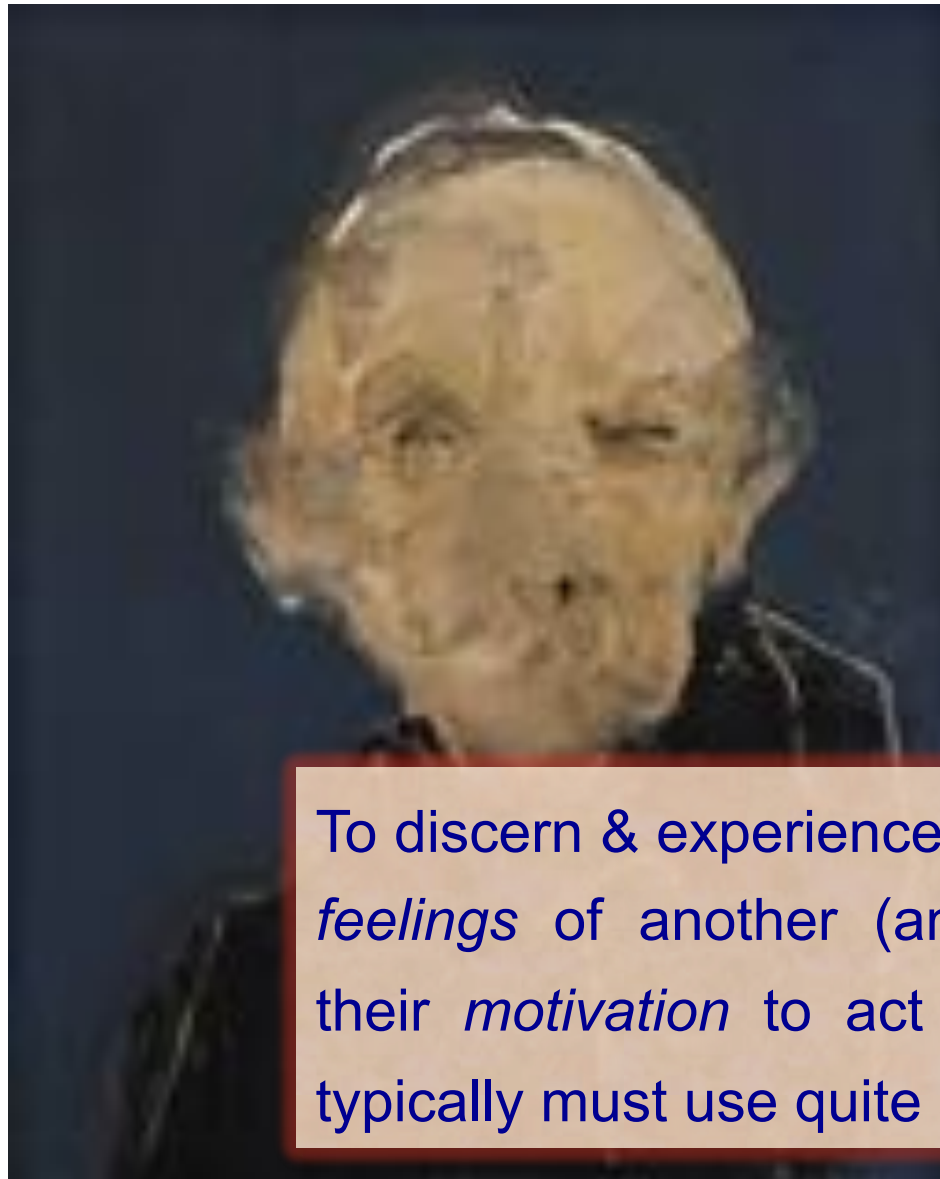




# Cultural communication ...

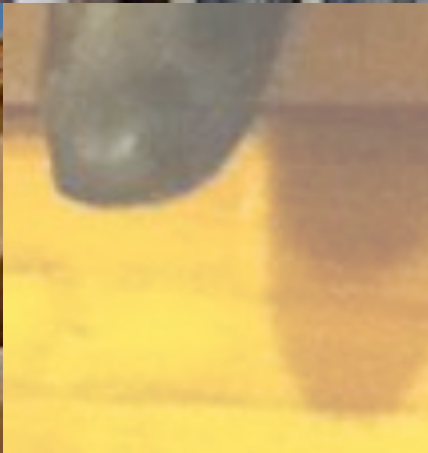


# Theory of Mind Heart



To discern & experience (empathically) the *feelings* of another (and, thereby, know their *motivation* to act and interact), we typically must use quite subtle cues...









## How & what does music communicate?

- Pitch
- Harmony
- Rhythm
- Melody / Gesture
- Articulation
- Timbre
- Cultural associations

**How does music support health?**

**How does music support learning?**

**How does music support culture?**

**What is the best music selection method?**

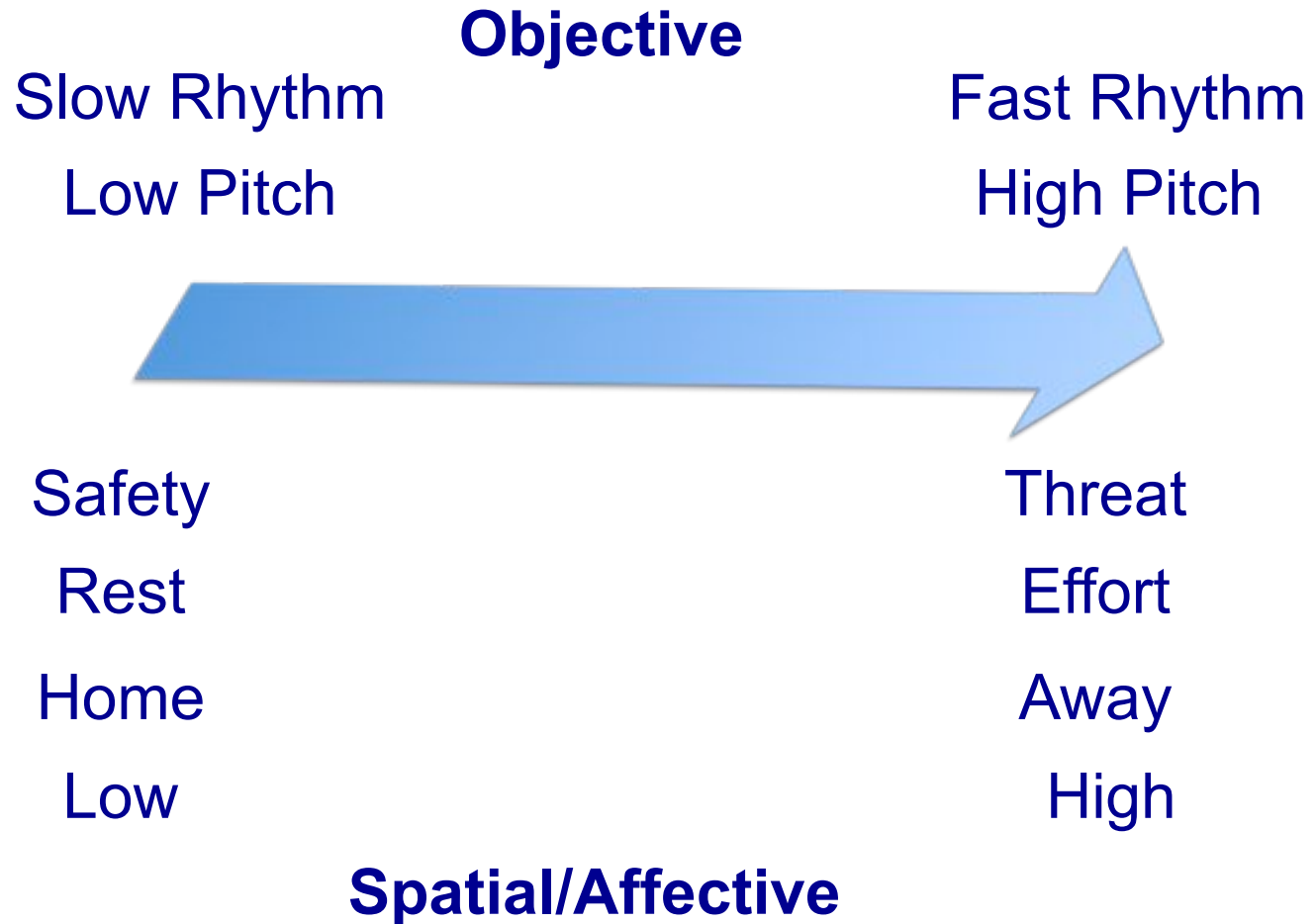
# Embodied Musical Experience

1-D Mapping of pitch to location/ effort/ risk

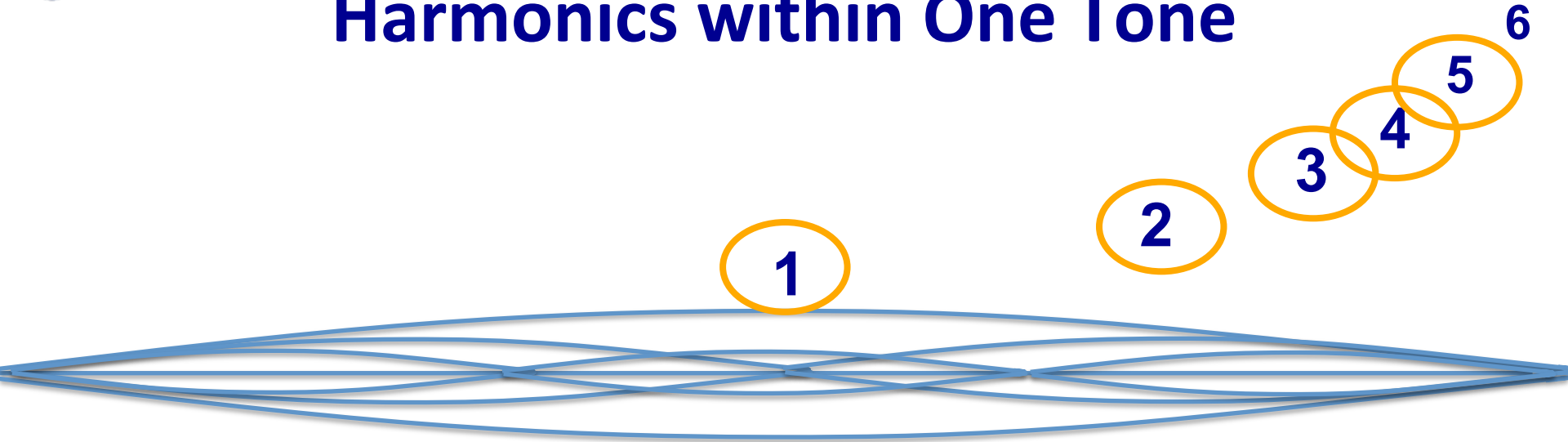


# Embodied Musical Experience

1-D Mapping of pitch to distance/ effort/ height / risk



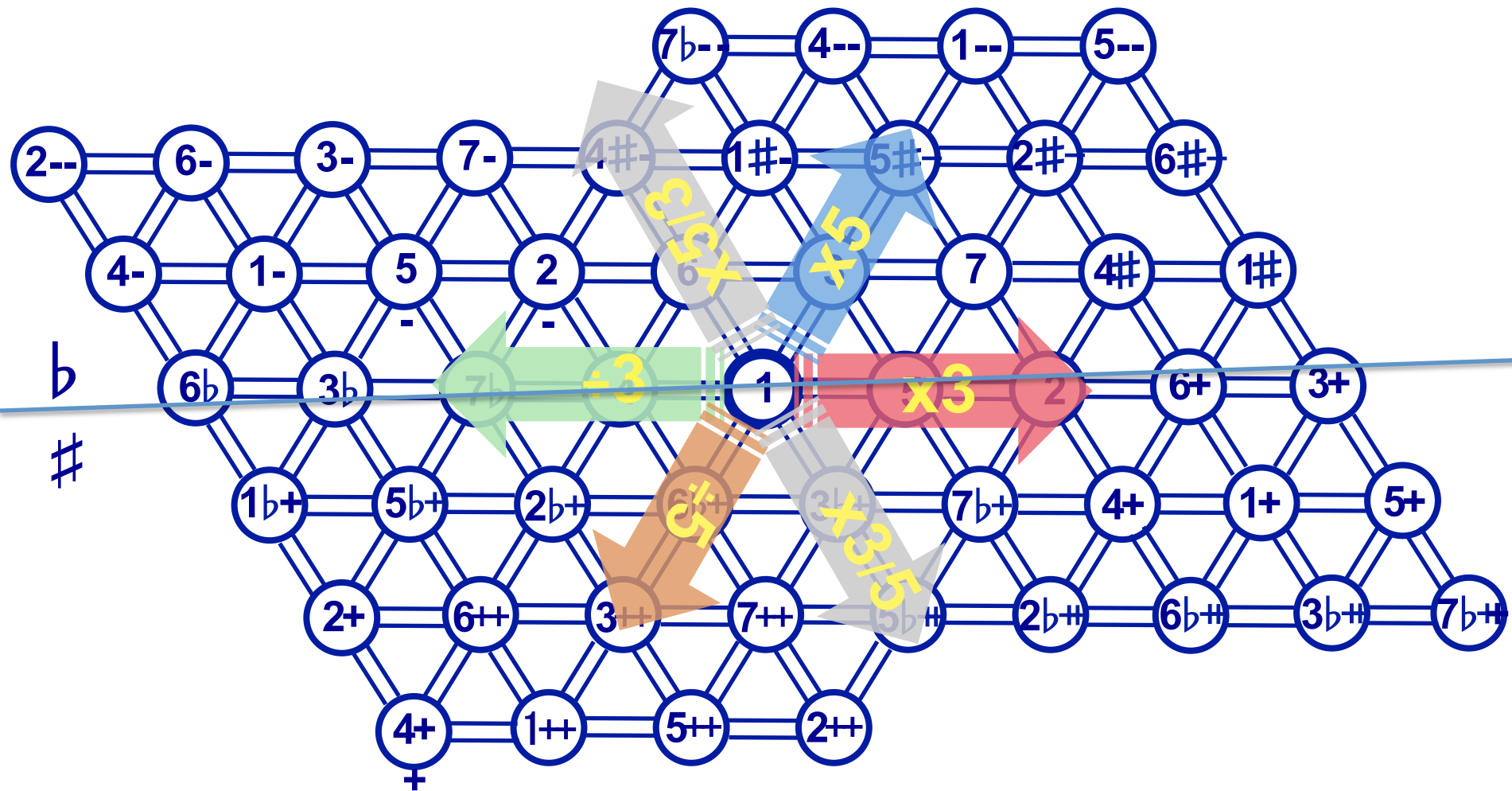
# Harmonics within One Tone

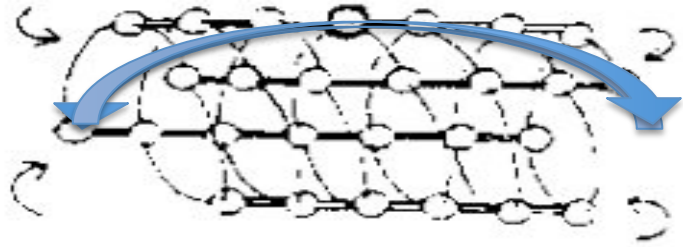


- The octave  $2/1 =$  musical 'identity'
- The 'perfect' fifth  $3/1 \rightarrow 3/2$  ratio
- The 'major' third  $5/1 \rightarrow 5/2 \rightarrow 5/4$  ratio

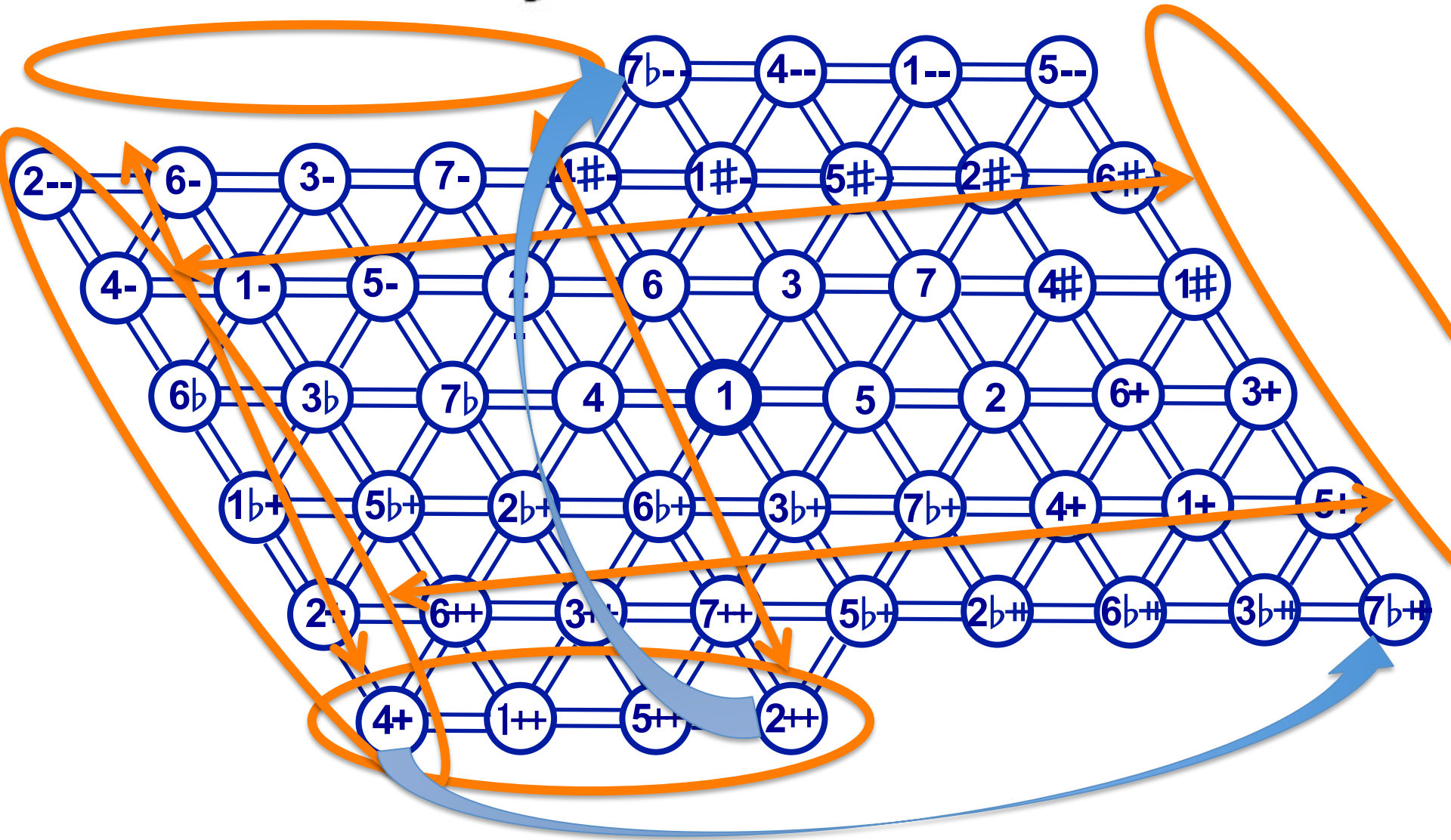


# The Web of Musical Fifths (3/2) and Thirds (5/4)



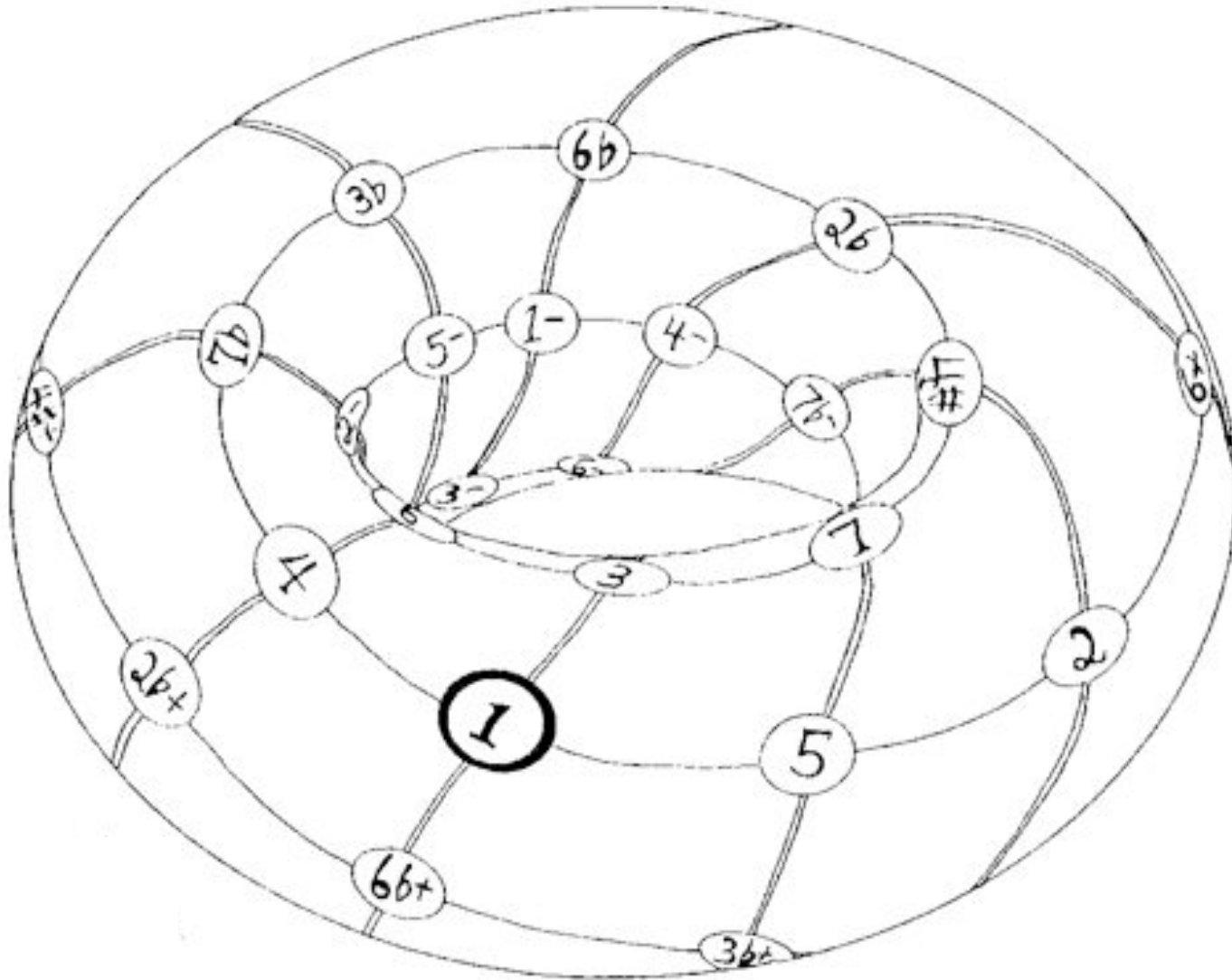


# Folding the Enharmonic Tone Group into a 53-note Torus



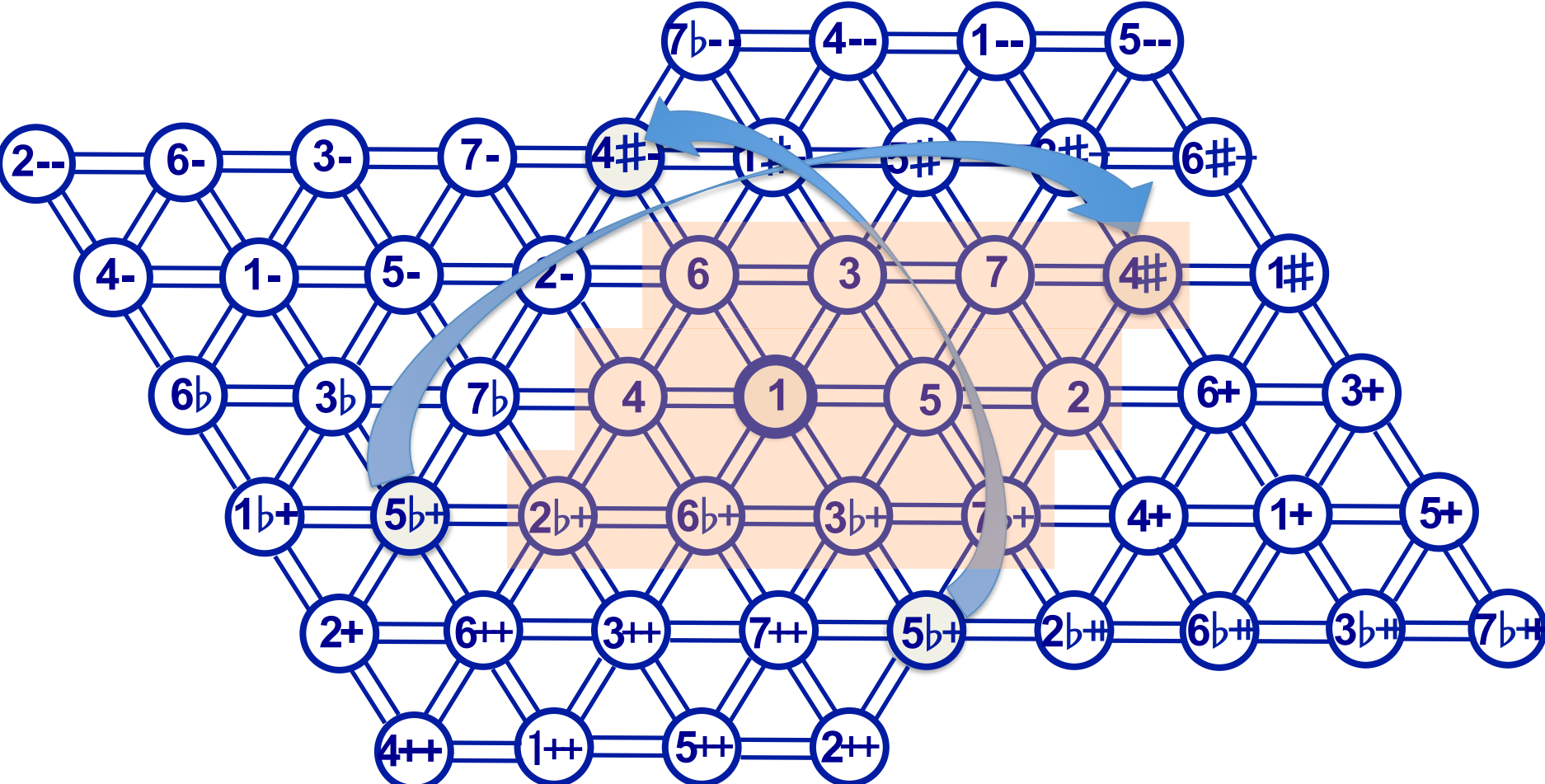
# The Enharmonic Tone Group

(53 notes per octave)



**Web of Fifths and Thirds**

# Folding the Enharmonic Tone Group into the 12-note torus

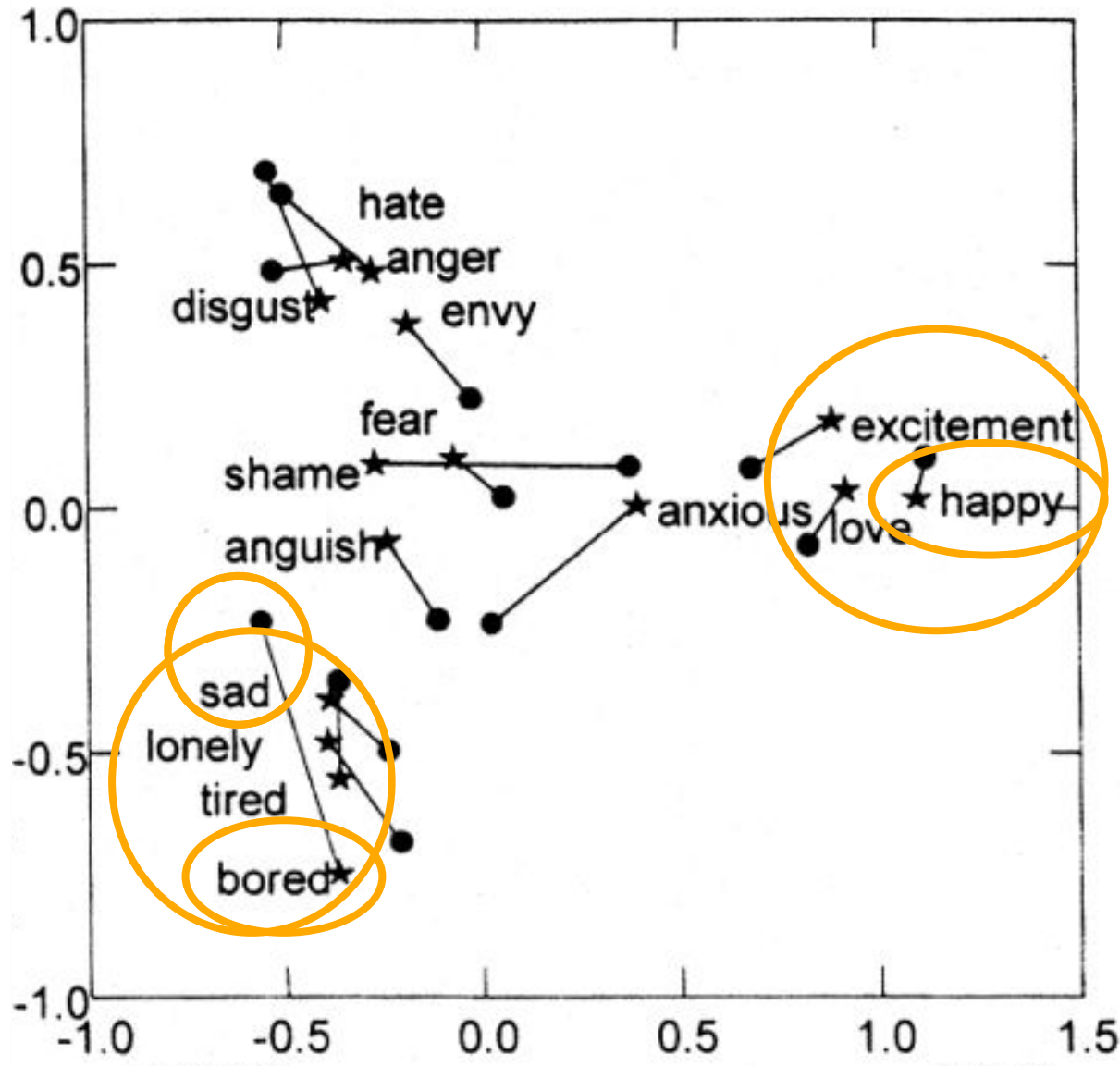




**How do composers & musicians use these harmonic relations to communicate affectively through music?**

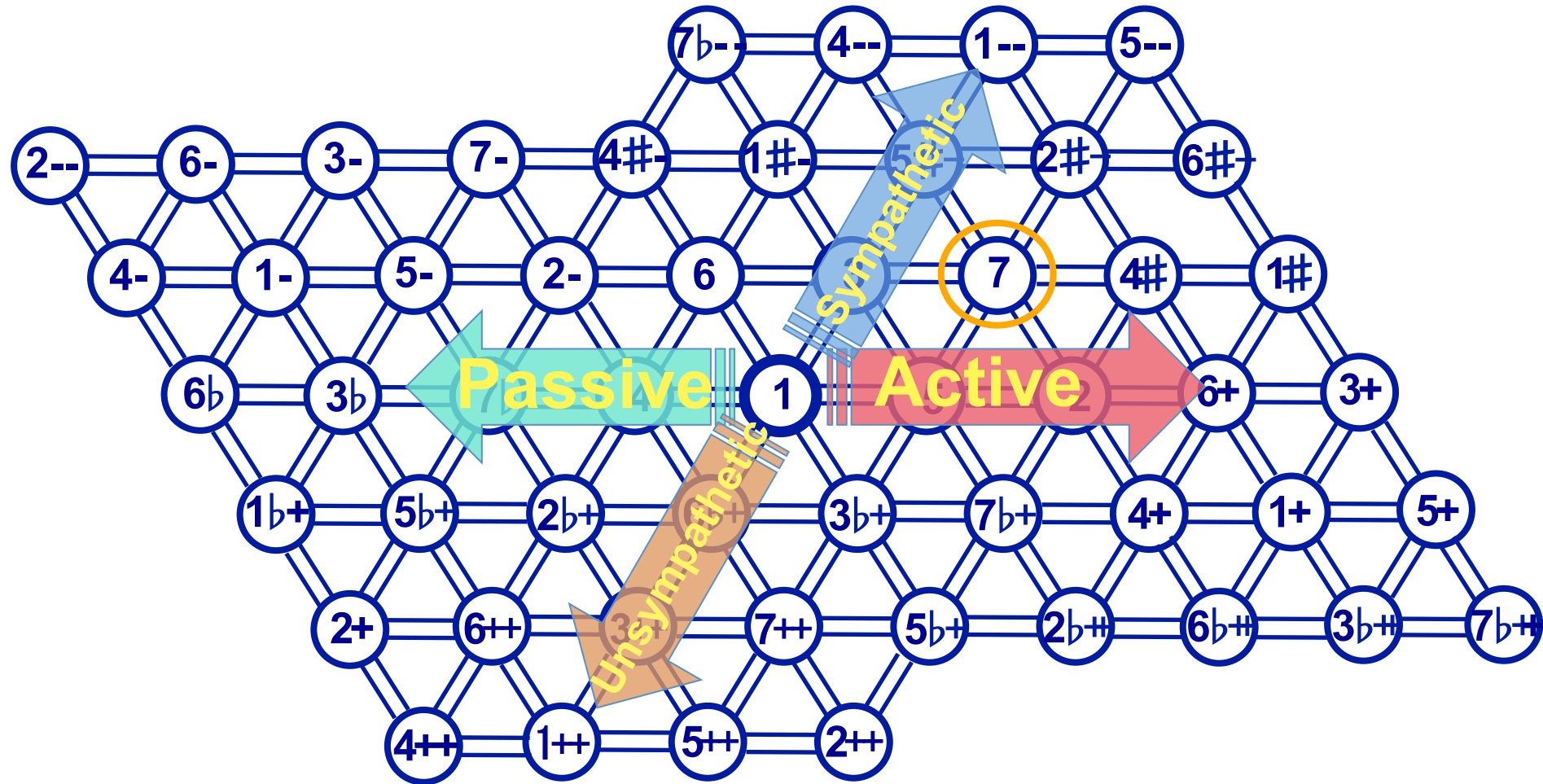
# Osgood's Semantic Differential

Potency



Evaluation

# 2-D Mapping: Intervals/Harmonies $\leftrightarrow$ Affect



(After Alain Danielou's Theory of interval affect)



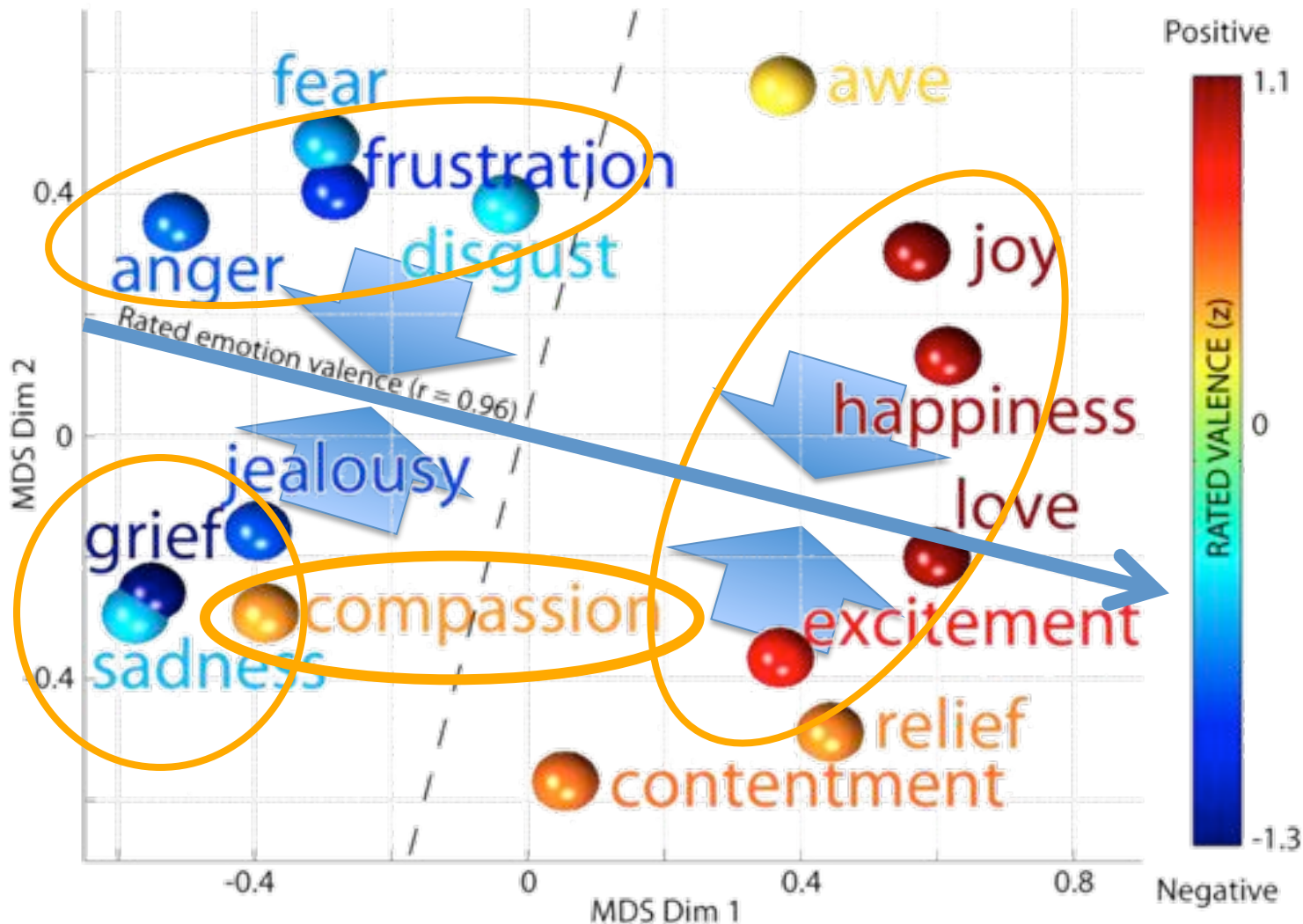
## Suggest the imaginative experience of 15 emotions:

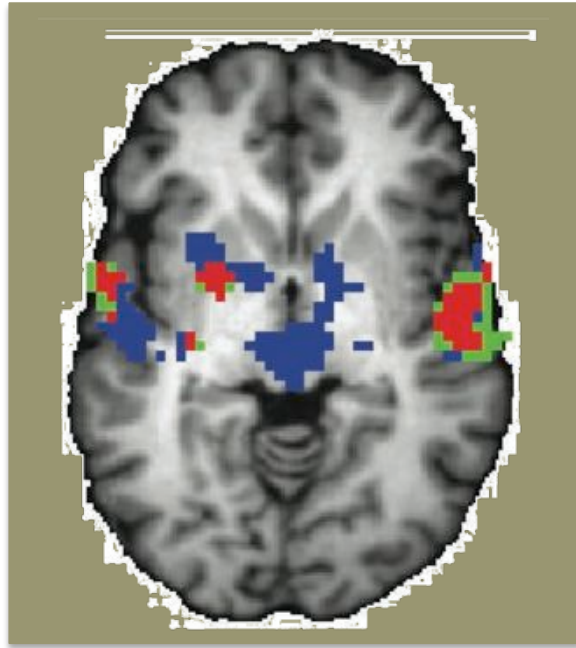
- After Helen Bonny (GIM)
- Preceding relaxation induction
- Alternate pos and neg emotions
- Relax between emotion episodes
- → **1-5 min periods of eyes-closed spontaneous EEG** ( x 15 emotions)
- ... from 33 subjects





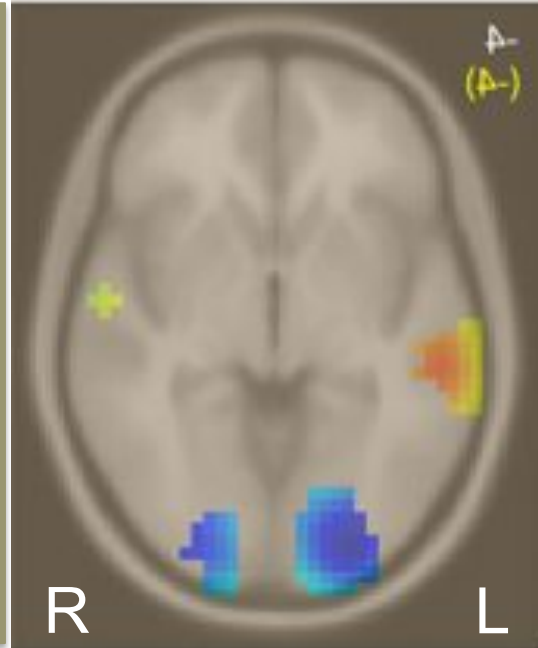
# Changes in distribution of broadband high-frequency EEG power with imagined emotions





T. Fritz, 2009

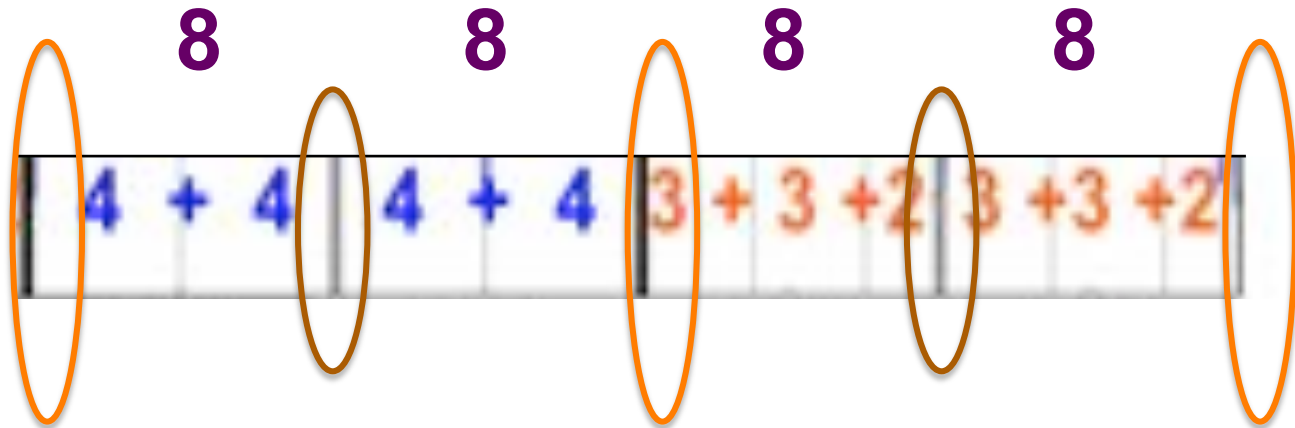
**fMRI**  
**BOLD**



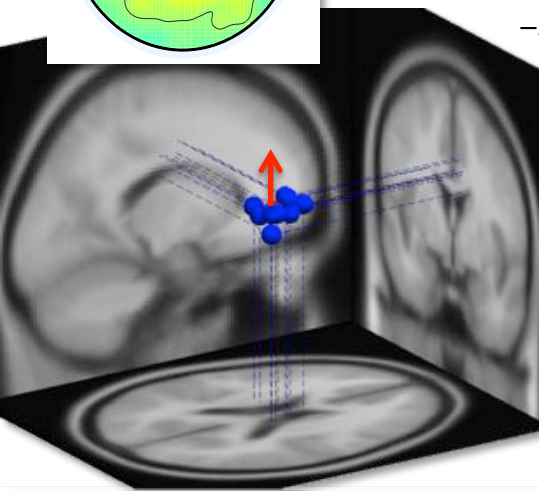
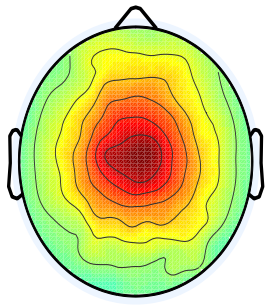
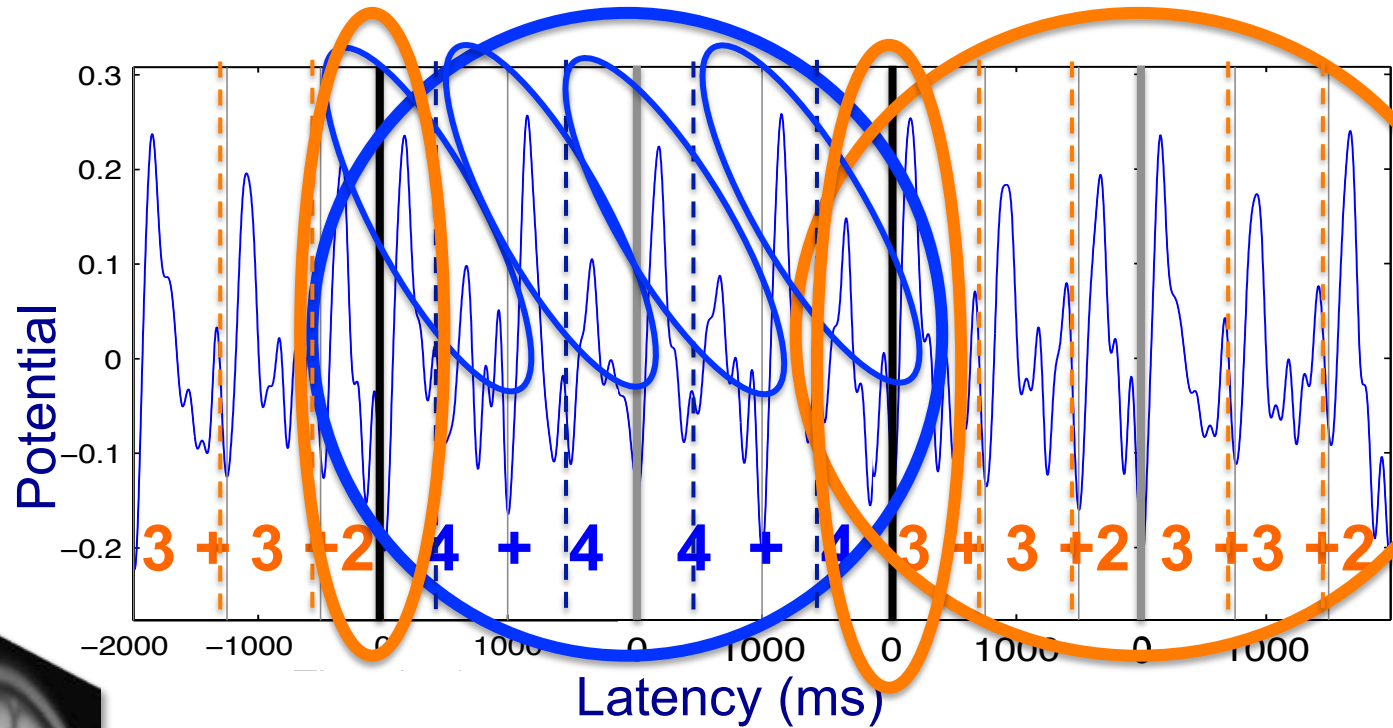
Onton & Makeig,  
2009

**EEG**  
**HFB**

# Performing a Rhythm Pattern involving Metric Modulation

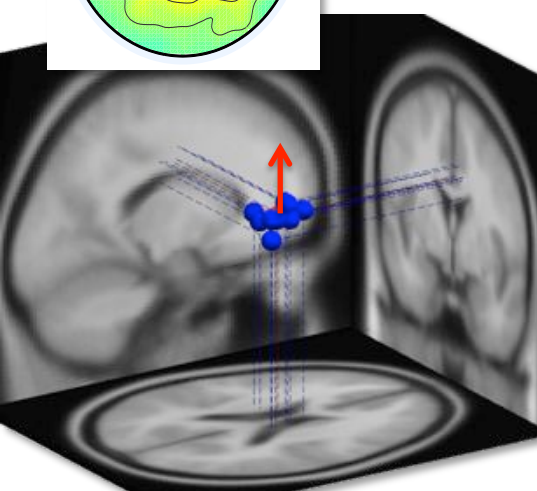
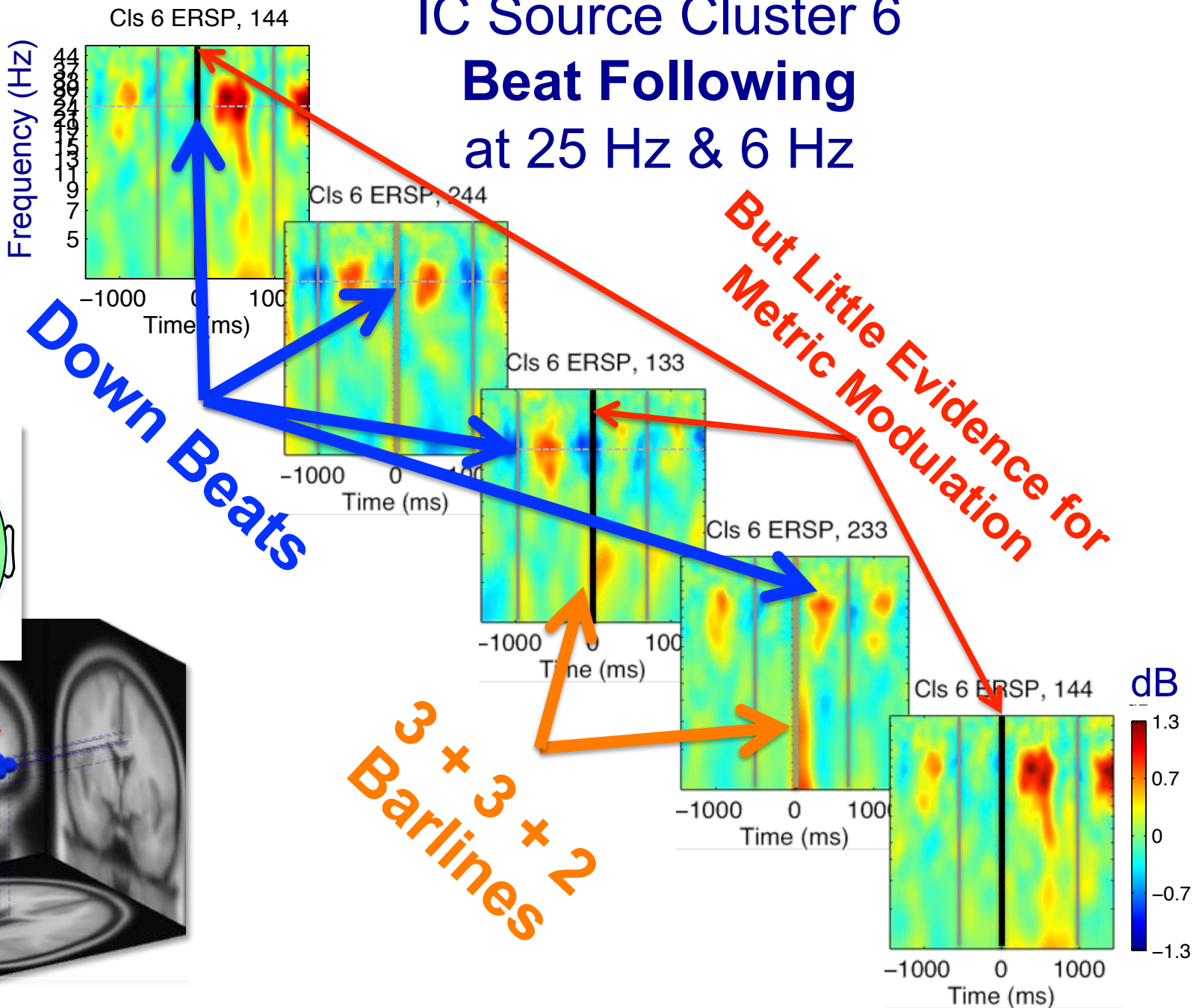


# Source Cluster with Beat-Following ERP



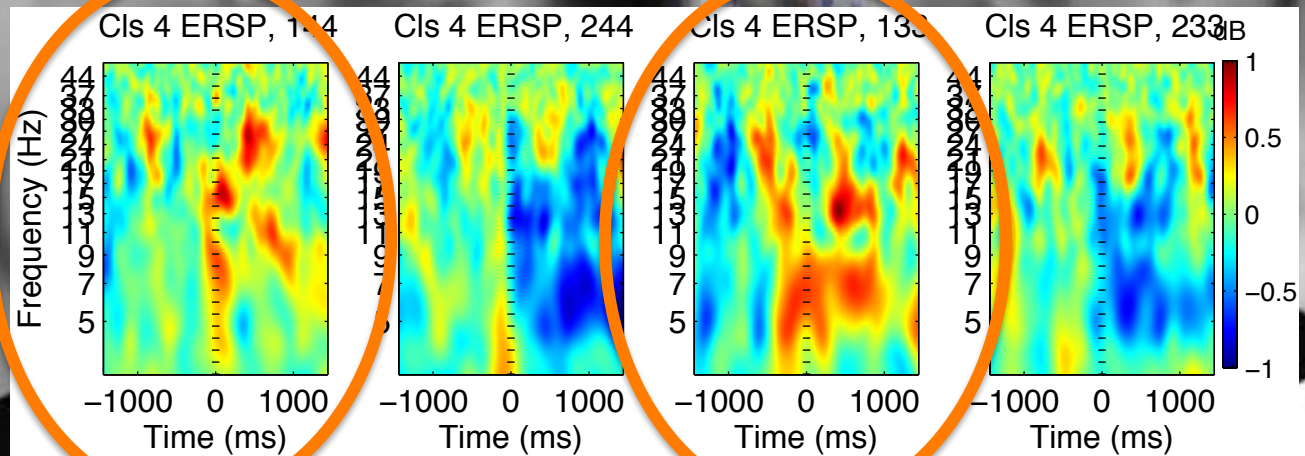
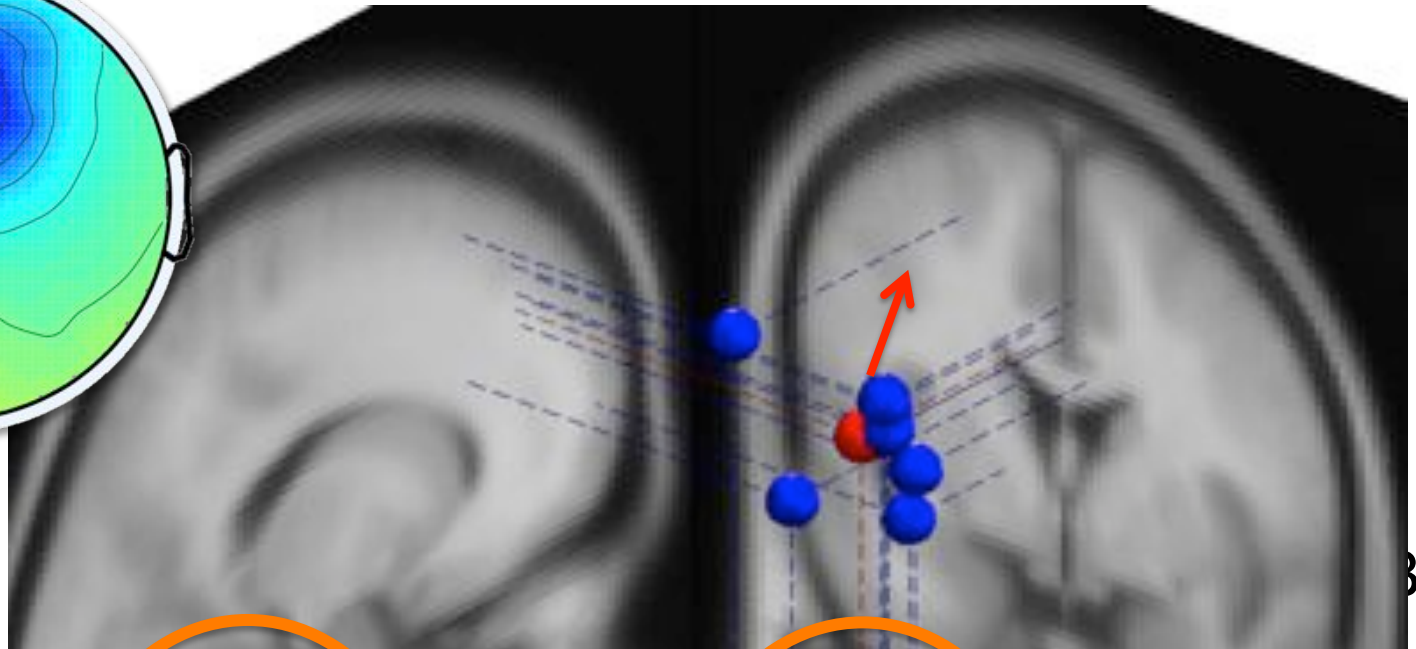
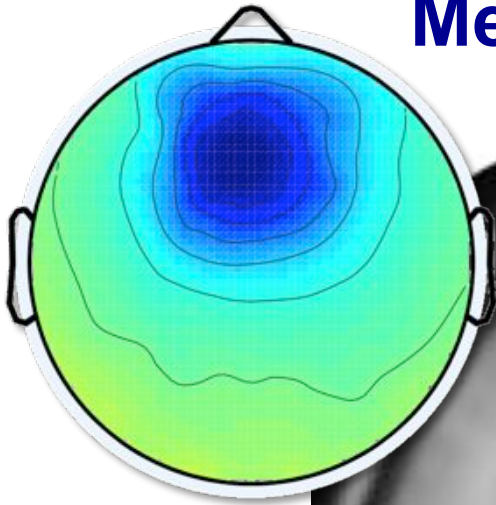


# IC Source Cluster 6 Beat Following at 25 Hz & 6 Hz



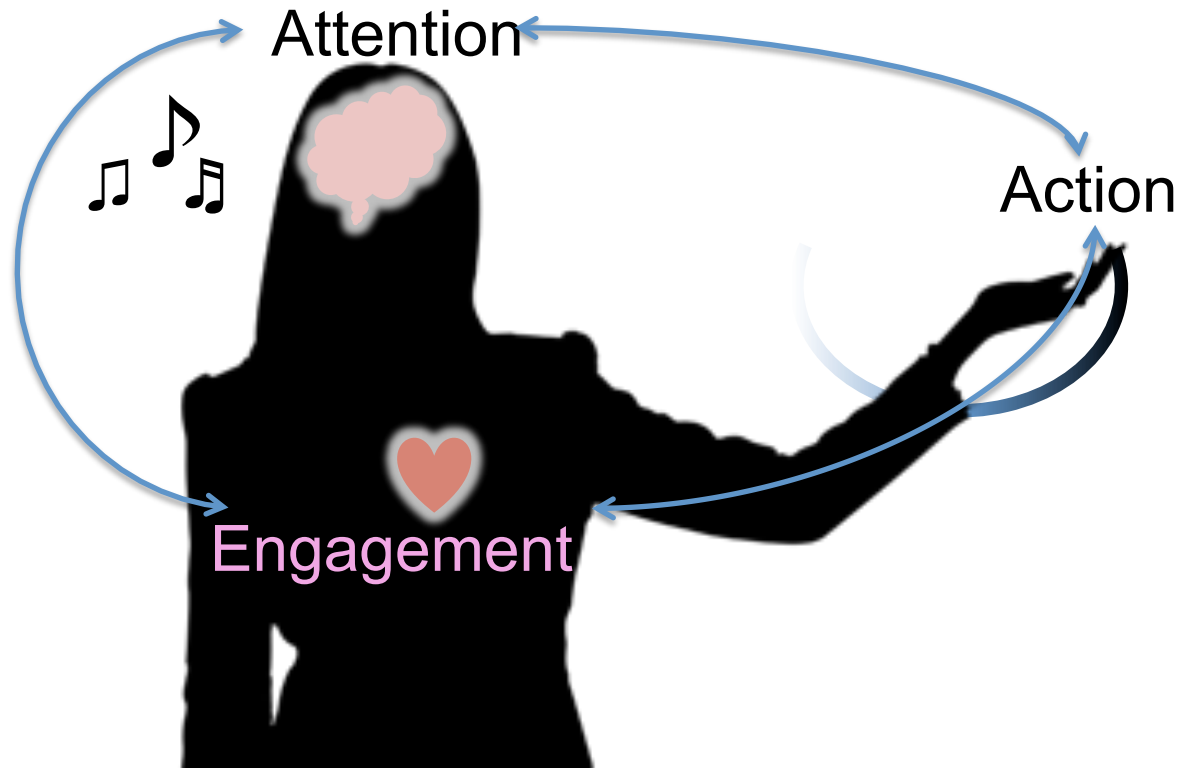
# IC Source Cluster 4

## Metric Modulation > Metric Repeat



# Measuring Musical Engagement Through Expressive Rhythm

How can we measure a listener's engagement level?





# Rhythmic expression task

The Heart is a  
Lonely Hunter (1968)



Two conditions

- Fully engaged
- Less engaged

The Conducting  
Experiment (2013)



# EEG Result: Full affective engagement →

Frequency (Hz)

“The TPJ controls representations of the self or of another individual across a variety of low-level (agency discrimination, visual perspective taking, control of imitation) and high-level (mentalizing, empathy), and socio-cognitive processes.”

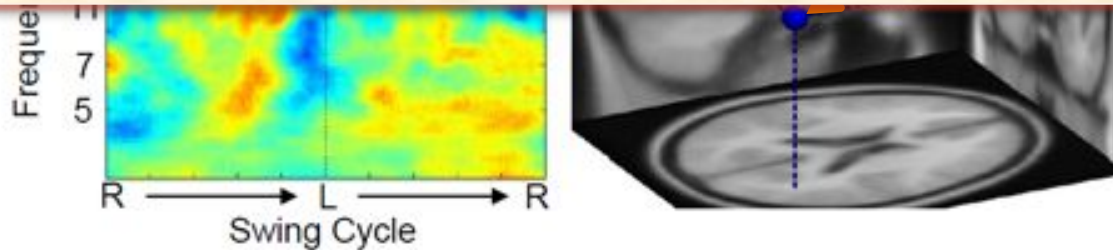
-Santestaban et al., 2012

The rTPJ is a key cortical structure for both motor and emotional control; rTPJ volume predicts level of emotional awareness of others in autistics; etc. ...

58

58

Right temporal-parietal junction (rTPJ)



Swing Cycle (%)

## UC MERCY 2015-16

- **6 Music Colloquia Webcasts**  
April 24 @ UC Davis
- **2 Music Science Workshops**  
July @ UCLA
- **Multi-campus Music Research Projects**  
Sarah Creel (partial funding available!)  
John Iversen  
Gert Lanckriet  
Piotr Winkielman
- **UC Music Science Web Portal**  
Scott Makeig & John Iversen

