

# Emotionotopy

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Siegfried Othmer

# Emotionotopy in the human right temporo-parietal cortex

Source:

- Emotionotopy in the human right temporo-parietal cortex
- Giada Lettieri, Giacomo Handjaras, Emiliano Ricciardi, Andrea Leo, Paolo Papale, Monica Betta, Pietro Pietrini, & Luca Cecchetti
- NATURE COMMUNICATIONS | <https://doi.org/10.1038/s41467-019-13599-z>

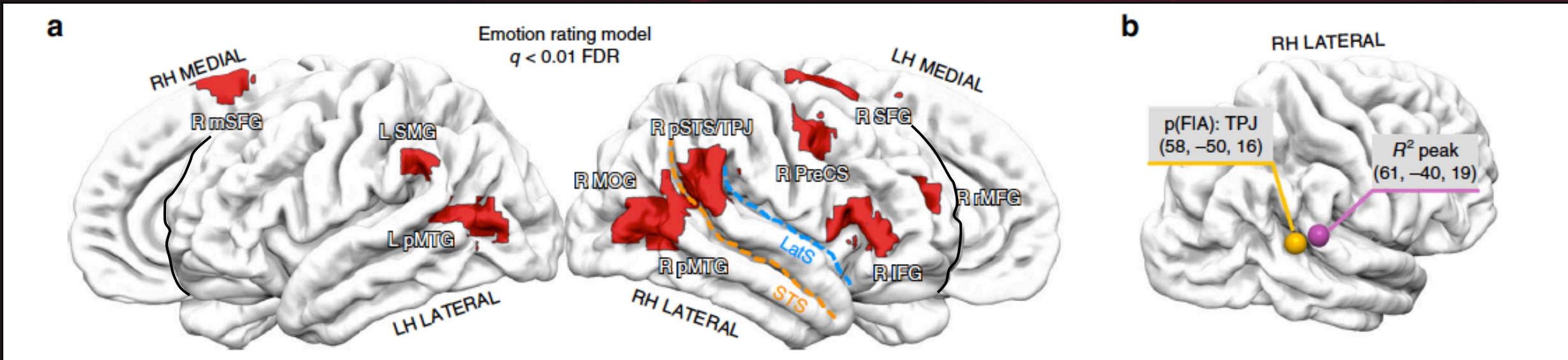
# Emotionotopy

- Term was generated by analogy to retinotopy and tonotopy, the spatial mapping of visual and frequency-based information
- But the analogy does not quite hold
  - In the analogues we have precisely localized spatial mapping, discrete, granular
  - In emotionotopy, we have distributed mapping of information
- With pools of neurons representing a construct, we can have nuance, proportionality, gradation.

# Distributed mapping

- We find that in visual processing also, for continuous variables such as location in the visual field in terms of angle and presumably distance
- And the same likely holds for auditory information as well
- We also have distributed processing of emotions on the macro-scale
  - Different nuclei and brain regions play their respective roles
  - We tend to treat them in a lumped perspective

# Cortical regions encoding emotions



**IFG** inferior frontal gyrus, **rMFG** rostral middle frontal gyrus, **mSFG** medial superior frontal gyrus, **preCS** precentral sulcus, **pSTG/TPJ** posterior part of the superior temporal sulcus/temporo-parietal junction, **MOG** middle occipital gyrus, **pMTG** posterior middle temporal gyrus, **SMG** supramarginal gyrus, **LatS** lateral sulcus, **STS** superior temporal sulcus.

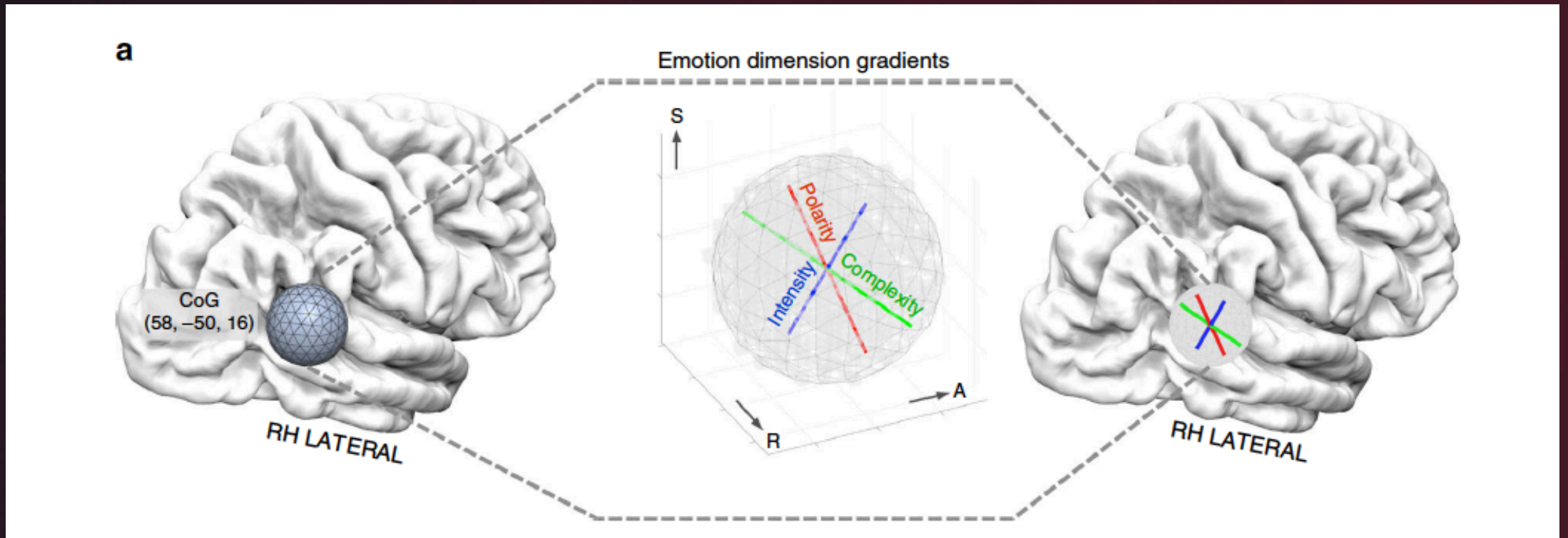


# These just include loci on the cortical surface

- We know the sub-cortical nuclei are likewise organized with a division of labor
  - And contain their own distributed mapping
    - Amygdala
    - Hippocampus
    - Anterior cingulate
    - Insula
    - Etc.

# “Emotionotopy”

- The multi-dimensional mapping of emotional states in cortex
- Three axes: Polarity; Intensity; Complexity

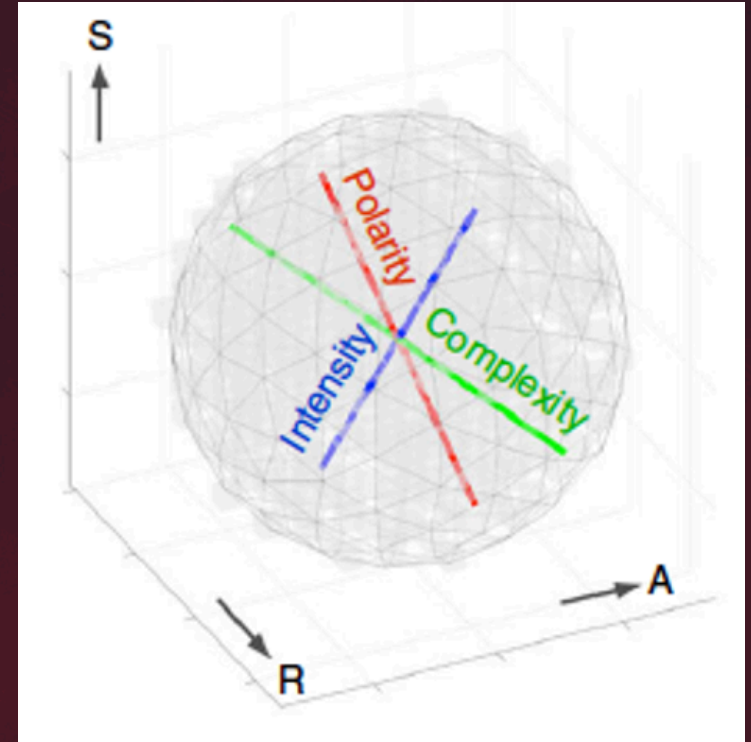


- “...these temporo-parietal regions are fundamental for social cognition, as they support empathic processing and the attribution of intentions, beliefs and emotions to others”
- “...the association between emotion ratings and brain activity was right-lateralized and the peak was found in the right posterior superior temporal sulcus/temporo-parietal junction”

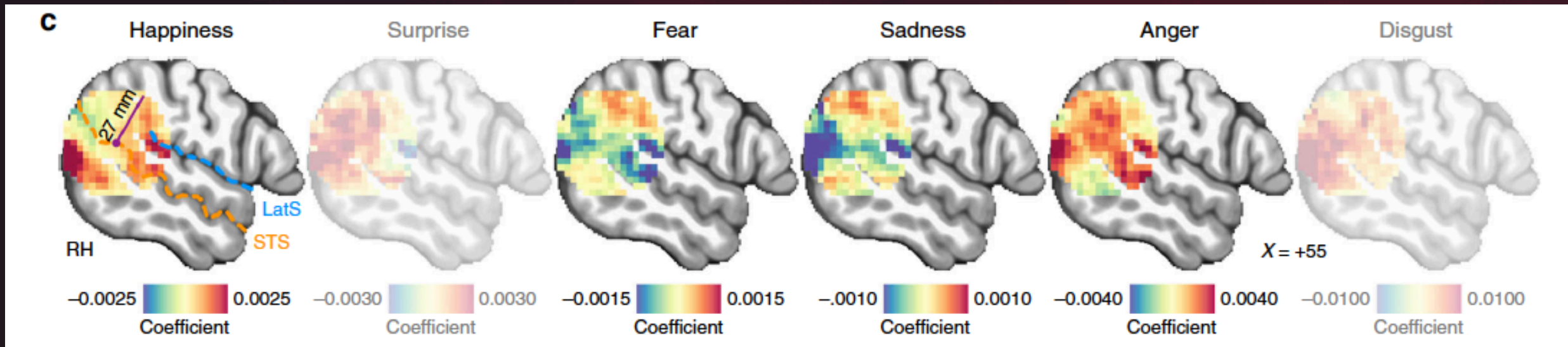


# The three dimensions

- Polarity
  - Negative to positive valence
  - Pleasure versus displeasure
- Intensity
  - E.g., weak to strong levels of sadness
- Complexity
  - Ranging from a positive pole of happiness and sadness to a negative pole of fear
  - The proximity of happiness and sadness “denotes inner conflict and ambivalence”
    - The tendency to ‘cry for joy’ may be an indicator of this proximity
    - We relate to the notion of ‘mixed emotions’



Patterns were consistent across subjects...



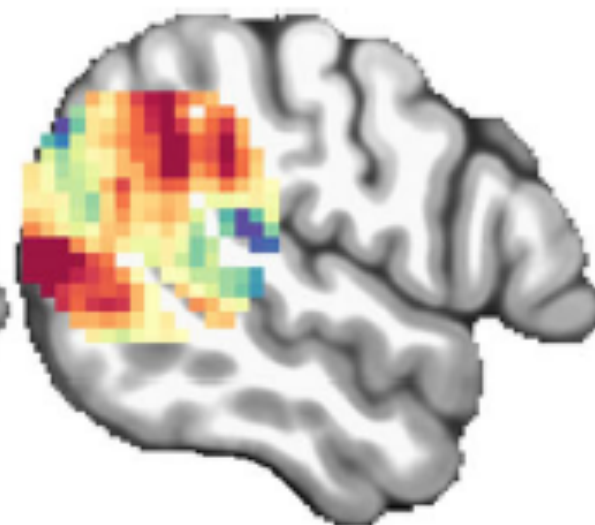
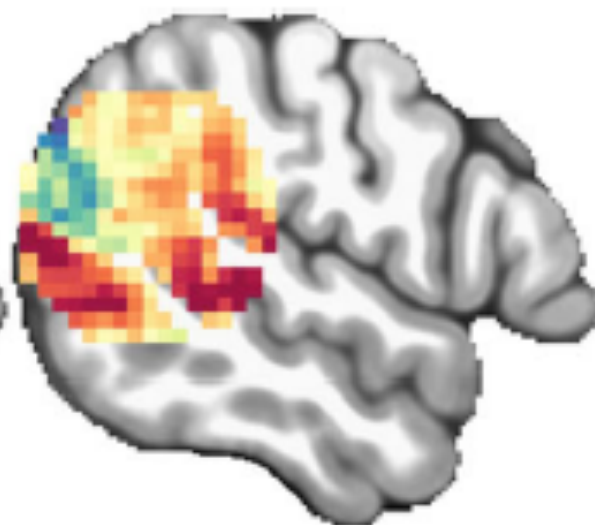
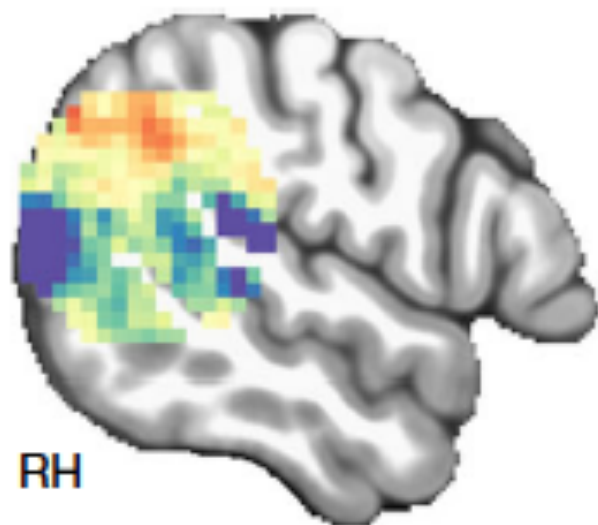
...except for surprise and disgust, shown shaded

**d**

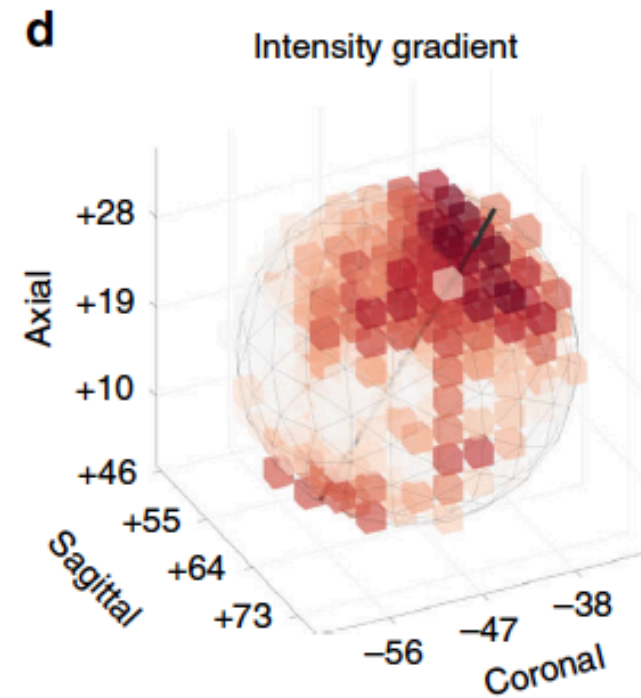
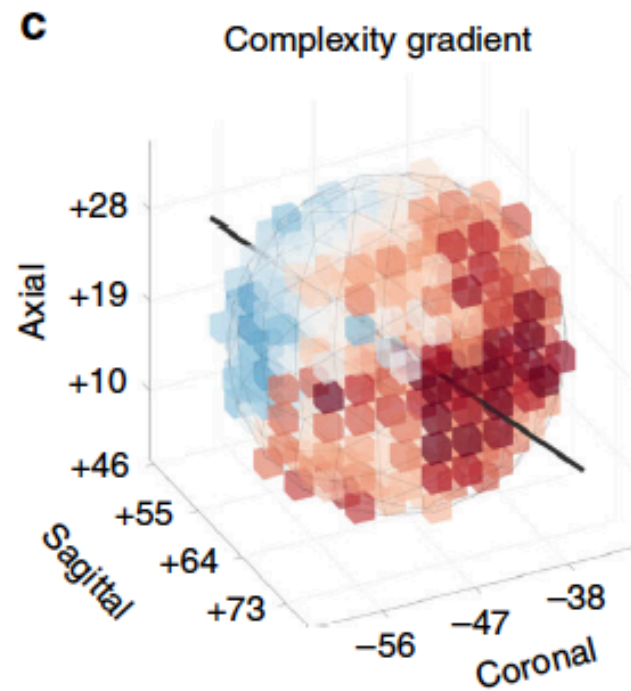
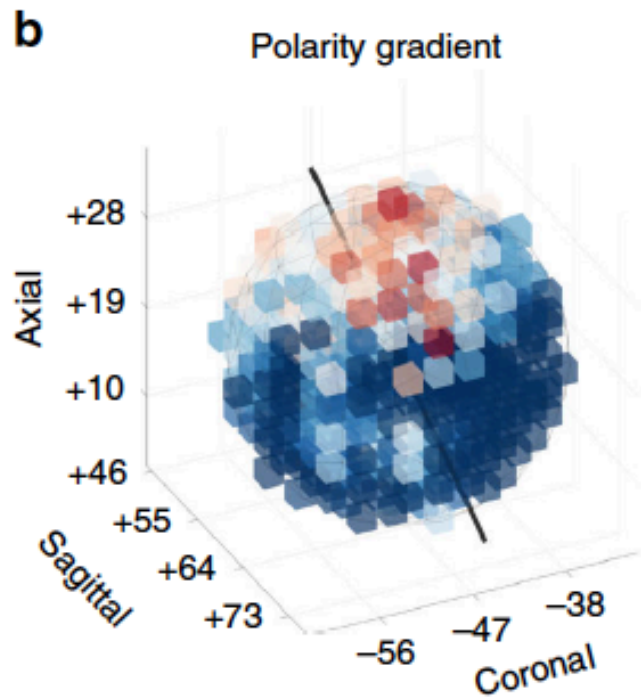
Polarity

Complexity

Intensity



# Observe the three-dimensional nature of the representation



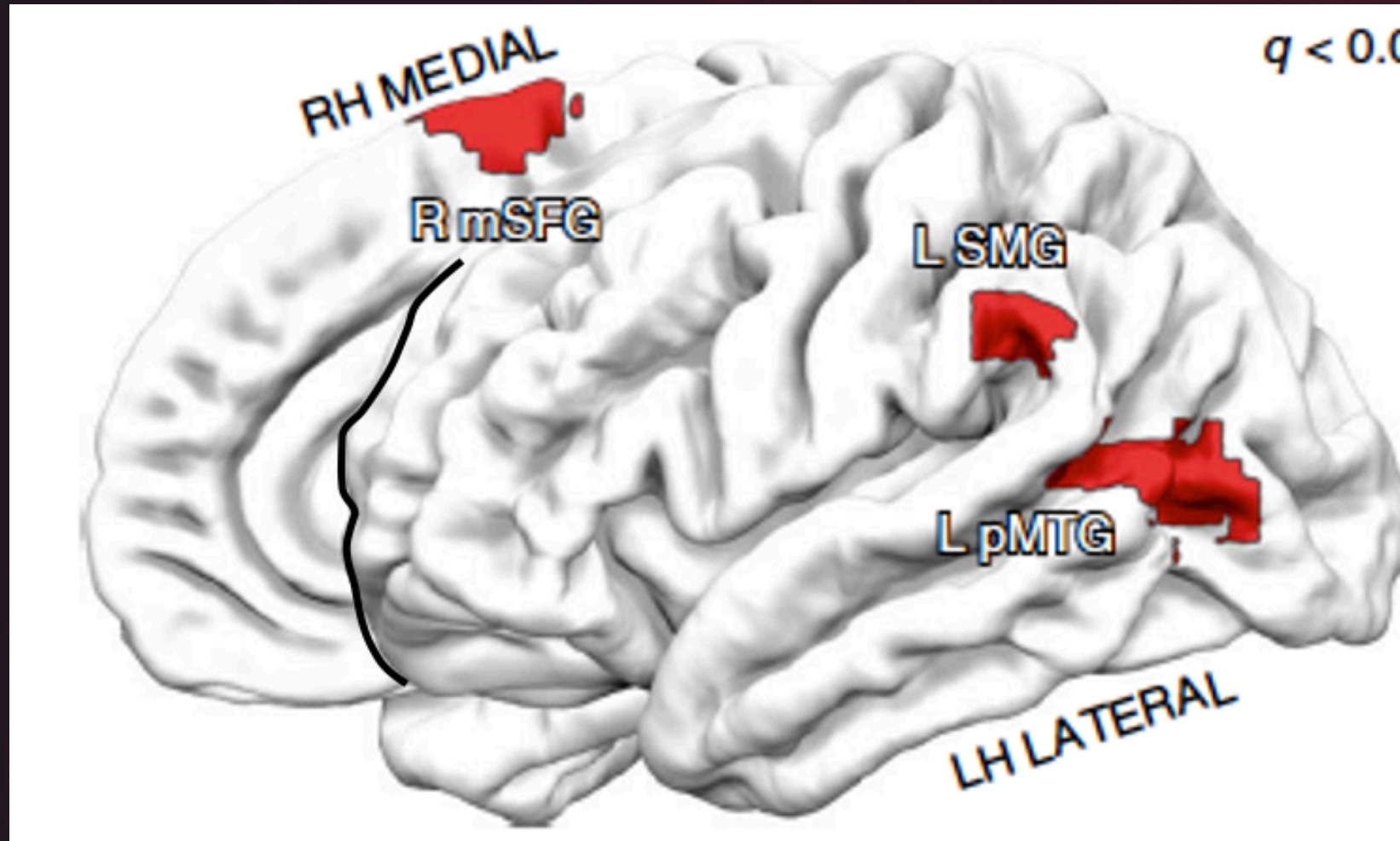


# Potential protocol innovation

- The Temporo-parietal junction
  - The [RTPJ-T4] protocol
  - The [LTPJ- RTPJ] protocol
  - The [ $\{RTPJ - T4\} - \{LTPJ - T3\}$ ] protocol



Left hemisphere involvement in emotion processing makes the case for inter-hemispheric placement



Superior Marginal Gyrus

Posterior Medial Temporal Gyrus

# Left hemisphere role

- ....[none] of the basic emotions showed a gradient-like organization in left TPJ
- So the role of the left-hemisphere sites remains ambiguous
- But we know that the L-R coordination is critical wherever we look!

Assume that temporal frequency rules apply...

