

# Visual Area (PPA) Correlates With Auditory, Spatial Cues Given by an Audio Drama's Narrator

## Is The PPA a Visual Area?

BOLD responses to incidental spatial cues in naturalistic stimulation

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### Introduction

#### Parahippocampal Place Area (PPA)

- increased BOLD responses to passively viewed pictures of landscapes & rooms<sup>1</sup>
- responses to auditory stimuli unclear<sup>2</sup>

#### exploratory re-use of "studyforrest" dataset

- natural stimulation via an audio drama & movie
- model-driven analysis (general linear model)

#### questions

- PPA's behavior during complex, more ecologically valid, taskless stimuli?
- an auditory stimulus for individual localization of a "visual" area, e.g. in visually impaired subjects?

### Methods

**stimuli:** visual localizer (block-design)<sup>3</sup>;  
audio drama<sup>4</sup>, movie<sup>5</sup> (3543 volumes each)

**annotation:** speech of the audio drama's narrator;  
movie cuts

**fMRI data:** taken from [StudyForrest.org](https://www.studyforrest.org/); N=14

**statistical analysis:** standard 3 level GLM for group averages using FSL

**primary contrasts of interest:**

**a) dedicated visual localizer**

- landscapes, houses > bodies, faces, objects, scrambled

**b) audio drama**

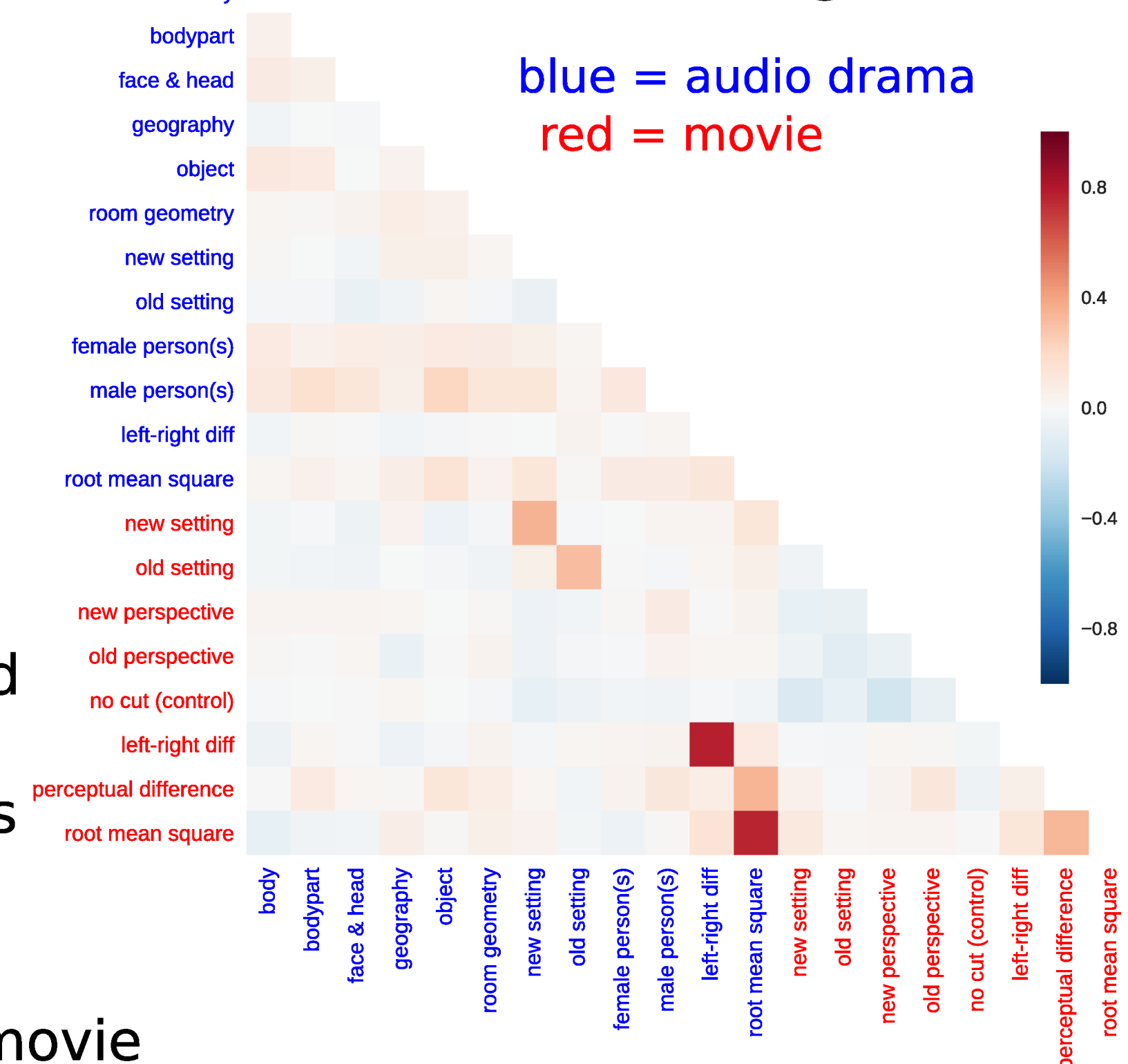
- geography, room geography > bodies, objects, persons

**c) movie**

- new settings > old perspectives

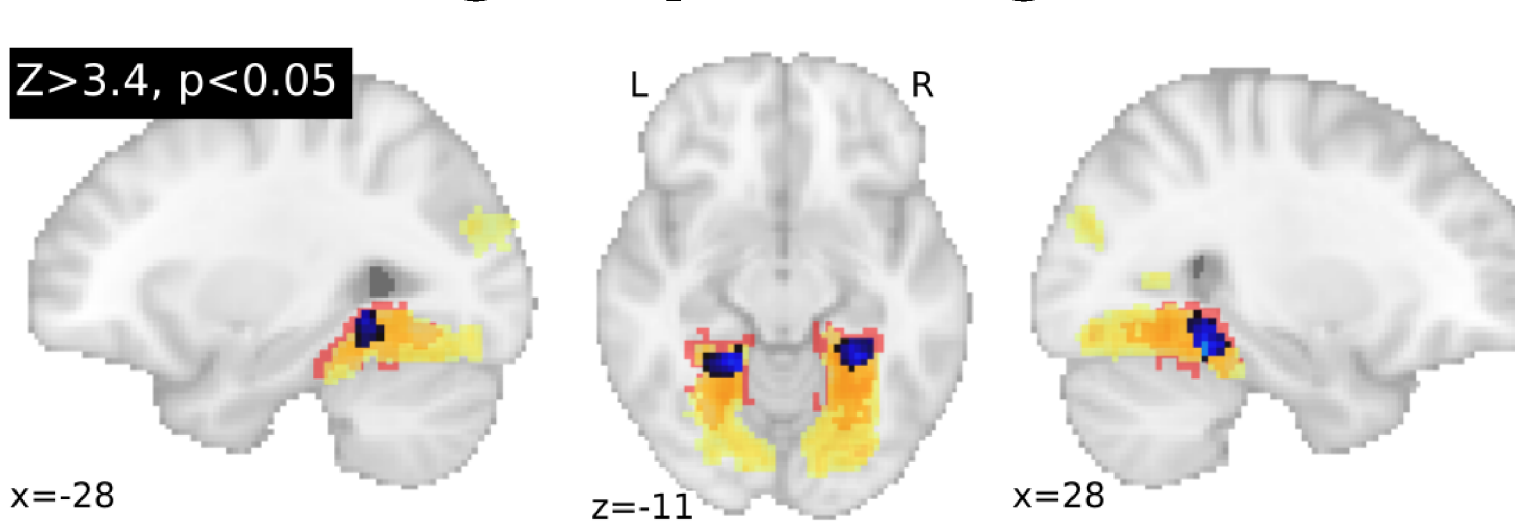
+ negative controls & cross-modal controls for audio & movie

#### correlation of regressors



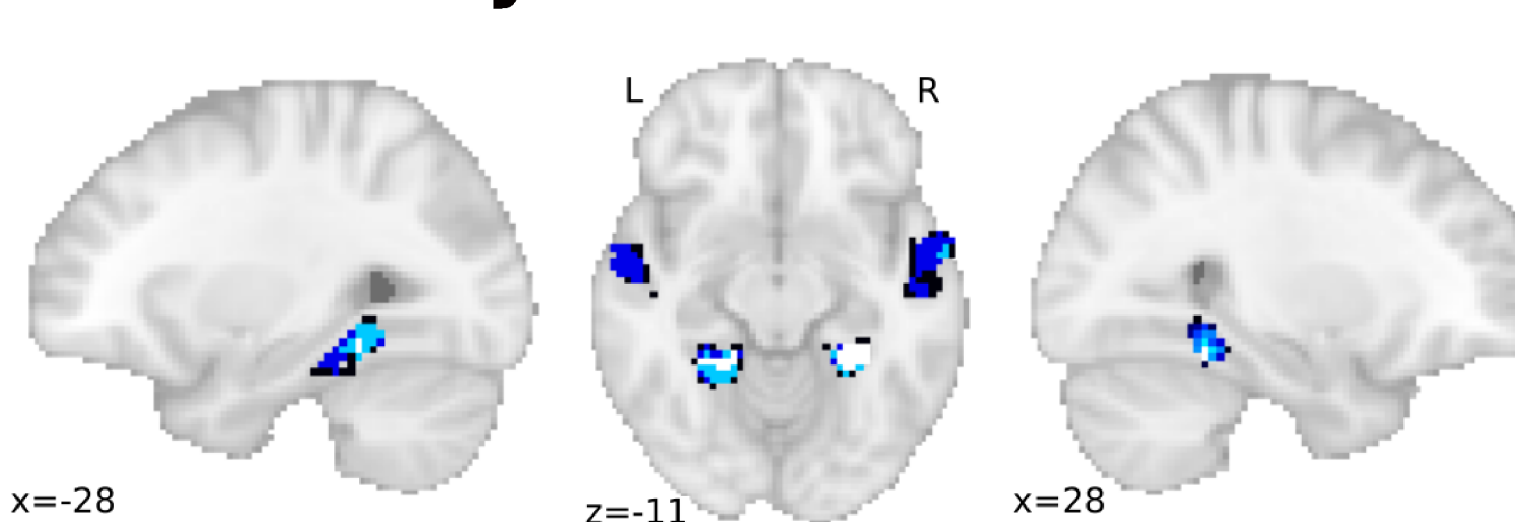
### Results

#### group average



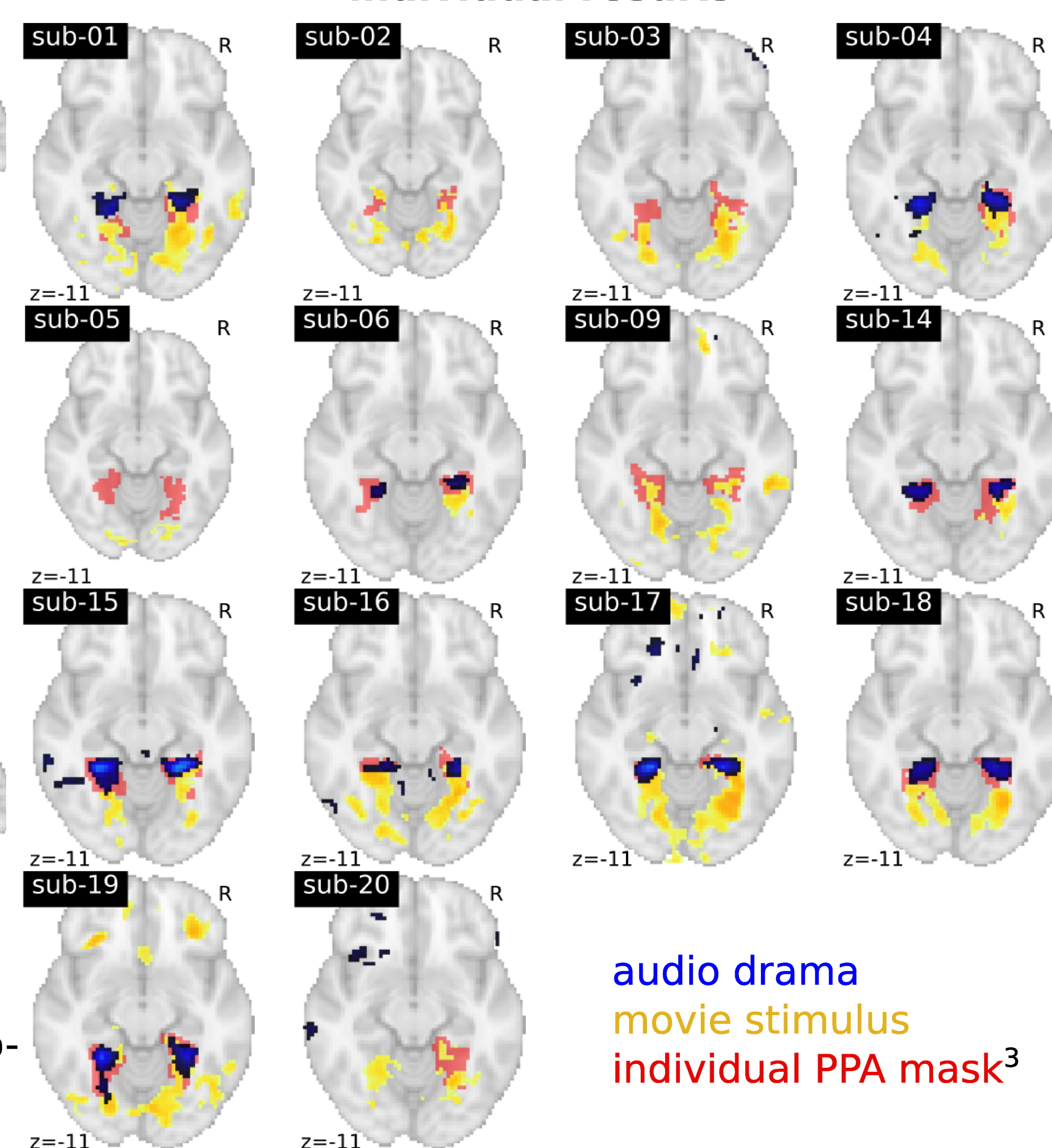
mixed-effects group-level (N=14) contrasts for the **audio** and **movie** stimulus; **overlap of individual PPA masks**<sup>3</sup> derived from visual localizer paradigm; coordinates in MNI 152

#### stability across 7 contrasts



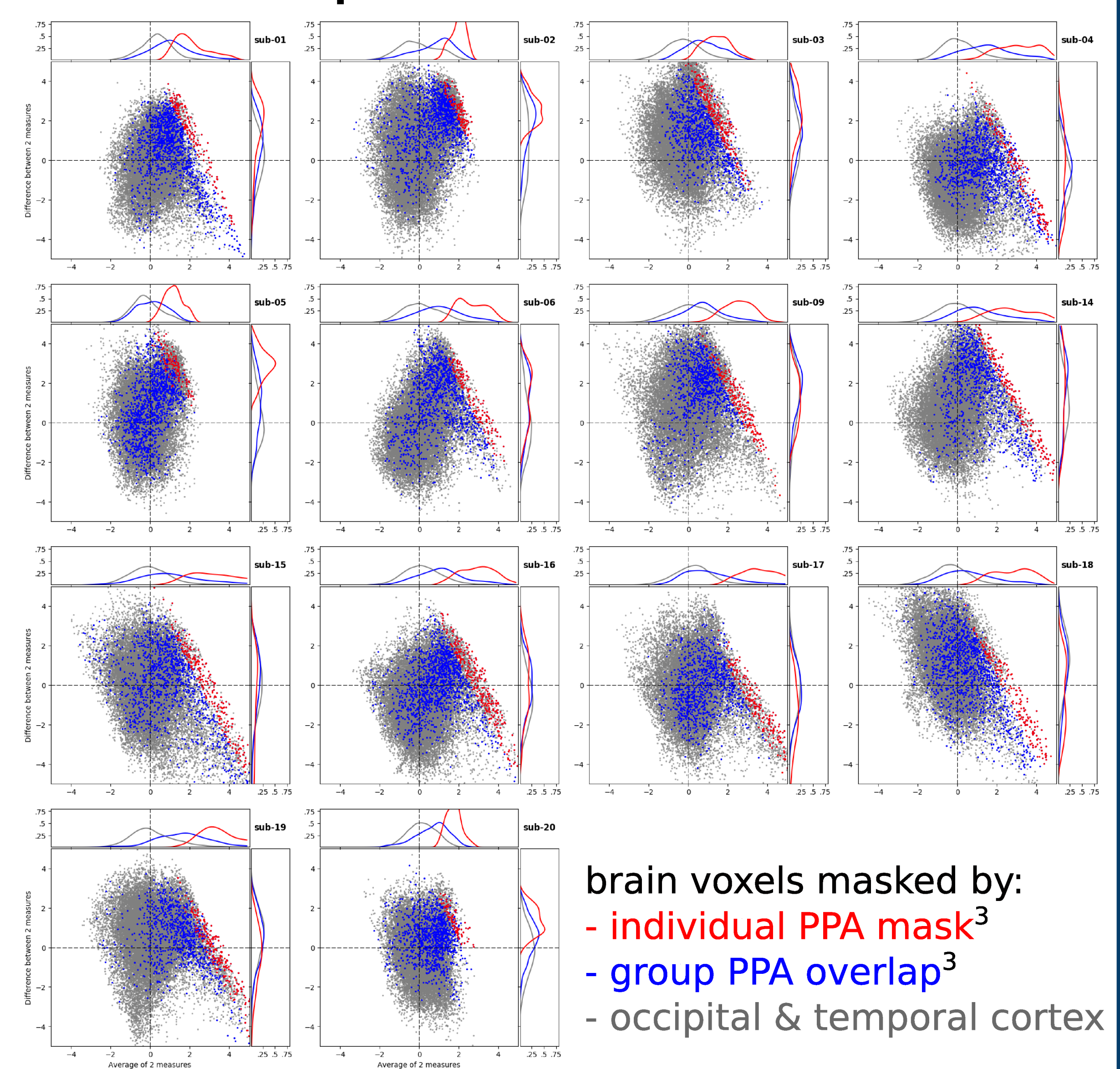
overlap of significant clusters ( $Z > 3.4$ ;  $p < 0.05$ ) across all seven tested audio-contrasts aiming for the PPA but with varying agreement with the spatial layout hypothesis<sup>1</sup>;  
s. QR-Code for unthresholded z-maps uploaded at neurovault.com

#### individual results



2nd level fixed-effects analyses across runs; significant clusters at  $Z > 2.3$ ;  $p < 0.05$ ; coordinates in MNI 152

#### Bland-Altman plots: visual localizer - audio drama



plots for two spatially corresponding z-values of voxels of the audio drama contrast & the visual localizer contrast; x-axis: average of voxels; y-axis: difference of voxels

brain voxels masked by:  
- individual PPA mask<sup>3</sup>  
- group PPA overlap<sup>3</sup>  
- occipital & temporal cortex

### Discussion

1. PPA shows increased activation during non-visual, complex auditory stimulation that provides incidental spatial information.
2. only minor temporal correlation of regressors of the audio drama & movie that were not designed for experimental research.
3. but still, alternative contrasts show significant clusters in auditory cortices.

4. inter-individual differences: for two subjects, an alternative audio-contrast shows bilaterally significant clusters whereas the primary contrast shows no significant clusters.
5. audio drama shows bilaterally increased activation in subject 4 in which the visual localizer shows an unilateral cluster.
6. nevertheless, a complex auditory stimulus might allow individual localization of a functionally defined brain region.

7. results of other studies suggest<sup>7</sup> the PPA does not exclusively process the "spatial layout" but "contextual associations".
8. an audio drama might be suitable as ecologically more valid "localizer" for a variety of brain functions.

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