Voxelwise Mapping of the Cingulate Cortex in Impression Formation

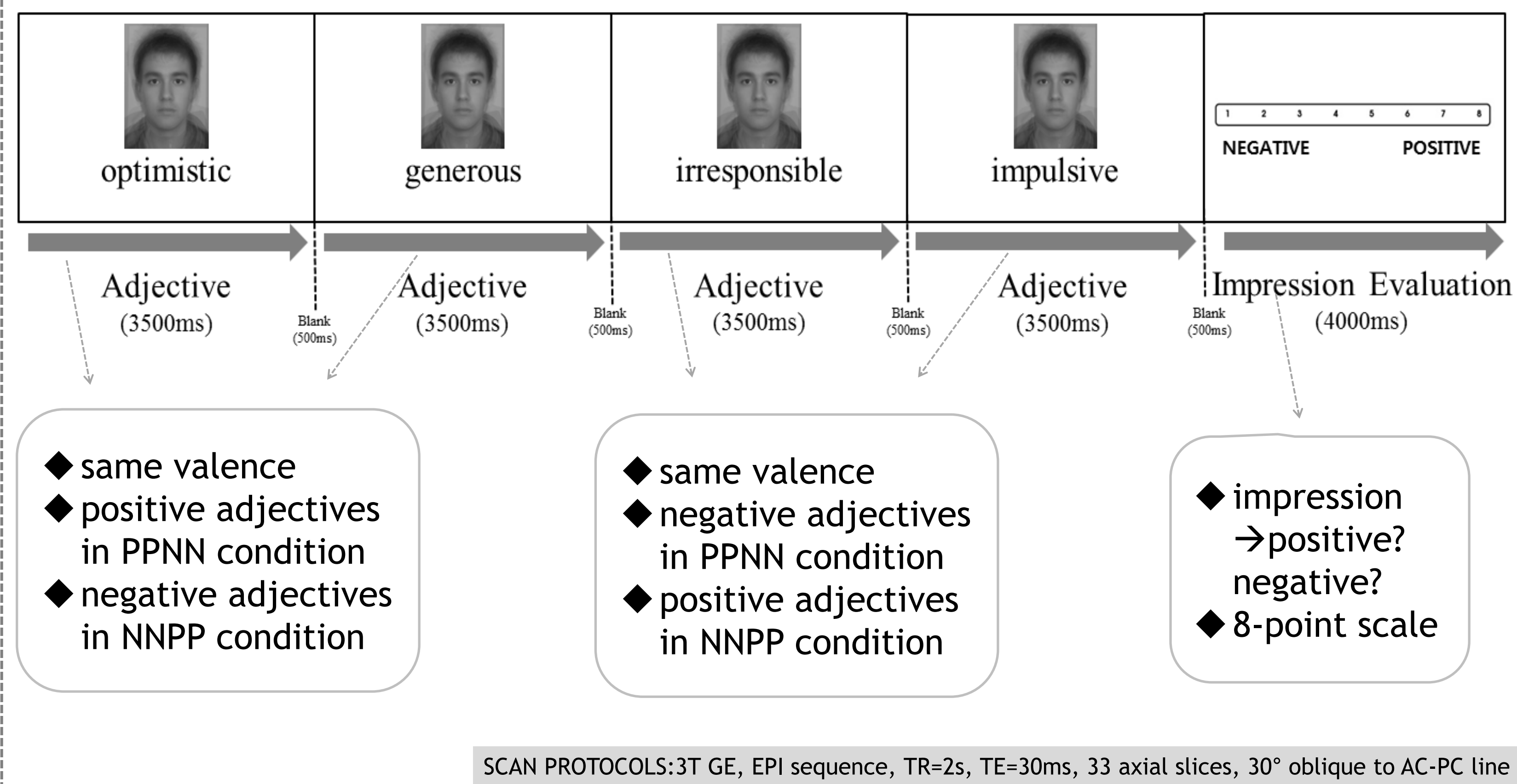Jeesung Ahn[1,2], Yoonjin Nah[2], Sanghoon Han[1,2]
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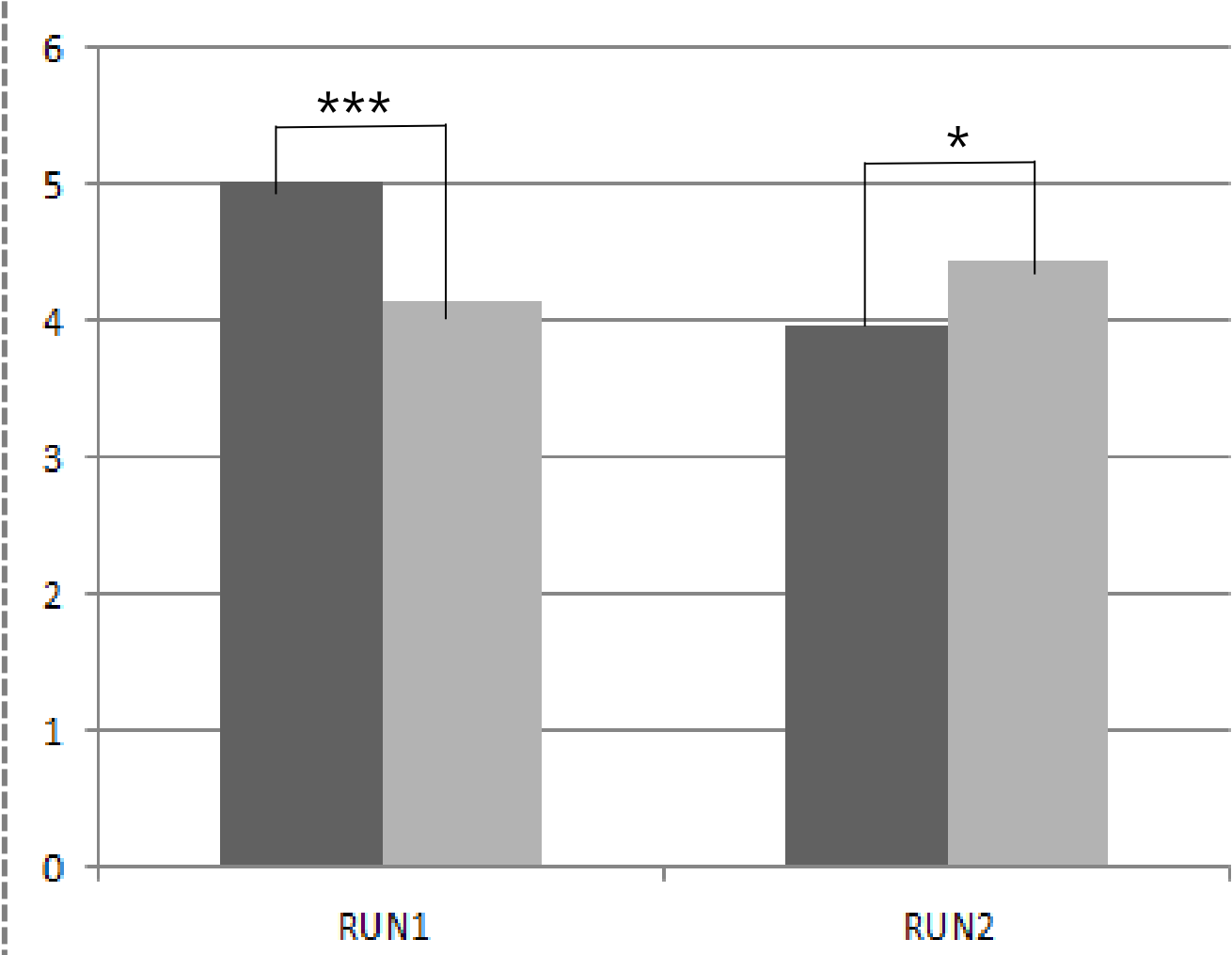[2] Department of Psychology, Yonsei University, Seoul, Korea

RESEARCH BACKGROUND

◆ People vary in processing information regarding social others. People can rapidly form an impression of an individual based on initial information provided. On the other hand, incongruent and ambiguous information of a person are often provided in complex social situation where impression keeps being updated.

◆ It can be assumed that different brain mechanisms are recruited for forming first impression and for updating impression. First impression can be regarded as a result of anchoring to initial information while updated impression regarded as a result of resolution of information incongruity.

◆ In this sense, we conducted an fMRI study to investigate voxelwise neural mechanisms on forming impressions while incongruent social information of an individual are provided.

EXPERIMENTAL DESIGN

optimistic — generous — irresponsible — impulsive — NEGATIVE ... POSITIVE

Adjective (3500ms) → Blank (500ms) → Adjective (3500ms) → Blank (500ms) → Adjective (3500ms) → Blank (500ms) → Adjective (3500ms) → Blank (500ms) → Impression Evaluation (4000ms)

◆ same valence
◆ positive adjectives in PPNN condition
◆ negative adjectives in NNPP condition

◆ same valence
◆ negative adjectives in PPNN condition
◆ positive adjectives in NNPP condition

◆ impression →positive? negative?
◆ 8-point scale

SCAN PROTOCOLS:3T GE, EPI sequence, TR=2s, TE=30ms, 33 axial slices, 30° oblique to AC-PC line

## BEHAVIORAL RESULTS

PPNN / NNPP

Impression Evaluation Score

◆ RUN1
-PPNN condition : M= 5.03 (positive impression)
-NNPP condition : M= 4.14 (negative impression)
- p <0.001
◆ RUN2
-PPNN condition : M= 3.98 (negative impression)
-NNPP condition : M= 4.45 (negative impression)
- p <0.05
◆ NO consistent ORDER effects

References Schiller, D., Freeman, J. B., Mitchell, J. P., Uleman, J. S., & Phelps, E. A. (2009). A neural mechanism of first impressions. Nature neuroscience, 12(4), 508-514.

fMRI ANALYSES -1.1 Single Trial Analysis

◆ **Beta Estimation & Extraction**

- Every adjective presentation and impression evaluation period of each trial (4 sec each) was considered as a single trial.
- General Linear Model (GLM) analysis : a statistical modeling was performed in every brain volume image of each participant by convolving a canonical hemodynamic response function (HRF) and its time derivative, with a delta function marking the onset of each adjective and impression evaluation
- For each participant, 300 beta estimates were calculated as 5 betas were estimated per each trial and there were 60 trials in total. Then, beta estimates of every voxel in ROIs were extracted for further model fitting analysis.

◆ **Regions Of Interest (ROI) Selection**
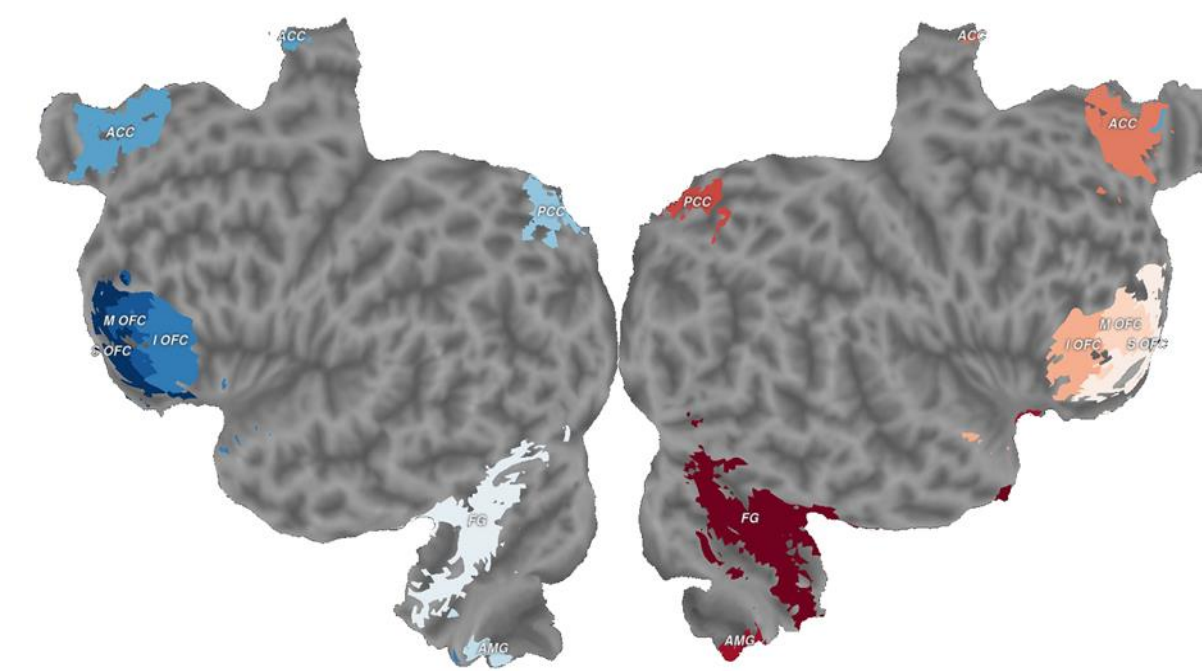
◆ ROI
- selected from previous studies

1. Orbitofrontal Cortex (OFC)
   1) Superior OFC   2) Mid OFC   3) Inferior OFC
2. Anterior Cingulate Cortex (ACC)
3. Posterior Cingulate Cortex (PCC)
4. Amygdala (AMG)
5. Fusiform Gyrus (FG)

fMRI ANALYSES -1.2 Model Fitting

◆ **Two Hypothetical Step Function Models**

	1st Adjective	2nd Adjective	3rd Adjective	4th Adjective
MODEL 1	1	1	-1	-1
MODEL 2	-1	-1	1	1

Step Function Models
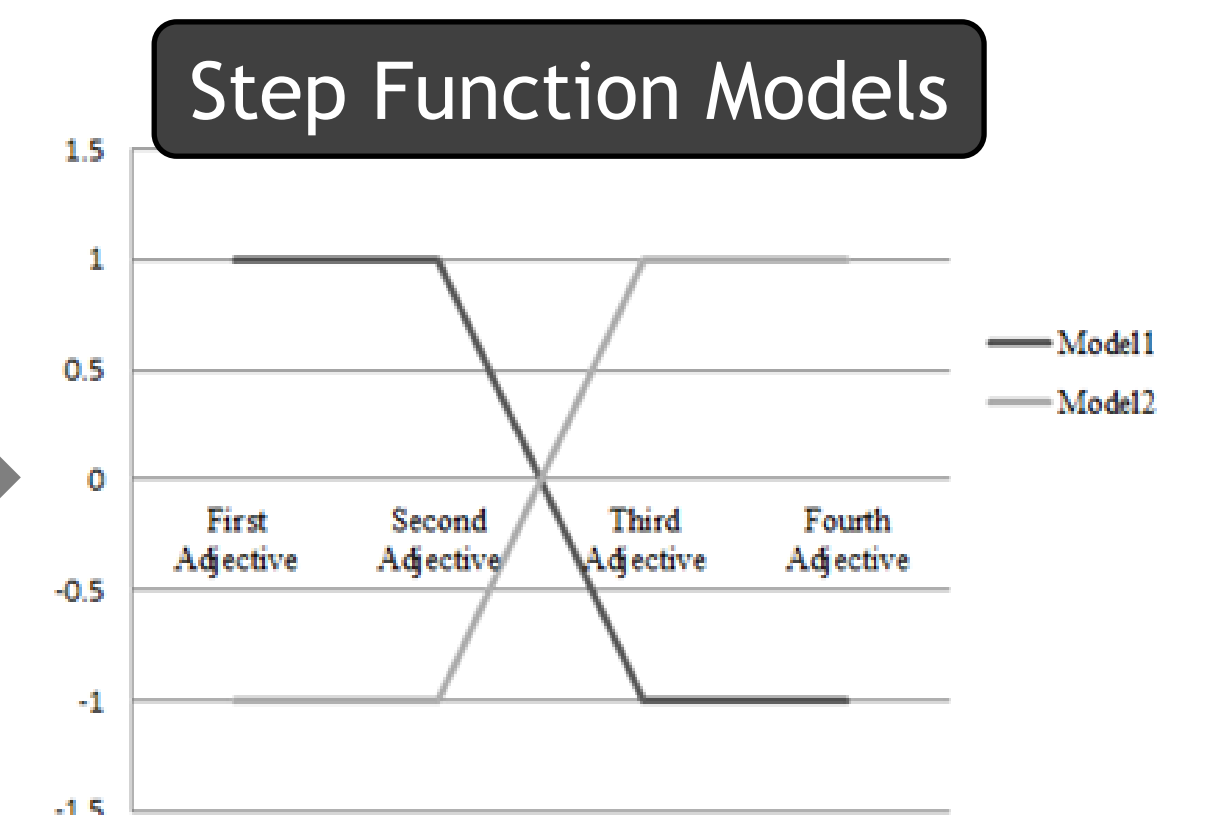
◆ **Parameter Estimation & Model Fitting**

- Solver add-in of Microsoft Excel
- Nonlinear Generalized Reduced Gradient (GRG) algorithm
- Optimal parameters minimizing sum of squared deviation (SSD) between beta estimates and parameters-multiplied models were estimated in each voxel

	1st Adjective	2nd Adjective	3rd Adjective	4th Adjective
MODEL 1	-1 x free parameter 1	1 x free parameter 2	-1 x free parameter 3	-1 x free parameter 4
MODEL 2	-1 x free parameter 1	-1 x free parameter 2	1 x free parameter 3	1 x free parameter 4

Model 1 & SSD

*SD=Squared Deviation

Model 2 & SSD
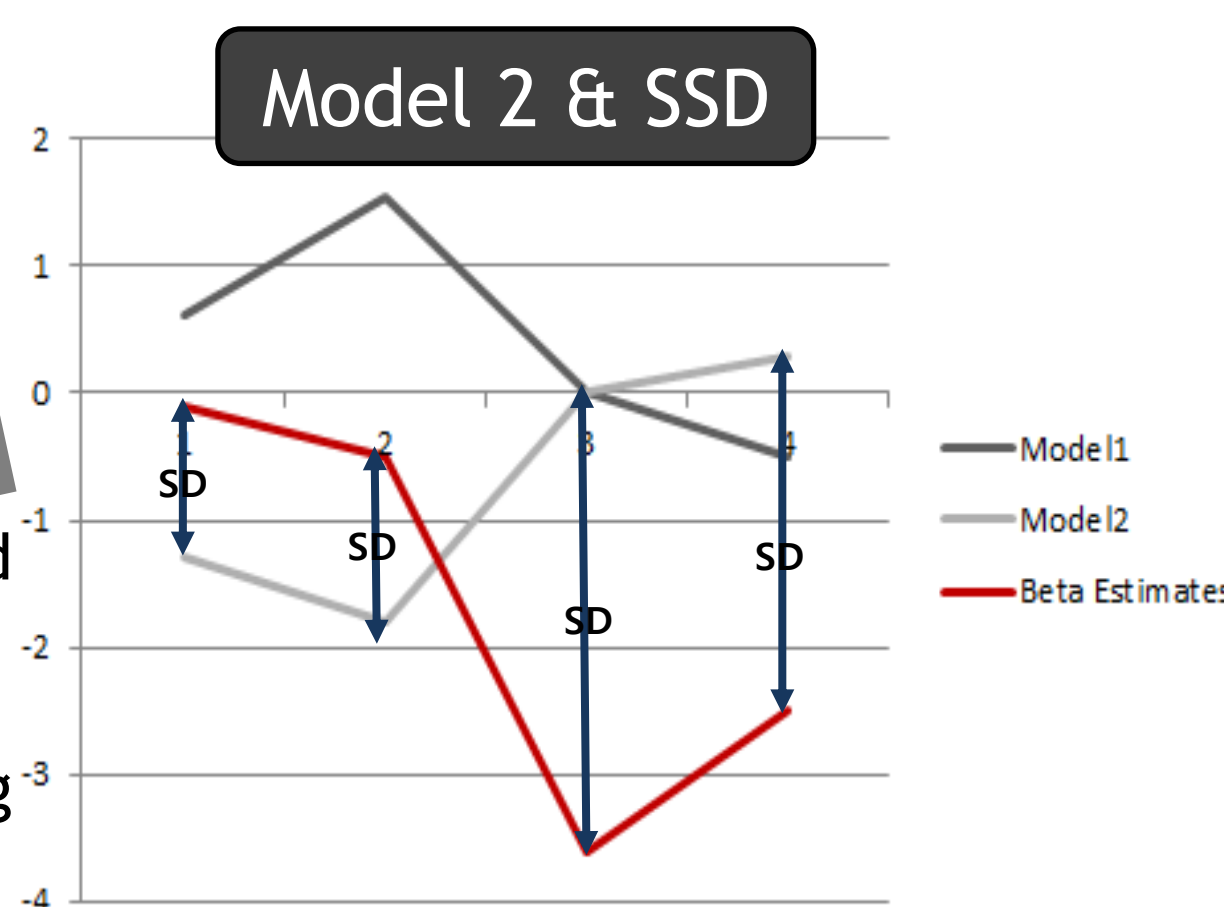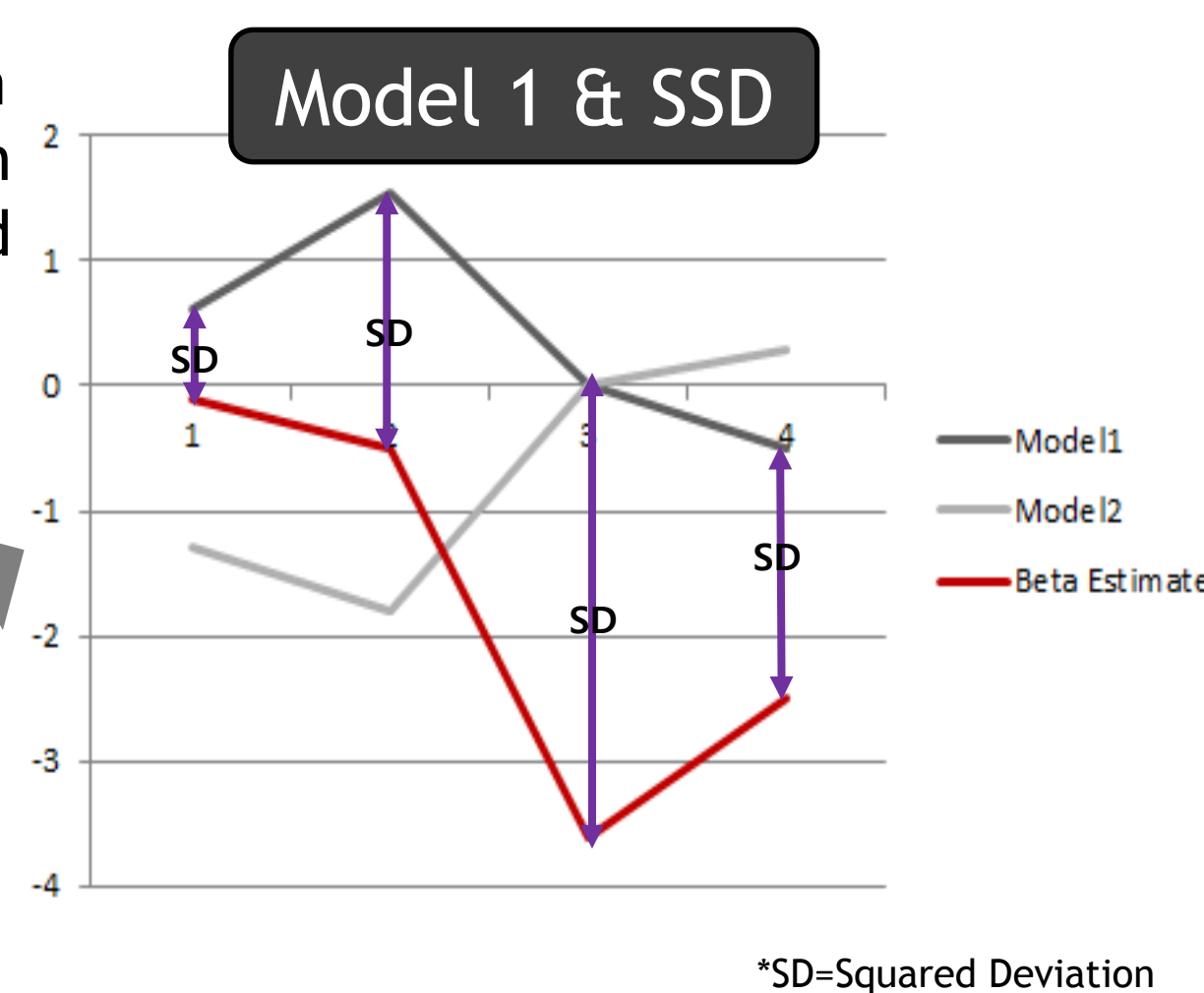
- SSD of model 1 and model 2 in each voxel were compared to confirm which model the voxel was more fit into
- Smaller SSD referred to better fitting
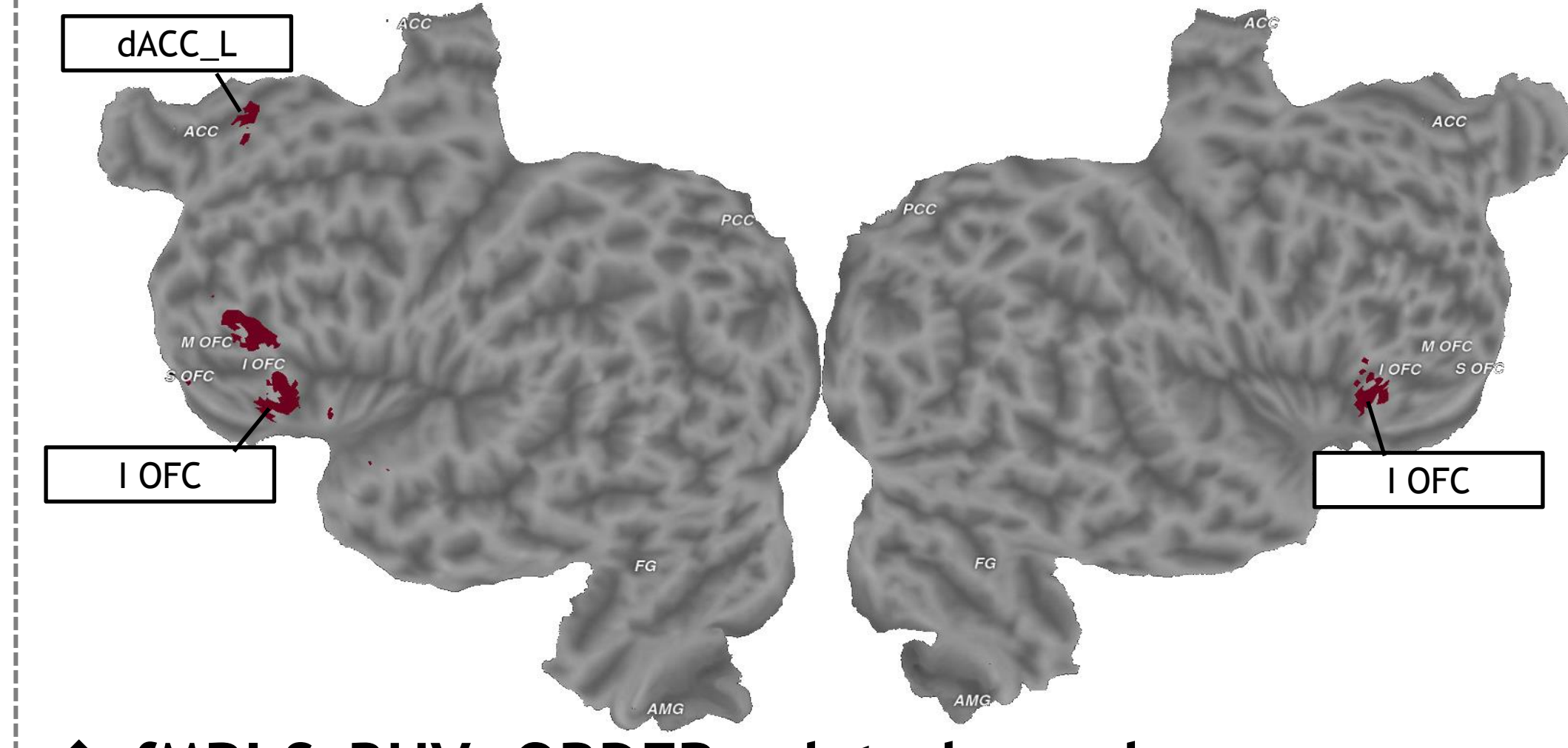- Final model of each voxel was determined by calculating probability of the model that each participant fit into

fMRI ANALYSES -2. RESULTS

◆ **fMRI: ORDER related voxels**

**First impression** : model1 in both PPNN and NNPP conditions (all trials, p<0.05)
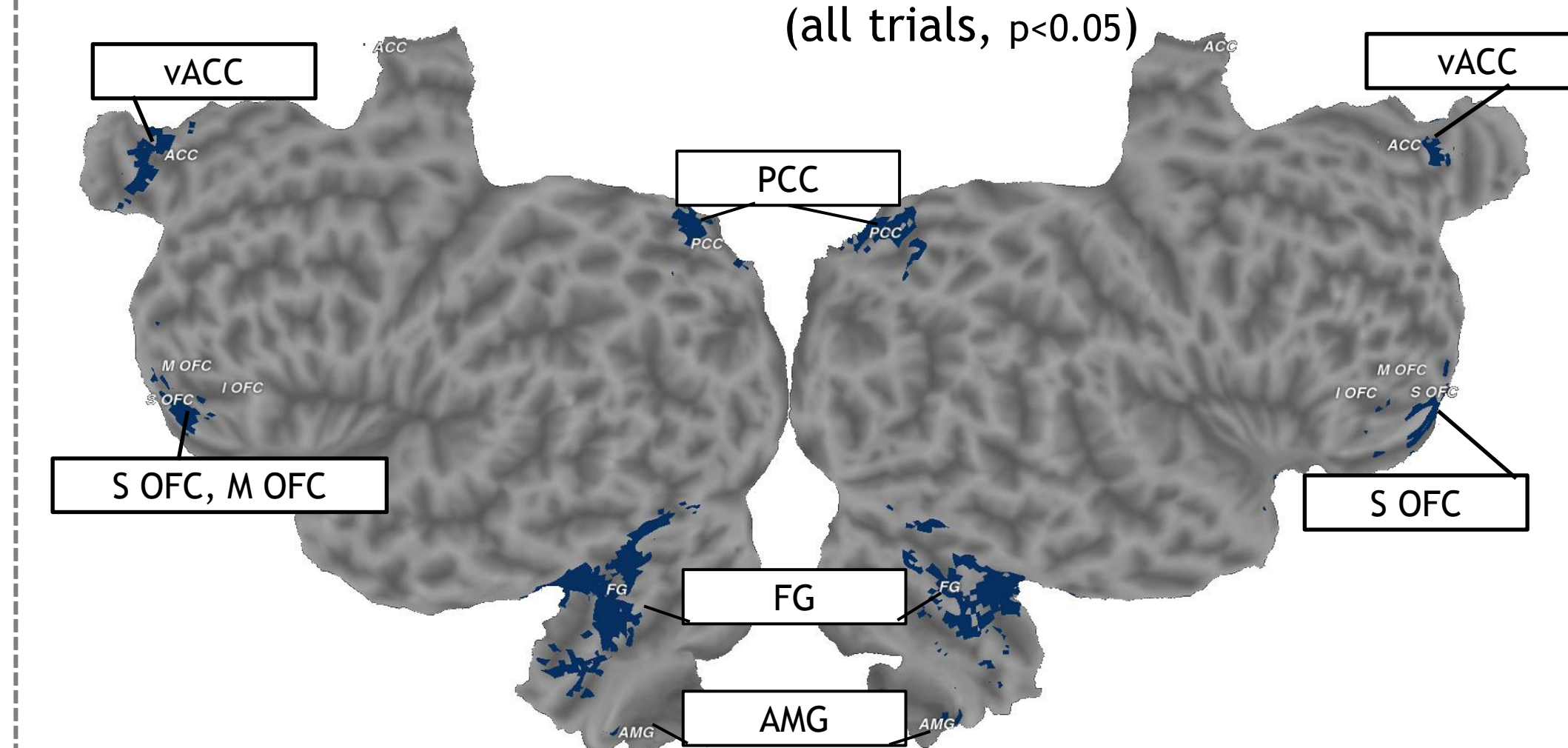
Conflict Resolution : model2 in both PPNN and NNPP conditions (all trials, p<0.05)
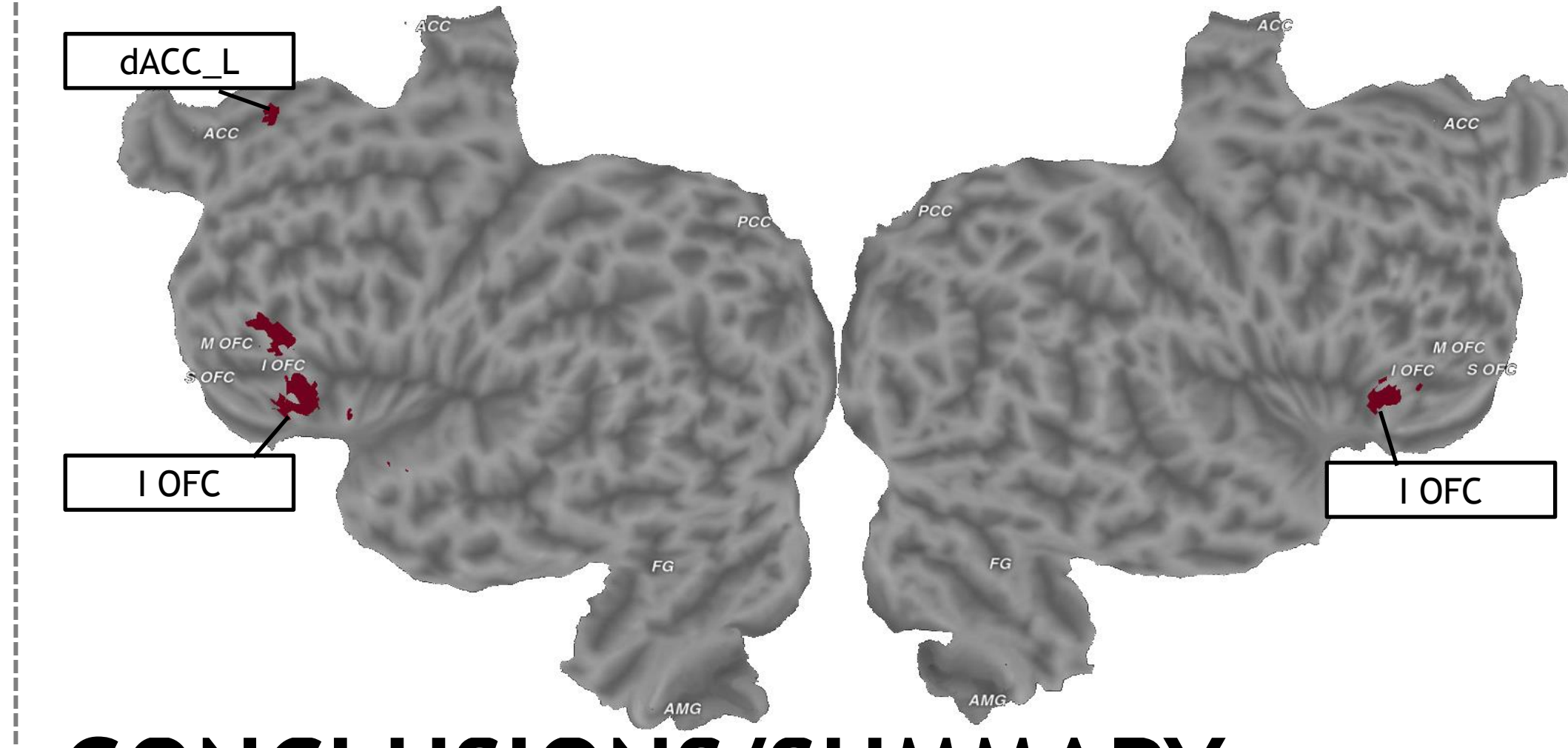

◆ **fMRI & BHV: ORDER related voxels**

First impression : model1 in PPNN condition (positive trials) & model1 in NNPP condition (negative trials) (p<0.05)

*positive trials = evaluation score above 5
*negative trials= evaluation score under 4
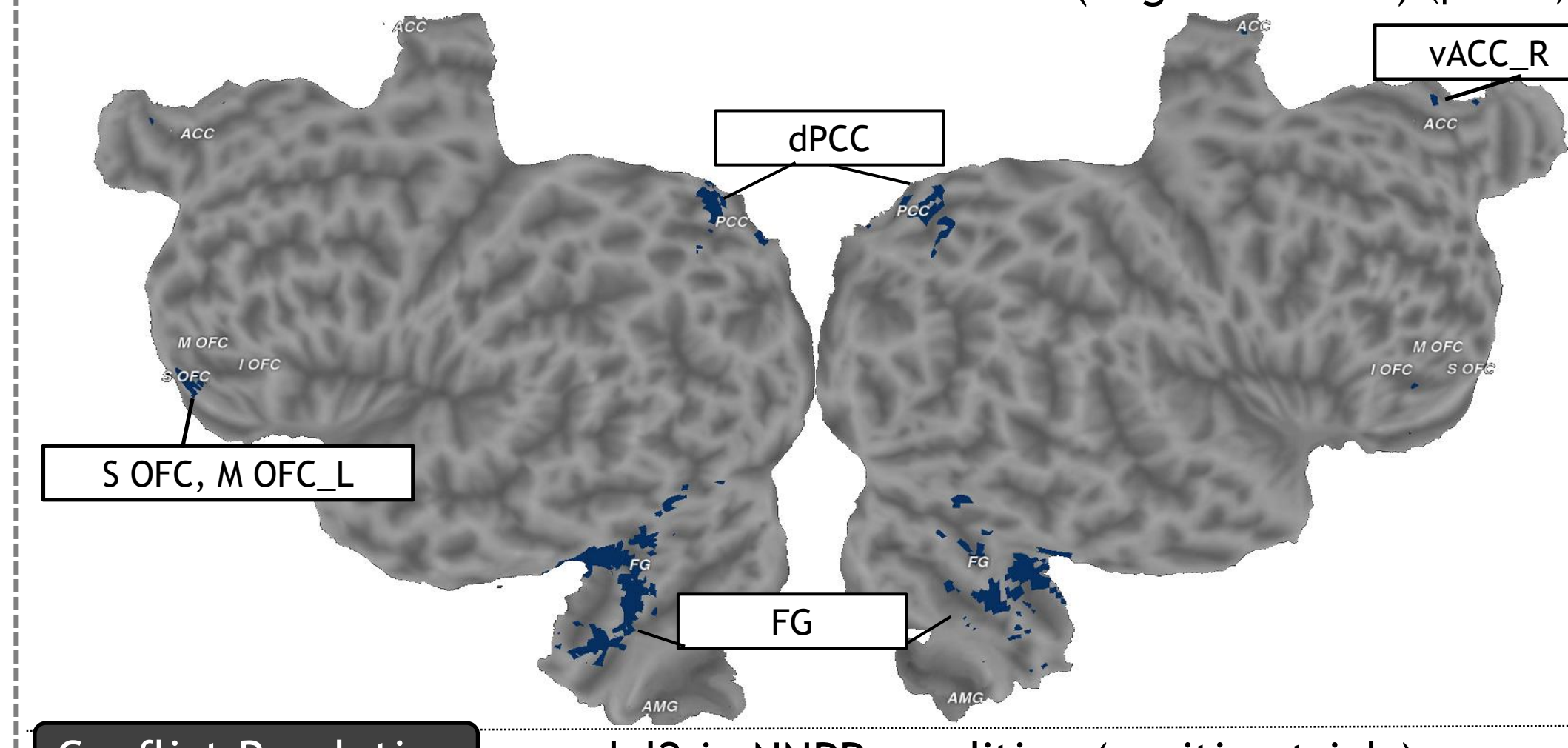
Conflict Resolution : model2 in NNPP condition (positive trials) & model2 in PPNN condition (negative trials) (p<0.05)

◆ **fMRI: VALENCE related voxels**

Positive Valence : model1 in PPNN condition & model 2 in NNPP condition (all trials) (not significant)

Negative Valence : model2 in PPNN condition & model1 in NNPP condition (all trials) (not significant)

◆ **fMRI & BHV: VALENCE related voxels**

Positive Valence : model1 in PPNN condition (positive trials) & model2 in NNPP condition (positive trials) (not significant)

Negative Valence : model2 in PPNN condition (negative trials) & model1 in NNPP condition (negative trials) (not significant)
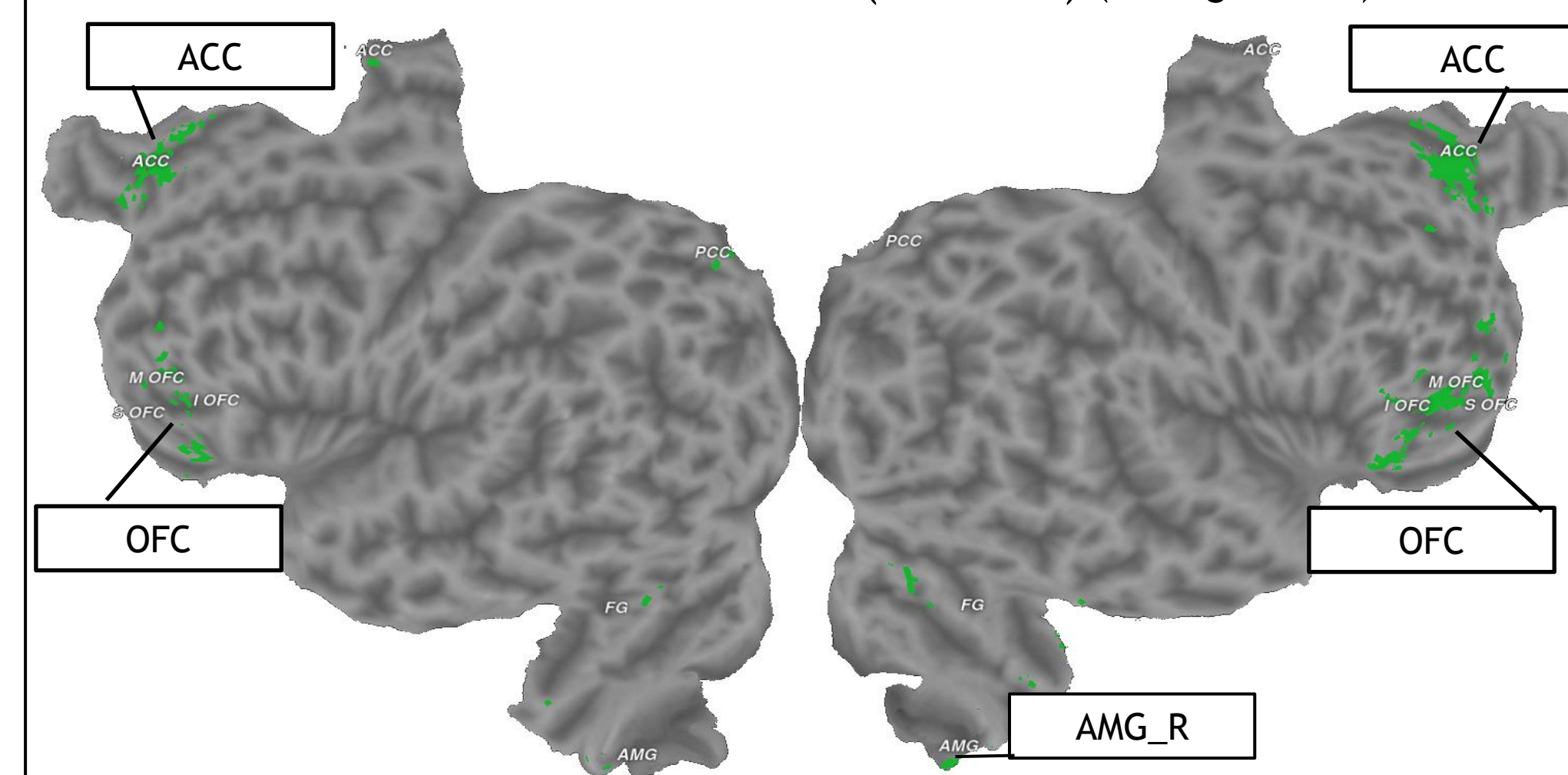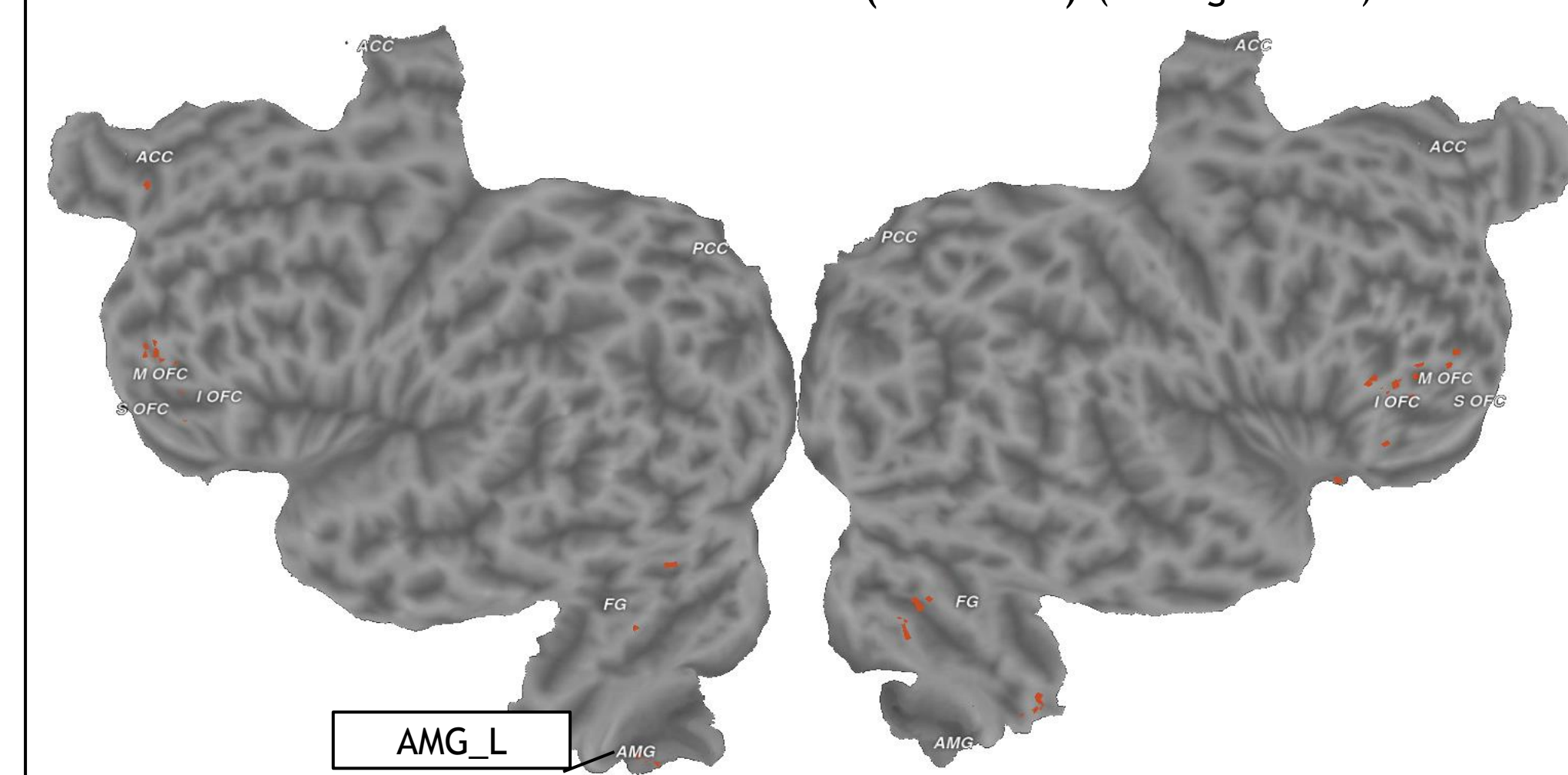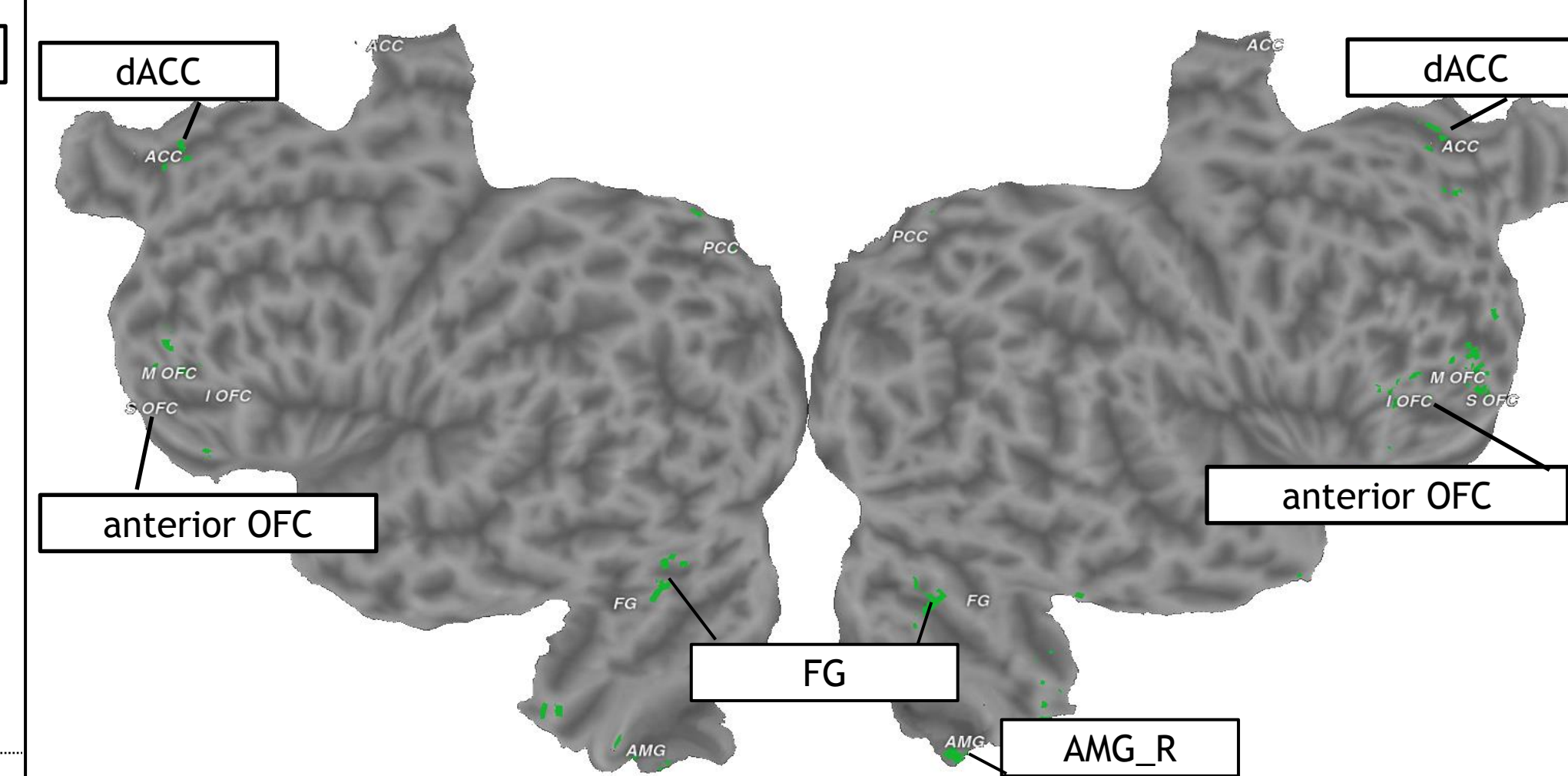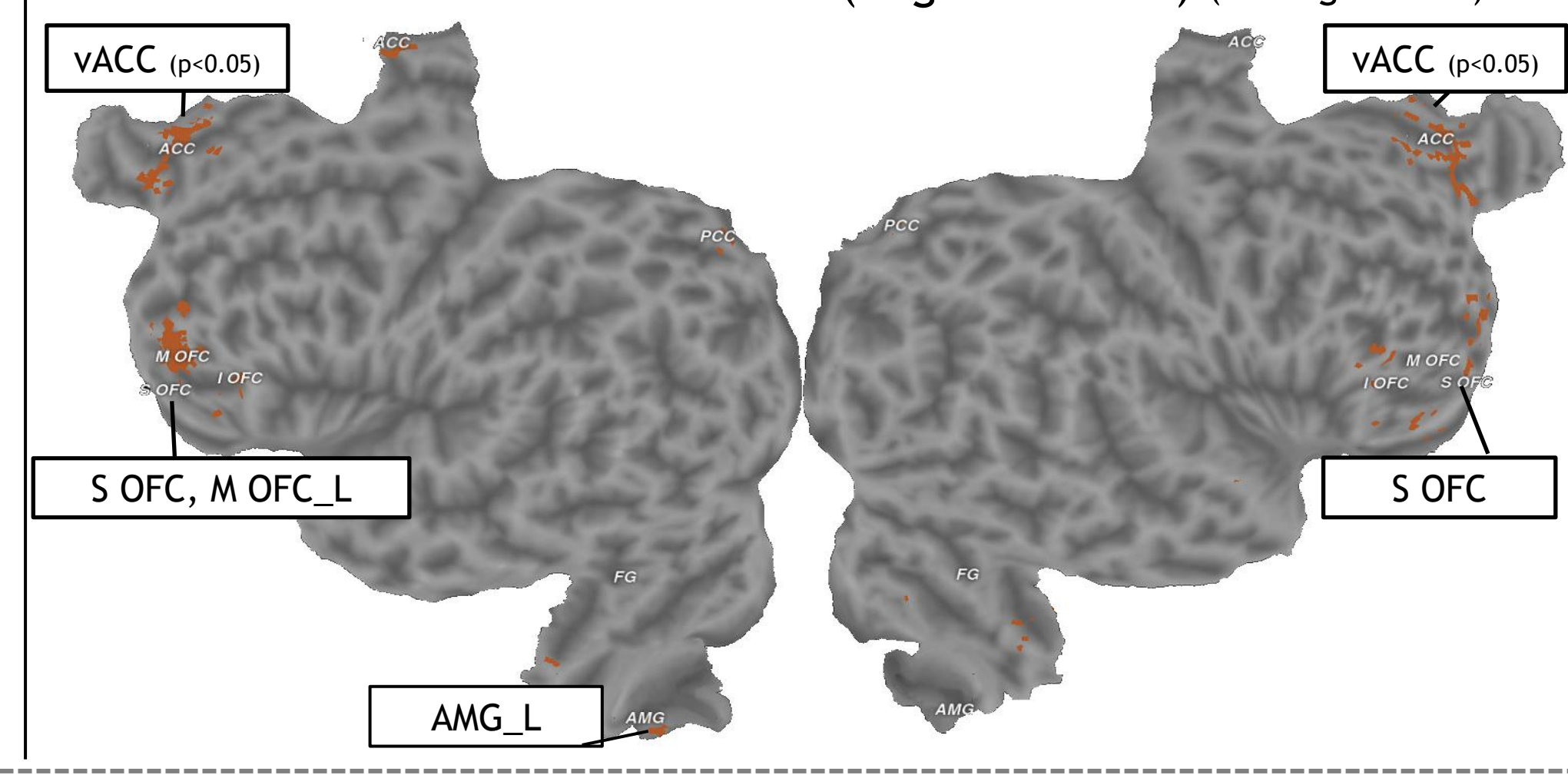

CONCLUSIONS/SUMMARY

◆ We could functionally parcellate ACC into dorsal and ventral parts in that the voxels of dorsal ACC(dACC) were involved with resolving information incongruity(model2) while those of ventral ACC(vACC) were involved with forming first impression (model1). We also found the voxels of dACC were more recruited to process positive information whereas vACC processed negative information.

◆ PCC yielded anchoring effects of first impression regardless of valence of information (model1).

◆ FG was mainly involved with forming first impression especially in positive way (model1&positive valence).

◆ AMG was lateralized in that voxels of right AMG were involved with processing positive information whereas those of left AMG were involved with processing negative information.

◆ Inferior part of OFC was involved with resolving information incongruity (model2) and superior and middle parts of OFC were involved with first impression (model1). Anterior part of OFC was generally involved with processing positive valence while parts of superior and middle OFC were more involved with negative valence.