Causal Mechanisms Of Individual Differences In Hemispheric Lateralization Of The Face Perception Network: A DCM-PEB approach

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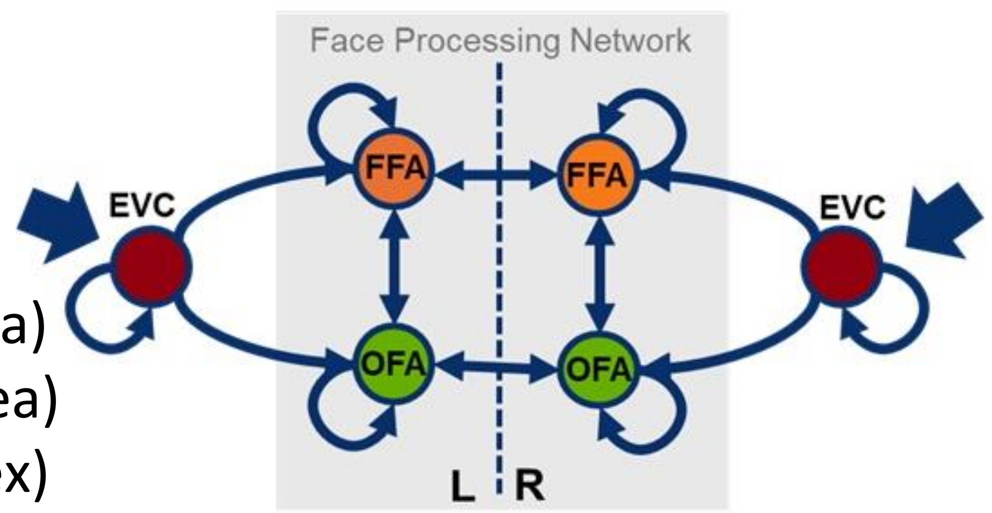
Introduction

The core face processing network consists of:

- the FFA (fusiform face area)
- the OFA (occipital face area)
- the EVC (early visual cortex) as input area of the network.



Face Processing is right lateralized. This means that there is stronger activation on the right hemisphere than on the left hemisphere when faces are viewed.

Can we explain right lateralization based on functional mechanisms of the face processing network?

Methods

fMRI experiment (n=110) with face localizer task (faces, objects, scrambled images).

$$LI = \frac{A_l - A_r}{A_l + A_r}$$

Lateralization Index (LI), quantifies regional lateralization (i.e. LI_{FFA}, LI_{OFA}). Negative values indicate right-hemispheric dominance.

DCM (Dynamic Causal Modelling) constructing network with regions of interest (**FFA**, **OFA**, **EVC**) and retrieving directed connectivity parameters ($\boldsymbol{\theta}$).

PEB (Parametric Empirical Bayes) constructing a general linear model (GLM), predicting the connectivity parameters based on covariates: *[Mean, LI_{FFA}, LI_{OFA}, Handedness, Gender, Age]*

$$\boldsymbol{\theta} = \boldsymbol{X\beta} + \boldsymbol{\varepsilon}$$

Results

The face processing networks differ across participants. We show that differences can be explained by some covariates. We focus on the mean variability and the inter-individual differences in FFA and OFA lateralization.
The PEB parameters ($\boldsymbol{\beta}$s) show the **influence of these covariates on the network connectivity.**

Figure 1. Face activation of right handers. Figure adapted from Thome et al [1].

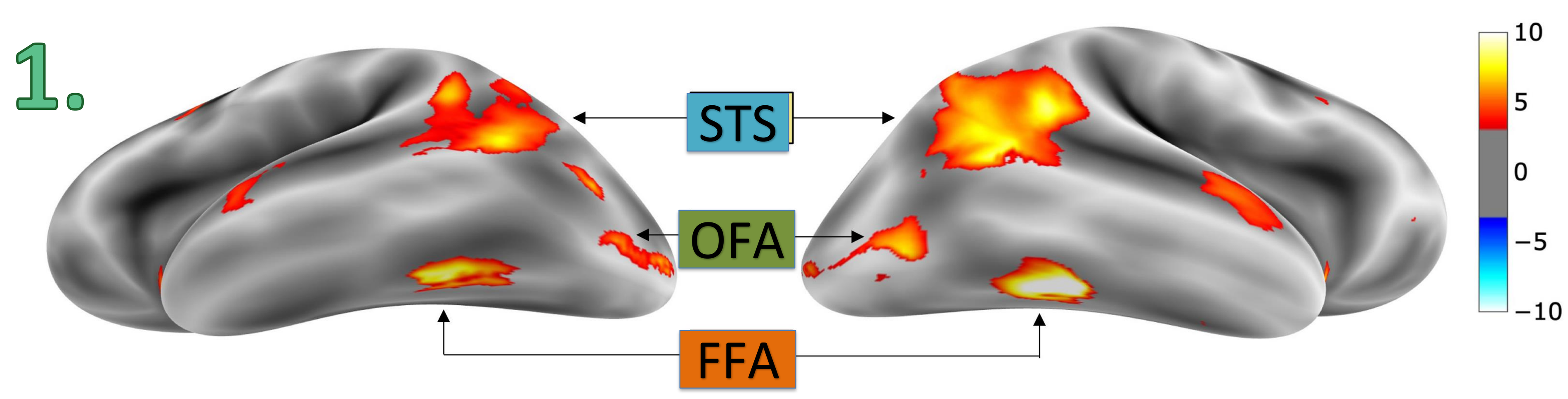


Figure 2. Group-level face modulated connectivity parameters ($\boldsymbol{\beta}$)

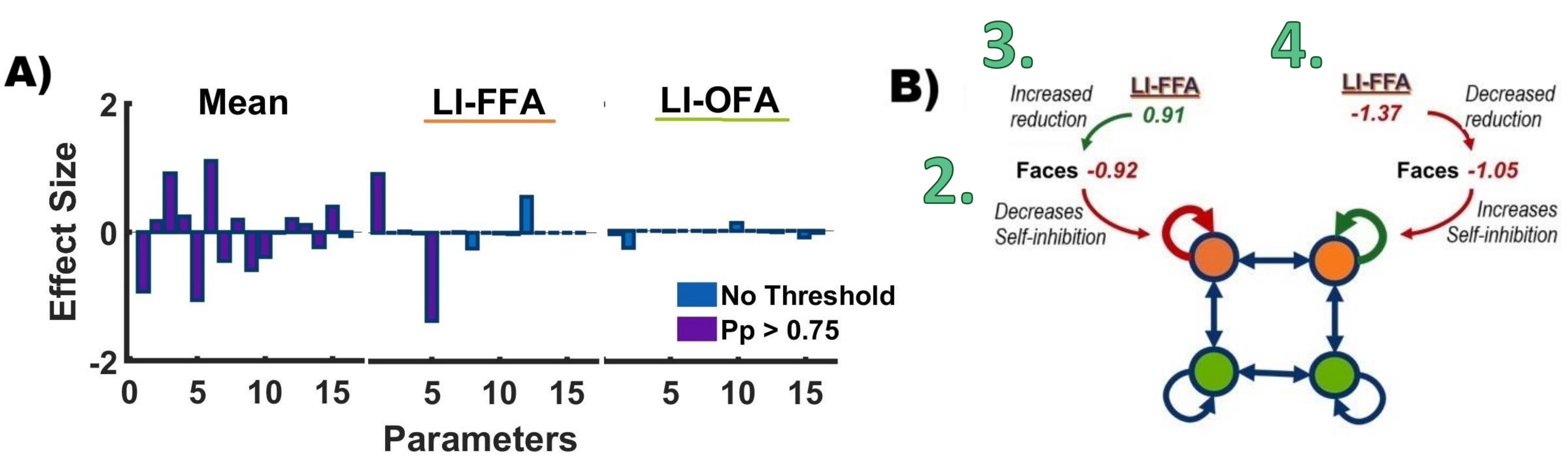


Figure A) shows sign. $\boldsymbol{\beta}$s for 16 mean connectivity parameters. Two connectivity parameters are sign. modulated by the LI_{FFA}. None are sign. modulated by LI_{OFA}

Figure B) illustrates sign. LI_{FFA} modulations happen on the FFA self-connections of the face-processing network

Summary

1. When faces are presented, FFAs become more active.
2. Face processing decreases self-inhibition on both FFA regions.
3. LI_{FFA} **increases** the face processing influence on the left FFA
4. LI_{FFA} **decreases** the face processing influence on the right FFA.

Conclusion

The study aimed to understand how lateralization manifests itself in the dynamic of a brain network. We discovered that the inter-individual lateralization differences of the FFA impact the FFA self-inhibitions of the face processing network. The more positive the lateralization (more left-lateralized), the less self-inhibition on the left hemisphere and more self-inhibition on the right hemisphere
Thus, **lateralization seems to manifest itself in the regional regulation and not in inter-regional connectivity as we previously assumed**.

References

[1] Thome, I., Alanis, J. C. G., Volk, J., Vogelbacher, C., Steinsträter, O., & Jansen, A. (2022). Let's face it: The lateralization of the face perception network as measured with fMRI is not clearly right dominant. *NeuroImage*, *263*, 119587.

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