A BILATERAL MODEL OF CONGENITAL PROSOPAGNOSIA – CONNECTIVITY BETWEEN FFA & ATL

LABORATORY for MULTIMODAL NEUROIMAGING

***Kessler R [1,2], *Albert I Gracenea P [1,2], *Zimmermann KM [1,2], Schmidt K[1] & Jansen A [1,2,3]**

1 Laboratory for Multimodal Neuroimaging, Department of Psychiatry and Psychotherapy, University of Marburg, Marburg, Germany
2 CMBB Center for Mind, Brain, and Behavior, University of Marburg & University of Giessen, Germany
3 Core-Unit Brainimaging, Department for Psychiatry, University of Marburg, Marburg, Germany
** equal contribution*

Philipps Universität Marburg

WHAT IS PROSOPAGNOSIA?

Face perception is an important human ability that uses large parts of cortical resources.
Prosopagnosia is a condition, in which face perception is affected ("face blindness").
We differentiate between:

- **Acquired prosopagnosia,**
  - an acquired cerebral damage in regions related to face perception or recognition of identities
- **Congenital/developmental prosopagnosia**,
  - heterogeneous disabilities of (mainly) identity recognitions with no macroscopic changes in cerebral structure

The nature of Congenital prosopagnosia

- **Pathological view**
  - congenital prosopagnostics form an own sub-population with a pathologic development of face perception
- **Normative view**
  - congenital prosopagnostics are "just extremely bad" in face recognition, therefore on the lower extreme of a normal distribution

We work with **the normative view of congenital prosopagnosia**. Our aim is to assess bilateral connectivity in two nodes of the face perception network – the Fusiform Face Area (FFA) and the Anterior Temporal Face Area (ATL). Previous studies have shown reduced ATL activation in congenital prosopagnostics. We assume it comes from disrupted forward-connectivity from FFA. To test this hypothesis, we examined a group of healthy subjects.

CAMBRIDGE FACE MEMORY TEST

Carrow, Dalrymple & Barton (2016), Duchaine & Nakayama (2006)

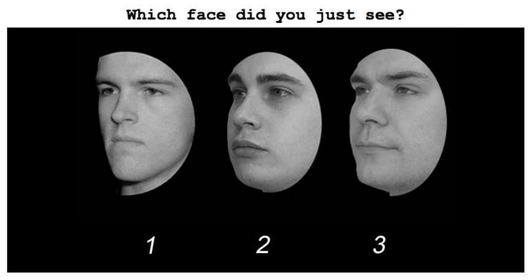
To determine the individual face recognition ability.

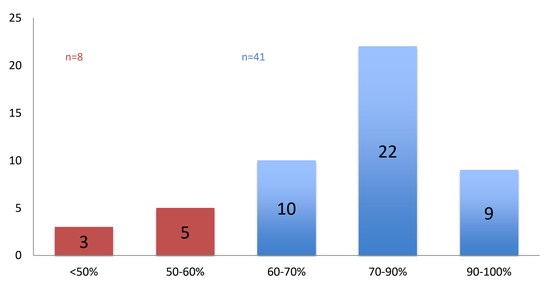
Method:

- encoding of 6 individuals
- retrieval in a series of new faces
- repeat encoding and retrieval with variying illuminations of faces
- repeat encoding and retrieval with noisy images
- threshold : <58% accuracy
  → congenital prosopagnosia

Result:

- 8 prosopagnostics
- 41 non-prosopagnostics

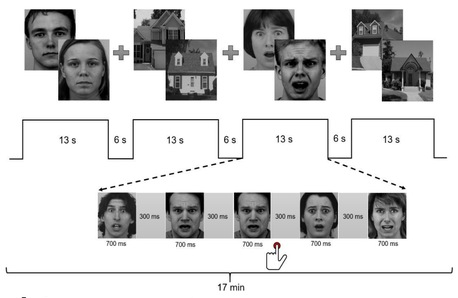




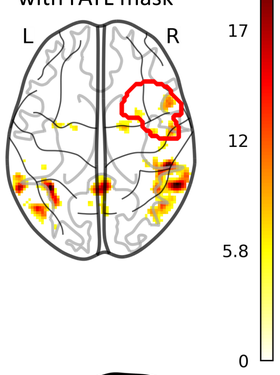
NEURAL FACE LOCALIZER

Zimmermann, Schmidt et al.(2018)

- presenting faces & houses in block conditions
- 1-back task

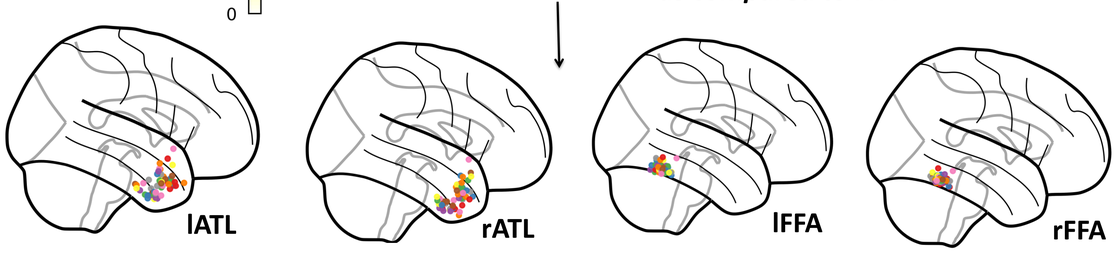


example subject with rATL mask



- faces > houses t-contrast →face perception areas
  - **FFA: core area for holistic face perception**
  - **ATL: face identity recognition**
- define mask for all regions, and find maximally activated voxel inside each mask (i.e. rATL, lATL, rFFA, lFFA) in each subject
- extract time series of areas for connectivity analyses

but: high inter-individual difference in localization of ATL as compared to FFA



HYPOTHESIS:

CONGENITAL PROSOPAGNOSIA IS ASSOCIATED WITH FFA/ATL DYSCONNECTIVITY

DYNAMIC CAUSAL MODELING (DCM) & PARAMETRIC EMPIRICAL BAYES (PEB)

Friston et al. (2004), Friston et al., (2013)

Connectivity model with bihemispheric FFA and ATL

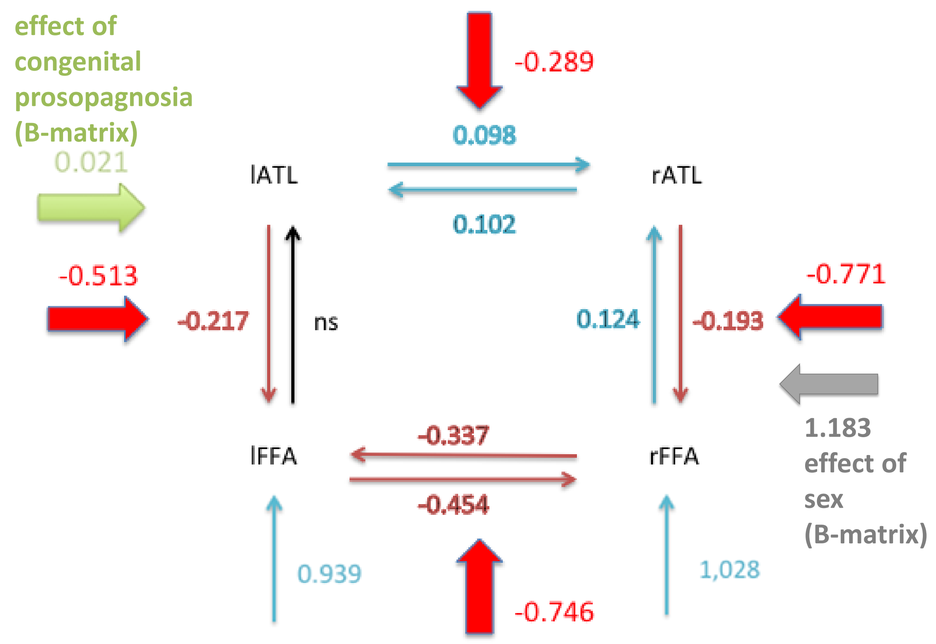
- input „faces" into bilateral FFA
- reciprocal connections between FFA and ATL, modulated by „faces"
- interhemispheric connections, modulated by „faces"

We use a PEB model to evaluate the effects of „faces" and covariates such as „prosopagnosia" (100 - CFMT), age and sex.

A MODEL OF FFA/ATL EFFECTIVE CONNECTIVITY

intrinsic (A-Matrix) connectivity and driving input (C-matrix)

„effect of faces" (B-matrix) on connectivity



- Only ‚significant' effects displayed (posterior probability > 0.95)
- positive , symmetrical input of faces into the system (C-Matrix)
- faces strengthen the backwards inhibitory influence from ATL to FFA (bilateral)
- faces increase interhemispheric inhibition on level of FFA

- congenital prosopagnosia (= bad face recognition) slightly weakens left ATL to FFA inhibition of face processing (weak effect)
- but: sex has a very strong effect on the very same connection on the right side (factor 500 times stronger)

- **Because of its weak effect size (compared to the effect of sex), we do not conclude an effect of congenital prosopagnosia on FFA/ATL effective connectivity !**

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DGBP Deutsche Gesellschaft für Biologische Psychiatrie e.V.

AGNP Arbeitsgemeinschaft für Neuropsychopharmakologie und Pharmakopsychiatrie

Correspondence:
Roman Kessler
Laboratory for Multimodal Neuroimaging
kessler5@staff.uni-marburg.de

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sea-eye

space eye

SCAN ME