A bilateral model of congenital prosopagnosia – connectivity between FFA and ATL

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Abstract Submission

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Introduction:

Prosopagnosia is a condition, in which face perception or recognition is affected (i.e. face blindness). We differentiate between acquired prosopagnosia – caused by a lesion in a cerebral region related to face perception (e.g. OFA, FFA, ATL) – and congenital prosopagnosia (CP) – a heterogeneous disability affecting primarily identity recognition with no macroscopic structural lesions. There are two different opinions about the nature of CP: The pathological view sees clear differences between CPs and healthy subjects, whereas the normative view sees them as "just extremely bad" in the ability of face recognition. Consequently, CP individuals' face recognition abilities are supposed to reflect the lower tail of a normal-like distribution. In the following, we work with the normative view of CP.
We whether alterations of connectivity between face regions are associated with CP. Recent studies (Avidan et al., 2014) have shown reduced brain activation in anterior temporal lobe face area (ATL) in CP. As part of the extended face perception system (Haxby et al., 2000), ATL is situated downstream to the core system, e.g. the fusiform face area (FFA). The reduced activation of ATL in CP may be associated with disrupted connectivity between those regions. We hypothesized, that a reduction of ATL activation in CP and subjects with low CFMT scores result from a lack of face specific information transfer from FFA to ATL.

Methods:

We recruited 49 subjects. Face recognition ability was quantified using Cambridge Face Memory Test (CFMT, Corrow et al., 2016). Participants with less than 58% accuracy were classified as CPs (8 out of 49 subjects). Each of the 49 subjects then underwent a face localizer paradigm (blocks of faces and houses). We identified bilateral FFA & ATL on a single-subject level and constructed a 4-node dynamic causal model (DCM, Friston et al., 2003) for each subject. Regressor faces entered the model via bilateral FFA. Each FFA and ATL shared structurally reciprocal connections and interhemispheric reciprocal connections between homotopic brain regions. Furthermore, faces modulated all available structural connections.
To estimate a group model, we used Parametric Empirical Bayes (PEB, Friston et al., 2013). We included each subjects model, and inter-subjects effects such as [1 - CFMT score] (as a proxy for prosopagnosia), gender and age.

Results:

Context-independent connection (A-matrix) became mostly positive in forward direction (FFA to ATL) and negative in backward direction (ATL to FFA), reciprocally positive between ATLs, and reciprocally negative between FFAs. Face perception excited the system symmetrically via bilateral FFA (C-matrix). Furthermore, face perception increased the negative (inhibitory) connections from lFFA to rFFA, rATL to rFFA, lATL to lFFA, and flipped the sign at the connection from lATL to rATL to negative.
PEB revealed just one significant effect of CP onto the model. That was, the inhibitory – face specific - backward connection from lATL to lFFA was slightly weakened by CP (parameter estimate of +0.021). In contrast, gender had a very strong effect on the homologue connection on the right hemisphere, but with an effect of 50 times larger (parameter estimate of +1.18).

Conclusions:

We saw a weak effect of CP on our bilateral model of face perception. However, this effect was factor 50 smaller than the effect of gender onto the homologue connection of the right hemisphere. Therefore we did not find support for our hypothesis, that CP or the individual ability of face recognition is associated with alterations in connectivity between FFA and ATL.
However, our study has limitations: We recruited unobtrusive subjects of which only around 20% were CP. Diagnoses of DP should also be supported by further tests. Additionally, individual ATLs were difficult to localize and show high inter-subject variability.

Modeling and Analysis Methods:

fMRI Connectivity and Network Modeling [2]

Perception, Attention and Motor Behavior:

Perception: Visual [1]

Keywords:

FUNCTIONAL MRI
Vision
Other - Congenital Prosopagnosia, Face Perception

[1|2]Indicates the priority used for review

My abstract is being submitted as a Software Demonstration.

No

Please indicate below if your study was a "resting state" or "task-activation" study.

Task-activation

Healthy subjects only or patients (note that patient studies may also involve healthy subjects):

Healthy subjects

Was any human subjects research approved by the relevant Institutional Review Board or ethics panel? NOTE: Any

human subjects studies without IRB approval will be automatically rejected.

Not applicable

Was any animal research approved by the relevant IACUC or other animal research panel? NOTE: Any animal studies without IACUC approval will be automatically rejected.

Not applicable

Please indicate which methods were used in your research:

Functional MRI
Neuropsychological testing
Computational modeling

For human MRI, what field strength scanner do you use?

3.0T

Which processing packages did you use for your study?

SPM

Provide references using author date format

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