Adults vs. neonates: Differentiation of functional connectivity between amygdala subnuclei and occipitotemporal cortex

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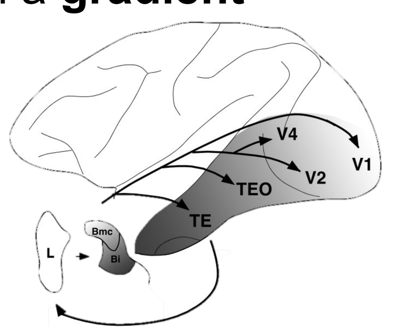
BACKGROUND

- Adult Macaques: lateral and basal amygdala subnuclei connect to occipitotemporal cortex on a **gradient** [1,2]
- Infant Macaques: connections with **posterior visual areas undergo refinement**[2]



- Humans: basolateral amygdala connectivity and visual cortex organization starts **adult-like but refines with age** (e.g., decreasing occipital projections)[3,4,5]

RESEARCH QUESTIONS

- Is connectivity between the basolateral amygdala and occipitotemporal cortex **topographically organized** in **humans**?
- Does the connectivity differ across **development**?
- What **functional regions** might be driving the developmental change in connectivity?

METHODS

Samples:

40 Adults from the Human Connectome Project (HCP)[6]

40 Neonates (mean GA = 39 weeks) from the Developing Human Connectome Project (dHCP)[7]

** Samples motion- and sex-matched*

Amygdala: Parcellated the **basolateral (BALA)** amygdala [lateral (LA) + basal (BA) subnuclei] in each individual's native space using automated segmentation[8]

Occipitotemporal cortex (OTC) regions:

Anatomical Analysis: Combined all anatomical regions in the occipital and temporal cortices. **Split OTC into 5 equal sections** in native space.

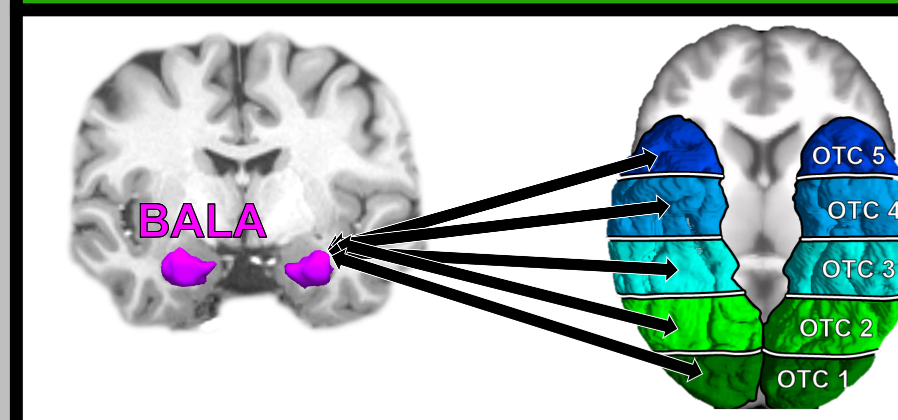
Adults: HCP-provided freesurfer aparc+aseg.nii.gz

Neonates: dHCP-provided drawem_all_labels.nii.gz

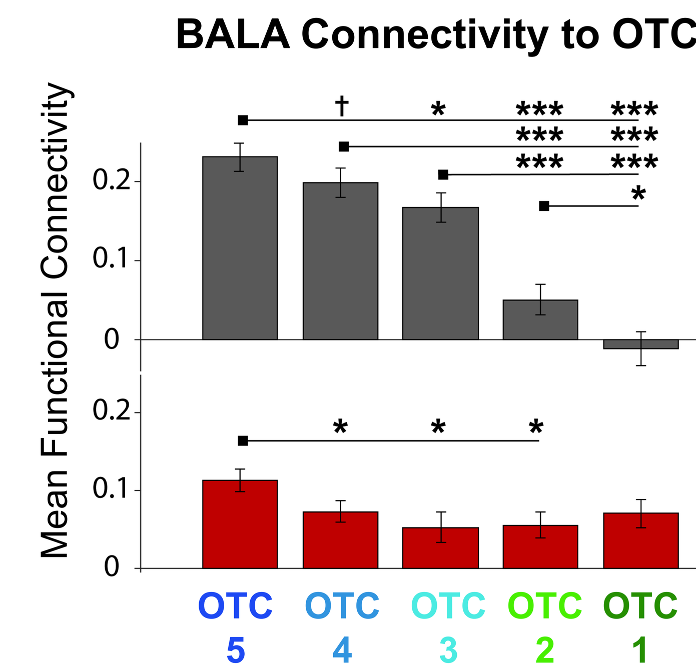
Functional Analysis: Used functional parcels[9] within each of the OTC sections associated with higher-level visual processing **(e.g., faces, scenes, and objects)** and lower-level sensory processing **(e.g., A1, V1),** anatomically defined. Overlaid parcels from CVS_avg35_inMNI152 onto each subject using ANTS[10].

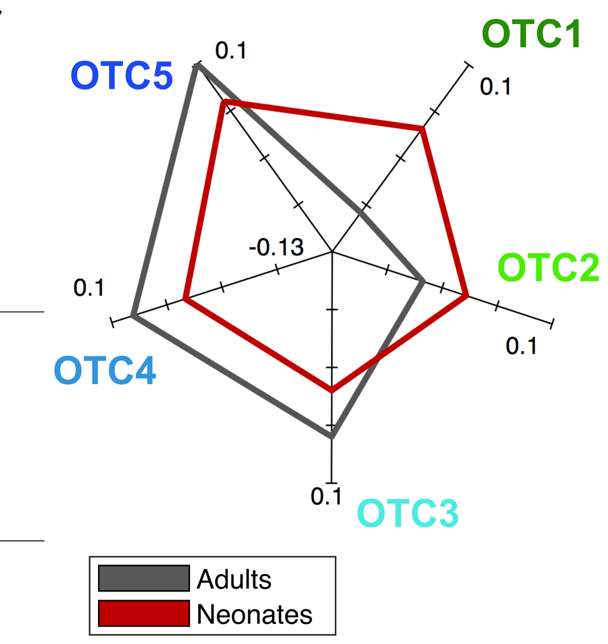
Calculated functional connectivity (FC) between basolateral amygdala and each OTC target region.

ANATOMICAL ANALYSIS

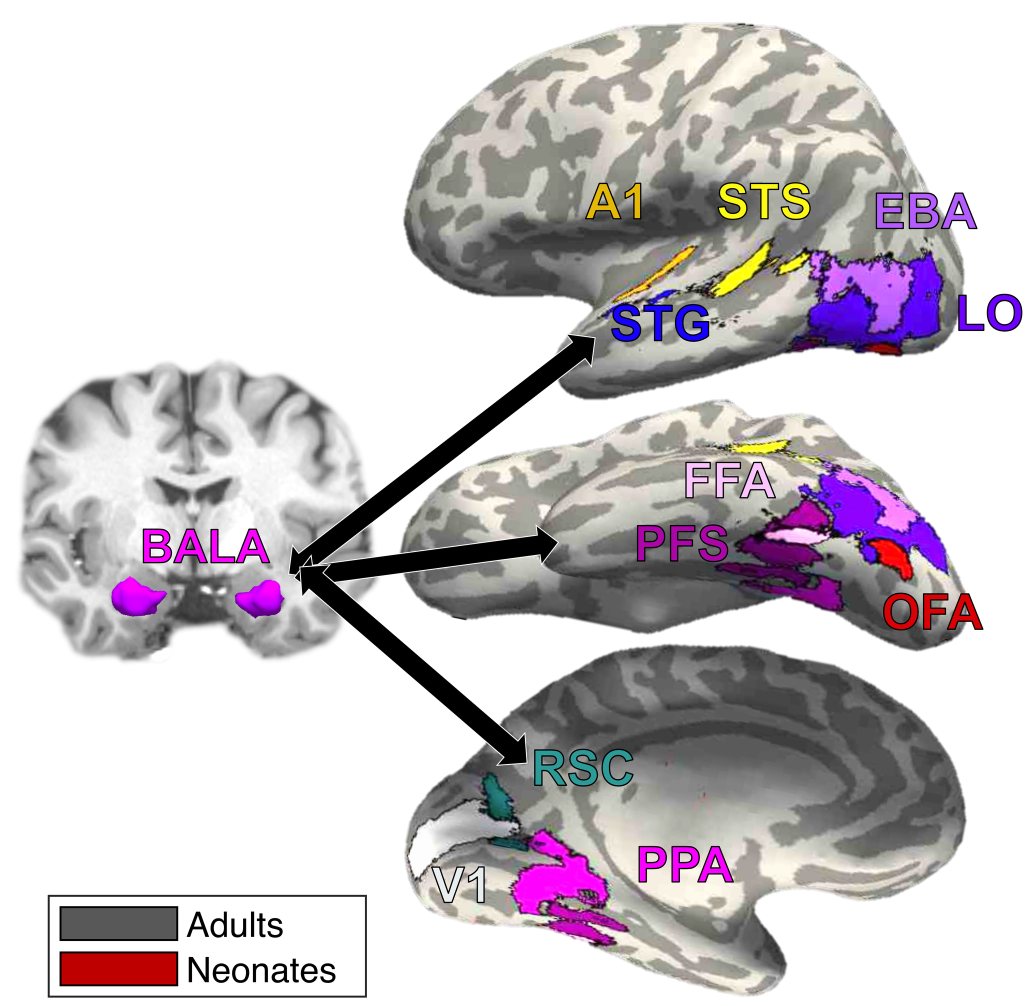


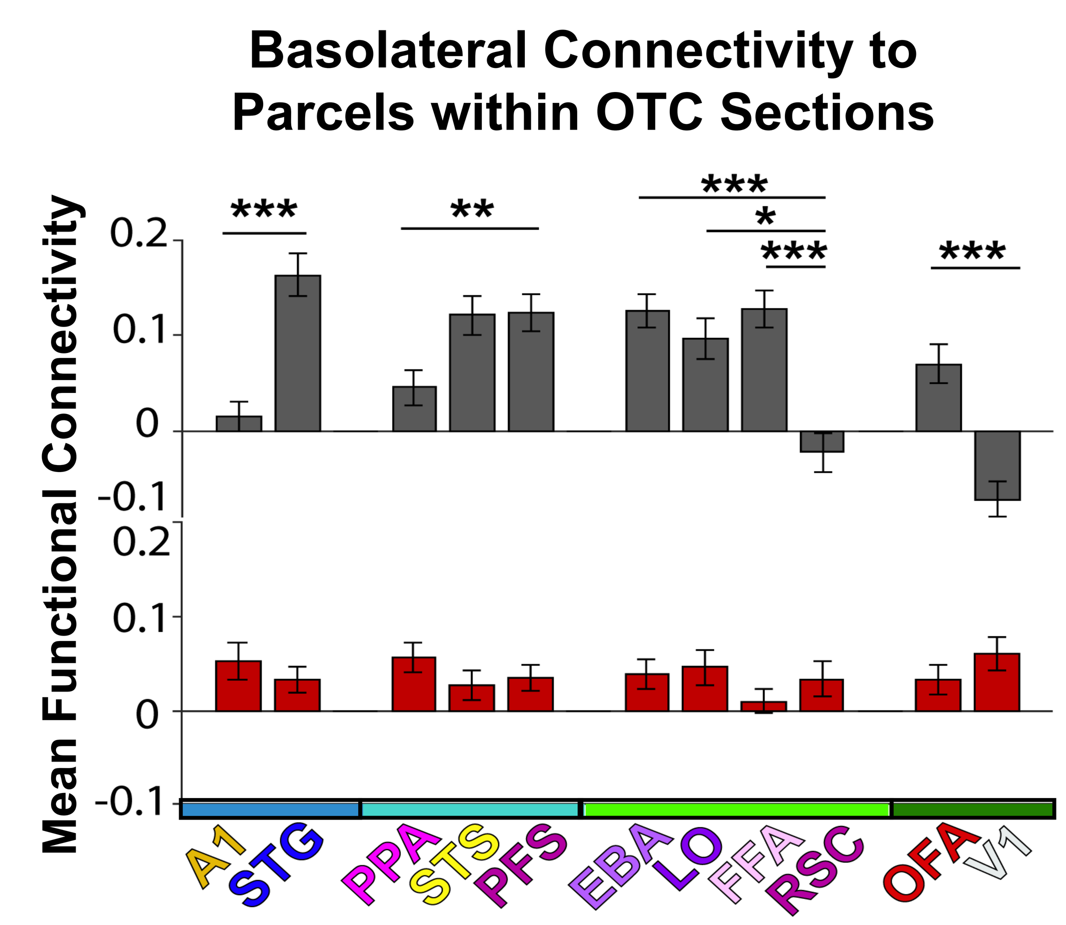
Adults show topographic organization on a gradient, neonates do not





FUNCTIONAL ANALYSIS

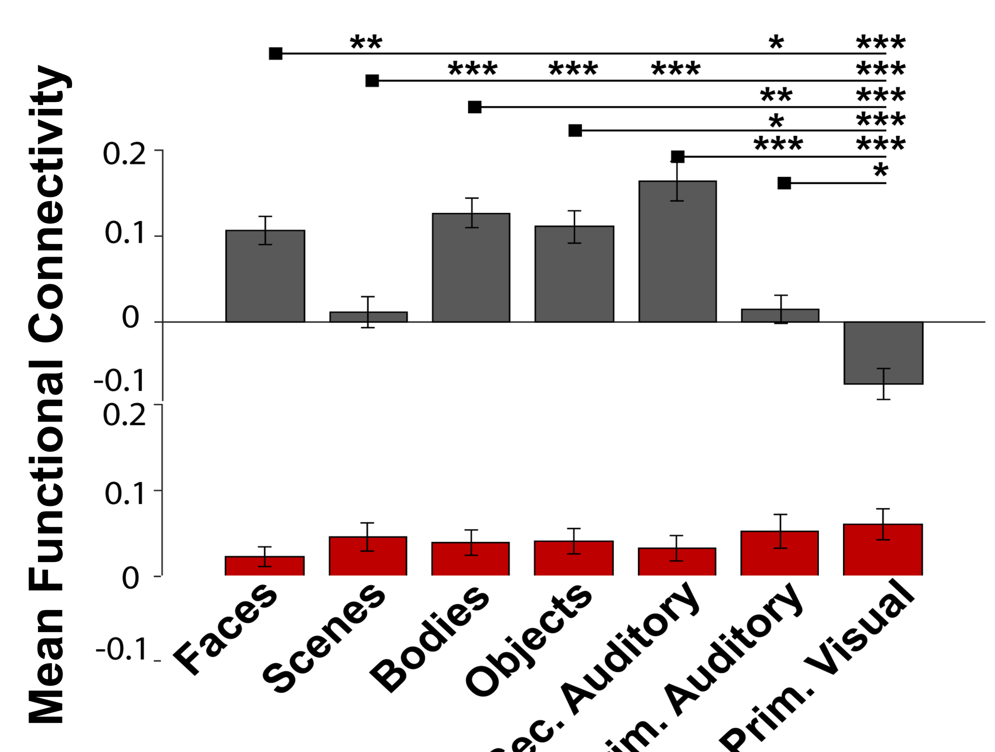


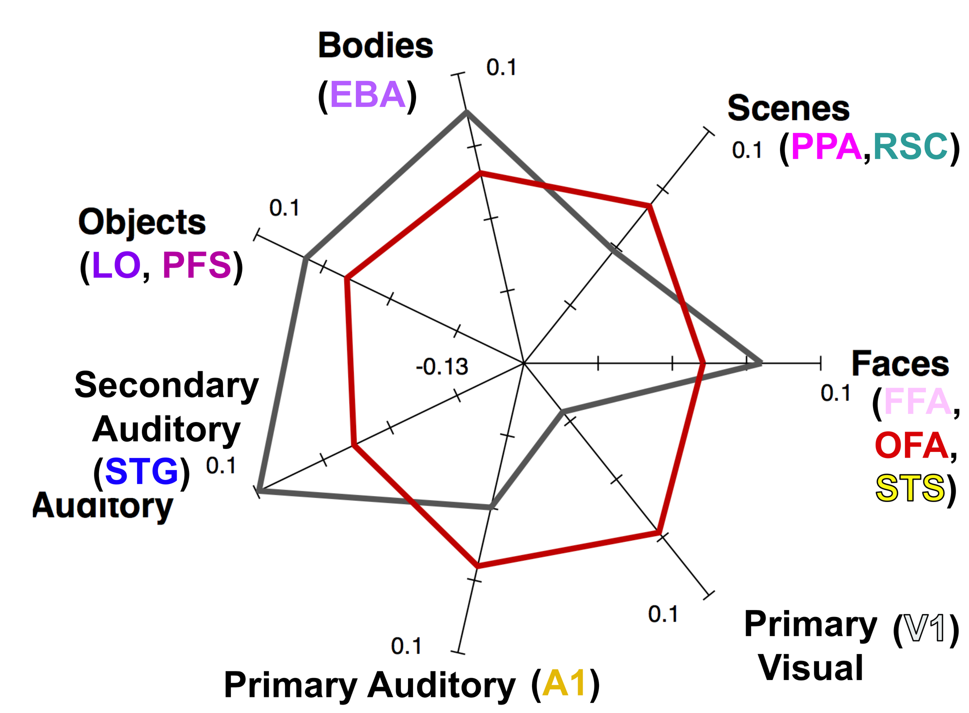


†p<0.06, *p<0.05, **p<0.01, ***p<0.001

(All p-values Holm-Bonferroni corrected)

Basolateral Connectivity to Functional Categories





Adults show functionally-specific connections, neonates are undifferentiated

CONCLUSIONS

Anatomical:

- **Adults**: connectivity between the basolateral amygdala and OTC **decreases on a gradient from anterior to posterior,** like macaques
- **Neonates**: no such gradient exists
- **Adults** vs. **Neonates**: connectivity is significantly different in **all sections but OTC2**

Functional:

- **Adults**: **stronger connections to higher level functional regions** (i.e., face, body, object processing), and **weaker connections to primary sensory regions** (i.e., A1, V1)
- **Neonates: similar connectivity** to all sensory regions
- **Adults** vs. **Neonates**: connectivity is significantly different in **STG, STS, PFS, EBA, FFA, and V1**, and in **all categories but scenes and primary auditory**

Overall, FC between amygdala and OTC is largely undifferentiated at birth, possibly facilitating experience-dependent cortex specialization.

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