



Assessing Visual Category Representations in Infant Visual Cortex using fMRI

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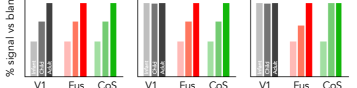


Introduction

- Prior studies in children suggest V1 is mature by childhood [1,2,3], place selective regions are mature by adolescence, and face selective regions continue to develop into adolescence [4,5,6]
- Infant fMRI studies found place and face selective regions in infants aged 2-to-9 months [7,8]. However, infant EEG studies found that face selectivity precedes place selectivity and is detected in 4-to-6-month-olds [9]
- It is unknown how either primary or high-level visual areas develop across the early lifespan

Using fMRI in infants, children, and adults, we ask:
What is the developmental trajectory of V1, face, and place selective regions from infancy to childhood to adulthood?

H1: Similar across regions **H2:** V1 matures earlier **H3:** Each region has its own developmental timeline



Methods

fMRI (T1/T2w) & fMRI sessions

- 7 infants (ages: 121 days-203 days); with infant coil
- 27 children (ages: 5-12 years), with adult coil
- 26 adults (ages: 22-28 years), with adult coil

fMRI:

- Subjects viewed faces, bodies, objects, and scenes presented in blocks that alternated with a blank image
- 5 infants viewed static grayscale and 7 viewed dynamic colorful stimuli (16s blocks, 8s baseline)
- Children and adults viewed static grayscale stimuli (8s blocks)

Stills from colorful video stimuli [1]



Example grayscale images



Generating cortical surface reconstructions:

- Infants: automated segmentation using BIBSnet and cortical reconstruction using infant FreeSurfer
- Children and adults: cortical reconstruction using FreeSurfer

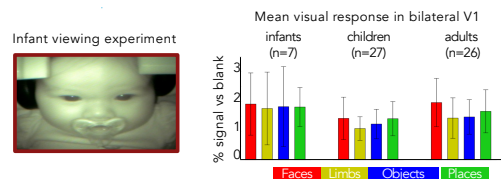
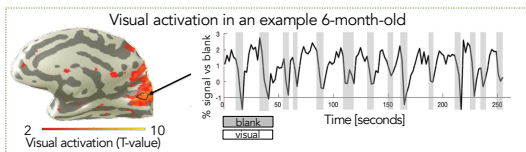
Quality Assurance:

- Exclude TRs/runs with motion > 2 voxels
- Equalize data duration across age groups (~5mins/participant)
- Test visual activation in V1 by comparing responses to all visual stimuli vs blank
- Used infant HRF [10] for infant subjects

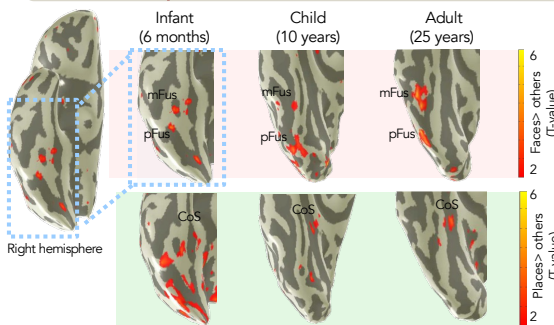
Analyses

- Identify category-selective voxels by comparing responses to one category vs all others (e.g., faces > other categories)
- Test if category voxels exist in expected anatomical locations
- Test development by comparing responses across age groups in category-selective ROIs defined in 2 different ways
 - 4mm disk centered at ROI (constant size)
 - ROIs from an adult atlas - anatomically consistent ROIs at the probabilistic location that will ultimately become adult face- or place-selective

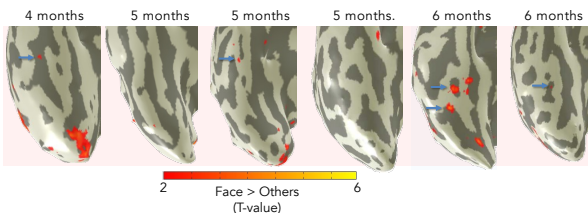
V1 activations are similar across infants, children, and adults



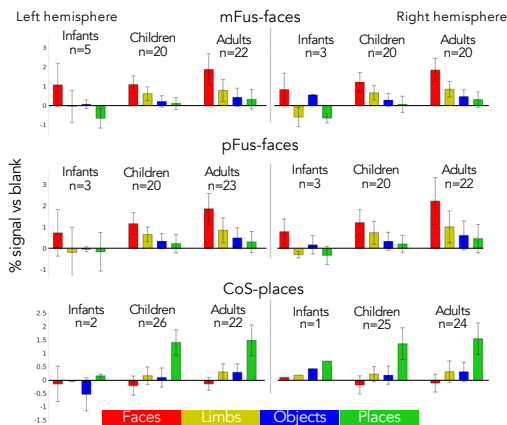
Face- and place-selective activations in expected anatomical locations



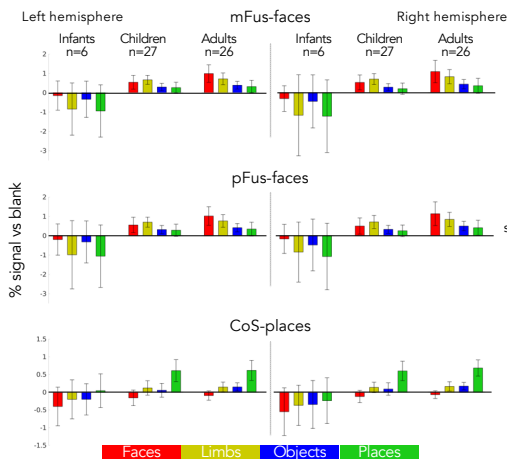
Face activation is variable in infancy



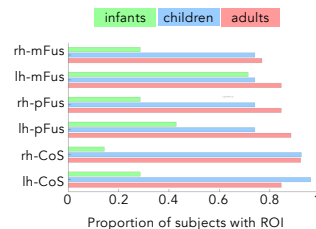
Face-selective regions have more prolonged development than place-selective regions



Infants have immature responses in adult probabilistic face and place selective regions



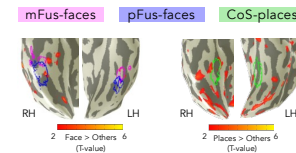
Face- and place-selective ROIs are less prevalent in infants



Conclusions

- V1 is more mature in infancy than face and place selective regions, which have an overall lower magnitude of responses
- In 4-to-6-month-olds, we can identify face regions more often than place regions, suggesting that they may emerge earlier, consistent with prior EEG results
- Place regions seem to be developing between infancy and childhood, and seem stable from childhood to adulthood
- Face regions are developing between infancy and childhood, and from childhood to adulthood, suggesting that they have a more prolonged development

Probabilistic adult ROIs in expected anatomical locations in infant



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