

# Longitudinal associations between negative parenting during early childhood and hippocampal resting-state networks three years later

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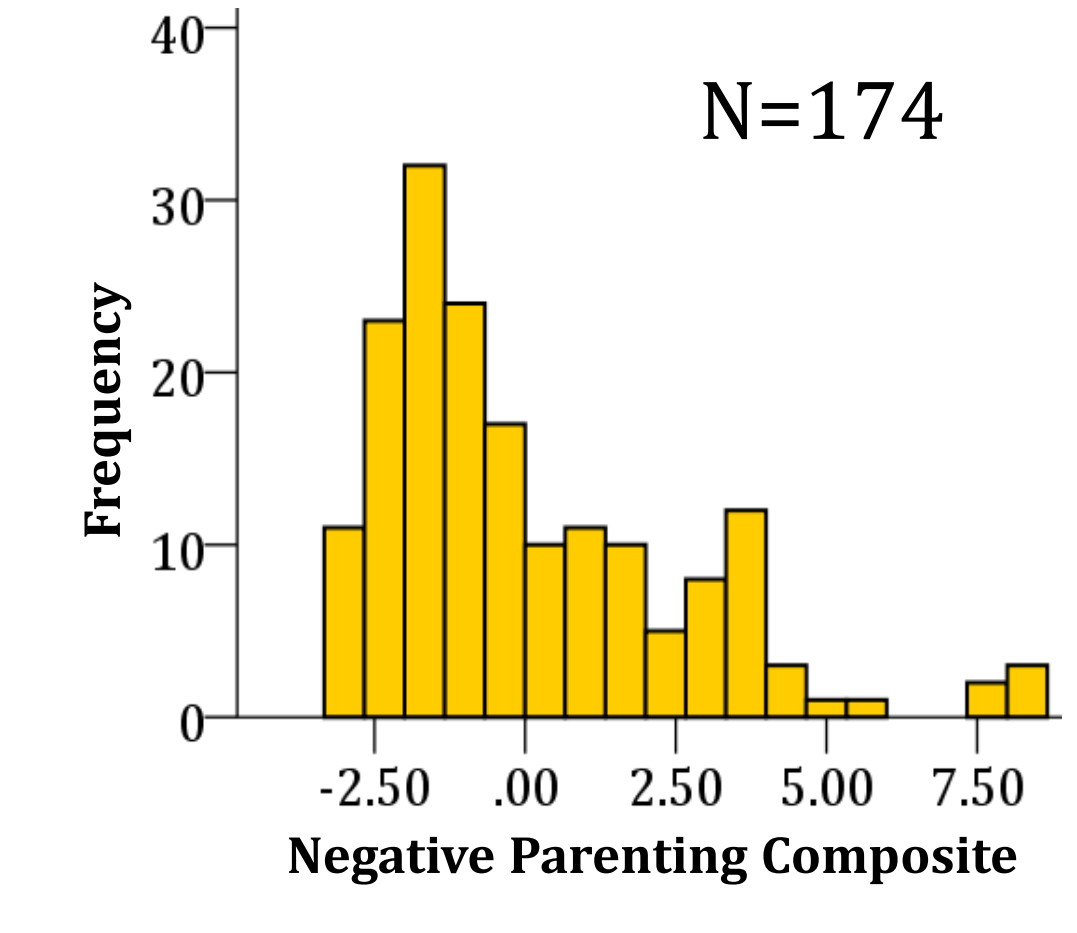
## Introduction

- Extreme negative parenting (i.e., maltreatment) during childhood has been associated with a wide range of cognitive, emotional, and neural deficits (for review, see Belsky & de Haan, 2011)
  - The hippocampus, a medial temporal lobe structure implicated in a number of cognitive processes such as memory and spatial navigation, is particularly sensitive to the effects of stress
- Little is known about how normative early life stressors, such as negative parenting, may influence hippocampal development
  - To date, two studies have provided evidence for early associations between normative levels of parenting and later hippocampal volume (Luby et al., 2012; Rao et al., 2010)
- Together, these studies provide evidence of an association between hippocampal structure and normative parenting behaviors, but importantly, no studies have investigated the relation between early negative parenting and hippocampal *function*
- Resting-state functional connectivity provides a useful method to examine how negative parenting may affect the functional organization of the brain, in contrast to studying the hippocampus as an isolated entity
- The present study sought to explore this gap in the literature by prospectively comparing negative parenting behaviors measured observationally at 3-5 years with hippocampal resting-state connectivity at 5-8 years

## Methods – Wave 1

- Participants**
- 174 children (85 male) aged 3-5 years ( $M = 49.72 \pm 9.73$  months) participated in the first wave
  - Children were recruited based on their mother's history of Major Depressive Disorder (MDD)
    - No Maternal MDD ( $n=83$ )
    - Maternal MDD ( $n=83$ )

- Behavioral Assessment**
- Children and their parents worked together to complete six episodes (e.g., Book readings, Maze, Blocks) modified from the Teaching Tasks Battery (Egeland et al., 1995)
  - Each episode was coded on a 5-point scale
    - Maternal Intrusiveness, Maternal Hostility, and Maternal Support (reverse-scored) were combined across episodes and converted to z-scores for a composite measure of Negative Parenting



## Methods – Wave 2

- Participants**
- To date, 40 children have completed the Wave 2 Imaging session. 15 participants were excluded from current analyses due to motion in any direction exceeding 2mm. Data from 25 children (13 male) aged 5-8 years ( $M = 7.23 \pm .66$  years) are included here.

**MRI Data Collection**

Functional and anatomical data were collected at the Maryland Neuroimaging Center using a 12-channel coil in a Siemens 3Tesla scanner. Participants watched a video of abstract patterns/shapes during the 6-minute acquisition of functional data.

- Data Processing**
- All functional analyses were conducted using AFNI (Cox, 1996).
  - BOLD signal from white matter and CSF masks and continuous motion regressors from 6 directions (roll, pitch, yaw, x, y, z) were included as noise covariates.
  - Data were band-pass filtered at  $.005 < f < .1$ .
  - Correlation coefficients were computed between bilateral hippocampal regions of interest and the whole brain using the Negative Parenting Composite as a covariate.
  - Hippocampal volumes for each participant were obtained using Freesurfer (Fischl et al, 2002).

## Right Hippocampal Connectivity (n=25)

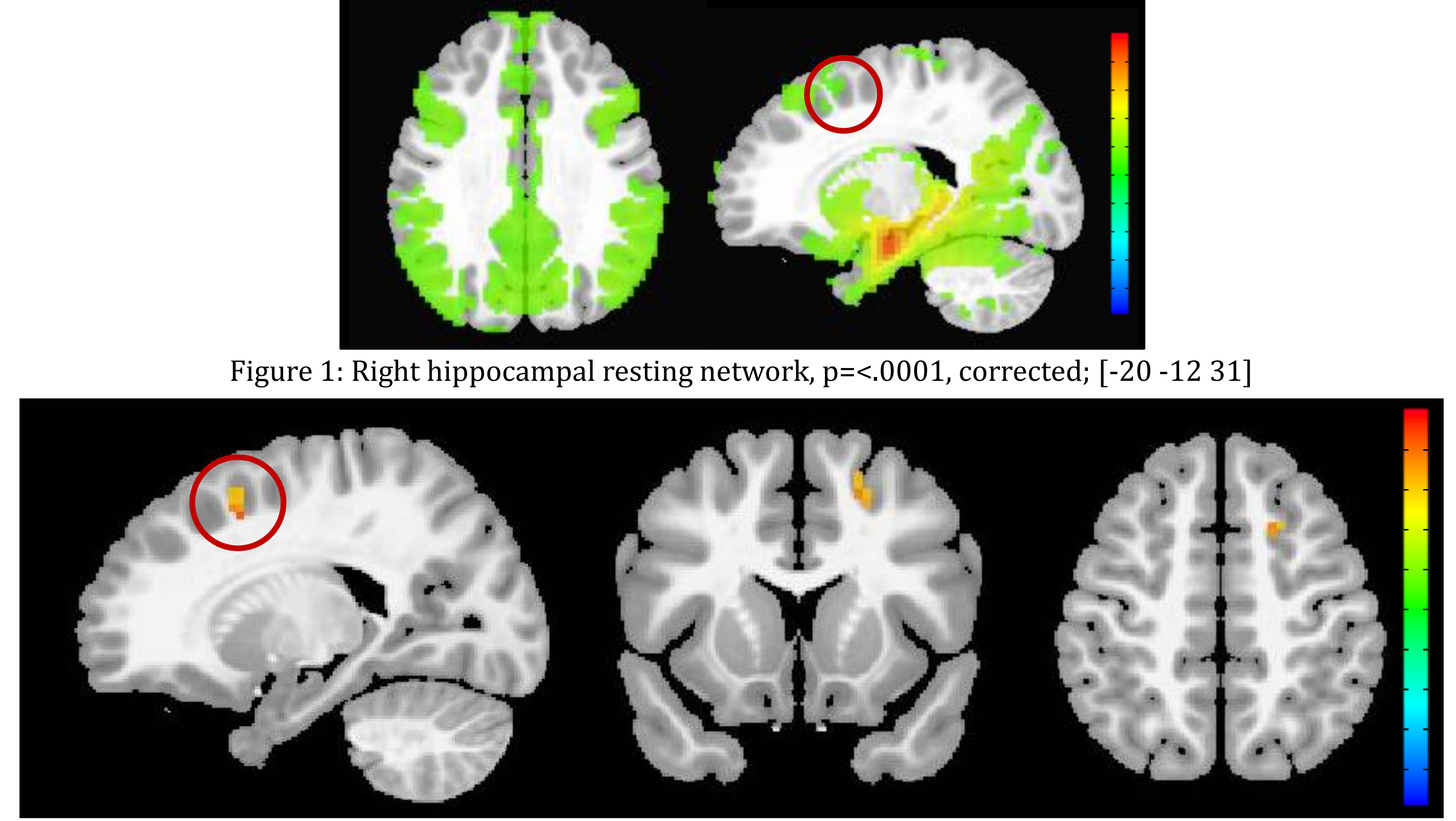


Figure 1: Right hippocampal resting network,  $p < .0001$ , corrected; [-20 -12 31]

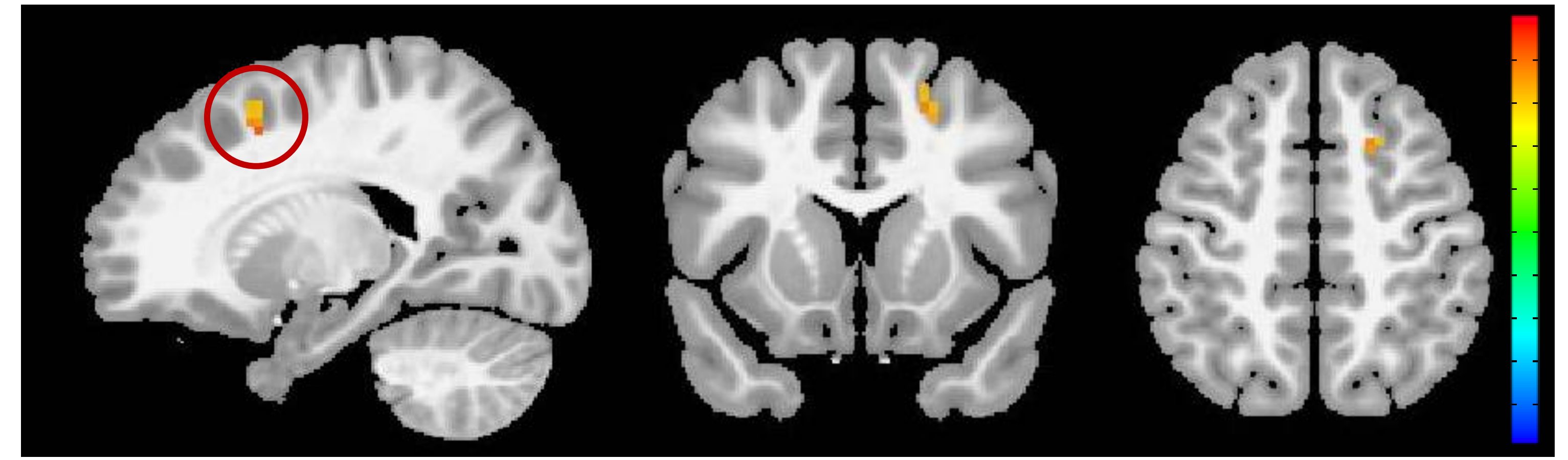
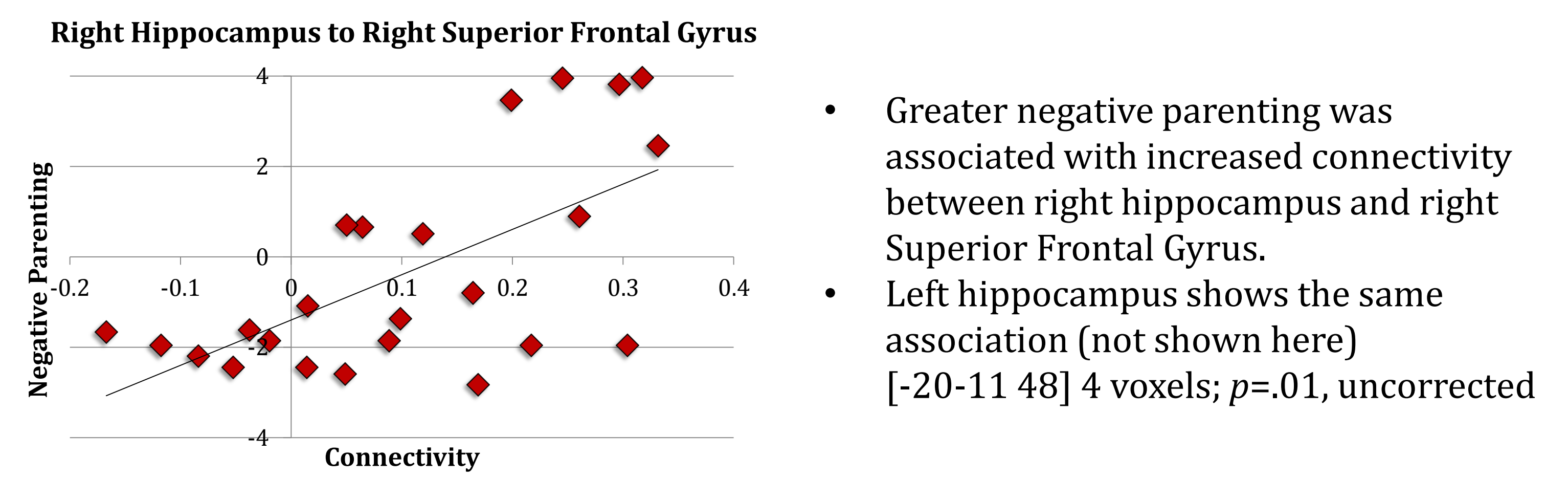


Figure 2: Right hippocampus to Right Superior Frontal Gyrus. [-20 -12 50] 10 voxels;  $p = .01$ , uncorrected



- Greater negative parenting was associated with increased connectivity between right hippocampus and right Superior Frontal Gyrus.
- Left hippocampus shows the same association (not shown here) [-20 -11 48] 4 voxels;  $p = .01$ , uncorrected

## Left Hippocampal Connectivity (n=25)

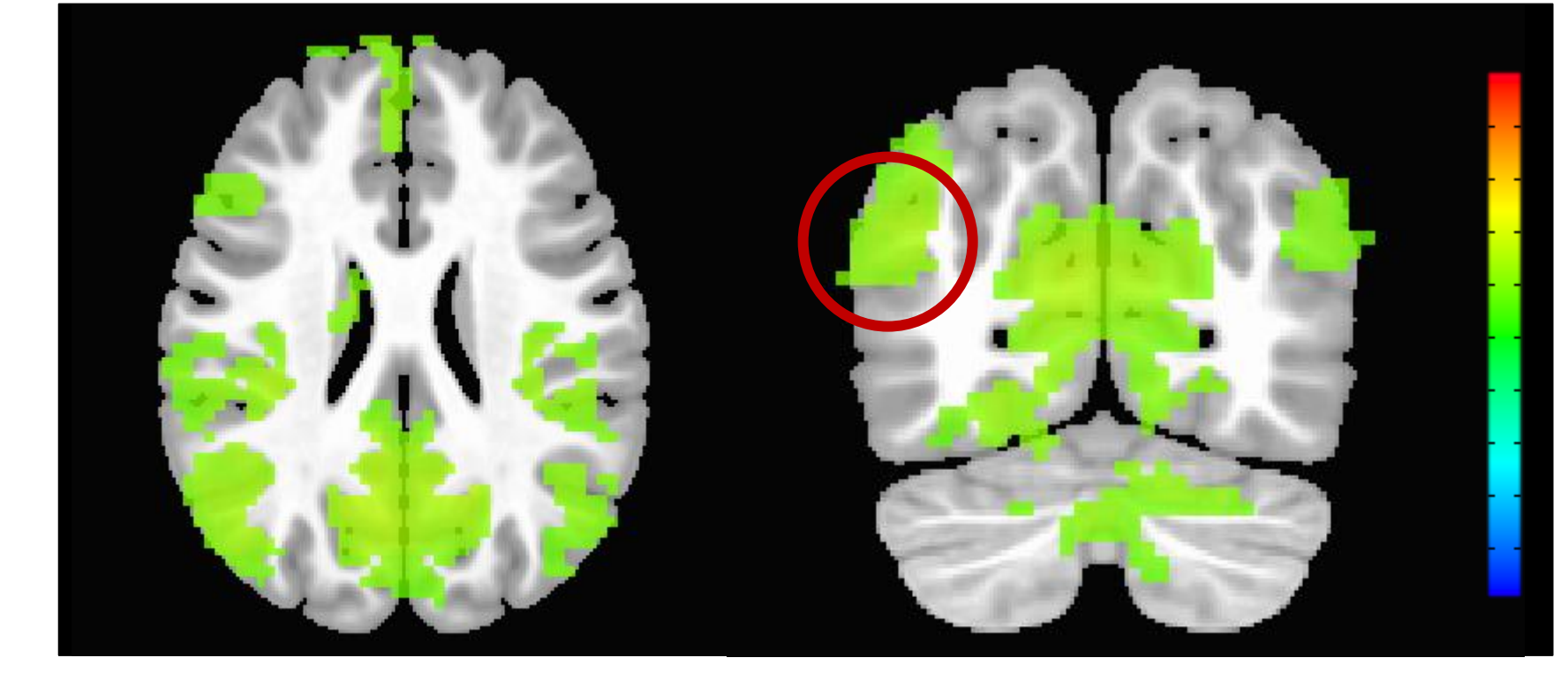


Figure 3: Left hippocampal resting network,  $p < .0001$ , corrected; [50 72 25]

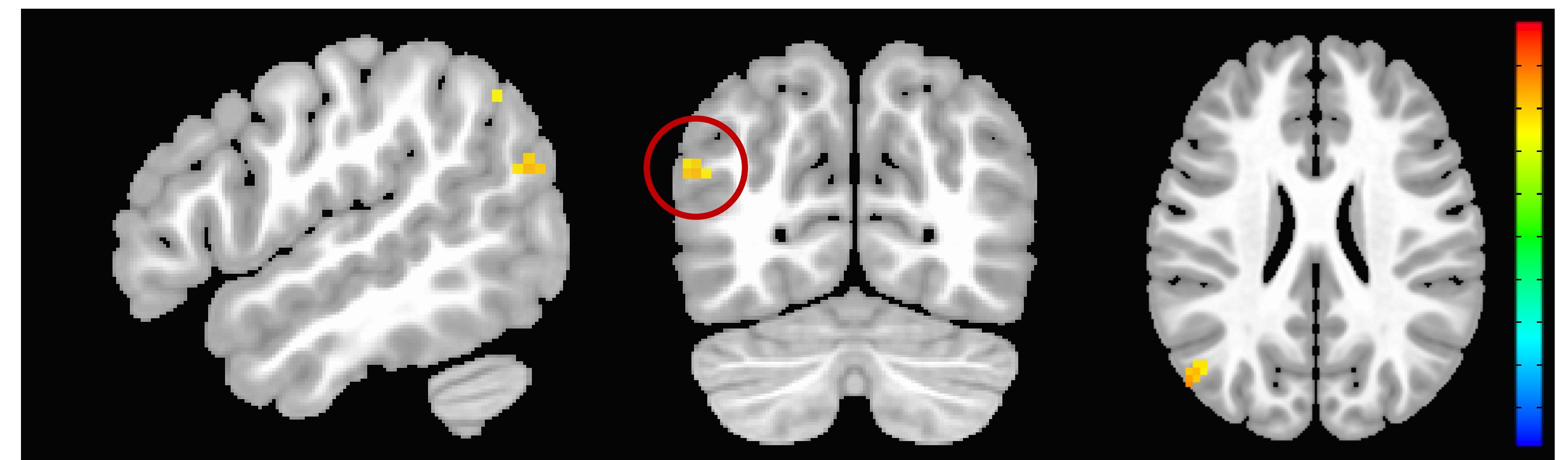
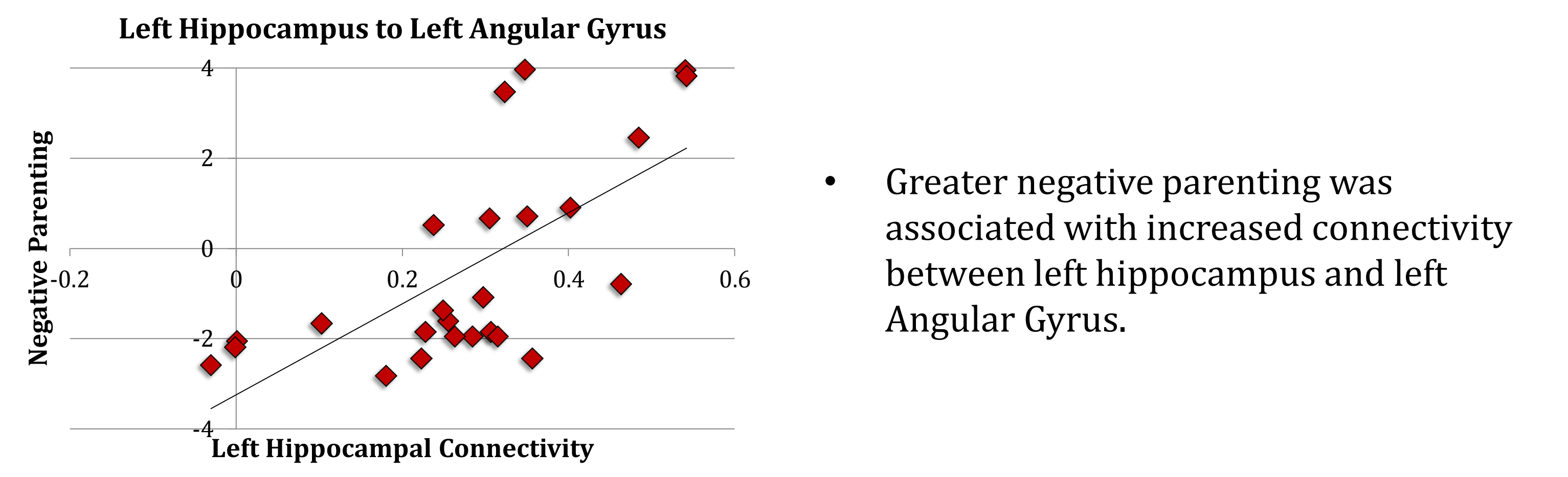
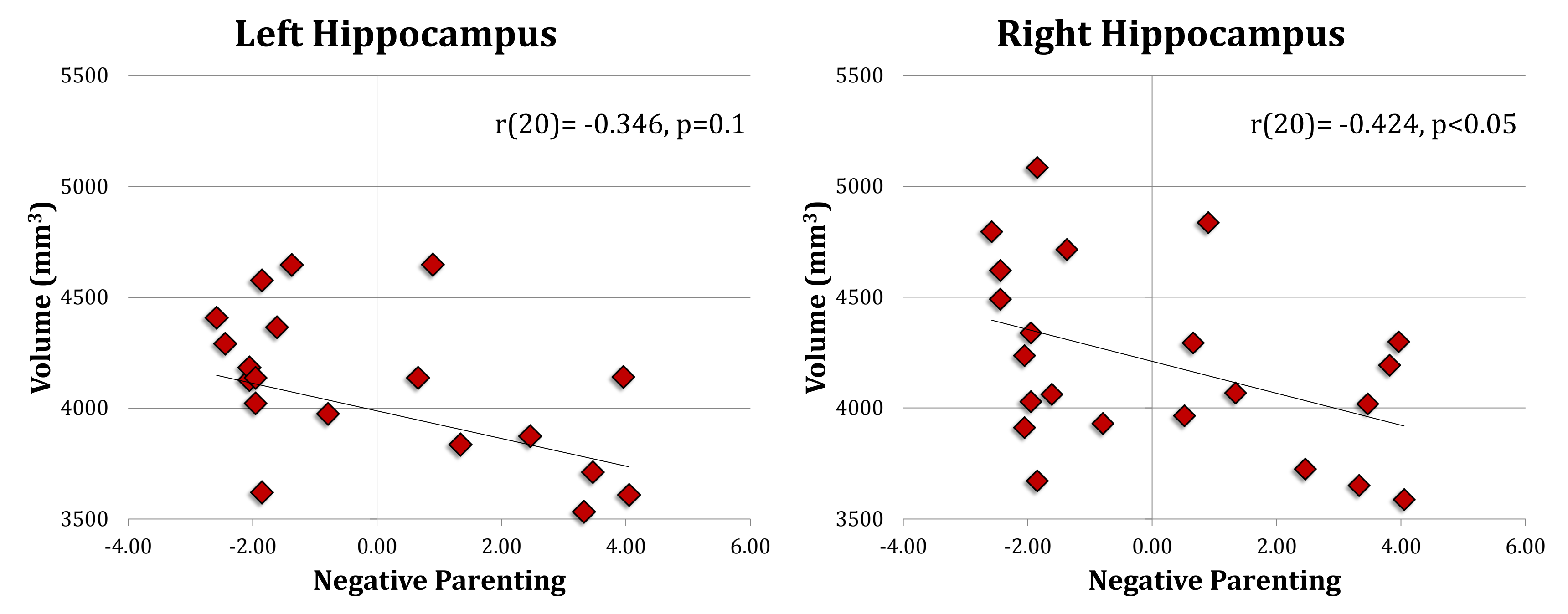


Figure 4: Left hippocampus to Left Angular Gyrus. [50 72 25] 14 voxels;  $p = .01$ , uncorrected



- Greater negative parenting was associated with increased connectivity between left hippocampus and left Angular Gyrus.

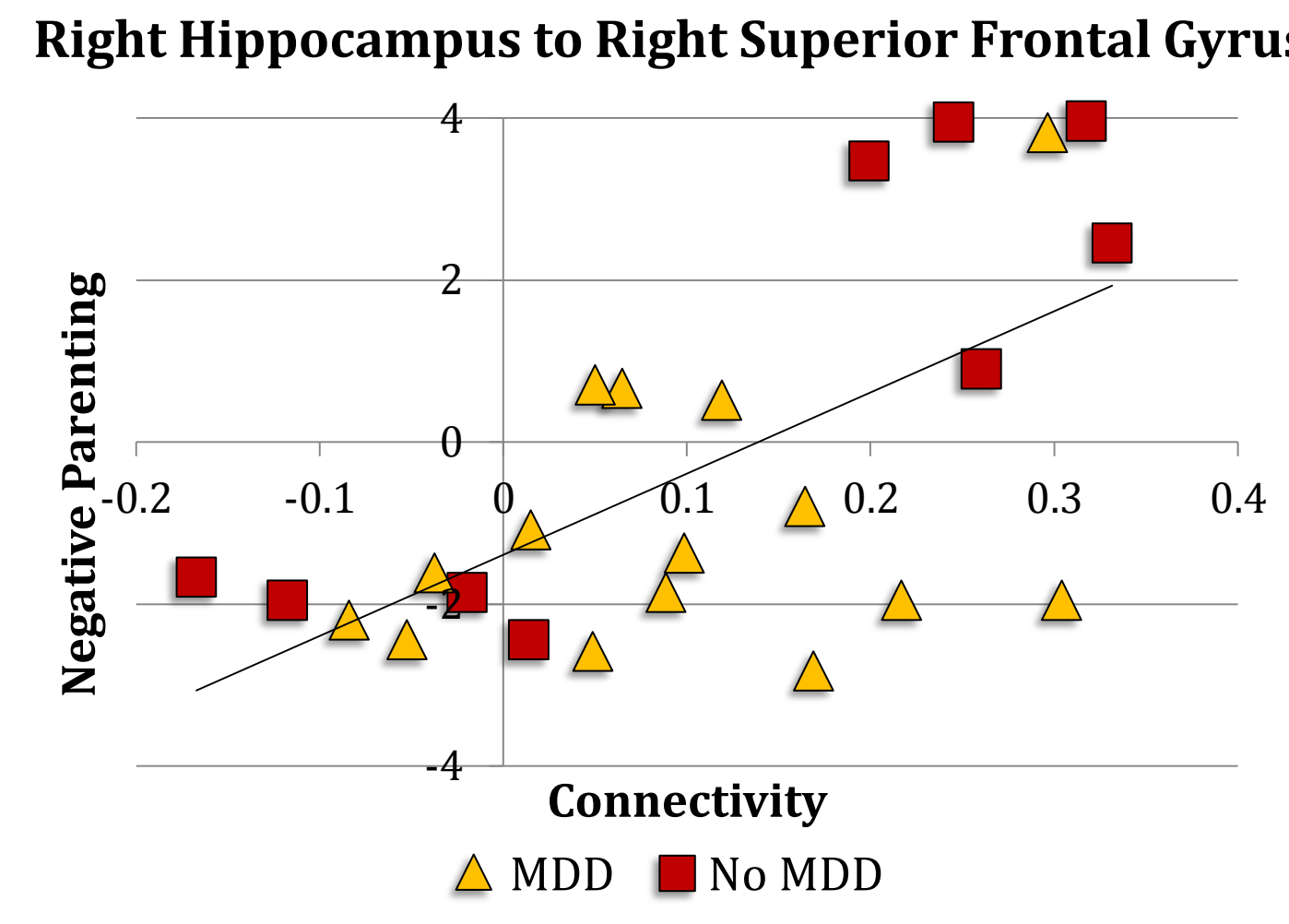
## Volumetric Results (n=22)



- Greater negative parenting in preschool-aged children predicted smaller right hippocampal volume three years later

## Discussion

- This is the first study to provide evidence that early normative levels of negative parenting predicted individual differences in hippocampal functional networks
  - Left and right hippocampal resting networks were differentially associated with negative parenting
  - In the regions presented here, greater negative parenting was associated with increased connectivity
- Greater negative parenting was associated with decreased hippocampal volumes – replicating Luby et al., 2012
- Conclusive interpretations of this data are limited due to our small sample size
- It will be important for future examinations to investigate the behavioral significance of the functional changes associated with parenting behaviors (e.g., memory, emotion regulation, stress reactivity)
- Exploratory analyses suggested that the relation between hippocampal networks and negative parenting may be driven by maternal MDD status
- Future analyses will have the added power of an increased sample and allow the statistical comparison of groups



## Acknowledgements

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