

Introduction

- Early childhood experiences of parental sensitivity and attachment security are critical for healthy development and predict a range of emotional, social, and biological outcomes (Thompson, 2016).
- Research on brain structure and caregiving has shown that the development of the amygdala and hippocampus may be impacted by severe negative parenting (e.g., early deprivation and neglect; Belsky & de Haan, 2011; Nelson et al., 2011).
- Researchers are just beginning to look at the role that normative variation in caregiving experiences may play on the developing brain in both children and adults. However, results have been conflicting thus far (Bernier, Calkins, & Bell, 2016; Moutsiana et al., 2015).
- Building on research examining early attachment with adult brain structure (e.g., Moutsiana et al., 2015), we present exploratory data investigating the relation between attachment security and hippocampal and amygdala volumes in early childhood.

Methods: MRI Data Collection

MRI Data Collection

- One week later, children returned to the lab for an MRI scan.
- T1-weighted high resolution (1mm³) anatomical images were acquired from a Siemens 3T scanner with a 32-channel coil at the Maryland Neuroimaging Center using a standard structural MRI scan sequence (MPRAGE).

Hippocampal, Amygdala, and Whole Brain Volume Extraction

- Freesurfer v5.1 (surfer.nmr.mgh.harvard.edu; Fischl, 2012) was used to derive hippocampal and amygdala volumes.
- Automatic Segmentation Adapter Tool (ASAT, nitrc.org/projects/segadapter; Wang et al., 2011) was used to refine hippocampal volumes.
- Hippocampal subregions were manually identified using standard anatomical landmarks (DeMaster et al., 2012; Riggins et al., 2015).
- Volumes were adjusted for total brain size (Raz et al., 2005). FSL was used to compute Intracranial Volume (ICV) (Smith, 2002).

Discussion

- Results do not provide support for a relation between normative variations in attachment security and hippocampal and amygdala volume.
- Based on our results and the conflicting literature, it is possible that only extreme negative parenting and not normal variation in parenting contributes to differences in brain development.
- Additionally, differences in brain development may not emerge until adolescence when the brain is already undergoing a great deal of change.
- Future studies should also consider the role of other variables, such as age, gender, and SES, when investigating relations between attachment security and brain structure.
- Finally, the lack of relation could be due to the adapted measure that was used. Future research should explore other measures that may be better suited to young children along with behavioral measures of attachment to investigate this relation.

Methods: Behavioral Data Collection

Participants

- 65 children aged 5-8 years ($M = 6.03$, $SD = 1.09$ years, 35 females) completed the study.
- Participants were part of a larger study examining the development of episodic memory in early childhood.

Young Child Security Scale

- Participants completed a modified version of the Security Scale, a self-report questionnaire of children's attachment to their caregiver (Kerns, Klepac, & Cole, 1996).
- Given the young age of our sample, the scale was shortened to 6 items and divided into *behavioral* and *beliefs* subscales. All analyses focus on the *behavioral* subscale.
- Items were read aloud by an experimenter and children responded verbally to each item using a graphic aid.
- Responses were scored on a 4-point scale, with 1 indicating lower security and 4 indicating higher security. A Security Score for each subscale was derived by taking the mean response across the 3 items for each subscale.
- Scores were split dichotomously to create secure (scores ranging from 1.00-2.99) and insecure (scores ranging from 3.00-4.00) attachment groups.

Behavioral Subscale

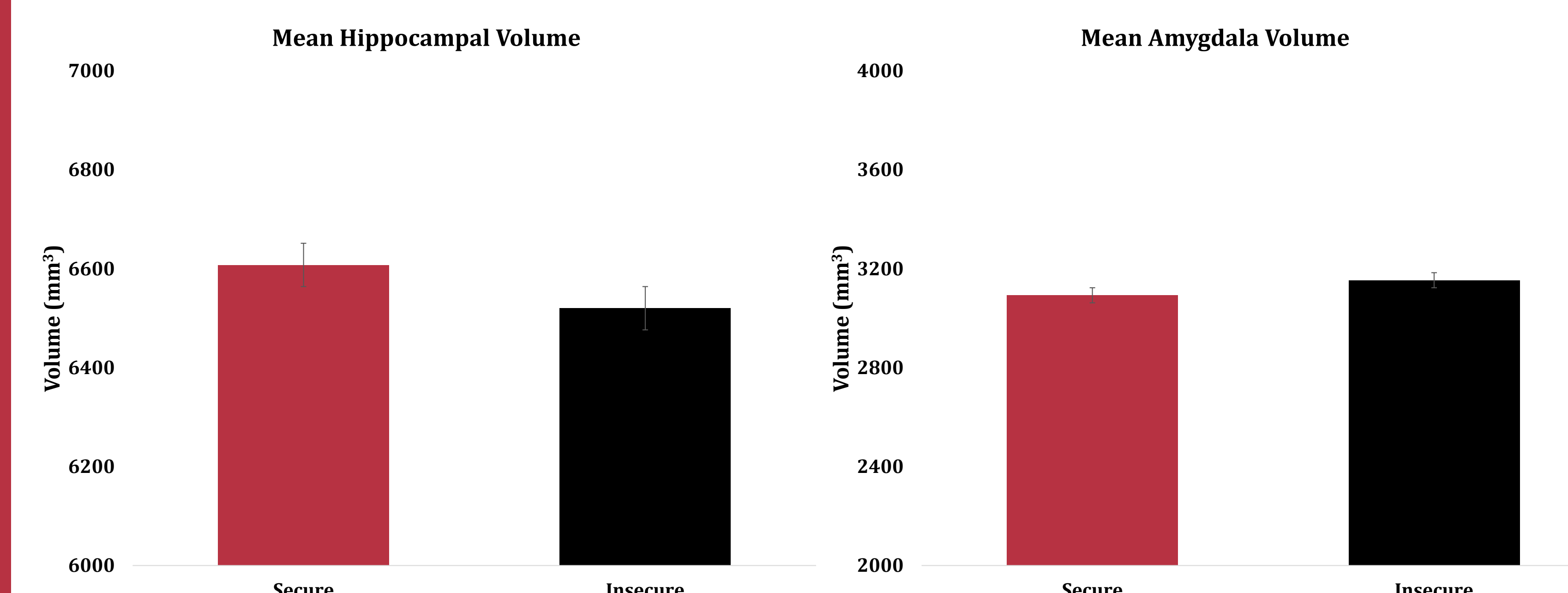
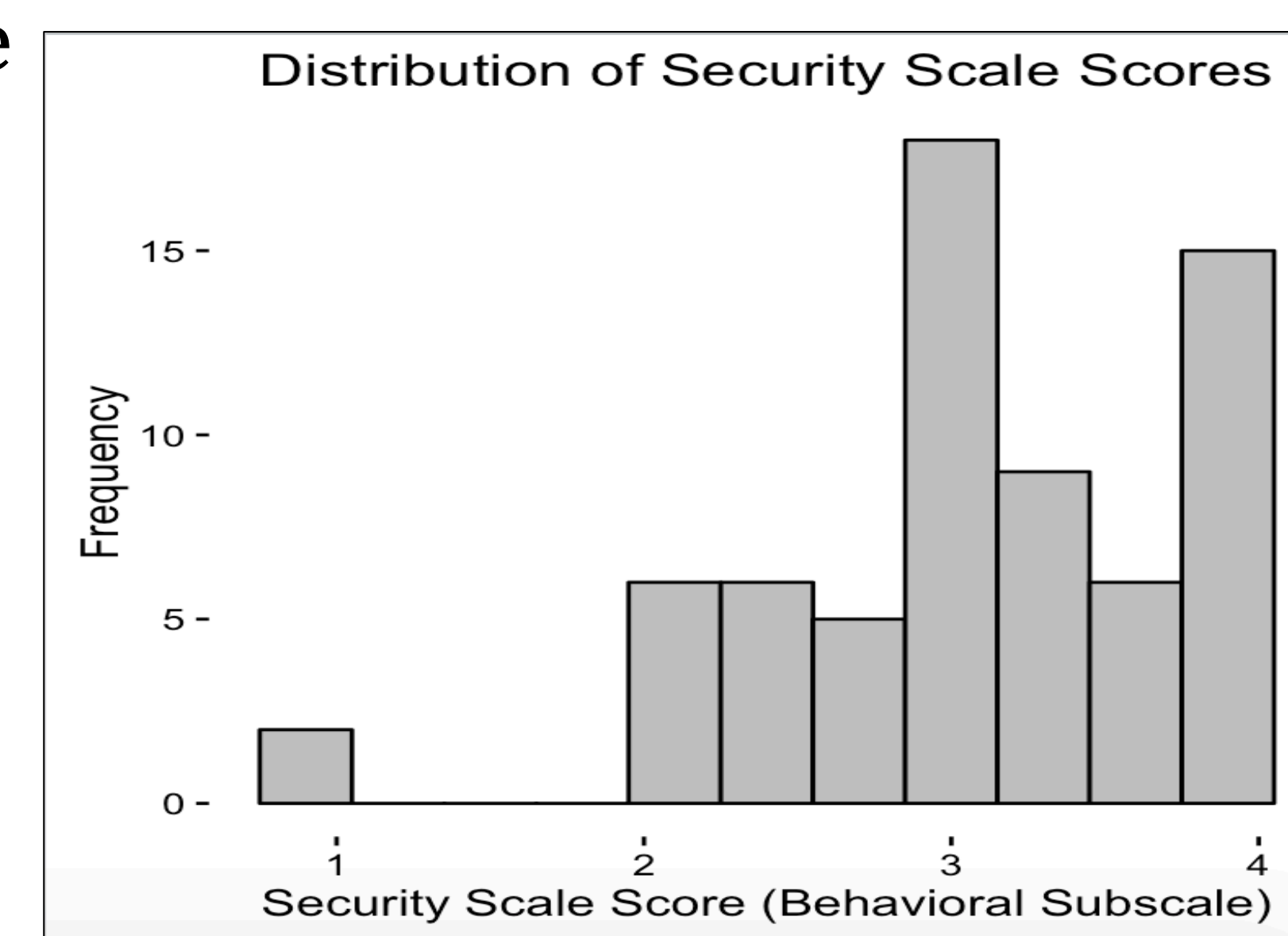
- Q1) Some kids go to their mom when they are upset BUT Other kids do *not* go to their mom when they are upset.
- Q2) Some kids go to their mom when they are hurt BUT Other kids do *not* go to their mom when they are hurt.
- Q5) Some kids don't usually go to their mom for help when they have a problem BUT Other kids usually *do* go to their mom for help when they have a problem.

Beliefs Subscale

- Q3) Some kids worry that their mom might not be there when they need her/him BUT Other kids are sure their mom will be there when they need her/him.
- Q4) Some kids really know their mom would not leave them forever, BUT Other kids sometimes wonder if their mom might leave them forever.
- Q6) Some kids know they can get their mom when they need her/him, BUT Other kids aren't sure they can get their mom when they need her/him.

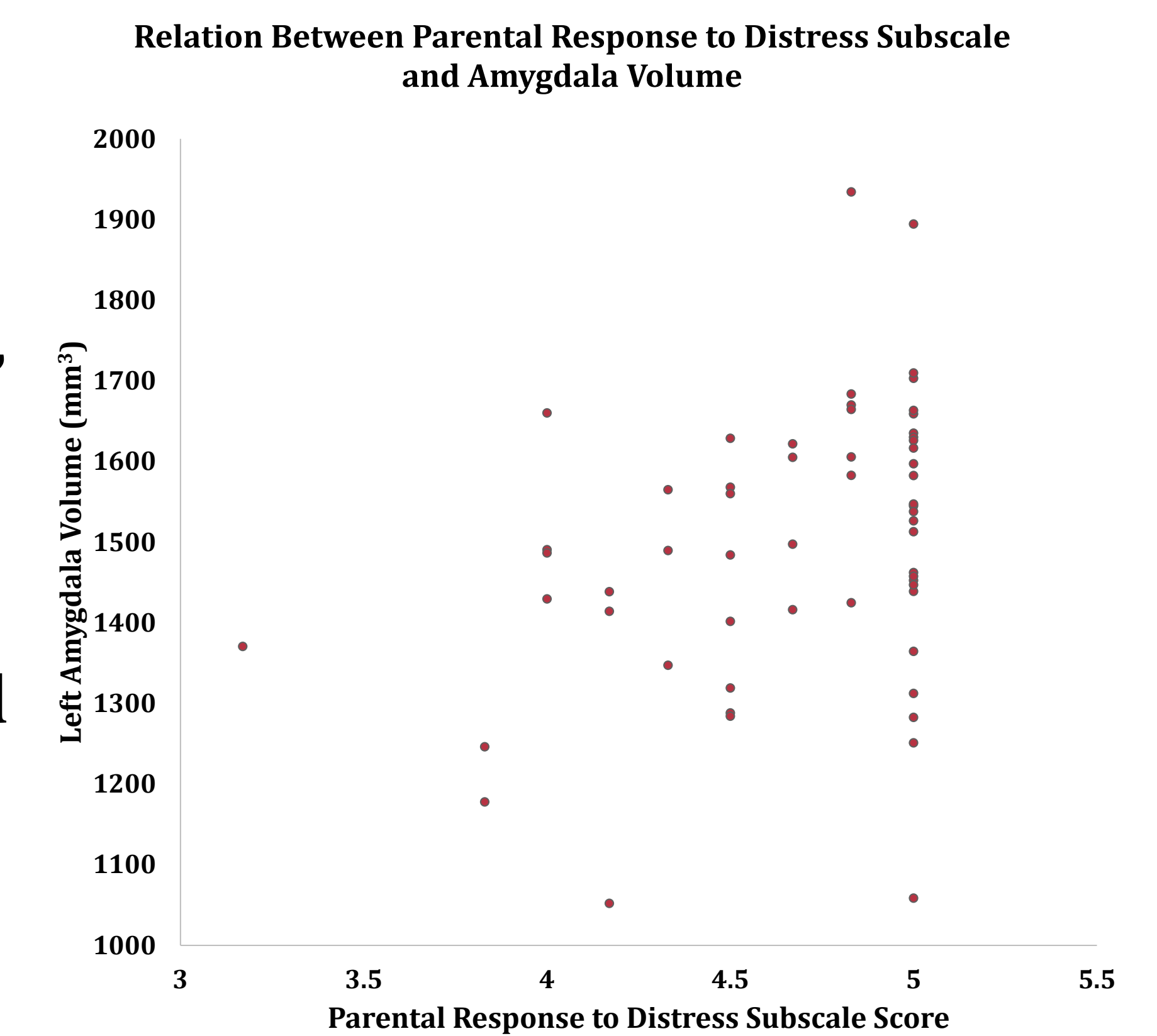
Results: Brain-Behavior Data

- 47 participants were in the secure attachment group and 18 participants were in the insecure attachment group.
- Though these are unequal sample sizes, they match the typical distribution of attachment data using more robust measures of attachment.
- Two equivalent one-way ANOVAs were conducted to determine whether there was an effect of secure vs. insecure attachment on total hippocampal volume or total amygdala volume.
- Results did not suggest a significant effect of attachment security on hippocampal volume, $F(1, 63) = 0.40$, $p = 0.53$, or amygdala volume, $F(1, 63) = 0.55$, $p = 0.46$.
- Analyses were also run for bilateral (left, right) and subregion (head, body, tail) hippocampal volumes and bilateral amygdala volumes, but no significant effects were found, all $ps > .05$.



Future Directions: Preliminary Findings

- Results from the Parental Response to Distress subscale of a modified version of the Parent-Child Touch Questionnaire (Stern & Cassidy, 2016) shows a positive linear relation with left amygdala volume, $r = .35$, $p < .01$.
- However, no relation was found with right amygdala volume or bilateral hippocampal volume.
- We will continue to explore the implications of these findings.



References

- Belsky, J., & de Haan, M. (2011). Annual Research Review: Parenting and children's brain development: the end of the beginning. *Journal Of Child Psychology And Psychiatry*, 52(4), 409-428.
- Bernier, A., Calkins, S. D., & Bell, M. A. (2016). Longitudinal Associations Between the Quality of Mother-Infant Interactions and Brain Development Across Infancy. *Child Development*, 87(4), 1159-1174.
- DeMaster, D. M., & Ghetti, S. (2012). Developmental differences in hippocampal and cortical contributions to episodic retrieval. *Cortex; a journal devoted to the study of the nervous system and behavior*.
- Fischl, B. (2012). FreeSurfer. *NeuroImage*, 62, 774-781. doi:10.1016/j.neuroimage.2012.01.021
- Kerns, K. A., Klepac, L., & Cole, A. (1996). Peer relationships and preadolescents' perceptions of security in the child-mother relationship. *Developmental Psychology*, 32(3), 457-466.
- Moutsiana, C., Johnstone, T., Murray, L., Fearon, P., Cooper, P. J., Plattsikis, C., ... Halligan, S. L. (2015). Insecure attachment during infancy predicts greater amygdala volumes in early adulthood. *Journal Of Child Psychology And Psychiatry*, 56(5), 540-548.
- Nelson C.A., Bos K., Gunnar M.R., & Sonuga-Barke E.J.S. (2011). V. The neurobiological toll of early human deprivation. *Monographs Of The Society For Research In Child Development*, 76(4), 127-146.
- Raz, N., Lindenberger, U., Rodrigue, K. M., Kennedy, K. M., Head, D., Williamson, A., . . . Acker, J. D. (2005). Regional brain changes in aging healthy adults: General trends, individual differences and modifiers. *Cerebral Cortex*, 15, 1676-1689.
- Riggins, T., Blankenship, S. L., Mulligan, E., Rice, K., & Redcay, E. (2015). Developmental differences in relations between episodic memory and hippocampal subregion volume during early childhood. *Child Development*, 86(6), 1710-1718.
- Wang H, Das SR, Suh JW, Altinay M, Pluta J, Craige C, Yushkevich PA (2011): A learning-based wrapper method to correct cortex and brain segmentation. *NeuroImage*, 55:968-985.