# Integrating Dimensional Models of Early Adversity: Relative Contributions of Caregiver and Environmental Risks on Frontal-Limbic Development in Early Childhood

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## Introduction

Introduction

- Models of neurodevelopment and adversity, such as threat-deprivation (Sheridan & McLaughlin, 2014) and harshness-unpredictability (Ellis et al., 2009) have linked specific stressful experiences with alterations to brain structure and function.
- Early childhood may be a period where youth are particularly impacted by caregivers, who may amplify or mitigate the effects of adversities occurring outside the home across these dimensions (Tottenham, 2020)

Present Study

- The present study builds off previous work integrating dimensional models of adversity (Usacheva et al., 2022), exploring how dimensions of adversity impact structural brain development differentially across proximal, caregiving or more distal contexts.
- We hypothesize that experiences of adversity in the caregiving context, such as parent psychopathology or family involvement with Child Protective Services (CPS) will be uniquely associated with brain development, over and above environmental stressors, such as economic and community resources.

## Methods

Sample & Analytic Plan

- Our sample consists of 123 caregivers and their children ages 3 to 8 (52% male, M= 5.24 , SD=0.93)
- Caregiving and environmental composite indicators were analyzed using linear regression to examine associations with structural brain development (volume, area, thickness, curvature, & convexity) in frontal and limbic regions.

Measures

*Caregiving Risk Composite*

- Anxiety (State-Trait Anxiety Inventory; Spielberger 1983)
- Depression (Beck Depression Inventory; Beck et al., 1987)
- Parent trauma history (Childhood Trauma Questionnaire; Bernstein et al., 1998)

***Family CPS Involvement:*** Has anyone ever contacted Child Protective Services (CPS) or Department of Children and Families (DCF) due to concerns about your infant or other children in your care?

*"Yes" (n=19); "No" (n=96)*

*Environmental Risk Composite*

- History of stressful and transitional events (Stress Index; Attar et al., 1994)
- Financial and community resources (Family Support Scale; Dunst et al., 1986)
- Income to needs ratio

*Neuroimaging Metrics*

- MRI – T1 weighted images, averaged across right and left hemispheres, processed using the Infant Brain Extraction and Analysis Toolbox (iBEAT V2.0; Wang et al., 2023)
- 8 Regions of interest in prefrontal & limbic areas:
  - Superior frontal gyrus, middle frontal area, lateral and medial orbitofrontal cortexes, anterior cingulate, putamen, amygdala, and hippocampus

*Covariates*

- Total Intercranial Volume (ICV)
- Child sex and age

## Results

***Table 1. Associations between Caregiving Risk, Environmental Risk, & CPS Involvement on Brain Development***

| | | *B* | *SE* | T | P |
|---|---|---|---|---|---|
| middle frontal volume | CPS | -390E+02 | 3.30E+02 | -1.179 | 0.24 |
| | **caregiver** | **1.10E+02** | **4.58E+01** | **2.404** | **0.02*** |
| | env. | 4.04E+01 | 6.27E+01 | 0.644 | 0.52 |
| middle frontal thickness | **CPS** | **-1.32E-01** | **6.08E-02** | **-2.171** | **0.03*** |
| | caregiver | 4.23E-03 | 8.42E-03 | 0.503 | 0.62 |
| | env. | -1.99E-03 | 1.15E-02 | -0.173 | 0.86 |
| middle frontal area | CPS | -1.49E+01 | 1.32E+02 | -0.113 | 0.91 |
| | **caregiver** | **3.75E+01** | **1.82E+01** | **2.057** | **0.04*** |
| | env. | 3.14E+01 | 2.50E+01 | 1.258 | 0.21 |
| middle frontal curvature | **CPS** | **1.42E-02** | **6.37E-03** | **2.225** | **0.03*** |
| | caregiver | -1.07E-03 | 8.82E-04 | -1.208 | 0.23 |
| | env. | 1.57E-03 | 1.21E-03 | 1.299 | 0.20 |
| medial orbitofrontal convexity | **CPS** | **-1.69E-01** | **8.08E-02** | **-2.089** | **0.04*** |
| | caregiver | -6.37E-03 | 1.12E-02 | -0.569 | 0.57 |
| | **env.** | **-3.20E-02** | **1.54E-02** | **-2.085** | **0.04*** |
| amygdala area | **CPS** | **-5.94E+01** | **2.37E+01** | **-2.505** | **0.02*** |
| | caregiver | 2.13E+00 | 3.29E+00 | 0.648 | 0.52 |
| | env. | -1.98E+00 | 4.50E+00 | -0.44 | 0.66 |

*Note:* Child age, sex, and total ICV were included as covariates in each model.

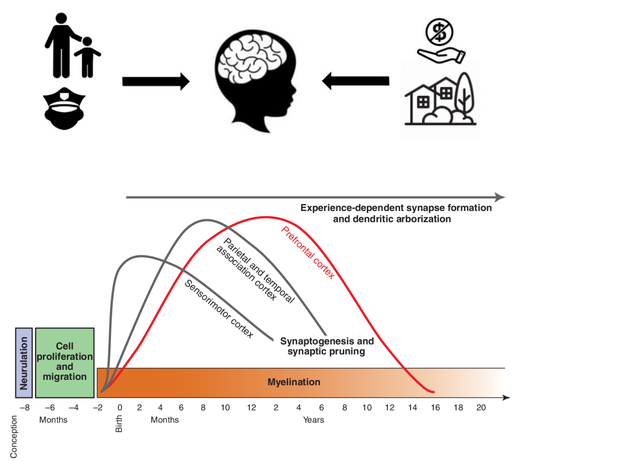


***Figure 1. Reproduced from Chini & Hanganu-Opatz, 2021.***
Trajectories of typical cortical development may be impacted by experiences of adversity, such as parental psychopathology, trauma, or poverty.
During sensitive developmental periods, such as early childhood, these experiences may cause deviations to normative synaptogenesis and synaptic pruning patterns. In particular, adversity may impact neural growth in frontal-limbic areas related to self and emotion regulation.

Key Findings

- Our hypotheses were partially supported, finding caregiving related risk was consistently associated with neurodevelopment, compared to environmental factors
- Increased caregiving risk was significantly associated with increased volume and area in the middle frontal gyrus, which is associated with executive functioning, above and beyond the effects of environmental risk
- Increased environmental risk was associated with decreased medial orbitofrontal convexity.
- Family history of CPS involvement was associated with decreased amygdala volume and thickness in the middle frontal region over and above the effects of caregiving and environmental risk.
- CPS involvement was also associated with increased convexity of the middle frontal region.

## Discussion & Future Directions

Discussion

- These findings highlight the effects of how proximal social experiences in early childhood may be particularly meaningful for brain growth.
- Supportive and predictable caregiving contexts may be linked with increased development of brain regions involved with emotion regulation and cognitive abilities during this important developmental period.
- Importantly, this study aims to characterize the differential impacts of stressful experiences occurring within the child's home and in their larger developmental context on neurobiology

- Future work with this sample will examine links between structural MRI measures, early caregiving experiences, child executive functioning and psychopathology symptoms.
- Limitations include cross sectional design, missing data across additional adversity measures, and excluding participants without usable MRI data, limiting the number of individuals included in our final analytic sample.

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