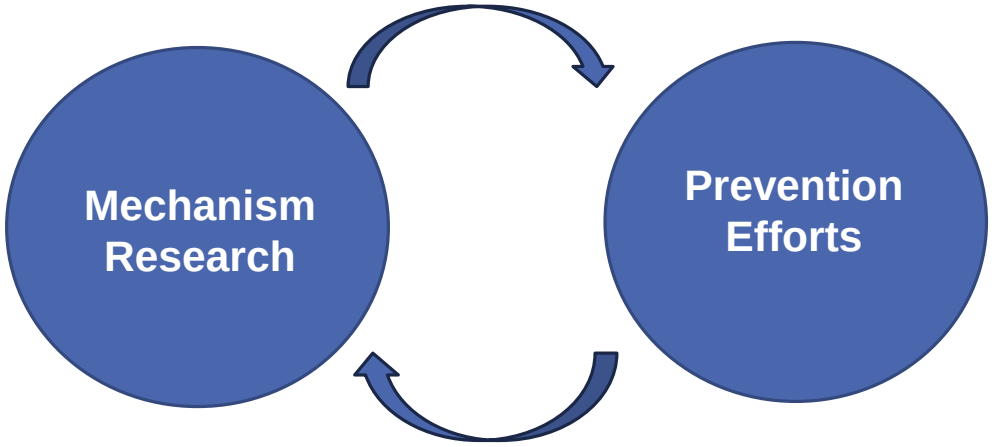
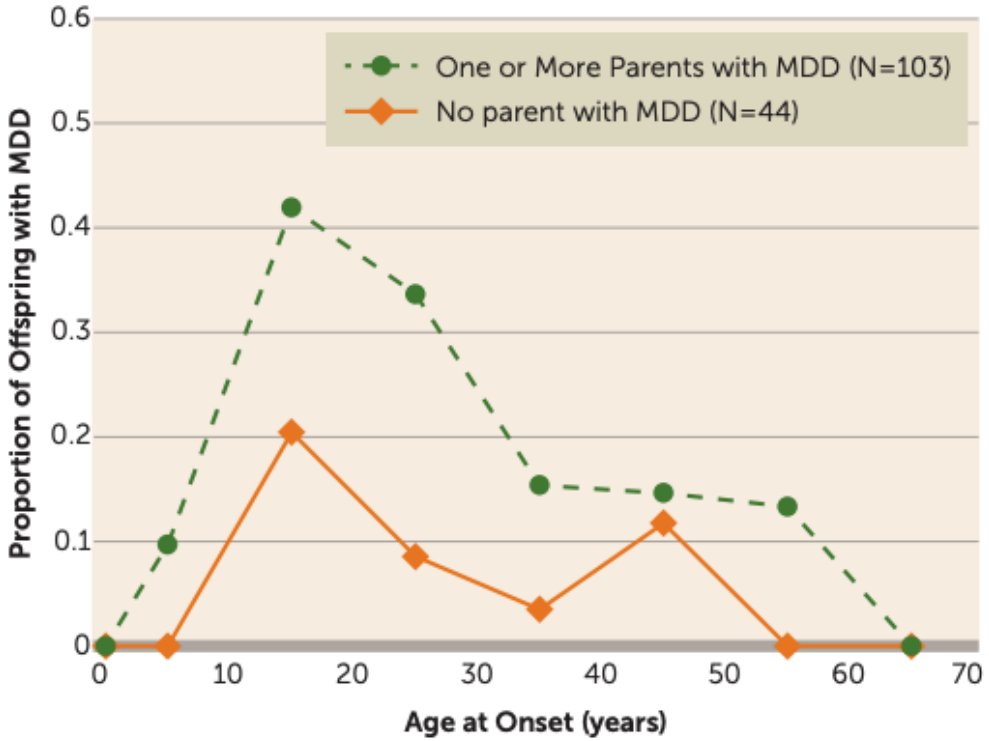
Electrocortical Reactivity to Emotional Faces in Mother-Daughter Dyads: The Moderating Roles of Emotion Regulation Styles and Maternal Depression

Katie Burkhouse, Ph.D., ABPP
Assistant Professor of Psychiatry & Behavioral Health
Nationwide Children's Hospital
The Ohio State University

Maternal MDD and Offspring Risk

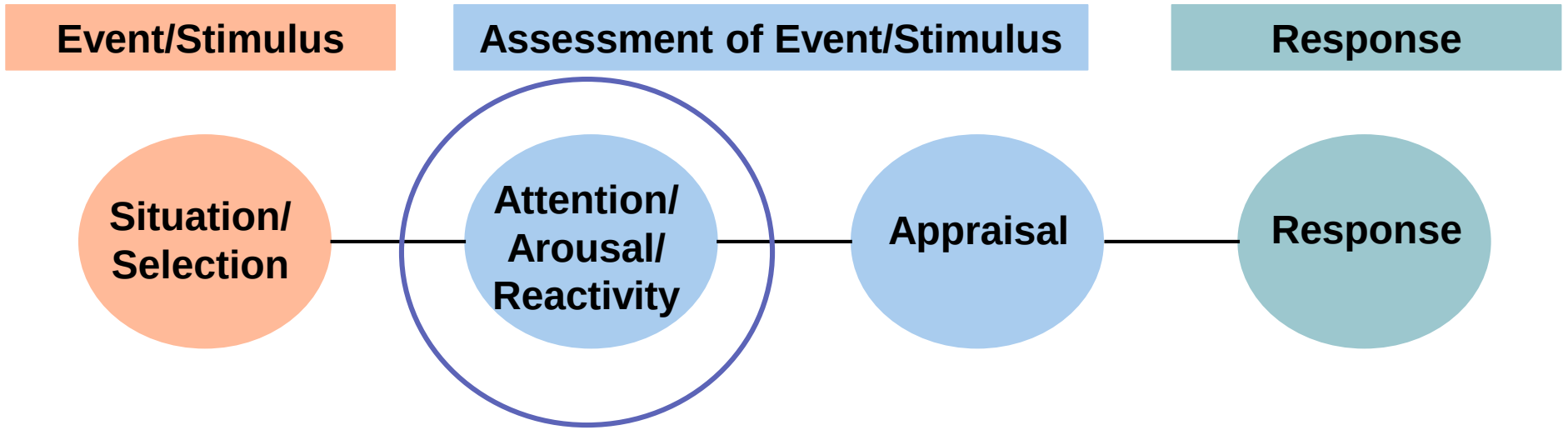
- Maternal major depressive disorder (MDD) associated with following youth MDD factors:
  - Earlier age of onset
  - Higher likelihood of recurrence
  - More chronic course





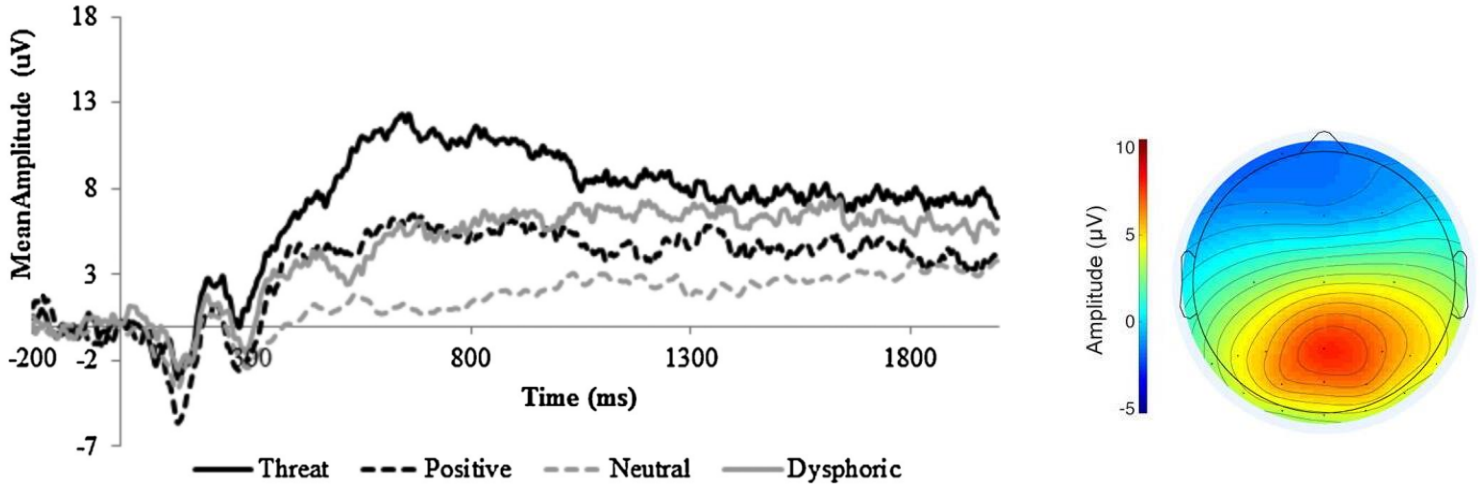
Goodman, 2007; Hammen, 2009; Weissman et al., 2016

Emotion Processing and Depression Risk



Late Positive Potential (LPP)

- Event-related potential (ERP) derived from electroencephalogram
- Time-locked to specific events (e.g., emotional stimuli)
- Index of sustained attention to emotional stimuli
- Early and late components
- Increases from childhood through adolescence and then decreases across adulthood (Deng et al., 2019)



Maternal Clinical Depression and Offspring LPP Response

- Systematic review of 64 studies investigating links between maternal depression diagnoses and offspring's emotion processing from birth through adolescence
- Conducted in accordance with PRISMA 2020 standards
- Study Inclusion criteria:
  - 1) Mothers with and without DSM-defined depressive disorders assessed via a clinical or diagnostic interview
  - 2) Measures of offspring emotion processing assessed at the psychophysiological (e.g., autonomic) or neural (EEG, neuroimaging) level between birth and 18 years of age

Maternal Clinical Depression and Offspring LPP

Table. Late positive potential (LPP) studies in high-risk (HR) offspring of mothers with depression compared to relatively low-risk (LR) offspring.

Study	Stimuli	Sample Size, *N*	Depression Timing (Method)	Age Range or *M* (*SD*)	Sample Gender (% Female)	Primary Finding	Estimated Cohen's *d*
Connell et al., 2019	Emotional go/no-go task	48	Current or Lifetime (SCID)	10-14 years	100	↑ LPP to sad faces in HR	-
Kessel et al., 2017	Emotional images	216 LR, 122 HR	Lifetime (SCID)	9.21 years (0.41)	44	No main effect; irritability associated with ↑ LPP in HR	0.29
Kujawa et al., 2012	Emotional faces	218 LR, 116 HR	Lifetime (SCID)	6.10 years (0.44)	42	↓ LPP to emotional faces at early stages in HR	0.29
Nelson et al., 2015	Emotional images	422 LR, 107 HR	Lifetime (SCID)	13.5-15.5 years	100	↓ LPP to all stimuli in HR	0.20
Seidman et al., 2020	Forward vs. averted emotional faces	34 LR, 22 HR	Lifetime (SCID)	12.15 years (1.33)	100	↓ LPP to averted faces in HR	0.55
Speed et al., 2016	Self-referential emotional words	91 LR, 30 HR	Lifetime (SCID)	8-14 years	100	↑ LPP to negative words in HR	0.51

Note: ERN = error-related negativity; HR = high risk; LPP = late positive potential; LR = low risk; SCID = Structured Clinical Interview for DSM disorders.

How do emotion regulation (ER) abilities impact the LPP?

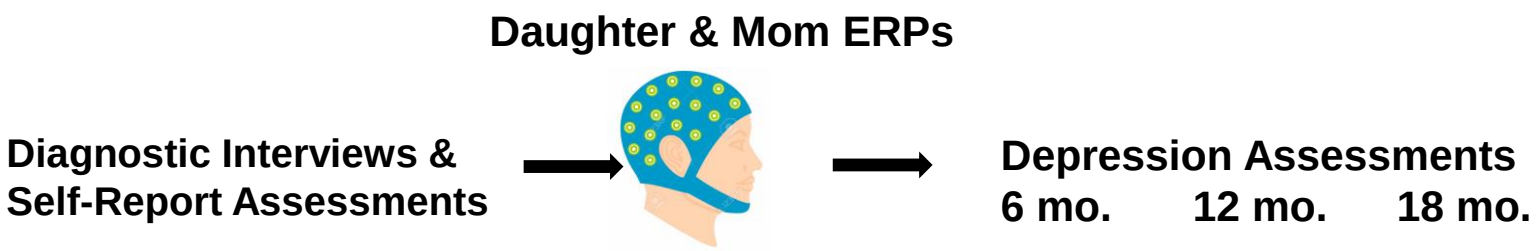
- Rumination → repetitive thoughts on symptoms, causes, and consequences of past personal distress
  - Trait rumination related to enhanced LPP to losses in reward task (Webb et al., 2017)
- Suppression → suppressing outward emotional expression (”poker face”)
  - No prior studies
- Cognitive Reappraisal → changing interpretation of affective stimuli
  - Reduced LPP following reappraise trials during task (Hajcak et al., 2010)

Current Study

1) Examine differences between LPP response to emotional faces between mothers with a history of MDD and healthy control mothers and between high and low risk daughters

2) Examine moderations by emotion regulation styles in mothers and their daughters

3) Examine familial associations among LPP patterns to emotional faces
   - Moderation by child age and maternal MDD



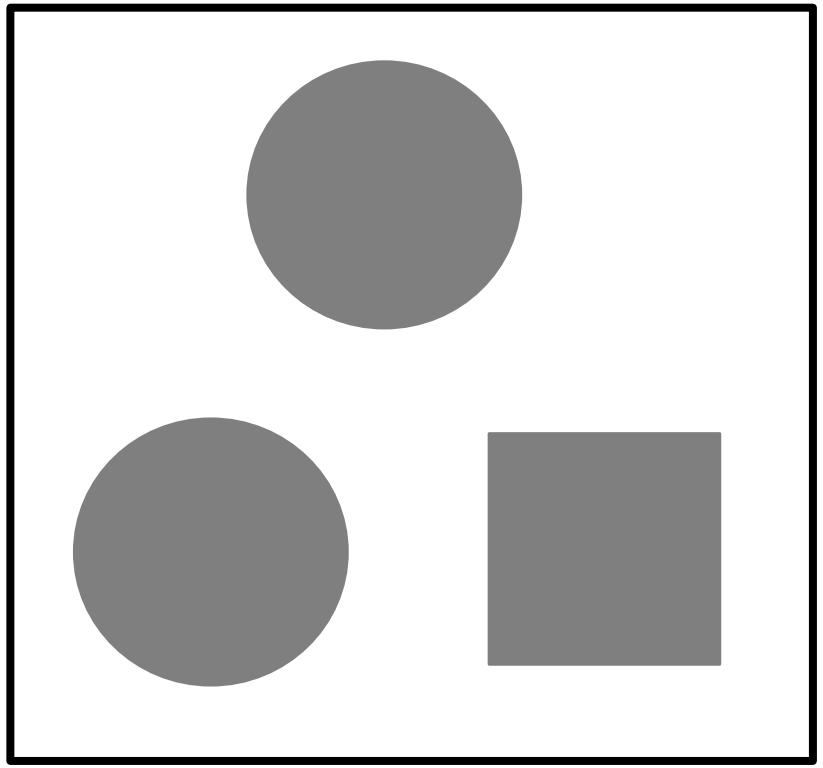
Participants

- 101 mother-daughter (ages 9-16) dyads
  - 57 HR: mother has a history of major depressive disorder (SCID)
    - Recurrent MDD – 82%
    - Current MDD – 28%
    - Comorbid anxiety – 54%
  - 44 LR: mother has no history of any DSM-V Axis I psychological disorder
- Exclusion criteria:
  - History of intellectual disability, bipolar, or psychosis disorder
  - Psychotropic medications
  - Seizure history

Social-Emotional Faces Task

Match Faces (Happy, Sad, Angry, Fearful)

Match Shapes



Hariri, 2022; Tottenham et al., 2012

Sample Characteristics

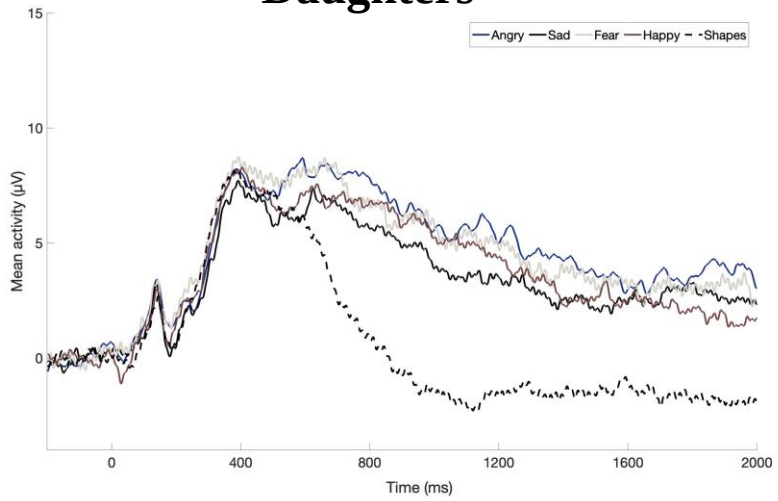
	Low Risk (N=44)	High Risk (N=57)	*t*-value
Child Age	13.43 (2.16)	11.98 (2.12)	-3.38**
Child RRS Brooding (RRS)	8.58 (2.99)	9.56 (3.03)	1.58
Child Reappraisal (ERQ-CA)	27.98 (8.12)	29.20 (8.14)	0.72
Child Suppression (ERQ-CA)	14.02 (4.90)	14.00 (5.04)	-0.02
Child Depressive Symptoms (CES-D)	9.63 (6.63)	14.07 (8.92)	2.73*
Mother Age	44.52 (6.22)	41.21 (5.73)	-2.77*
Mother Brooding (RRS)	7.57 (2.39)	10.13 (3.80)	3.90**
Mother Reappraisal (ERQ)	32.18 (7.54)	30.31 (6.04)	-1.36
Mother Suppression (ERQ)	12.84 (5.46)	13.95 (12.84)	1.37
Mother Depressive Symptoms (BDI)	5.10 (4.85)	11.53 (4.52)	2.89*

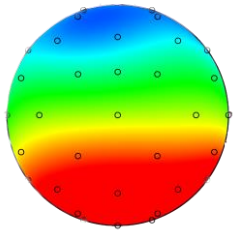
Sample Characteristics

	Low Risk (N=44)	High Risk (N=57)
Child Race/Ethnicity		
White	50%	48%
African American	23%	26%
Asian American	11%	11%
Biracial	16%	15%
Hispanic/Latinx	32.3%	29%
Maternal Race/Ethnicity		
White	51%	52%
African American	25%	26%
Asian American	11%	7%
Biracial	13%	15%
Hispanic/Latinx	27%	29%

LPP Response

Daughters

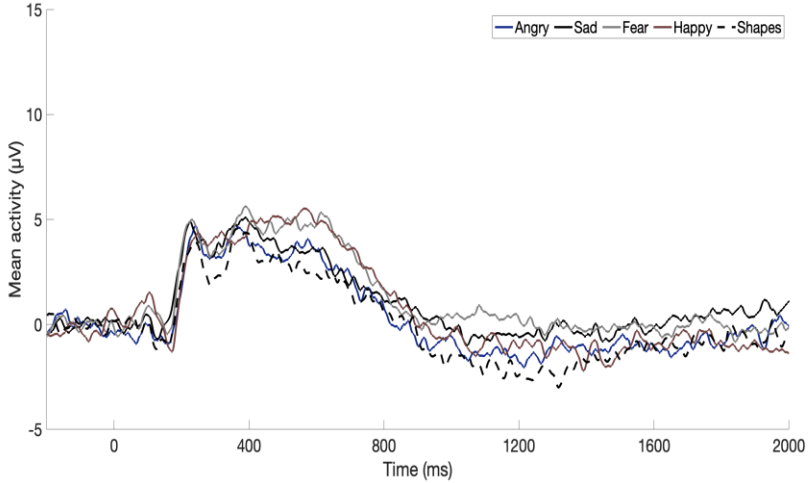


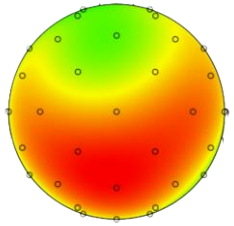


400 to 2000ms

-5uV 7uV

Mothers





400 to 2000ms

-5uV 3uV

Group Differences in LPP Response among Mothers and Daughters

- Daughters → no main or interactive effects with maternal MDD
- Mothers → Main effect of maternal MDD on LPP to all stimuli, $F(1,56)=3.89$, $p<.05$.
- Effect no longer significant after adjusting for maternal anxiety symptoms ($p = .18$).

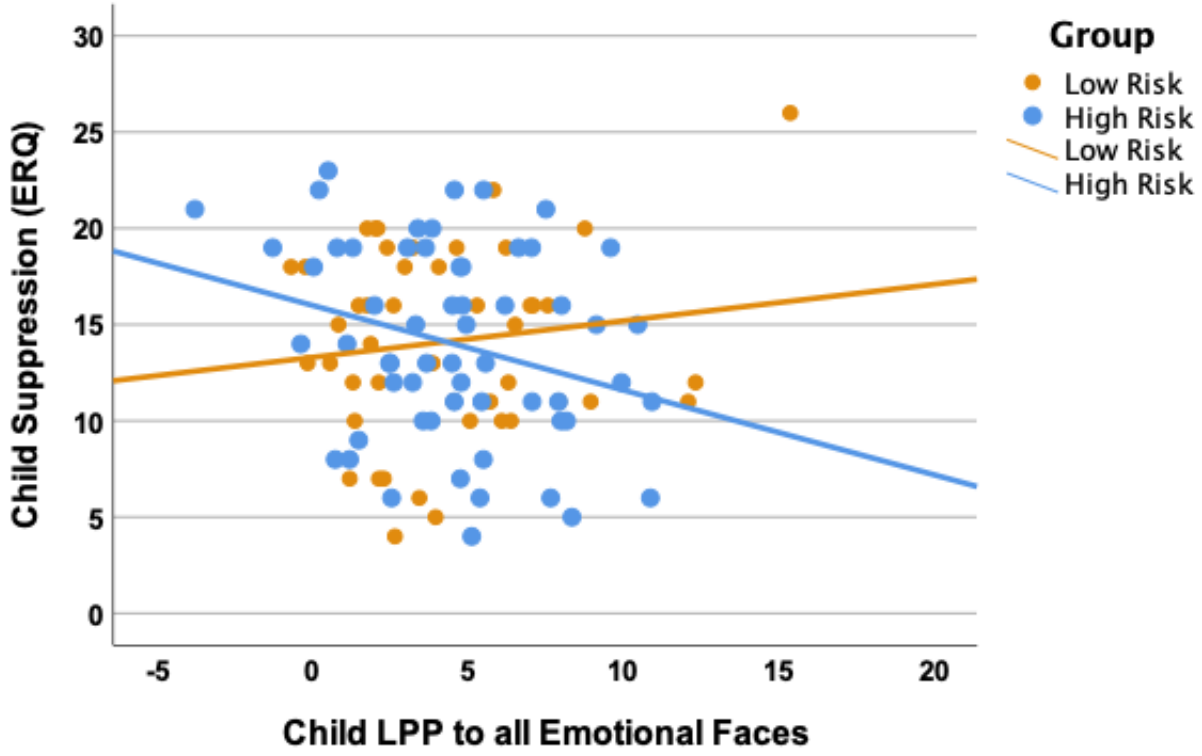
ERQ x Maternal MDD → LPP

- ERQ - Cognitive Reappraisal
  - No significant main or interactive effects for mother or daughter

- ERQ – Suppression
  - Mothers: No significant main or interactive effects
  - Daughters: Maternal MDD **x** suppression between-subjects significant effect: $F(1,101)=4.30$, $p=.04$.

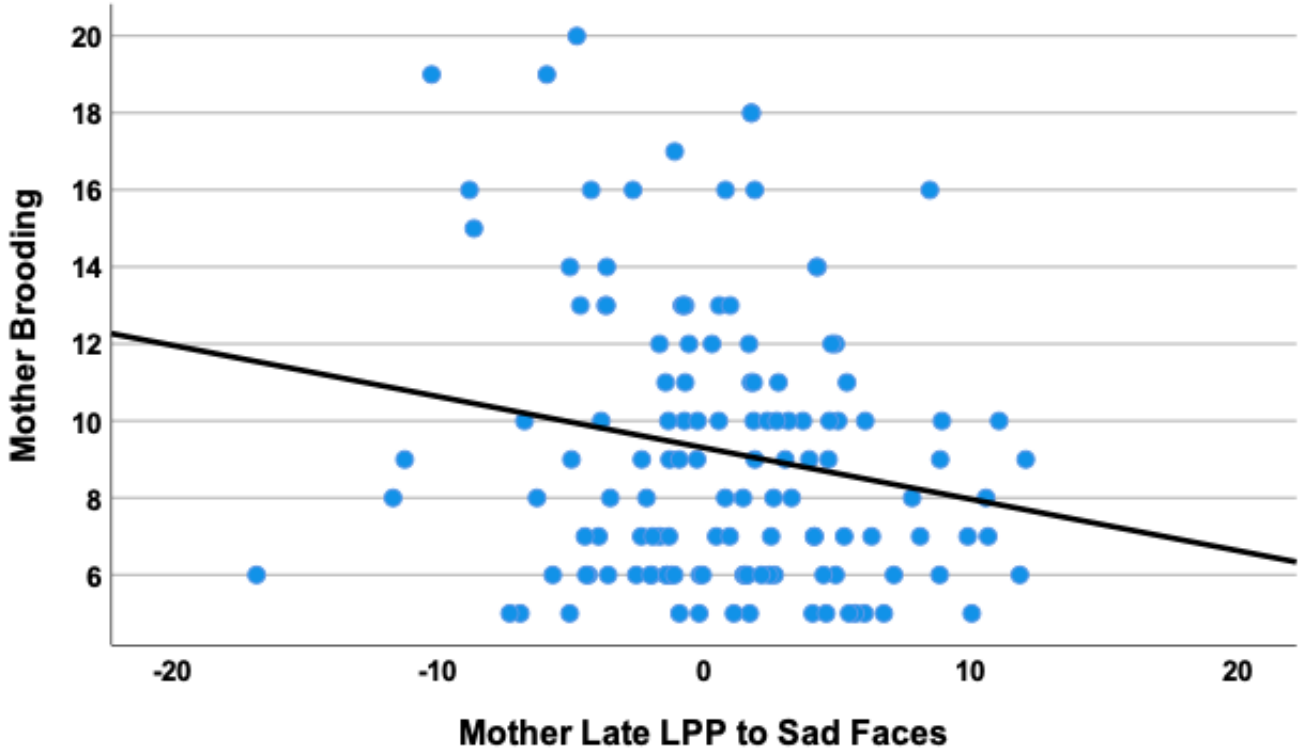
Child Suppression x Maternal MDD → Child LPP

- **Higher levels of suppression associated with blunted LPP to all emotions in HR daughters, F(1,56)=4.31, *p*=.04, *r*=-.28**.
- No association between suppression and LPP in LR daughters, *p*=.37.
- Maintained when adjusting for child age and depressive and anxiety symptoms.



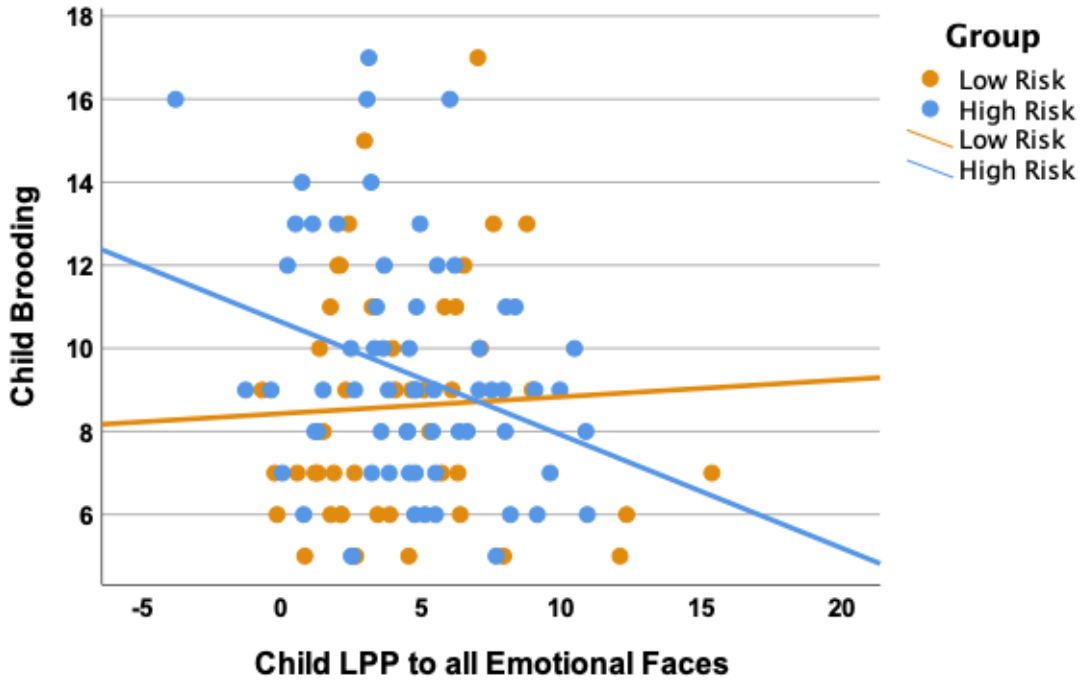
Maternal Brooding x MDD → LPP

- No effects with maternal MDD
- Time **x** Emotion **x** Maternal Brooding effect, $F(4,116) = 2.38$, $p<.05$.
- **Higher levels of brooding associated with a more blunted late LPP to sad faces in mothers, $r=-.19$, $p=.03$.**



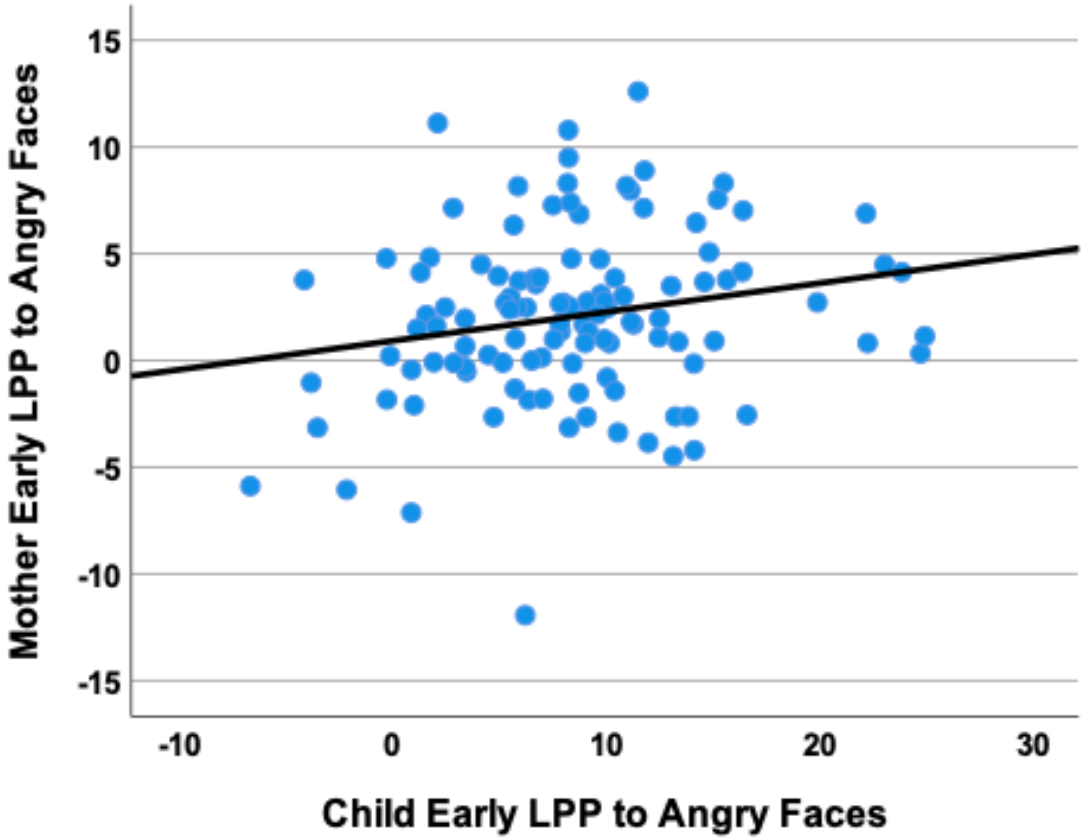
Child Brooding x Maternal MDD → Child LPP

- Maternal MDD **x** child brooding between-subjects significant effect: F(1,101)=4.34, *p*=.04.
- **Higher levels of brooding associated with a more blunted LPP to all emotions in HR daughters, F(1,56)=4.25, *p*=.04, *r*=-.30.**
- No association between suppression and LPP in LR daughters, *p*=.75.
- Maintained when adjusting for child age and anxiety and depressive symptoms.

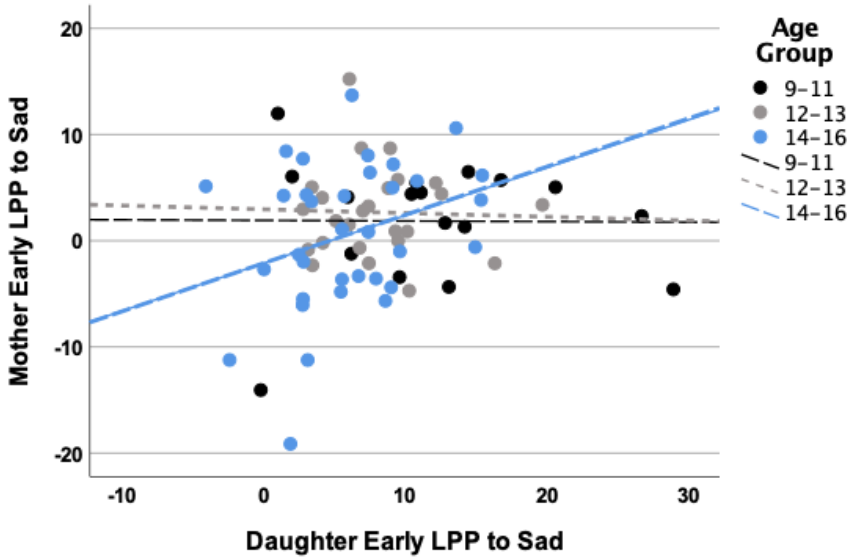


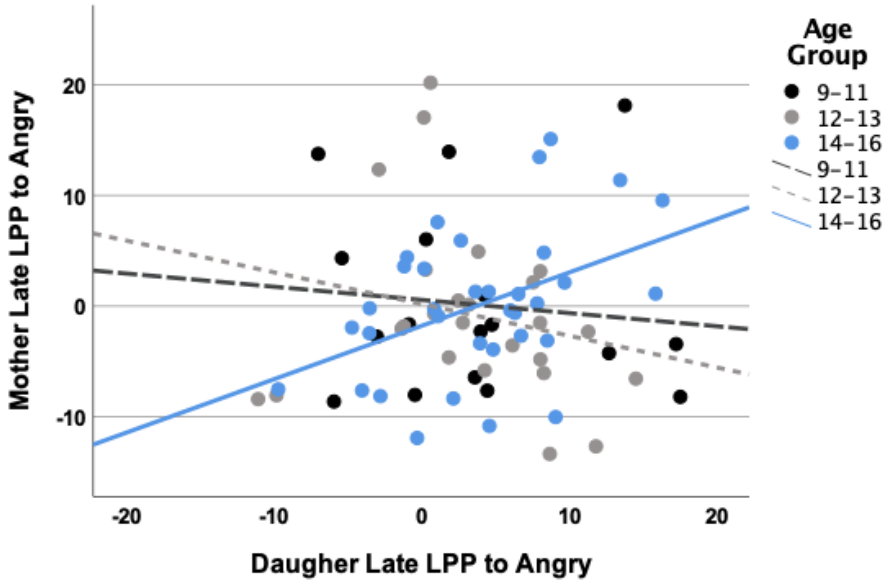
Mother-Daughter LPP Relations

- No significant effects for fear or happy faces or shapes
- **Significant association between mother and child early LPP to angry faces, *r*=.26, *p*=.04.**



Mother-Daughter LPP Relations by Child Age





- **Among older daughters (beginning ~age 14), positive correlations between mother and daughter early LPP to sad and faces (*r*=.46, *p*<.01) and late LPP to angry faces (*r*=.43, *p*=.01).**

Summary

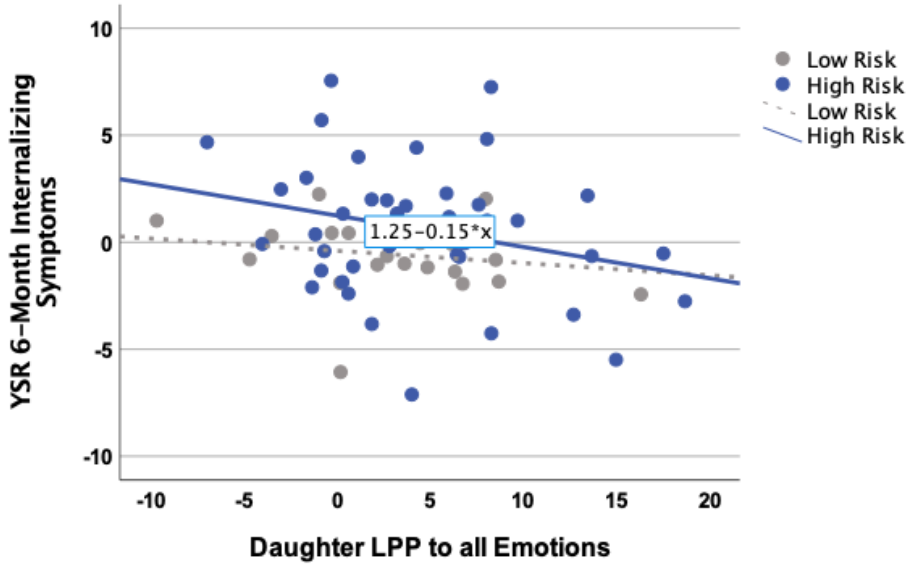
- Maternal LPP:
  - No effects with maternal MDD after accounting for anxiety
  - Rumination associated with more attenuated late LPP to sad faces (disengagement)
- Child LPP:
  - No main effects with maternal MDD
  - Attenuated LPP to all stimuli in HR daughters reporting more frequent use of maladaptive emotion regulation strategies (i.e., brooding, suppression)
  - Consistent with LPP emotional disengagement literature in HR offspring, but suggest only apparent in certain subgroups

Summary (cont.)

- Mom and Child LPP relations
  - Effects for angry and sad, but some effects only apparent in dyads with older daughters
  - No effects for happy, fear, or neutral stimuli
    - Reliability and scoring of LPP
    - Smaller effects observed for faces versus other types of stimuli (Kujawa et al., 2012)
- Role of environmental factors
  - Parenting (maternal warmth, criticism)
  - Stress (exposure to crime, income-to-needs)

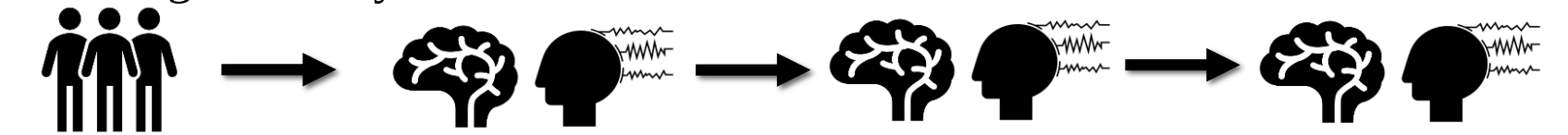
Next Steps – Ongoing Projects

- Longitudinal prediction of symptoms (6-, 12-, and 18-month follow-ups)
- Testing associations during early childhood (ages 5-6)
- Prevention study (family group-based CBT)
  - Can LPP be modified to prevent the emergence of depression in at-risk youth?



Future Directions– New R01 Project

- Aim 1: Examine whether alterations in brain networks during negative emotion processing (reactivity and regulation) precede and predict depression trajectories among high-risk youth
- Aim 2: Examine whether *changes* in depression correspond to *changes* in brain-based indices of negative emotion processing in high-risk offspring
- Aim 3: Integrate multiple units of negative emotion processing (ERPs, fMRI) to increase specificity in depression risk models among high-risk youth
- Aim 4: Explore moderators in these pathways → child pubertal status/timing, age, and gender, emotion regulation styles



***N*=250 High and Low Risk Youth (Ages 9-15)**

Baseline- Month fMRI, EEG, Behavior Assessments

12- Month fMRI, EEG, Behavior Assessments

24- Month fMRI, EEG, Behavior Assessments

Maternal and Child Depression Assessments, Baseline, 6-, 12-, 18-, and 24- months

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