Environmental Influences on Neurodevelopmental Trajectories:

Relevance for Substance Use Prevention

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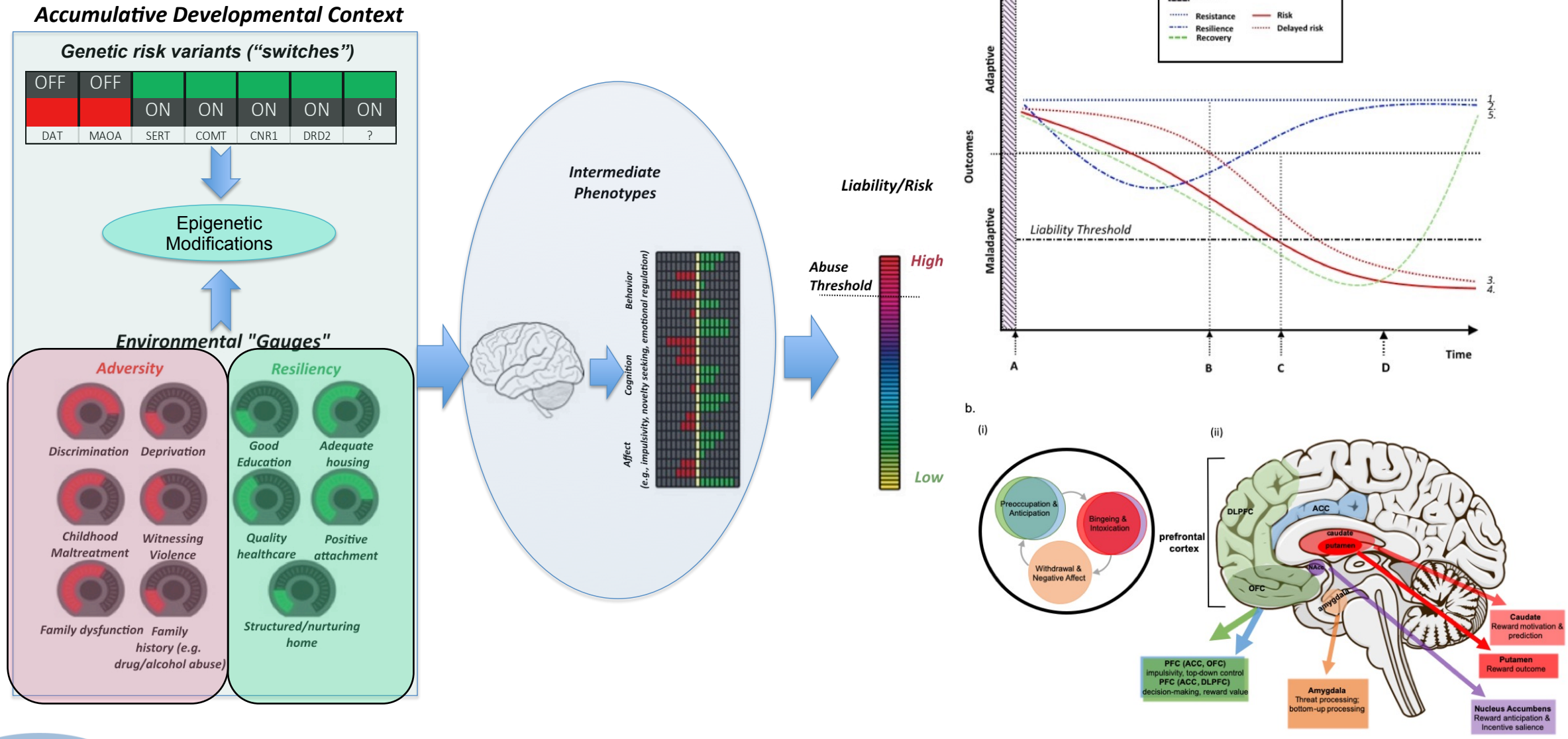
Overview

1. Environmental Risk for Substance Use
    - Brain-based risk pathways

2. The Adolescent Development Study
    - Socioeconomic status & responsibility

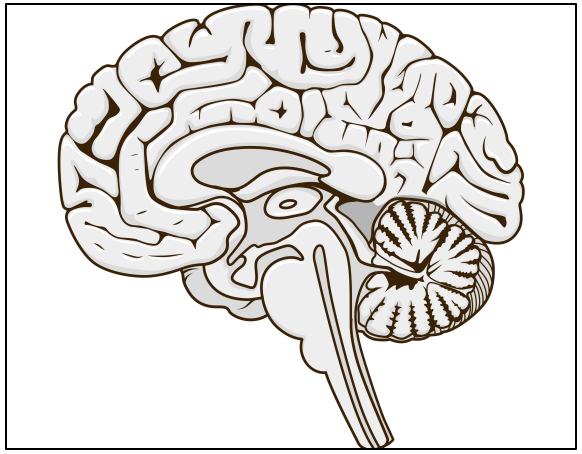
3. The Child Health Study
    - Maltreatment and neglect

4. Implications for substance use prevention



The Accumulative Developmental Context and Substance Use Liability

Socioeconomic status, responsibility and Adolescent Substance Abuse



135 Drug and Alcohol Naïve 11 -13 year olds

Functional and Structural Imaging at 0, 18, and 36 months

Genetic, environmental, and psychosocial indices

The Adolescent Development Study

Level of responsibility and social expectations from within the home during childhood may impact brain development, possibly influencing the rate at which higher order cognitive functions mature.

H1: A higher level of responsibility will be associated with increased thickness in brain regions subserving executive functions (e.g., problem solving) and self-regulatory behaviors (e.g., superior, orbital and middle frontal cortices, precuneus, and anterior cingulate).

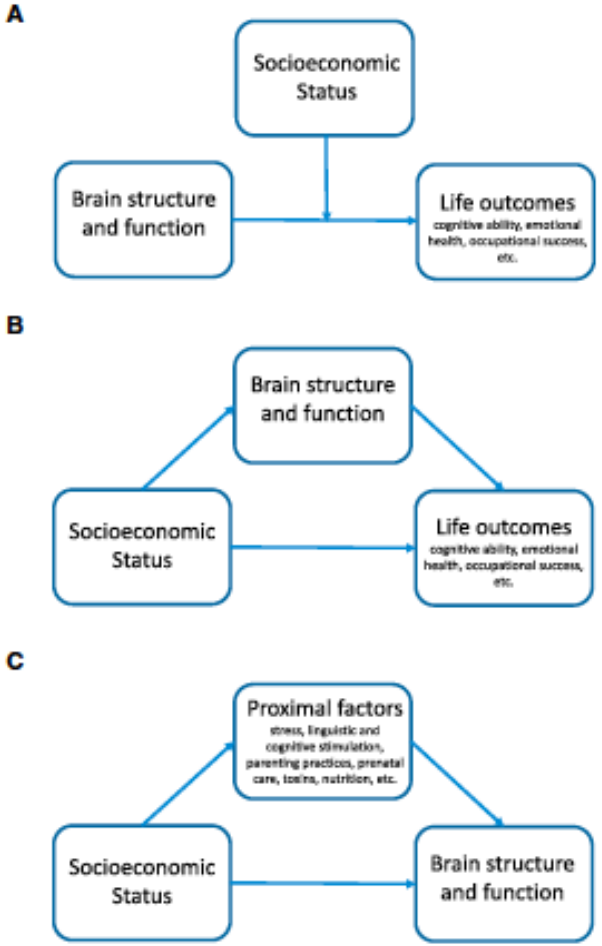


Figure 1. Possible Relations among the Causes and Consequences of SES and Its Neural Correlates
(A) Moderation of brain-behavior relations by SES.
(B) Mediation of behavioral consequences of SES by the brain.
(C) Mediation of SES-brain relations by proximal factors associated with SES.

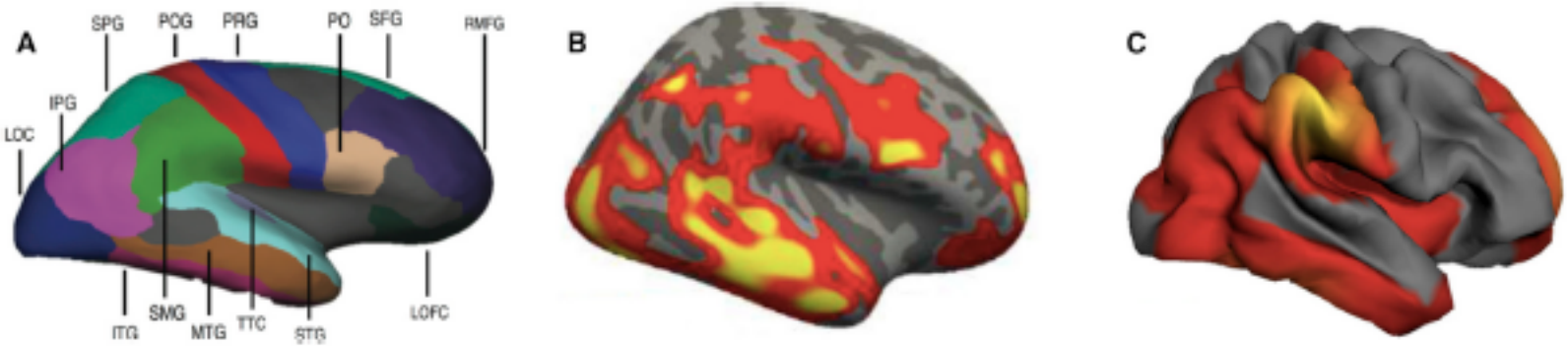


Figure 2. Visualizations of Findings Relating Different Aspects of SES to Different Aspects of Brain Structure
(A) Volumes, labeled and in color, varying with neighborhood SES in adults (left and right collapsed).
(B) Cortical thickness varying with income in children.
(C) Surface area varying with parental education in children.

(from Farah (2016) Neuron)

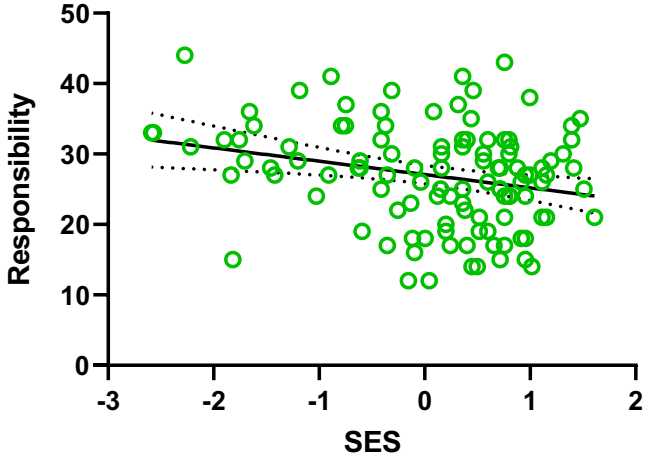
Specific contextual factors might impact the association between responsibility and brain development.

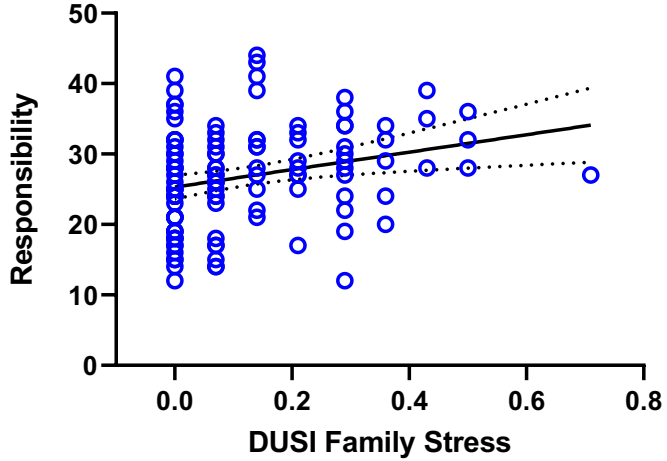
H2: SES and family stress will moderate the relationship between responsibility and cortical thickness.

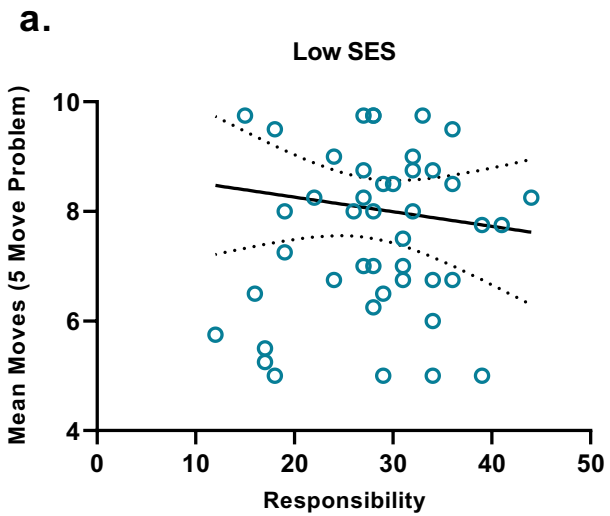
- Hierarchical regression: SES, Family Stress, and Responsibility
- Neurocognitive testing (problem solving; Stockings of Cambridge)
- Region of interest analysis of brain structure (thickness and volume)

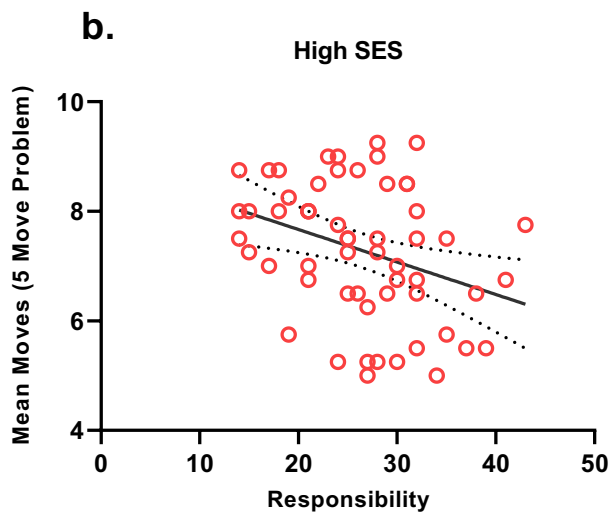
Total (*N*)	Sex (F:M)	Age (M(SD); Range years)	Race/Ethnicity (% W:L:B:Other)	Parental Education (M(SD); years)	Household Income (M(SD); Range*)	SES index (M(SD))
108	57:51	12.65(.72); 11-14	57%:7%:30%:6%	16.45(2.86)	12.67 (.74) 11 - 14	.08 (.97)

Note: W = White/Caucasian; L = Latino/a; B = Black/African American. *Household income range: 1 = < $5000 per year to 15 = $200,000 or more

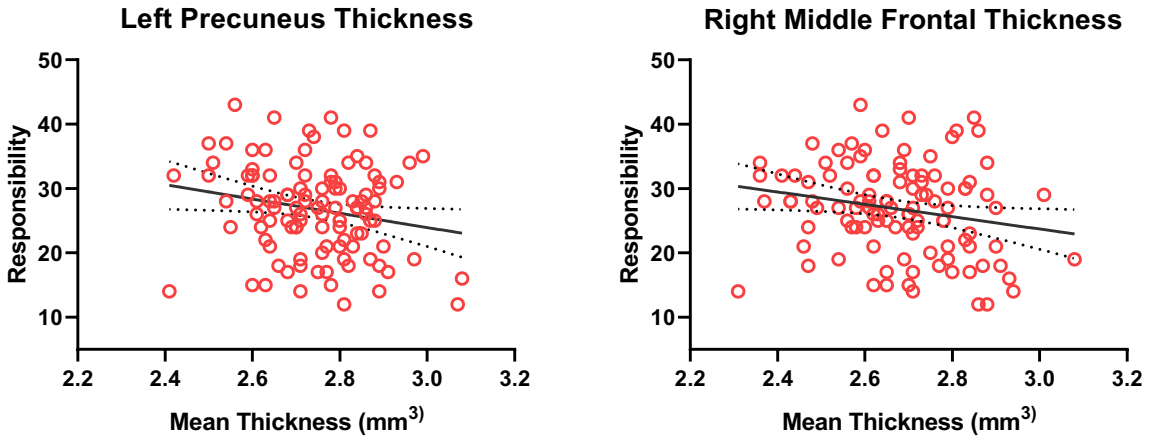


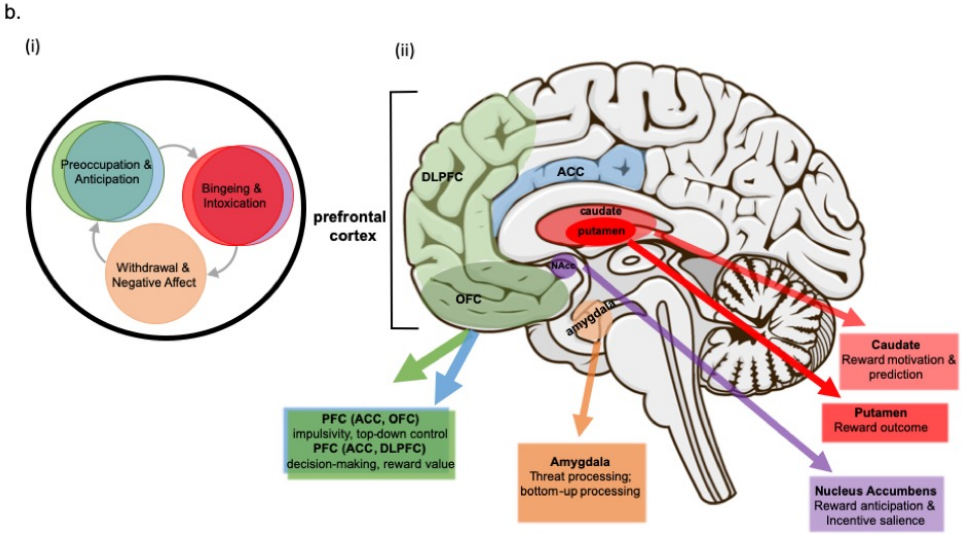


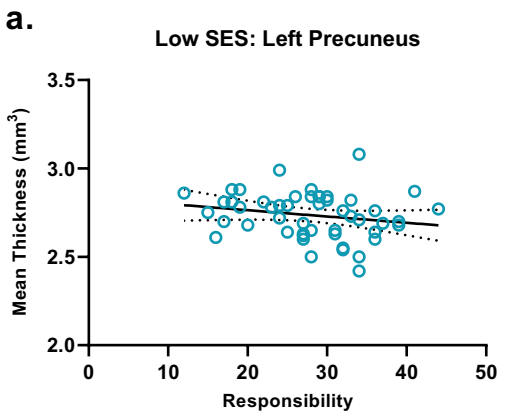


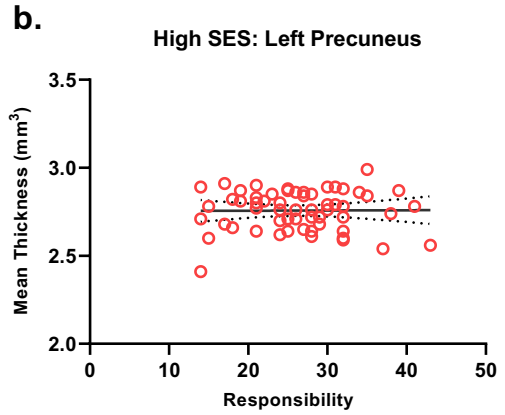


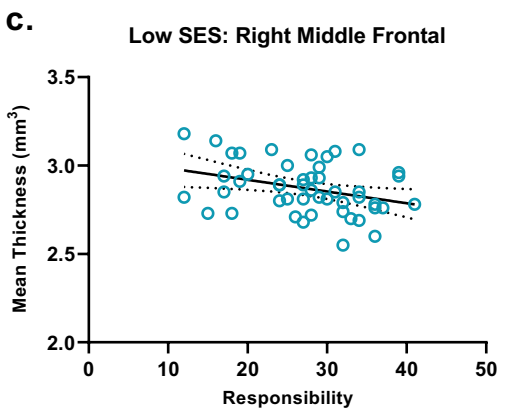
Socioeconomic Status, Responsibility, Problem Solving

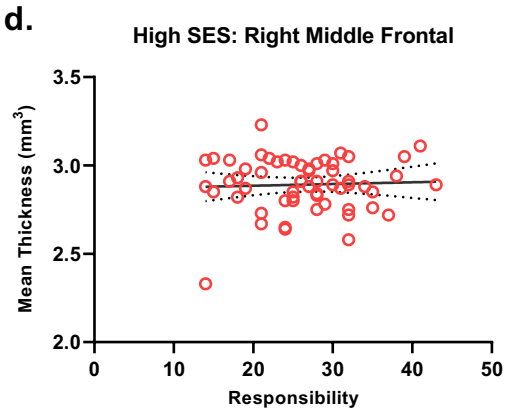












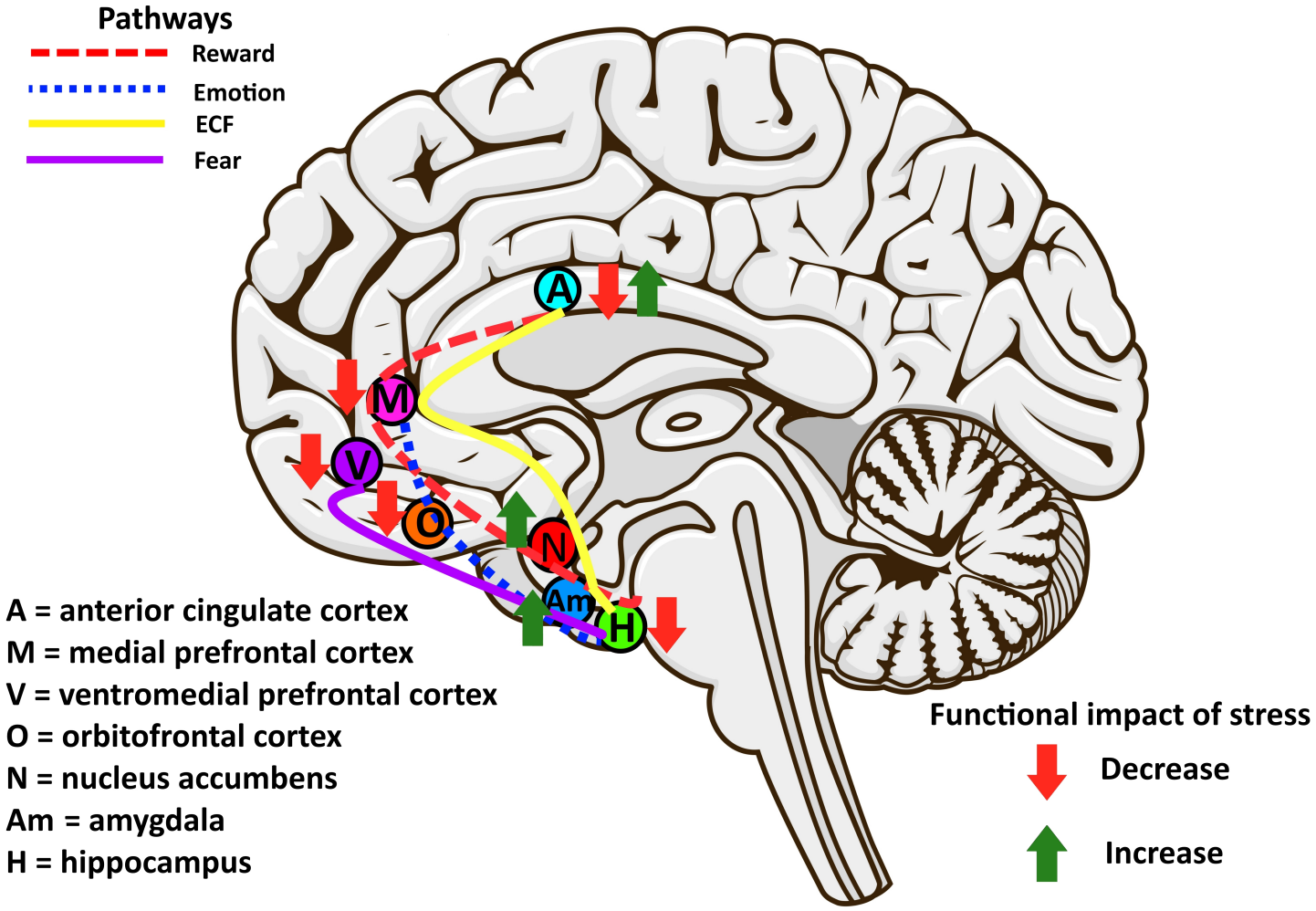
Socioeconomic Status and Responsibility Predict Brain Structure in Drug-Naïve Children

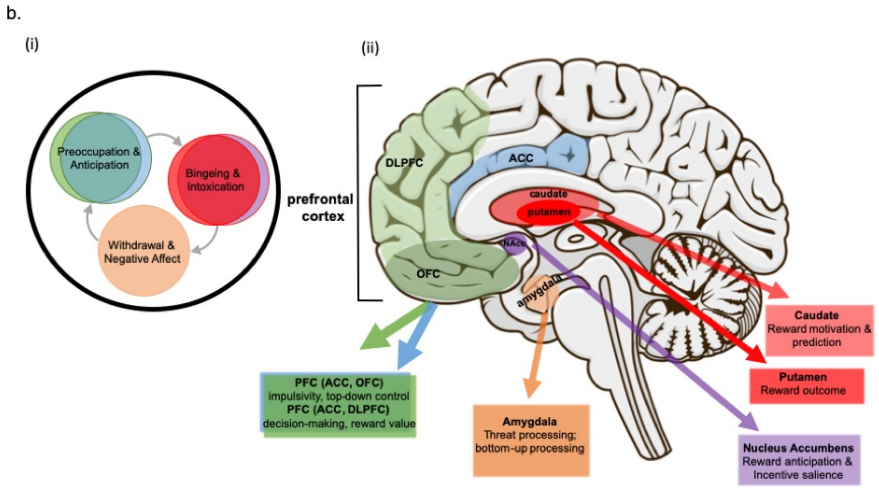
The Biological Embedding of Childhood Maltreatment

CHILD HEALTH STUDY

The Pennsylvania State University
sponsored by the National Institutes of Health

CHILD MALTREATMENT SOLUTIONS NETWORK





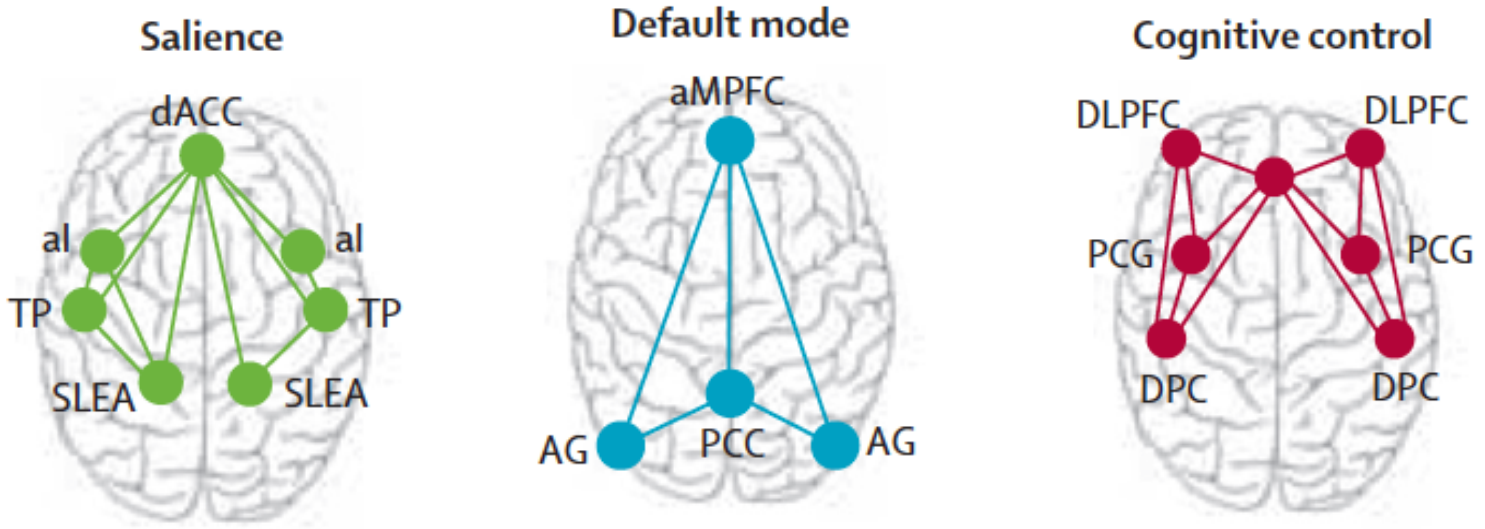
(from Rose & Fishbein, 2019)

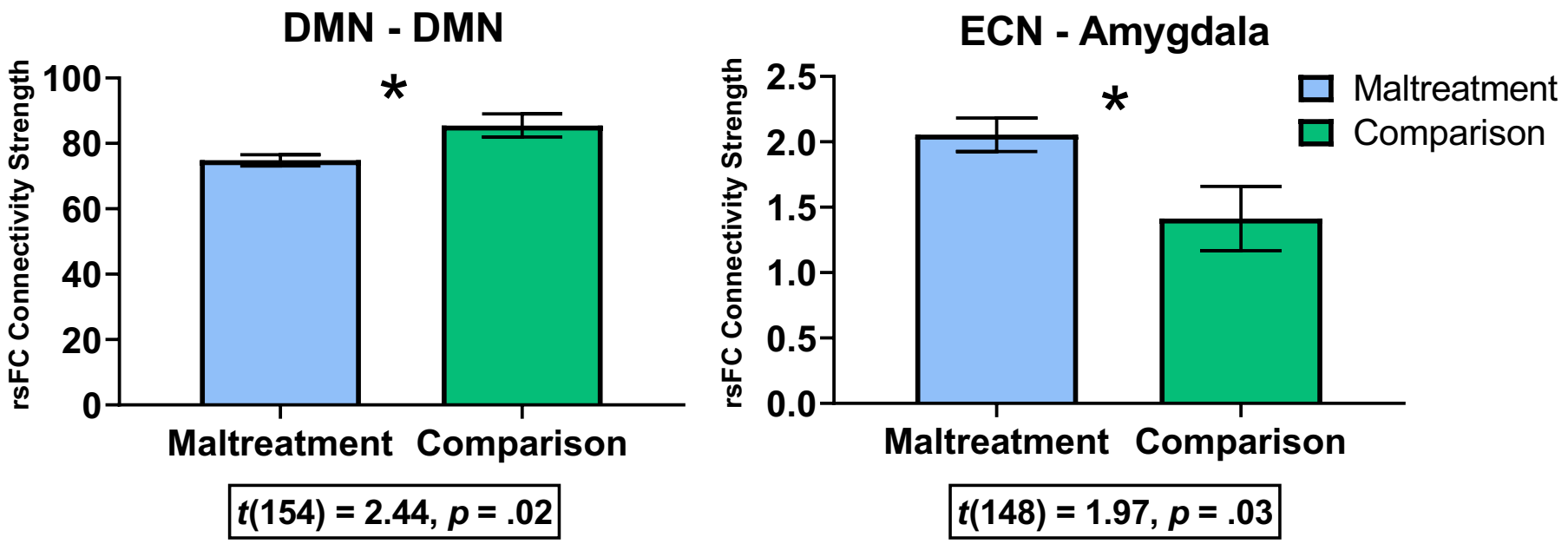
1200 8 – 13 year old children:
900 maltreatment
300 controls

- Biological Embedding Mechanisms
- Cognitive and affective functions
- Family, school and lifestyle indices

Brain health
Behavioral health
Physical Health

	Maltreatment Group (N = 132)	**Comparison Group (N = 23)**	
Age (M (SD); (years)	11.23 (1.44)	11.15 (1.52)	$t_{(154)} = .24$, p = n.s.
Gender (female: male)	59:74	9:14	$\chi 2_{(1)} = .22$, p = n.s.
Race (AA: L: W: Multi: Other)	24:8:82:13:6	5:0:17:1:0	$\chi 2_{(4)} = 3.67$, p = n.s.
Ethnicity (Hispanic: Non-Hispanic)	12:121	0:23	$\chi 2_{(1)} = 2.25$, p = n.s.
Adverse Childhood Exp. (ACES; (M(SD); (range 1-10)	3.53 (2.91)	1.32 (1.78)	**$t_{(153)} = 3.45$, $p = .001$**


Salience
dACC
al
al
TP
TP
SLEA
SLEA
Default mode
aMPFC
AG
PCC
AG
Cognitive control
DLPFC
DLPFC
PCG
PCG
DPC
DPC

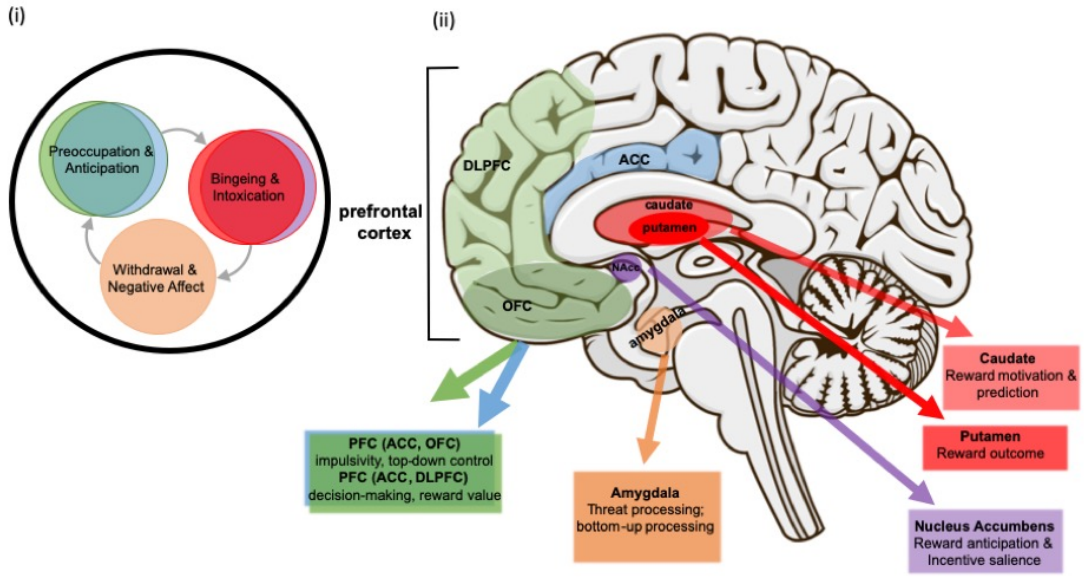

DMN - DMN
rsFC Connectivity Strength
100
80
60
40
20
0
*
Maltreatment
Comparison
t(154) = 2.44, p = .02
ECN - Amygdala
rsFC Connectivity Strength
2.5
2.0
1.5
1.0
0.5
0.0
*
Maltreatment
Comparison
Maltreatment
Comparison
t(148) = 1.97, p = .03

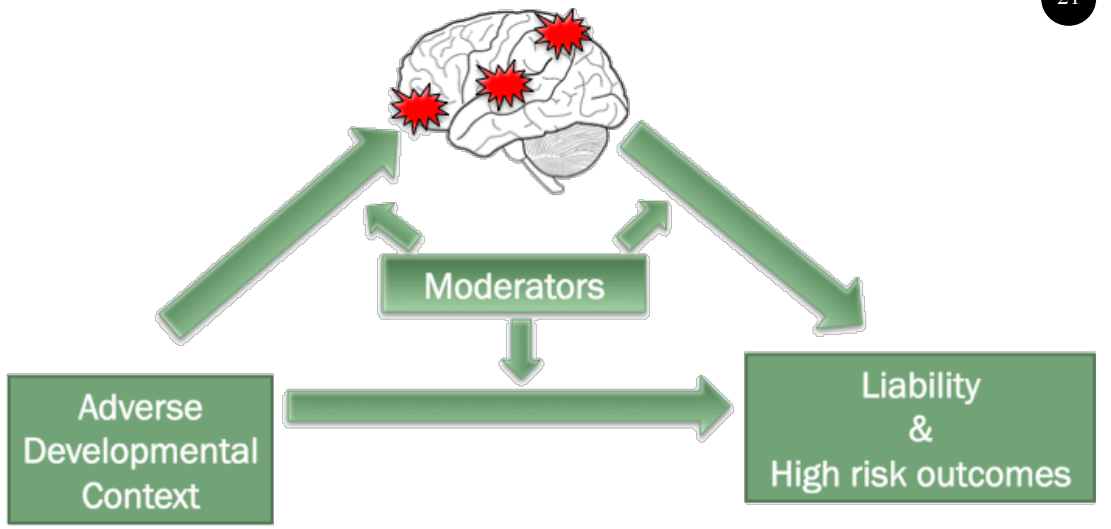
Differential Resting State Functional Connectivity Patterns Across Maltreatment Subtypes

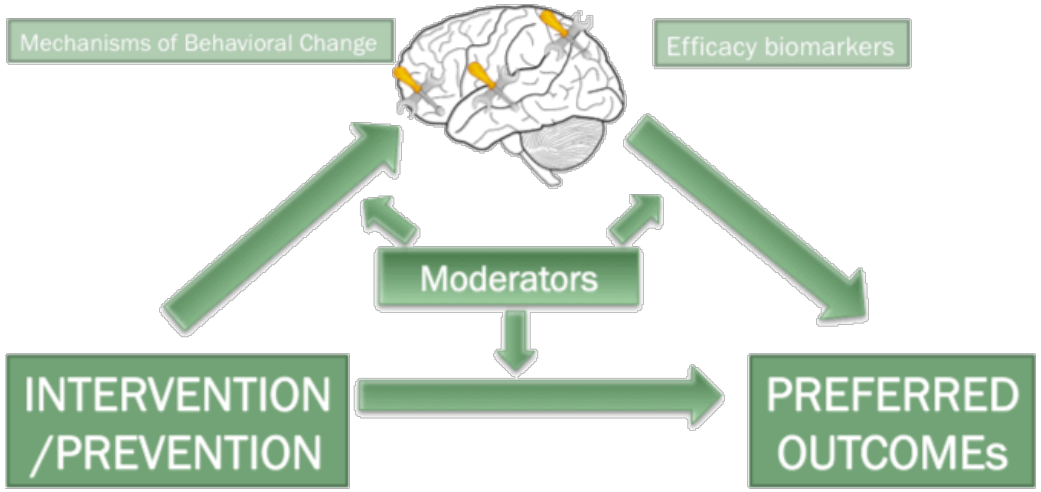
Trauma, Anxiety, and Emotion Dysregulation Predict Diminished Resting State Functional Connectivity in Maltreated Groups

Substance Use Prevention

b.







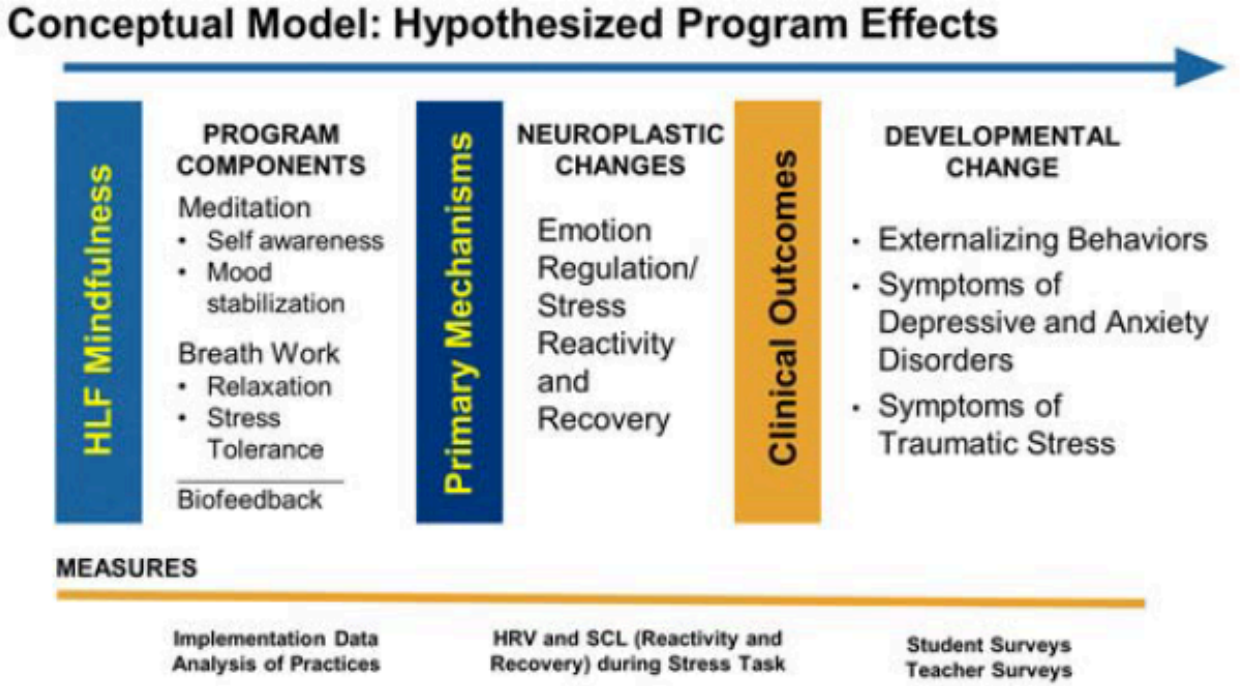
Why neurobiology? Implications for Substance Use Prevention.

WHO?

WHY?

WHAT CIRCUMSTANCES?

Aims for “neuro-prevention”



AIM 1: To measure the effects of mindfulness on physiological stress mechanisms implicated in externalizing behaviors and symptoms of affective and traumatic stress in at-risk youth

- Phase 1: Baltimore City High School Students (N=160); mindful yoga or attention control
  - Measure heart rate variability and skin-conductance during stress task

AIM 2: To compare the effects of mindfulness with and without biofeedback

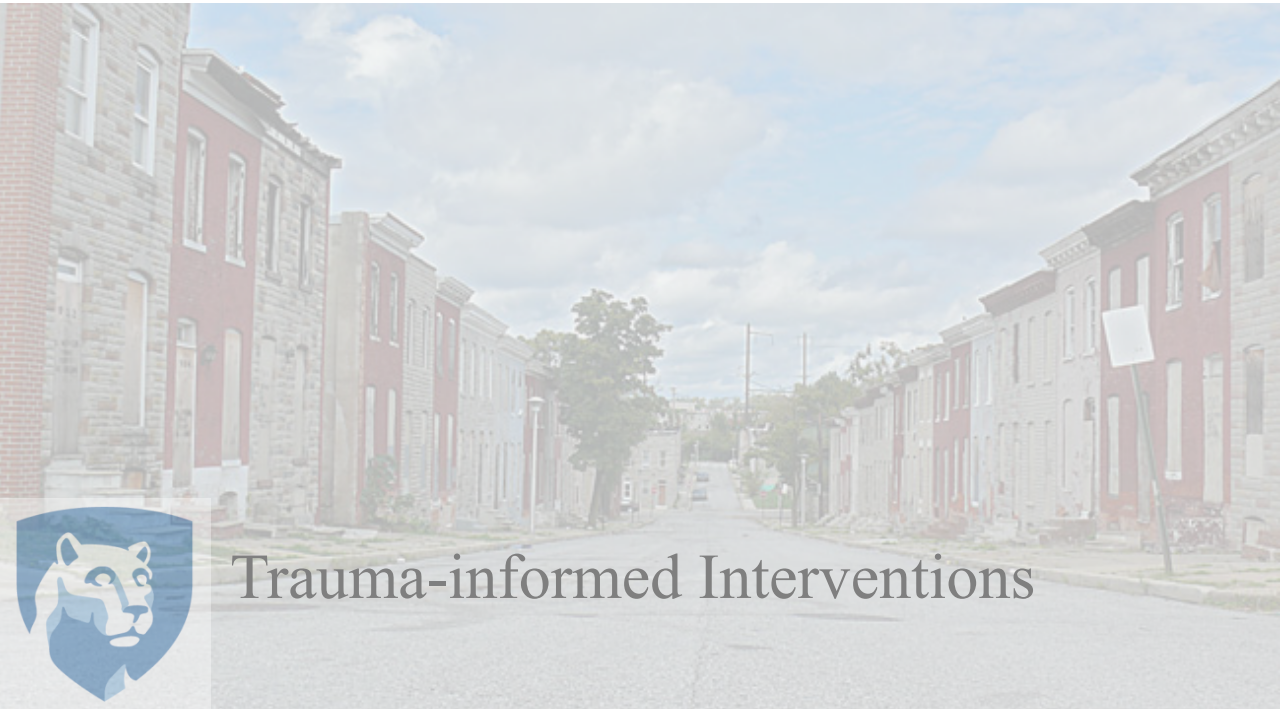
- Phase 2: Larger RCT (N=240); mindful yoga vs. mindful yoga + biofeedback

AIM 3: To determine whether changes in stress physiology mediate the effects of the most potent intervention condition on outcomes

RAP Club is a 12-session group intervention adapted from Structured Psychotherapy for Adolescents Responding to Chronic Stress (SPARCS)

8th grade program recipients (N=30) and control students (N=30)

Aim 1. To measure the direct effects of intervention on executive functioning and stress physiology in low income adolescents with a high rate of trauma.
Aim 2. To delineate the executive cognitive and physiologic mechanisms of action of this intervention.
Aim 3. To identify individual characteristics at baseline that moderate intervention outcomes.



Conceptual Model: Hypothesized Program Effects

RAP Club

PROGRAM COMPONENTS

- Awareness of stress
- Mood regulation
- Inhibition
- Distress Tolerance

Mechanisms

NEUROPLASTIC CHANGES

Stress Reactivity and Recovery

Executive Cognitive Functioning

Outcomes

DEVELOPMENTAL CHANGE

- Emotion Regulation
- Externalizing Behavior
- Academic Performance

MEASURES

Implementation Data
Analysis of Practices
Skill Acquisition

HRV and SCL (Stress Test)
CANTAB

Student Surveys
Teacher Surveys

Thank you!

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