CHILDHOOD ADVERSITY, SELF-REGULATION, & PSYCHOPATHOLOGY: FROM NEUROBIOLOGY TO INTERVENTION

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Childhood Adversity

Mental Disorders

Birth - Childhood - Adolescence - Adulthood
Overview

1. Scope of the problem
   • Childhood adversity and mental disorders in the population

2. Neurodevelopmental Mechanisms
   • Trauma exposure and emotion regulation
   • Psychosocial deprivation and cognitive control

3. Interventions
   • Plasticity in neural systems associated with early intervention
1. Scope of the problem
• Nationally representative
• National Comorbidity Survey Replication
  • 2001-2002
  • 9,282 U.S. adults
• National Comorbidity Survey Adolescent Supplement
  • 2004-2005
  • 10,484 U.S. adolescents
Diagnostic Assessment

• Composite International Diagnostic Interview
• Lifetime and 12-month DSM-IV psychiatric disorders
  • 3 Mood Disorders
  • 7 Anxiety Disorders
  • 4 Substance Use Disorders
  • 4 Behavior Disorders
• High prevalence

• Predicts the subsequent onset of mental disorders

• Associated with disorder severity

• Effects persist throughout the life-course
Public Health Impact of Childhood Adversity

- High prevalence
- Predicts the subsequent onset of mental disorders
- Associated with disorder severity
- Effects persist throughout the life-course
Childhood Adversities and Disorder Onset

McLaughlin et al, 2012, Archives of General Psychiatry
Public Health Impact of Childhood Adversity

- High prevalence
- Predicts the subsequent onset of mental disorders
- Associated with disorder severity
- Effects persist throughout the life-course
### Childhood Adversities and Disorder Severity

<table>
<thead>
<tr>
<th>Number of Childhood Adversities</th>
<th>Odds Ratio for Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
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<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
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</tr>
<tr>
<td>6+</td>
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McLaughlin et al, 2010a, *Psychological Medicine*
Public Health Impact of Childhood Adversity

- High prevalence

- Predicts the subsequent onset of mental disorders

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- Effects persist throughout the life-course
Population Attributable Risk Proportions

- **Childhood**: 44.6%
- **Adolescence**: 32.0%
- **Early Adulthood**: 28.6%
- **Mid-Later Adulthood**: 25.9%
2. Neurodevelopmental Mechanisms
Neurodevelopmental Mechanisms

Self Regulation

A set of control processes that regulate emotions and behavior in the service of long term goals
Neurodevelopmental Mechanisms

Self Regulation

Emotion Regulation

Trauma/Threat

Cognitive Control

Deprivation
Emotion Regulation Model

Antecedent-Focused

Situation  Attention  Appraisal

Experiential
Behavioral
Physiological

Response-Focused

Emotion
Response

(Gross, 1998; Gross & Thompson, 2007)
Emotion Regulation Model

Antecedent-Focused

Situation  Attention  Appraisal  Emotion

Response-Focused

Experiential

Behavioral

Physiological

(Gross, 1998; Gross & Thompson, 2007)
Physiological Reactivity to Stress

Experiential
Behavioral
Physiological

Emotion
Hypothesized Model

CHILD MALTREATMENT → ANXIETY DEPRESSION

(Liu et al, 1997; Meaney, 2001; Suomi, 1997)
Stress Reactivity

- Childhood adversity predicts emotional reactivity to stress, which mediates association between adversity and onset of anxiety disorders and depression in 70-year longitudinal study (McLaughlin et al., 2010a)

- Relationship between adult stressful life events and onset of anxiety and mood disorders is stronger among individuals with greater exposure to childhood maltreatment (Hammen et al, 2000; Espejo et al, 2002; McLaughlin et al, 2010b)
Hypothesized Model

CHILD MALTREATMENT → ANXIETY DEPRESSION
How do we differentiate adaptive versus maladaptive responses to social stress?
Samples

BOSTON

- 200 adolescents aged 13-17
- Racially and ethnically diverse
- With and without exposure to physical and sexual abuse

ROMANIA

- 260 adolescents aged 12-13
- IG, FCG, NIG
Trier Social Stress Test

• 5 minute “evaluated” speech about qualities of a good friend
  • Negative and neutral feedback
• 5 minute arithmetic task with feedback
## Theoretical Model

### Stress Responses

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<th>Challenge (Adaptive)</th>
<th>Threat (Maladaptive)</th>
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<td><strong>ANS reactivity:</strong></td>
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<td>↓ Pre-ejection period</td>
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</tr>
<tr>
<td>↓ Vasoconstriction</td>
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<td>↔ Cardiac output</td>
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<td><strong>Recovery:</strong> Quick</td>
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(Blascovich et al., 1999; Mendes et al, 2001; 2008)
Gerald sensed that more than just his reputation was riding on the success of the presentation.
# Theoretical Model

## Stress Responses

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(Blascovich et al., 1999; Mendes et al, 2001; 2008)
Autonomic Measures

Heart Rate Variability

Impedance cardiography

Parasympathetic Reactivity
- Respiratory Sinus Arrhythmia (RSA)

Sympathetic Reactivity
- Pre-ejection Period (PEP)
- Cardiac Efficiency
- Cardiac Output (CO)
Impedance Cardiography
Research Question

THREAT APPRAISAL

CHILD MALTREATMENT

ANXIETY DEPRESSION
Maltreatment & Threat Appraisal

- The task will be demanding
- The task will be stressful
- I have the abilities to perform well on the task
- I view the task as a positive challenge
- The upcoming task represents a threat to me

Abuse

\[ F = 10.62, \ p = .001 \]
Maltreatment & Cardiac Output

A Cardiac Output (ml/min)

** No Abuse

** Abuse

Prep

Speech

Math
Mediation Analysis – CO Reactivity

\[ \beta = 0.38, \ p \leq 0.001 \]

\[ 95\% \ CI: (0.02, 0.17) \]
Sample

- 200 adolescents aged 13-17
- Racially and ethnically diverse

- 60 adolescents
  - 20 exposed to physical or sexual abuse
  - 20 age, gender, and handedness-matched controls
  - 20 exposed to community violence (not shown)
Emotion Regulation Task

(Ochsner et al., 2004)
LOOK
STRENGTH OF EMOTION

0 1 2 3 4

LOW MEDIUM STRONG
DECREASE
1. Psychological distancing
   (the situation is far away, the people aren’t real, the situation isn’t relevant to you)

2. Improvement with time
   (the situation will get better)

3. Reframing
   (the situation is not as bad as it looks)
Neural Correlates of Regulation

(Ochsner et al., 2004)
Emotional Reactivity and Regulation

Emotional Reactivity $\rightarrow$ Amygdala Activation
- Maltreated $>$ Controls during Look trials

Emotion Regulation $\rightarrow$ Amygdala and PFC Activation
- Maltreatment $>$ Controls during Regulation trials relative to Look trials
Neural Correlates of Regulation

(Ochsner et al., 2004)
Greater activation for maltreated teens than controls during emotional reactivity:
*Amygdala and putamen*
Regions with greater activation for controls than maltreated teens during emotion regulation:

**Dorsal anterior cingulate cortex (PFC)**
Regions with greater activation for maltreated teens than controls during emotion regulation:

Amygdala and hippocampus
Neurodevelopmental Mechanisms

Self Regulation

Emotion Regulation

Trauma/Threat

Cognitive Control

Deprivation
Bucharest Early Intervention Project

- 136 children aged 6-30 months living in institutions in Bucharest
  - Half of children randomized to foster care intervention
- 72 community controls
- Brain development assessed using MRI
- DSM-IV diagnoses assessed at multiple time points
- Multiple aspects of development assessed repeatedly over time

(Zeanah, Nelson, Fox, et al., 2003)
Institutionalization & Deprivation

• Isolation
  • Little interaction with peers or adults
  • No response to distress

• Lack of psychological investment by caregivers
  • Rotating shifts
  • High child/caregiver ratio

• Insensitive care
  • Regimented schedule
  • Non-individualized care
Institutionalization and ADHD

ADHD Prevalence

- Institution
- Foster Care
- Community
• Used to detect grey/white matter borders and identify:
  • Grey and white matter volume
  • Cortical thickness across numerous cortical areas
  • Volume of sub-cortical limbic structures:
    • Amygdala, hippocampus, basal ganglia (caudate, putamen, globus pallidus, nucleus accumbens)
How the Brain Looks to MRI
Used previously with children\textsuperscript{1-3} and adults\textsuperscript{4} to study typical development and ageing.

Deprivation & Brain Development

1. Gray Matter

1. White Matter
Gray Matter Development

Frontal Lobe Gray Matter

(Lenroot & Giedd, 2006)
Synaptic Density

Development Differences in Synaptic Density of Layer 3 Human Frontal Cortex (Huttenlocker 1979)

Years

Synapses / mm$^3 \times 10^8$

NB 0.5 1 5 10 15 20 40 60 80 100
Cortical Grey Matter

(Sheridan, et al., 2012, *PNAS*)
Gray Matter Development

Frontal Lobe Gray Matter

(Lenroot & Giedd, 2006)
• Cortical thickness differences in regions associated with working memory, impulsivity, attention, and other aspects of cognitive control
Working Memory

![Graph showing IG, FCG, and NIG with error bars.](image)
Institutionalization & Inattention

64.8%

Institutional Deprivation → 64.8% → Inattention

(McLaughlin et al., 2013, Biological Psychiatry)
Institutionalization & Hyperactivity

81.7% (McLaughlin et al., 2013, *Biological Psychiatry*)
Specificity of Threat & Deprivation

- Reduced thickness in previously-institutionalized children
- Reduced thickness in abused children
- Reduced thickness in both groups
- No group differences
3. Intervention Effects
High-Quality Foster Care

• Foster parents carefully screened and selected by study staff

• Trained in sensitive, responsive caregiving

• Supported by social workers who made weekly visits to help manage behavior problems and support families

• Foster parent support groups
Nelson et al. (2008) Science
Attachment Security

Institution Foster Care Community

Secure Insecure

Internalizing Disorders

Deprivation & Brain Development

1. Gray Matter
2. White Matter
White Matter Development

White Matter

- Nucleus
- Oligodendroglia
- Axon
- White Matter

Age in years

95% Confidence Intervals

Male (152 scans from 90 subjects)
Female (91 scans from 55 subjects)

Volume in cubic cm

Age in years
Myelin $\rightarrow$ Increased Bandwidth

Speed 100x

Signal “hops” between nodes of Ranvier
(Sheridan, et al., 2012, *PNAS*)
Corpus Callosum

B = -67.6, t = 2.0, p = .05

B = -65.6, t = -3.1, p = .003

B = -37.1, t = -1.9, p = .06

B = -55.6, t = -1.9, p = .06

B = -63.7, t = 1.4, p = .07
Childhood Adversity

Mental Disorders

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Childhood Adversity
Thank You

Collaborators:
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