POST-INSTITUTIONALIZED CHILDREN BECOME TEENAGERS: EARLY DEPRIVATION AND THE DEVELOPING TEEN BRAIN

Megan R. Gunnar
Institute of Child Development
University of Minnesota
Plan for the Talk

* How Does Experience Affect Brain Development?
* Sequelae of Early Institutional Rearing in Neurobehavioral Functioning of Post-institutionalized (PI) Children Prior to Puberty
* Normative Changes in Neurobehavioral Development in Adolescence
* Behavioral and Emotional Problems of PI Adolescence
* Emerging work on Puberty and Brain Development in PI Youth
* Glass Half Empty and Half Full: Risk and Resilience
How Does Experience Affect Brain Development?
Building Healthy Brain Architecture – The Ingredients

* Takes more than having the right genes
* Takes the right, supportive experiences
* In fact, we now know that experience literally writes on our genes, determining how well our genes work
How Early Experiences Alter Gene Expression and Shape Development
Genes Carry Instructions that Tell Our Bodies How to Work
Early Experiences Leave Lasting Chemical “Signatures” on Genes

External Experience

Gene Regulatory Proteins

Epigenetic “Signature” Turns Gene On or Off
Prenatal Conditions

• Maternal Conditions
  • Malnutrition
  • Infections
  • Severe & Chronic Stress
  • Drug and Alcohol Use
• Fetal Conditions
  • Low Birth Weight
  • Early Delivery
  • FAS/FAE
Experience Shapes Brain Architecture by Over-Production Followed by Pruning
(700 synapses formed per second in the early years)
Neural Circuits are Wired in a Bottom-Up Sequence

Sensory Pathways (Vision, Hearing)

Language

Higher Cognitive Function

FIRST YEARS

Birth (Months) (Years)

Stimulation is Needed In Order for the Brain To Develop

Human Infant is Unable to Provide Itself Adequate Stimulation for Normal Brain Development
The Brain Develops in the Context of Relationships
Physical Growth: Rapid
Motor Development: Rapid
Language Development: Rapid
Social Development: Rapid
Most children are within normal ranges of development by 2 years post adoption
Impact of Early Institutional Rearing on Neurobehavioral Functioning of Post-institutionalized (PI) Children Prior to Puberty

Social Cognitive Skills Underlying Social Competence

Emotional Responses: Anger and Fear

Risk Taking and Sensitivity to Rewarding Stimuli
Parents Tell Us that PI children often struggle with being as socially competent as their peers.

Building Blocks of Social Competence
- Reading and Understanding Emotions
- Perspective Taking
- Understanding and Appropriately Negotiating Social Boundaries and Intimacy Rules
- Ability to Regulate Emotions and Behaviors
Reading and Understanding Emotions

* Long developmental progression to full adult competency; adults also differ in their emotion skills
* Several years after adoption, around age 5, children adopted from institutions in Russia/Eastern Europe have difficulty identifying emotions in static pictures of faces and in mapping the emotion to the context. (Fries & Pollak, 2004)
* But there is some evidence that reading peak emotional expressions may be spared or recoverable (McDermott).
* Parent Report at age 8 (Gunnar et al), PI children are poorer at
  * (1) interpreting peers emotions and behavior
  * (2) being considerate of other’s feelings
With development children come to understand that other people have minds (thoughts, beliefs, perceptions) and that these may differ from their own.

TOM is at the very least delayed and for some PI children may be seriously impaired.

For Good or ILL

- Basis for being good at deception
- Basis for being good at being socially cruel
- Important skill to avoid being deceived and manipulated
- Important skill to have in order to respond appropriately to others who are different from ourselves.
Indiscriminate Friendliness: Responding to friendly or neutral strangers as if they were “intimates”.

Neither completely indiscriminate nor really “friendly”

Likely serves a role in getting child’s social needs met while in the institution

Decreases rapidly for many children once placed in a family

Does not resolve for a substantial number
Indiscriminate Friendliness

* Not a reflection of a poor attachment relationship to the adoptive parent.
* Associated with problems in cognitive inhibitory control (i.e., like playing red light/green light or Simon Says)
* Disinhibited Social Approach might be a better term
* Not just about being more sociable. More about violating boundaries or engaging in social behavior that is inappropriate for the context
* Indiscriminate Friendliness changes in form with development, but has been reported among adolescent PI children. (Asking inappropriately intrusive questions, sharing too much private information, pesterling teachers/peers)
Emotions
Anger and Fear

- Anger and Aggression
  - In childhood, PI children are not more aggressive nor do they have more conduct problems than children reared in their birth families
  - They do have more problems with controlling “meltdowns”. ---- Emotion Regulation

- In childhood, PI children report more fear/anxiety than do birth children and children adopted from overseas foster care
Children’s Self Reports of Sad and Anxious Feelings at Age 8 & 9

![Graph showing standard scores for Sad/Lonely, Separation Anxiety, and General Anxiety]

Wiik et al., 2011
Risk Taking and Reward Seeking

- Anxious children take fewer risks, but early deprivation may make it harder to judge risks.
- Risk taking increases in adolescence
- Where are PI children on Risk Taking Prior to Adolescence?
- Two tasks: Children 12-13 years, all were pre/early puberty
  - Self Report of Sensation Seeking
  - BART Balloon Task
Thrill and Adventure Seeking and Social Disinhibition Combined

Prepubertal

Loman et al., unpublished
Balloon Analogue Risk Task (BART)

PRE-Pubertal

- Press to Collect $$$
- Press this button to pump up the balloon
- Total Earned: $0.00
- Last Balloon: $0.00

![Graph showing PUMPS with categories PI and NA]
PI children show remarkable recovery from early deprivation once placed in supportive families.

Many do extremely well.

Despite this, as a group they exhibit delays/deficits in:

- Skills needed for being socially competent
- Regulating strong emotions
- More anxious
- Lower in risk taking
Teen Years

(It was the best of times; it was the worst of times)
Complex time, especially for adopted youth because identity issues are particularly tricky to solve.

Longitudinal Studies have shown that PI youth are particularly vulnerable (Rutter et al):
- Increase in depression, more so than other children
- Increase in conduct problems, more so than other children
- Emergence of emotional and conduct disorders in youth who had not shown them before the teen years
- Most vulnerable were the youth who had problems with TOM, Indiscriminate Friendliness, Lower IQ
Adolescent Brain Development

**FROM HERE TO MATURITY**

Brain scans showing how the brain matures between the ages of five and 20. Grey matter decreases in a wave from the back to the front of the brain as unwanted neural connections are pruned.

**The Adolescent Years**

- Greater capacity to learn and create
- Increased risk of damage from drugs and alcohol
- Increased risk of developing addiction
- Increased risk of mental illness
- Increased desire for risk taking
- Parts of brain that control impulses and emotions not yet mature
Decision Making and Self Control

Working Memory
Cognitive Control
Planning

Valence (pos/neg)
Input to Amygdala
Reward Circuits

- Reward/Addiction
- Orbital PFC (value; past rewards)
- PFC
- NAcc
- Dopamine
- VTA
- Hippocampal formation
- Memory for Events
Reward Sensitivity and Cognitive Control

Rational Decision Making & Cognitive Control

Childhood  Adolescence  Young Adult
Rational Decision Making & Cognitive Control

Reward Sensitivity

Childhood  Adolescence  Young Adult
Fear and Its Regulation
Sex Hormones Change the Brain

2\textsuperscript{nd} Sensitive Period
Fear and Stress

Amygdala

Hypothalamus

Cortisol

Adrenaline
Increase in Response to the Trier Social Stress Test with Puberty

Cortisol in ug/dl

Gunnar et al., 2009

Age range: 9 to 15 years
Emerging work on Neurobehavioural Development and Puberty in PI youth
Prefrontal Cortex Volume x Group

- Minnesota Controls
- Earlier Adopted (<= 12 months)
- Later Adopted (> 12 months)

<table>
<thead>
<tr>
<th>Group</th>
<th>Left Prefrontal Cortex</th>
<th>Right Prefrontal Cortex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota Controls</td>
<td>75,000</td>
<td>82,000</td>
</tr>
<tr>
<td>Earlier Adopted</td>
<td>77,000</td>
<td>85,000</td>
</tr>
<tr>
<td>Later Adopted</td>
<td>79,000</td>
<td>87,000</td>
</tr>
</tbody>
</table>

Note: * indicates a statistically significant difference.
Fear and the Amygdala (9-18 years of age)

Maheu et al., 2010
Early Deprived Youth Respond More to Negative Faces

Maheu et al., 2010
Hypo-responsiveness to Reward in PI Adolescence

- Monetary Incentive Task
- Comparison Youth the Reward System responded
- PI Youth, no response in the reward system
- Caution: Extremely deprived

Mehta et al., 2010
Thrill and Adventure Seeking and Social Disinhibition

Scale Scores

Pre/Early
Mid/Late

PI
Non-Deprived

Loman et al., unpublished
BART and PUBERTY

![Bar chart showing comparison of PUMPS between Pre/Early and Mid/Late stages.]

- **Pre/Early**:
  - PI: 25
  - NA: 35

- **Mid/Late**:
  - PI: 25
  - NA: 40
Increase in HPA Reactivity to Performance Stressor with Puberty

Stroud et al., 2009
Cortisol Levels 6-7 years Post Adoption
Romanian Children Adopted in 1990-1991
Ames Study of British Columbia

Salivary Cortisol in ug/dl

Romanian Institutionalized Group

> 8 months
< 4 months
family reared

Gunnar et al., 2001
Growth (Height) Suppression in Institutionalized Children

Lack of Nurture
Poor Nutrition
Parasites/Illness

Chronic Stress
CRF− Decrease GH
CORT−Decreases Tissue Response to GH

Stunted: $Z \leq -2$ Sds; 40% of PI children

Parent Reported Deprivation
IA Foster and Institutions

$z$ height for age at adoption
$N=1,125$
Growth System and HPA Axis

- CRH
  - GHRH (+)
  - Somatostatin (-)

- Bone Growth
- Muscle Development
- IGF-1
- GH
- Cortisol

The pituitary secretes hormones that are essential to growth and reproduction.
STUNTING MODERATES RELATIONS BETWEEN INSTITUTIONAL CARE AND CORTISOL LEVELS

Children 9-11 years
Trier Social Stress Test

Gunnar et al., Psychoneuroendocrinology, 2009
Pubertal Stress Recalibration Hypothesis

Development

Conditions
- Harsh
- Benign

Neuronal Development
- Plasticity
- Stability
- Plasticity
- Stability

Calibration → Recalibration
Degree of Abnormality in the Cortisol Awakening Response

12 and 13 year olds

- Pre/early: PI (20), NA (10)
- Mid/late: PI (10), NA (10)
Teen Years

(It was the best of times; it was the worst of times)
Summarize

* Normative Development of the Teen Brain
  * Maturation of brain regions involved in rationale decision making
  * Period of increased activity of reward-sensitive/addiction-prone systems
  * Period of Increased stress hormone activity and thus maybe plasticity of fear/anxiety systems

* Development in children exposed to deprivation/neglect early in life
  * Impaired/Delayed Development of systems involved in rational decision making
  * Heightened responsivity in fear system
  * Hypo-responsivity of brain reward systems
  * Possibility of recalibration of stress system
    * Critically important to reduce psychosocial stress in adolescence for PI children
    * Support the development of skills that will allow them to successfully navigate the teen landscape making adolescence some of the best, not worst, of times
Thanks to Many

* Gunnar Research Laboratory Staff & Students
  * Bonny Donzella, Shanna Mliner, Kristin Frenn, Meg Bale, Bao Moua, Karina Quevedo, Anna Johnson, Michelle Loman, Kristen Wiik, Cam Hostinar, Elisa Esposito, Sarah Stellern, Jamie Lawler, Jena Doom,

* International Adoption Project
  * Dana Johnson, Maria Kroupina, Rich Lee

* Early Experience, Stress and Neurobehavioral Development Center
  * Nathan Fox, Mary Dozier, Phil Fisher, Mary Dallman, Steve Suomi, Mar Sanchez, Jackie Bruce, Katherine Pears, Paul Plotsky, Jim Ritchie, Hyun Kim

* National Scientific Council on the Developing Child

* National Institute of Mental Health