**Reversing Programmed Adversity: The Romanian Orphan Study**

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**Precis**

I. The impact of experience on the brain is not constant throughout life.

II. Early experience often exerts a particularly strong influence in shaping the functional properties of the immature brain.

III. Many neural connections pass through a period during development when the capacity for experience-driven modification is greater than it is in adulthood.

IV. Such phases are referred to as sensitive or critical periods.

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**Early windows of experience shape brain function**

- In utero
- Environment
- Critical period
- Genes
- Behavior
- Adulthood

- Development
- Motor / Language
- Sensory

Figure courtesy of Takao Hensch 3
What happens to the brain when it is deprived of expected experiences?

- For the brain to “wire” correctly, it needs input; the lack of input could lead to under-specification of circuits and miswiring of circuits
- Normative input is lacking among children living in neglectful environments; thus, might expect errors in brain development among such children
- Moreover, the timing of when the neglect occurs could prove important; if certain experiences fail to occur during critical periods, the consequences could be worse than if the neglect occurs at a later age.
- Thus, we studied children growing up in profound neglect – large, state-run institutions in Romania; thought of institutionalization as a model system for understanding neglect

Study Design

First ever randomized controlled trial of foster care as intervention for social deprivation associated with institutionalization
- >180 children screened;
- 136 institutionalized children between 6 and 31 months initially assessed at baseline (Mean Age=20 months)
  - 68 randomly assigned to remain in institution (CAUG);
  - 68 randomly assigned to foster care (FCG);
- 72 never-institutionalized children (NIG) matched on age and gender serve as controls
- Following baseline assessment, children assessed comprehensively at 9, 18, 30, and 42 months...then again at 8 and 12 years; 16 year follow up has begun.
Summary of Behavioral Findings

Effects of Institutional Care –
- Reduction in IQ; reduction in language, motor, and social-emotional development; deficits in executive functioning; high prevalence of psychopathology

Effects of Intervention –
- Improvement in most domains except executive functioning; also no reduction in ADHD
- But… of those domains that improved, many were tied to critical periods – placement before ~24 months led to more improvement than >24 months (see next slide)

Timing of placement effects

<table>
<thead>
<tr>
<th>Variable assessed</th>
<th>Sensitive period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stereotypies</td>
<td>12 months</td>
</tr>
<tr>
<td>Expressive language</td>
<td>15 months</td>
</tr>
<tr>
<td>Receptive language</td>
<td>15 months</td>
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<tr>
<td>Security of attachment</td>
<td>24 months</td>
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<tr>
<td>Organization of attachment</td>
<td>24 months</td>
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<tr>
<td>IQ at 54 months</td>
<td>24 months</td>
</tr>
<tr>
<td>Alpha and theta EEG power at age 8 yr</td>
<td>24 months</td>
</tr>
<tr>
<td>Teacher rated social skills at age 8 yr</td>
<td>20 months</td>
</tr>
<tr>
<td>Cortisol/vagal tone</td>
<td>24 months</td>
</tr>
</tbody>
</table>

Some specific findings

- Brain
- Stress responsivity
EEG

EEG Activity at Baseline (22 months)

Institutionalized children (IG)

Never institutionalized children (NIG)

Follow up Findings for alpha band (7-12 Hz) (8 Years)

CAUG

FCG > 24

NIG

Vanderwert et al. (2010) Ped.Drive
Summary

Institutionalization leads to dramatic reduction in brain activity (EEG power)
Placement in foster care leads to recovery, particularly if placement occurs before 24 months
Intervention effects persist through age 12 (i.e., no washout)

Magnetic Resonance Imaging
Diffusion Tensor Imaging (DTI)

Measurement of white matter “integrity”
- Organization and density of white matter tracts, degree of myelination, axonal projection
- Quantitative estimates
  - Fractional Anisotropy: organization
  - Mean Diffusivity: neuronal membrane density
    - Axial Diffusivity: projection/degradation of fibers
    - Radial Diffusivity: degree of myelination

48 white matter tracts examined
Summary

Structural MRI revealed dramatic reduction in gray and white matter, with partial remediation of white matter following placement into foster care.

DTI revealed that some white matter tracts recovered with intervention (e.g., fornix, cingulum), whereas others do not (e.g., body of corpus callosum).

This is part of a consistent story across the first 12 years – that not all domains benefit from the intervention (although most do).
Responsivity to Stress

Development of Stress Response Systems

- Disruptions in stress response system functioning are thought to be a central mechanism by which exposure to adverse early-life environments influences human development
- Extensive evidence suggests that caregivers play a critical role in regulating responses to stress in children
- Early regulation of stress responses by caregivers may have lasting effects on development of stress response system

Research Questions

1. How does profound early-life psychosocial deprivation influence ANS and HPA axis reactivity?
2. Does randomization to a high-quality environment mitigate these effects?
3. Does the timing of placement matter?
Delivered a speech about what makes a good friend in front of two teachers that they never met before

- Preparation
- Speech
  - Negative and neutral feedback
- Math
  - With feedback about accuracy

**Trier Social Stress Test**

**TSST Reactivity**

**Cortisol Reactivity**
Does the timing of placement matter?

Timing of Placement

![Graph showing cortisol levels over time for different groups (Baseline, Peer, TSST, Frustration, Recovery) and for two age groups (< 24 months and > 24 months). The graph indicates that cortisol levels vary significantly between the groups.]

Timing of Placement

![Graph showing RSA (Relative Spectral Area) changes for different age groups (< 18 months and > 18 months) across Prep, Speech, and Math tasks. The graph indicates that RSA changes are significant for some tasks.]
Summary

- Psychosocial deprivation is associated with a pervasive pattern of blunted physiological responses to stress, in both the sympathetic nervous system and HPA axis.
- Random assignment to high-quality family care following institutionalization mitigates otherwise persistent effects of early psychosocial deprivation on the functioning of stress response systems in children.
- Earlier age of placement into foster care leads to normalization of cortisol reactivity and enhanced vagal engagement during social tasks.

Overall Conclusions

- Exposure to profound deprivation in first years of life leads to greatly altered developmental trajectory.
- Placement into families (high quality foster care) before ~2 years lead to great improvement in functioning (although not in all domains and not to the same level as never institutionalized children).
- Take-home: important implications for thousands of children in US exposed to early neglect and millions of children being raised in institutions around the world.

THE FUTURE

History of institutional care associated with reduced telomere length.

Question: are there health consequences associated with a) history of institutional care generally or b) telomere length?
The End
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