CRITICAL PERIODS IN THE DEVELOPMENT OF ATTACHMENT: LESSONS FROM THE BUCHAREST EARLY INTERVENTION PROJECT

NATHAN A. FOX, DISTINGUISHED UNIVERSITY PROFESSOR

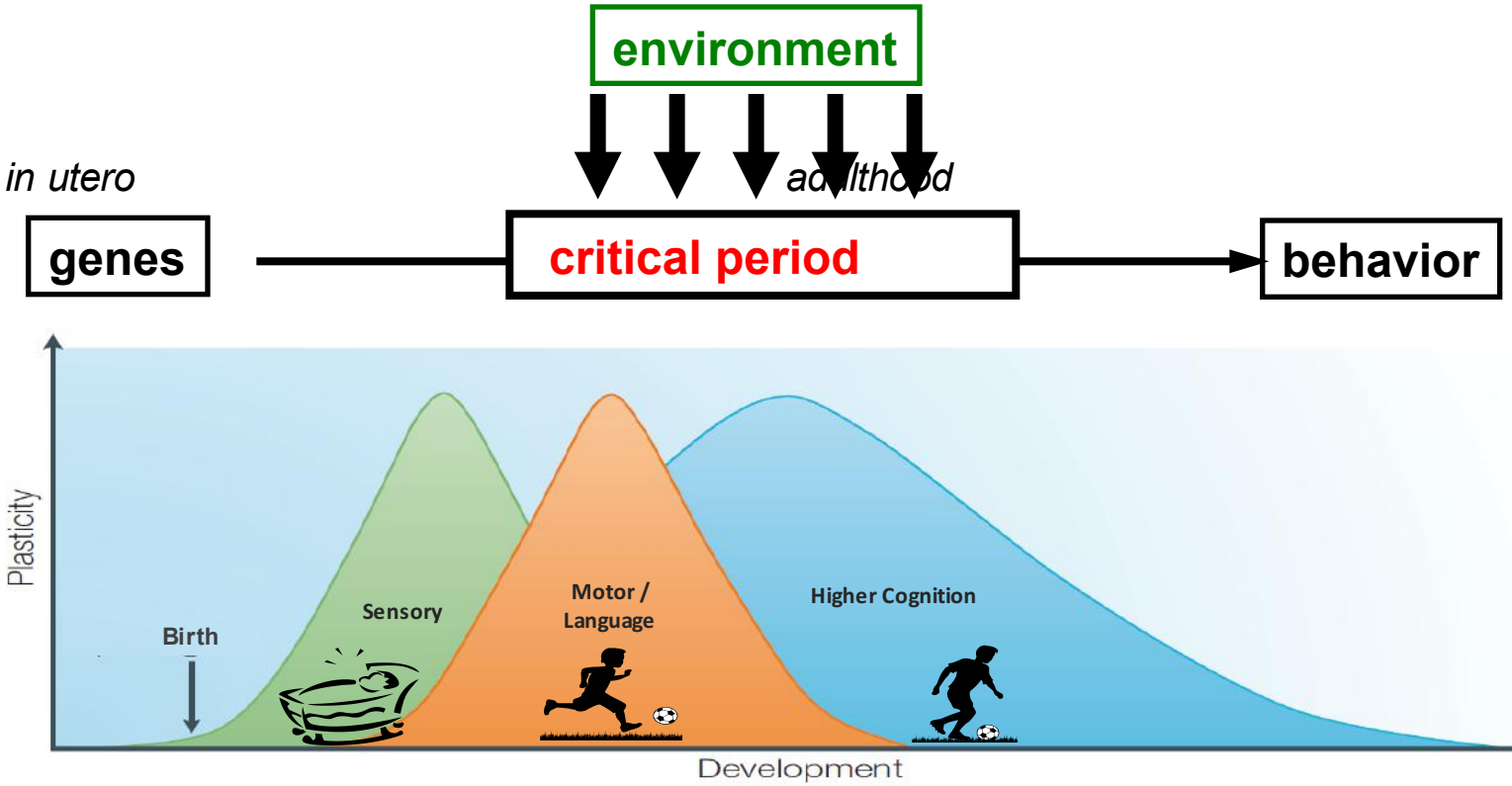
UNIVERSITY OF MARYLAND

SACKER BRAIN COURSE: THE NEUROBIOLOGY OF ATTACHMENT

AMERICAN MUSEUM OF NATURAL HISTORY

JANUARY 21, 2017

Early Windows Of Experience Shape Brain Function



CRITICAL PERIODS

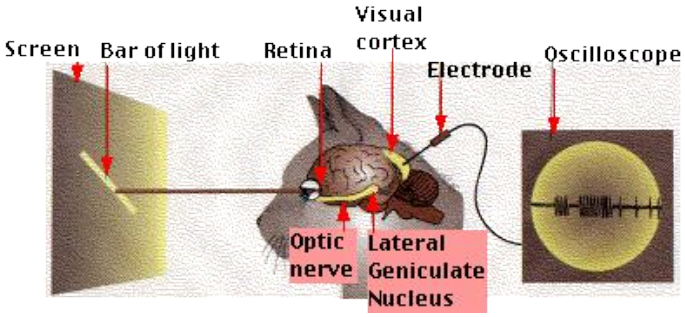
Are limited time periods during which the effect of experience on the brain is particularly strong

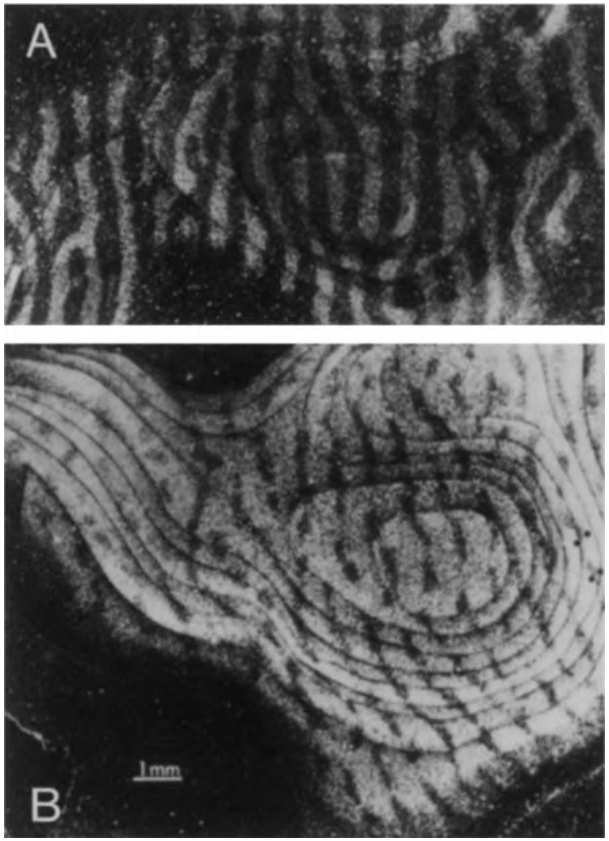
Allow experience to instruct neural circuits to process information in an adaptive way

Provide information that is essential for normal development and may alter performance permanently

Lorenz and imprinted ducklings walking after him

Hubel and Weisel: Classic studies on early experience and critical periods





Monocular deprivation in early infancy led to deficits in brain organization in visual cortex

Studies of infants born with bilateral cataracts—timing of surgical removal

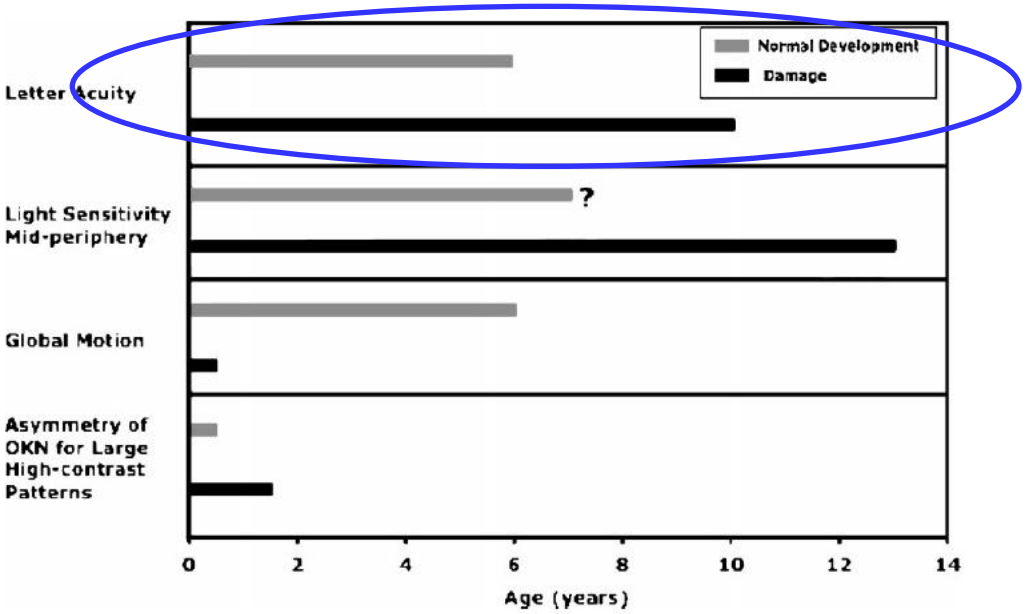


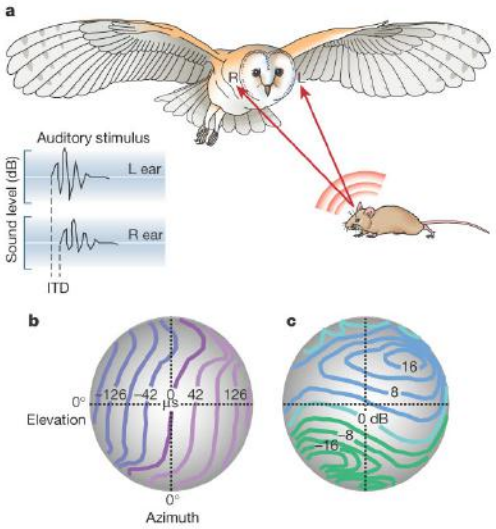
FIGURE 9 Examples of sensitive periods across four aspects of vision. Gray bars represent periods of normal development, and black bars represent sensitive periods for damage. Ages indicating the end of each period are approximate and apply to the conditions described in the text. For convenience, we chose birth as the beginning of each sensitive period for damage, although the actual ages are unknown. The graph illustrates that the period of normal development ends at ages varying from a few months (asymmetry of OKN for large, high-contrast patterns) to 6 or 7 years of age (letter acuity, global motion, and perhaps light sensitivity in the midperiphery—for which 7 years is the youngest age tested beyond infancy). The sensitive period for damage can be considerably longer or shorter than the period of normal development.

Daphne Maurer

Effects of unilateral and bilateral deprivation of patterned vision (Lewis & Maurer, 2005)

Critical Periods for Integration of Auditory and Visual Information

Eric Knudsen studies Barn Owls manipulating their early visual or auditory experience identifying sensitive periods for these inputs



GENERAL CONCLUSIONS ABOUT CRITICAL PERIODS

Collectively, in most cases sensory/perceptual development proceed normally if such systems are "set" correctly during a critical period of development—(e.g. Hubel and Wiesel)

There is also evidence for critical periods in specific domains of language and perception

The human brain "expects" certain types of input at particular times in development.

It is not clear what aspects of cognitive or social and emotional development require experience at particular (e.g., critical) points in time. Inferences drawn from intervention studies suggest some advantage to early experience.

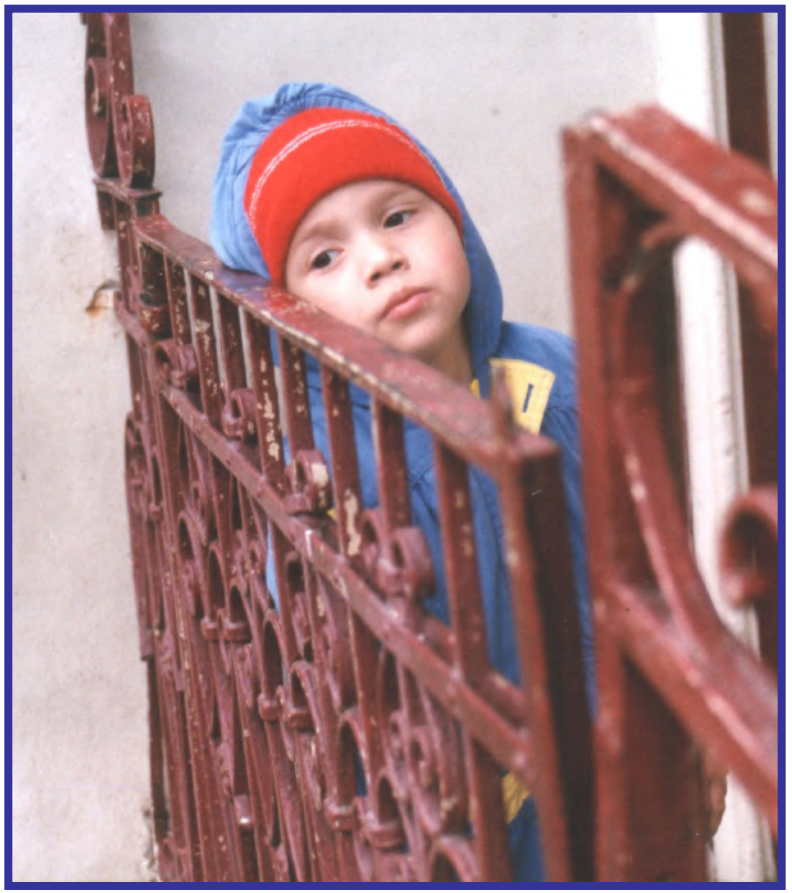
Project Background

CEAUSESCU'S LEGACY TO ROMANIA

- Raise production by increasing population
- Establishment of the MENSTRUAL POLICE - state gynecologists who conducted monthly checks of women of childbearing age who had not borne at least 5 children
- Establishment of CELIBACY TAX - families received a stipend for having more than 2 children; were levied tax for having fewer than 5 children
- OUTLAWED all contraception and abortion

THE RESULTS OF CEAUSESCU'S 1966 POLICY

- **Child abandonment** became a national disaster, as families could not afford to keep their children, and were encouraged to turn them over to the state. This destroyed the family unit and led to thousands of children being raised in institutions.



1989: The fall of the Ceausescu regime

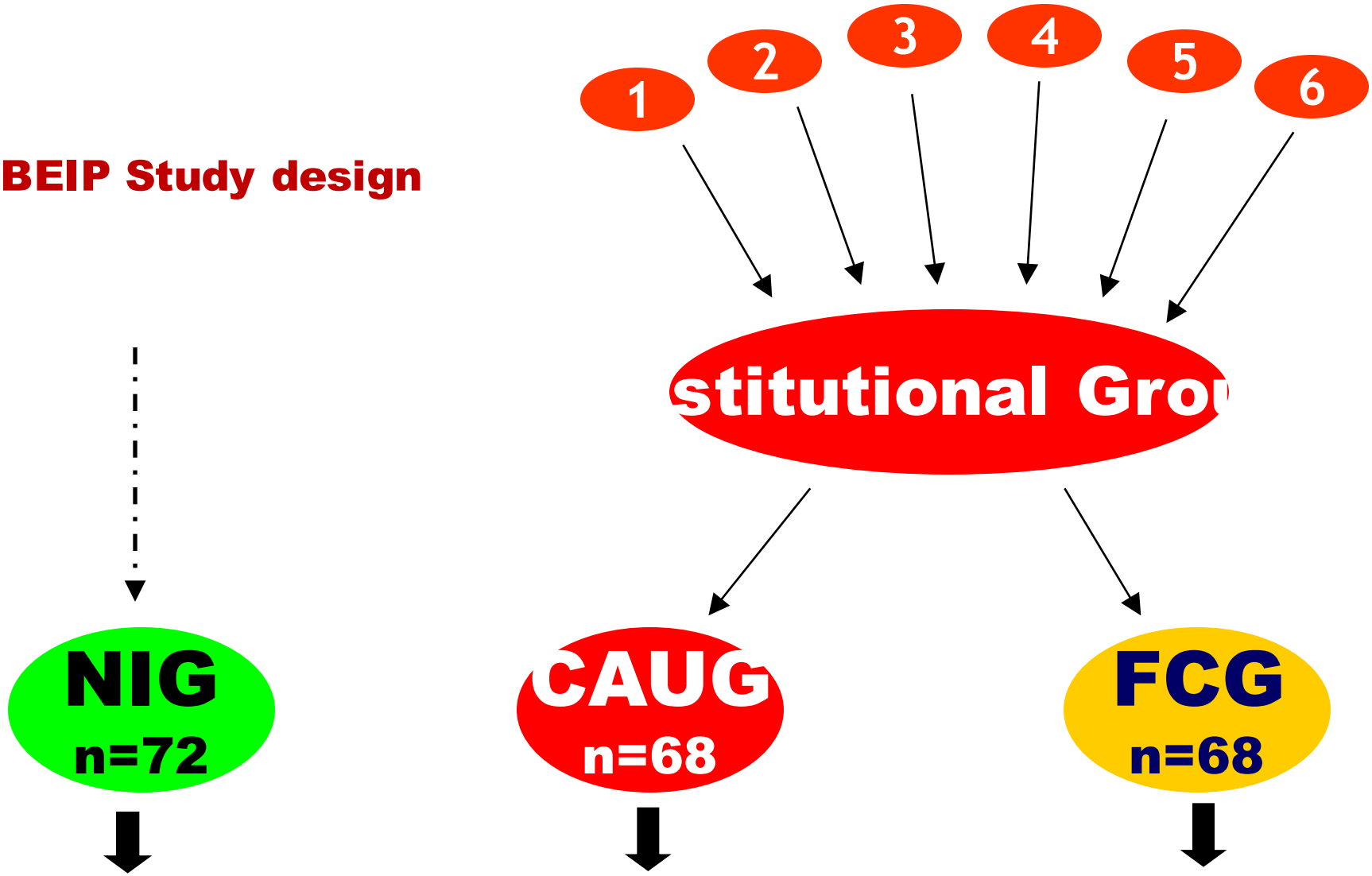
The aftermath….

100,000 children "warehoused" in state institutions

- Poverty #1 reason for child abandonment
- International media brought the plight of these children to the attention of the world
- Large numbers of children adopted internationally, often by
  Western families unprepared for challenges that lay ahead
- And then, Romania banned international adoption

The Study

BEIP Study design



After baseline assessment (pre-group assignment), comprehensive follow up performed at 30, 42, 54 months, 8 and 12 years

GENERAL HYPOTHESES OF THE BEIP STUDY

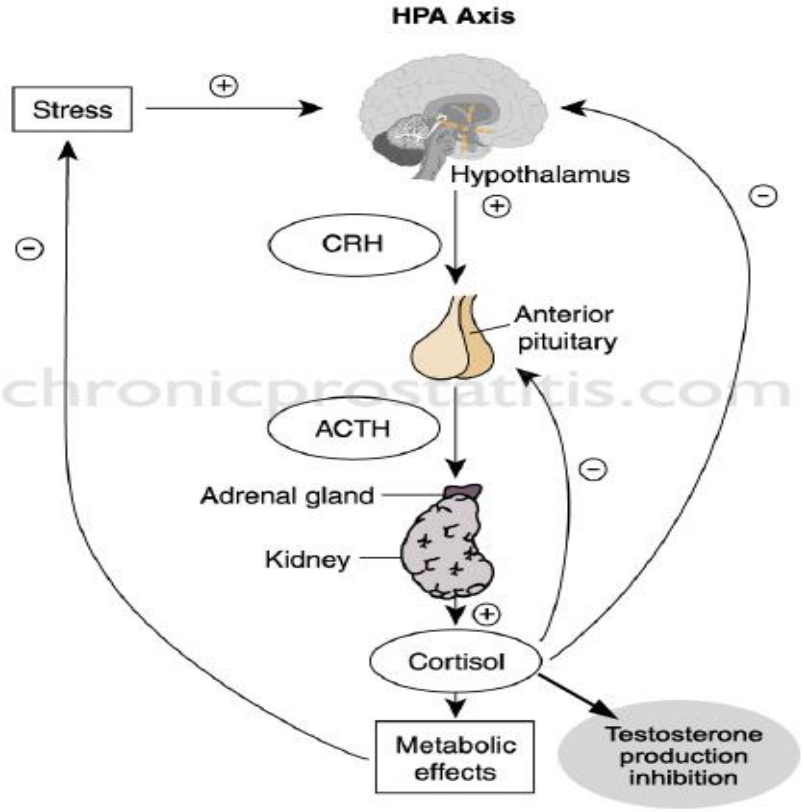
- Institutional rearing will have profound effects upon children's socio-emotional development

- Removing children from the institution and placing them in family environments will remediate some of these deficits.

- The age or timing of placement into foster care will be a significant factor explaining intervention effects (thought this may vary by domain)

STRESS RESPONSIVITY

Physiological and Emotional Responses to Stress via the HPA Axis



Cortisol

Development of Stress Response

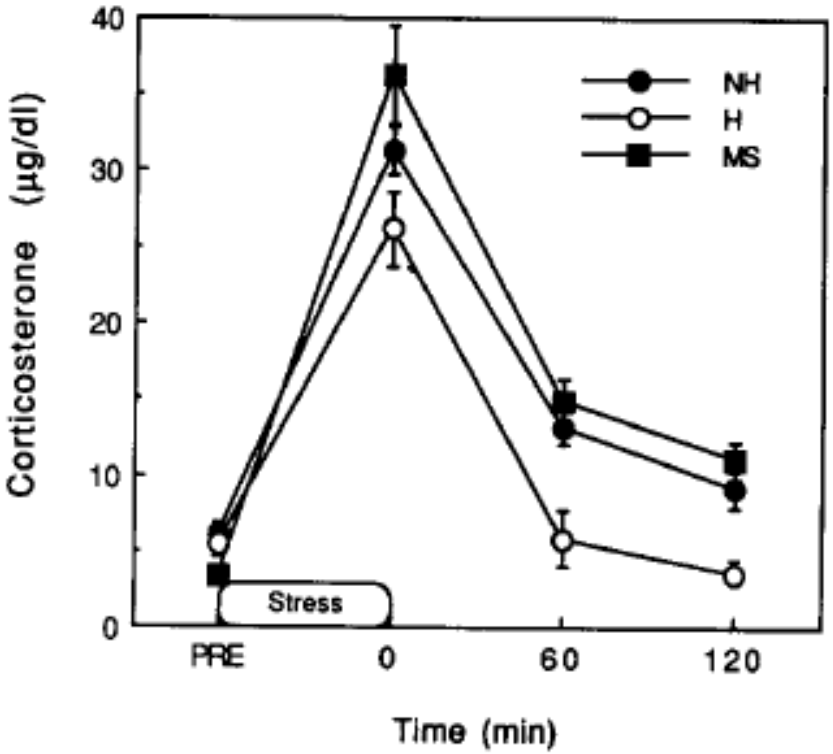
- Disruptions in stress response system functioning are thought to be a central mechanism by which exposure to adverse early-life environments influences human development
- Extensive evidence suggests that caregivers play a critical role in regulating responses to stress in children
- Early regulation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

(Gunnar & Donzella, 2002; Gunnar & Quevedo, 2007

RODENT STUDIES ON MATERNAL SEPARATION

- Early life adversity is experimentally induced by forced separation of the animal from its mother for an extended period

- Rodents exposed to this type of maternal separation exhibit elevated HPA axis response to stress later in development



(Plotsky et al, 1993)

NON HUMAN PRIMATE STUDIES OF MATERNAL SEPARATION

- This pattern of elevated HPA axis reactivity following maternal separation has been replicated in some studies of non-human primates

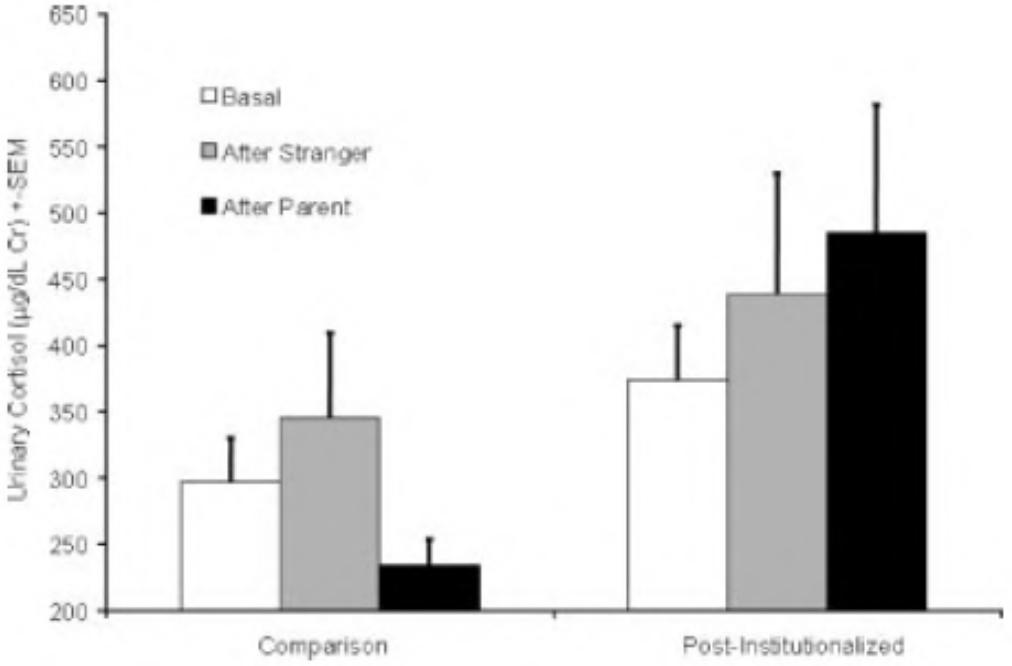
- However, some studies of non-human primates indicate an opposite pattern: blunted reactivity of the HPA axis following maternal separation

(Bayart et al., 1990; Lyons et al, 2000; Capitanio et al, 2005)

HUMAN STUDIES OF EARLY ADVERSITY

- Impact of early adversity on HPA axis and autonomic nervous system (ANS) responses has varied widely across studies

- Some studies have observed elevated HPA axis and sympathetic nervous system activity

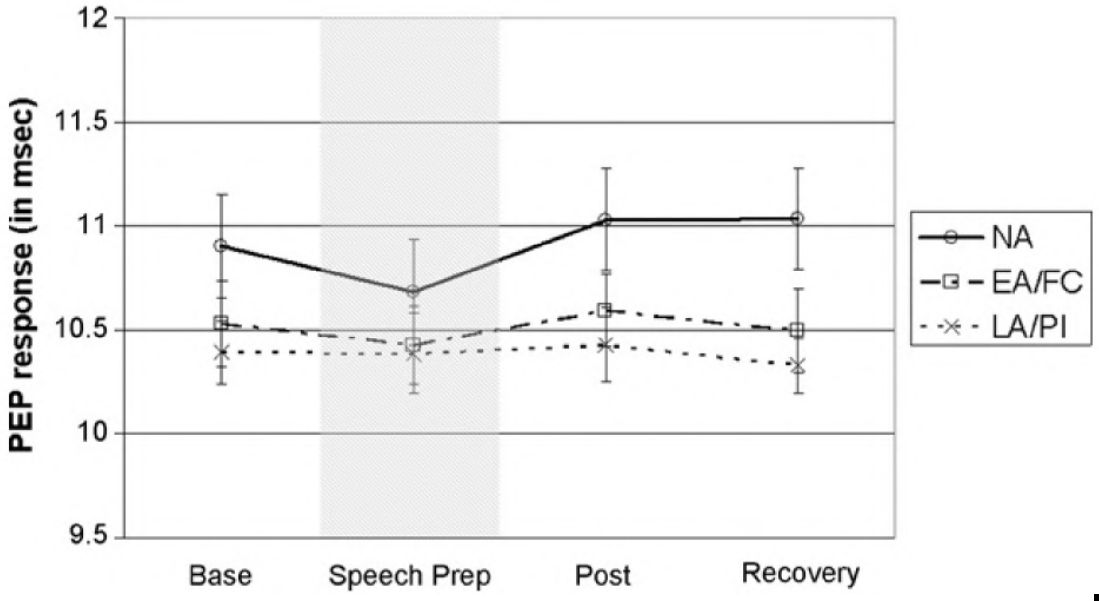


(Fries, Shirtcliff, & Pollak, 2008)

HUMAN STUDIES OF EARLY ADVERSITY

- Impact of early adversity on HPA axis and autonomic nervous system (ANS) responses has varied widely across studies

- Others have observed *blunted* HPA axis and sympathetic nervous system activity



(Gunnar et al., 2009)

Intervention for Early Adversity

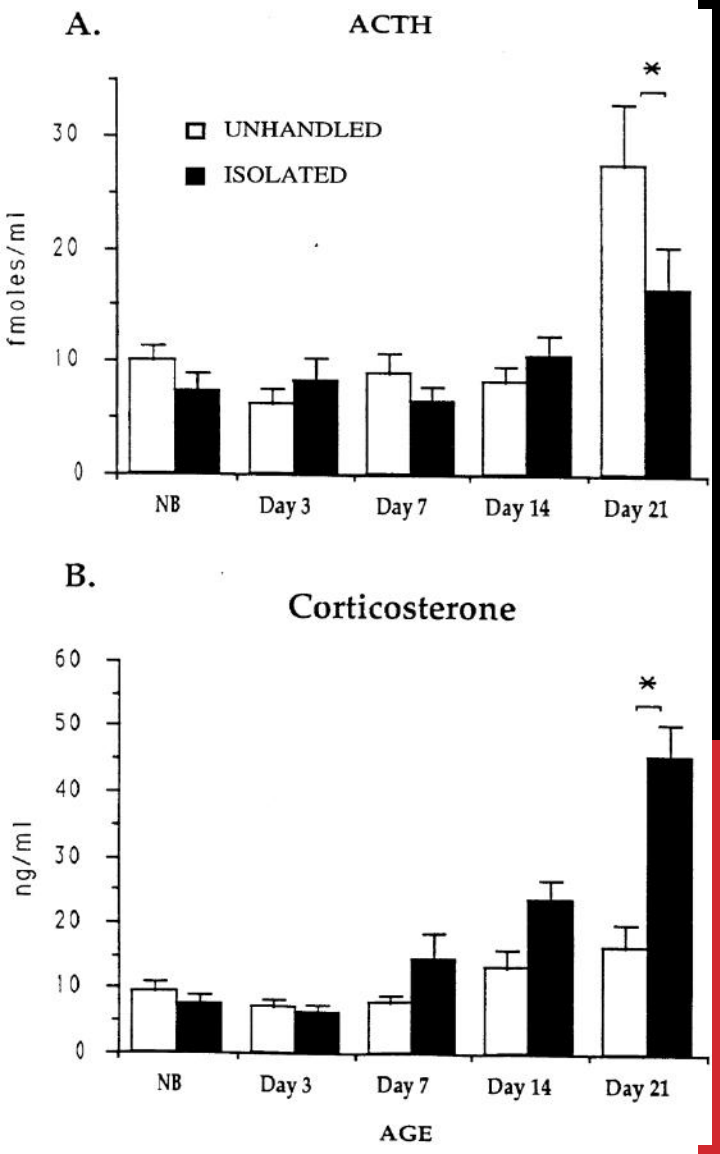
- Effects of adverse early-life experiences in rodents can be mitigated by placing them in an enriched environment in adolescence

- Short-term psychosocial intervention can also lead to normalization of HPA axis regulation in children

(Fisher et al, 2011; Francis et al, 2002)

Developmental Timing and Stress Responsivity

- Although critical periods related to the development of physiological stress response systems are well characterized in animals, we know little about when they exist in human development



(Vazquez. 1998)

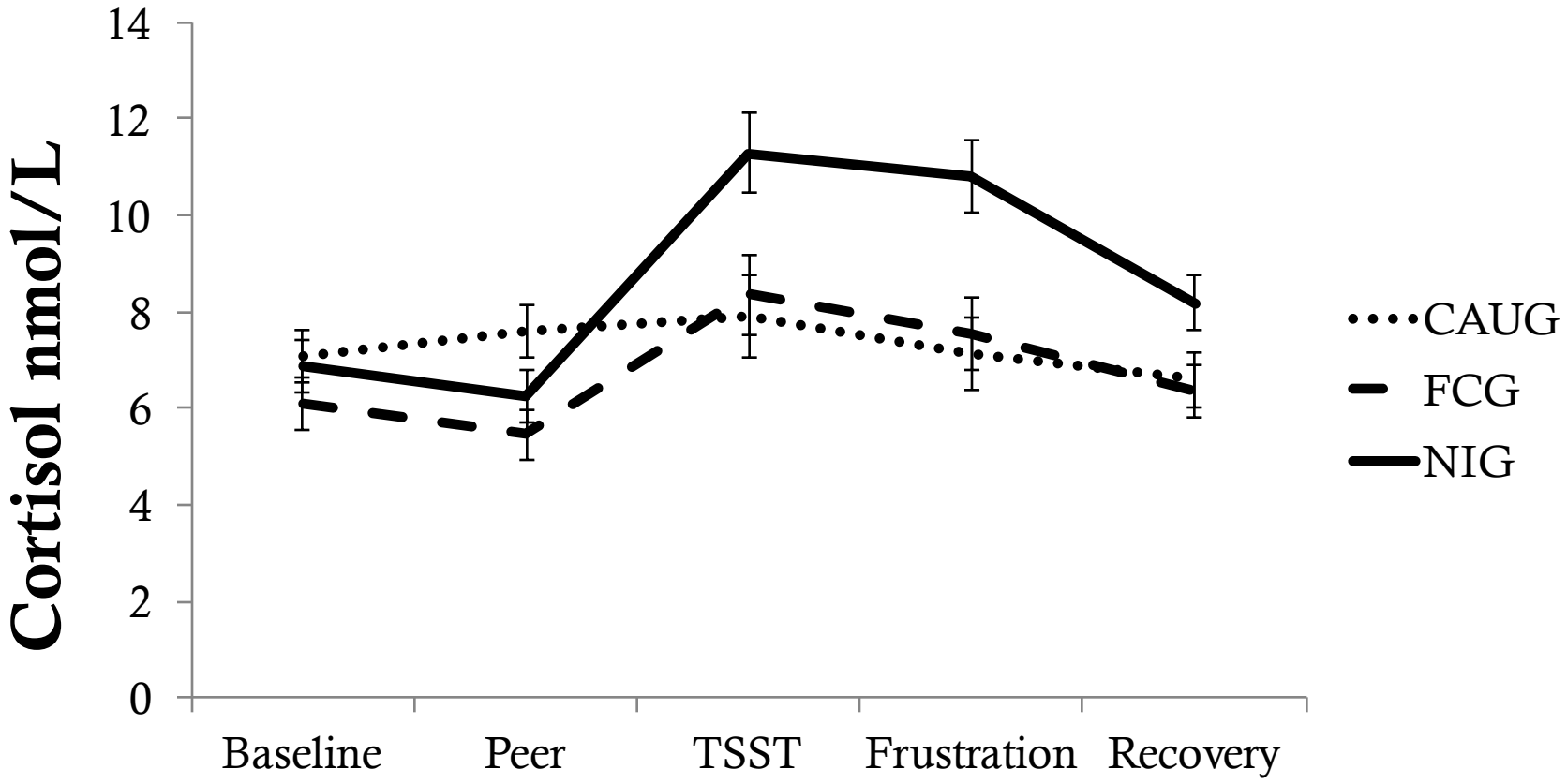
How Does the Early Environment Shape ANS and HPA axis reactivity?

Trier Social Stress Test

Delivered a speech about what makes a good friend in front of two teachers that they never met before

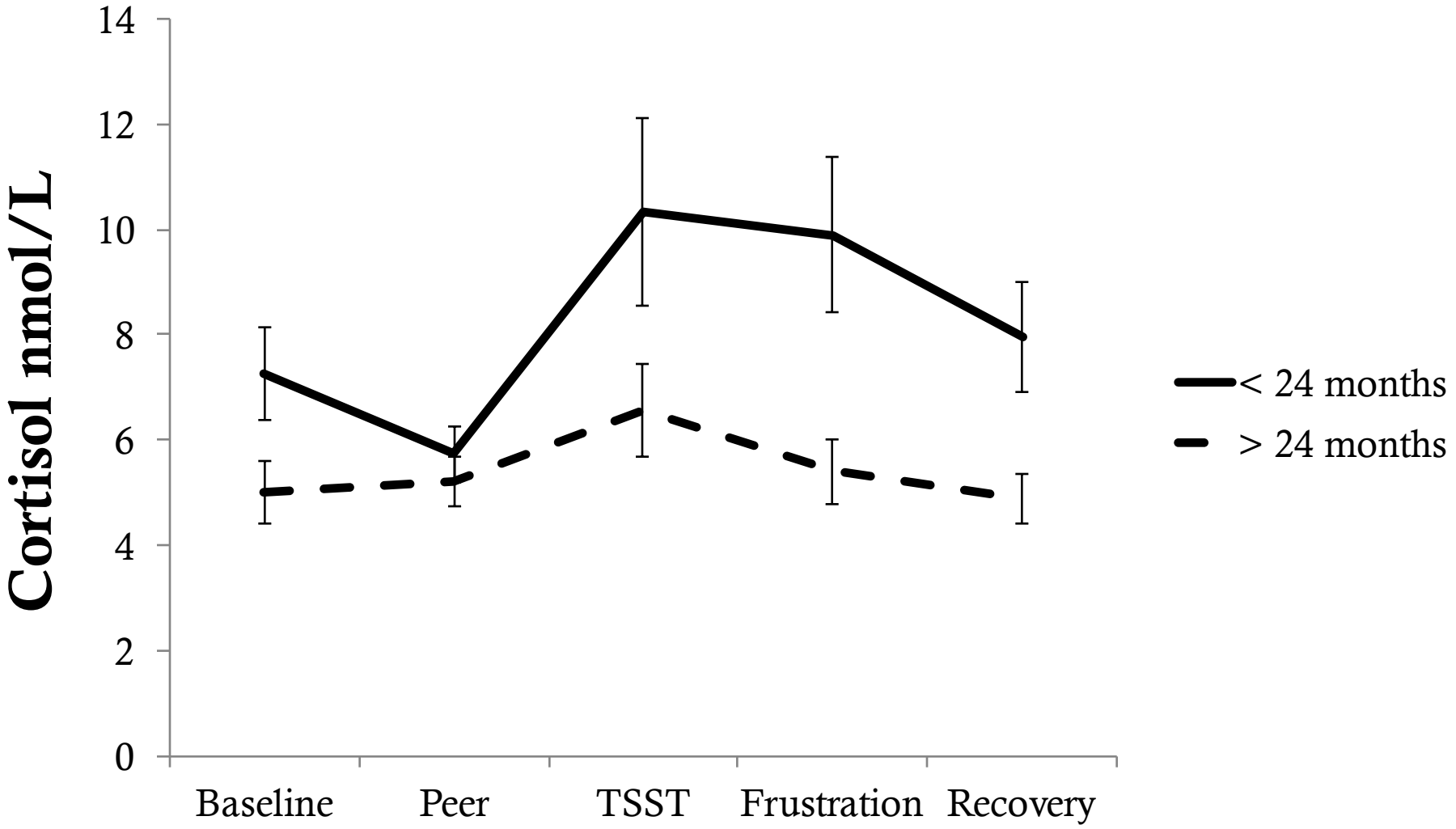
- Preparation
- Speech
  - Negative and neutral feedback
- Math
  - With feedback about accuracy

Stress and Cortisol Reactivity



Does the timing of placement matter?

Timing of Placement Affects Cortisol Reactivity Amongst Foster Care Children



Interim Conclusions: Stress

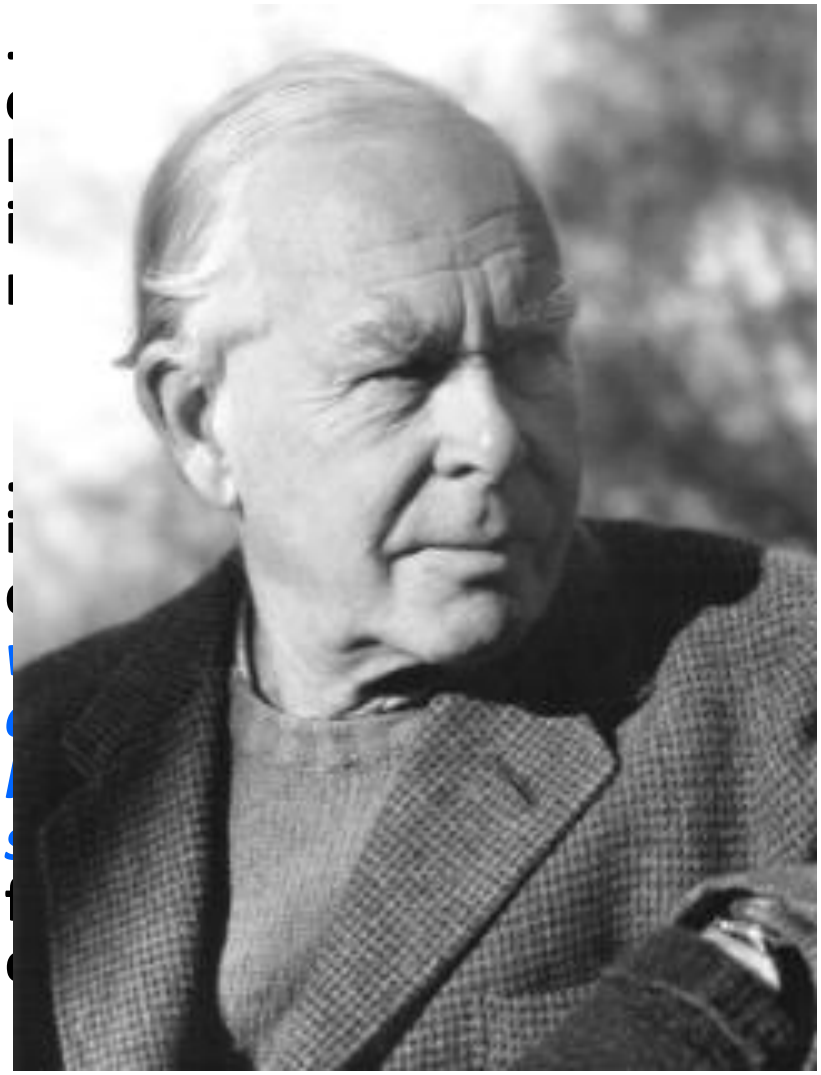
- Psychosocial deprivation is associated with a pervasive pattern of *blunted* physiological responses to stress, in both the sympathetic nervous system and HPA axis
- Random assignment to high-quality family care following institutionalization mitigates otherwise persistent effects of early psychosocial 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

ATTACHMENT

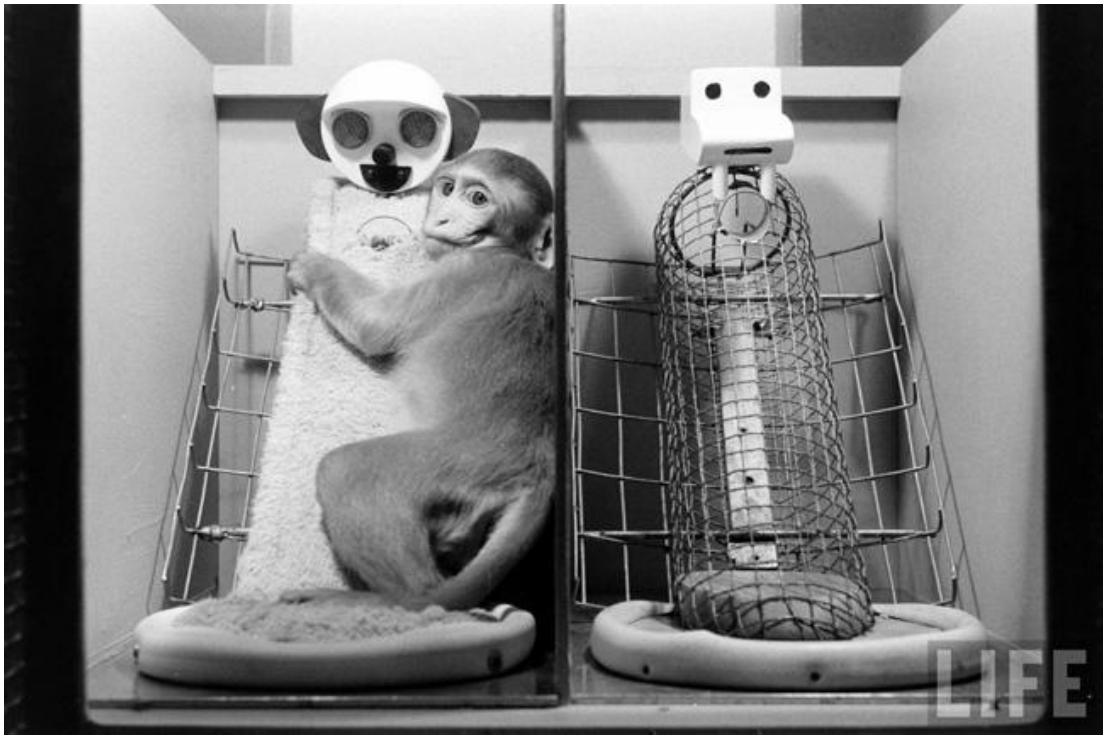
What is attachment?

Attachment describes a young child's tendency to seek comfort, support, nurturance, and protection selectively from at least one adu caregiver. Human infants are biologically predisposed to form attachments to caregivers.

JOHN BOWLBY



Harlow's Studies Influenced Bowlby and the Theory of Attachment



Bowlby formed his ideas, in part from the work of Harry Harlow, who showed the infant monkeys preferred a "cloth mother"---contact comfort—rather than a "wire mother" that gave mile

Harlow also showed the devastating effects of maternal separation on the developing infant monkey

Attachment Review

Infants are strongly *biologically predisposed to form attachments* to caregiving adults

Adults are strongly *biologically predisposed* to *respond to infants*

Attachment in young children *develops gradually* over the *first several years of life*, based upon relationship experiences with caregivers

Under usual rearing conditions, infants develop "focused" or "preferred" attachments in the *second half of the first year of life (7-9 months of age).*

- *Separation protest*
- *Stranger wariness*

BASELINE DIFFERENCES: 11-31 MONTHS

BEIP: SSP CLASSIFICATIONS

Community

- 76.7% secure
- 3.6% avoidant
- 0.0% resistant
- 19.7% disorganized
- 0.0% unclassifiable

Institution

- 16.8% secure
- 4.7% avoidant
- 0.0% resistant
- 65.4% disorganized
- 13.1% unclassifiable

Zeanah, et al 2005

CONTINUUM OF ATTACHMENT

5 -- ABCD patterns of attachment

4 -- Patterns of attachment with behavioral anomalies

3 -- Clear preference but passive

2 -- Preference discernible

1 -- No attachment behaviors evident

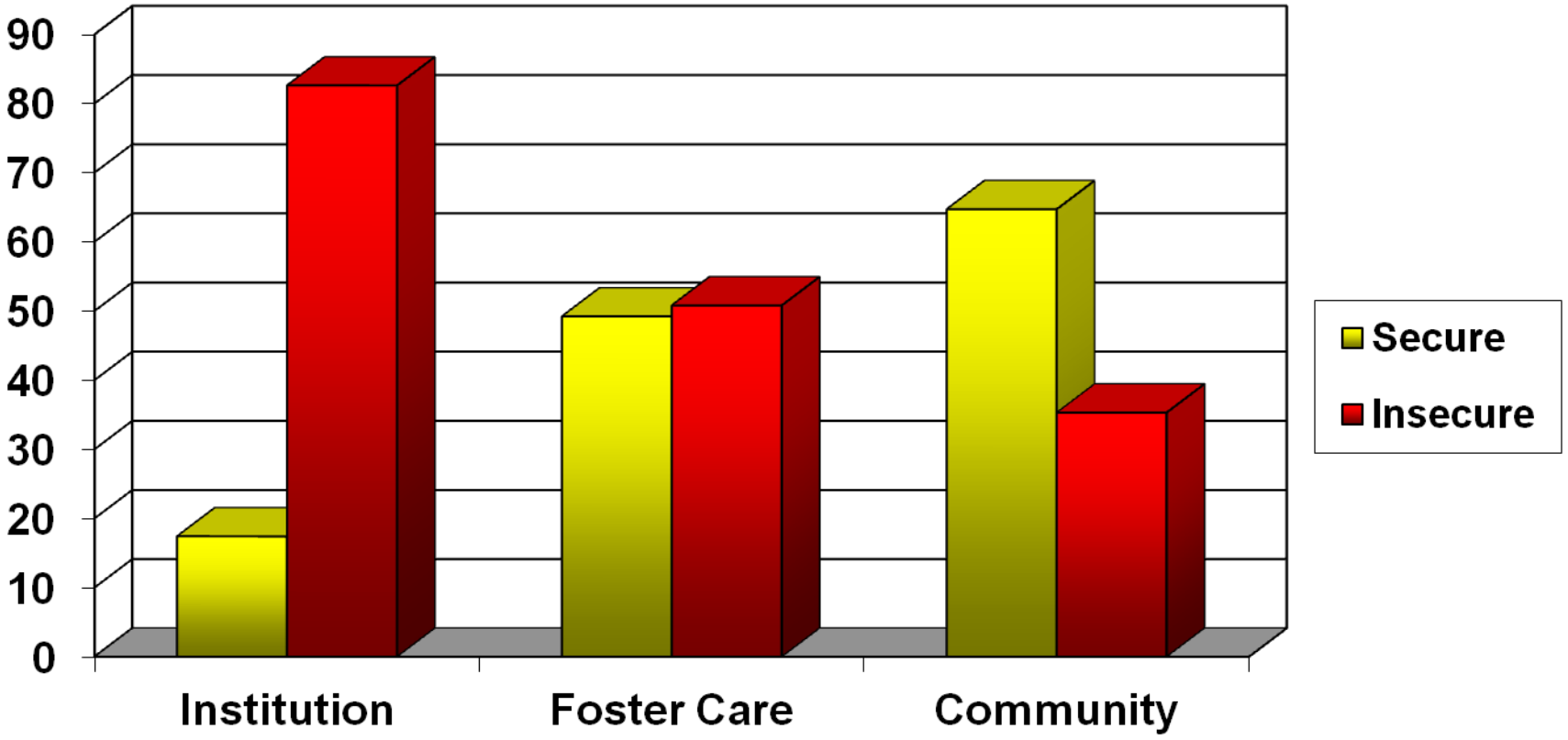
DEGREE TO WHICH CHILDREN LIVING IN INSTITUTIONS HAVE FORMED ATTACHMENTS TO THEIR CAREGIVERS

	Romanian Community	Romanian Institution
1=No attachment	0%	9.5%
2=Some differentiation	0%	25.3%
3=Some preference	0%	30.5%
4=Attachment with anomalies	0%	31.6%
5=Clearly recognizable attachment patterns	100%	3.2%

Zeanah et al (2005)

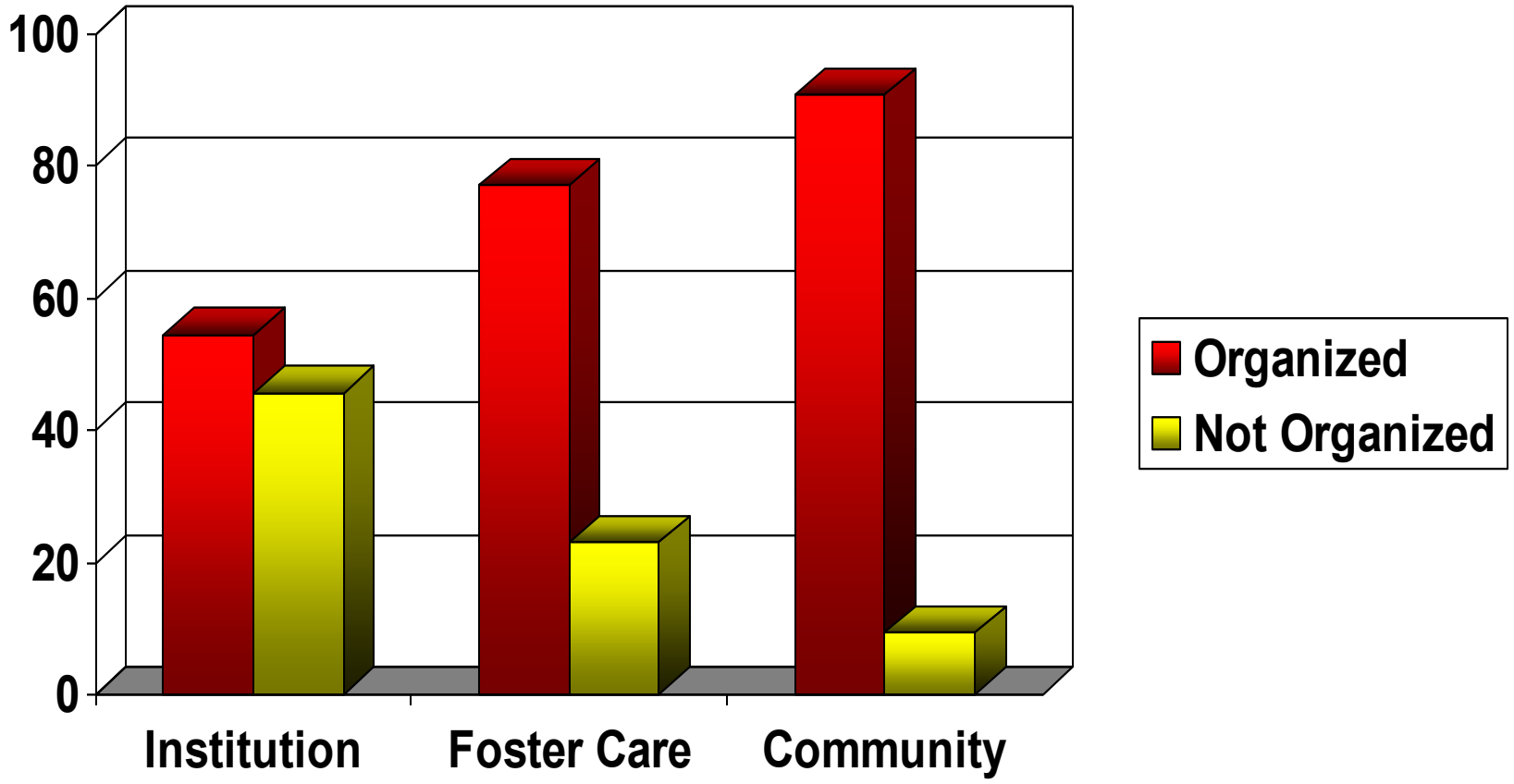
Intervention Effects at 42 Months

EFFECTS OF INTERVENTION ON SECURITY OF ATTACHMENT42 MONTHS



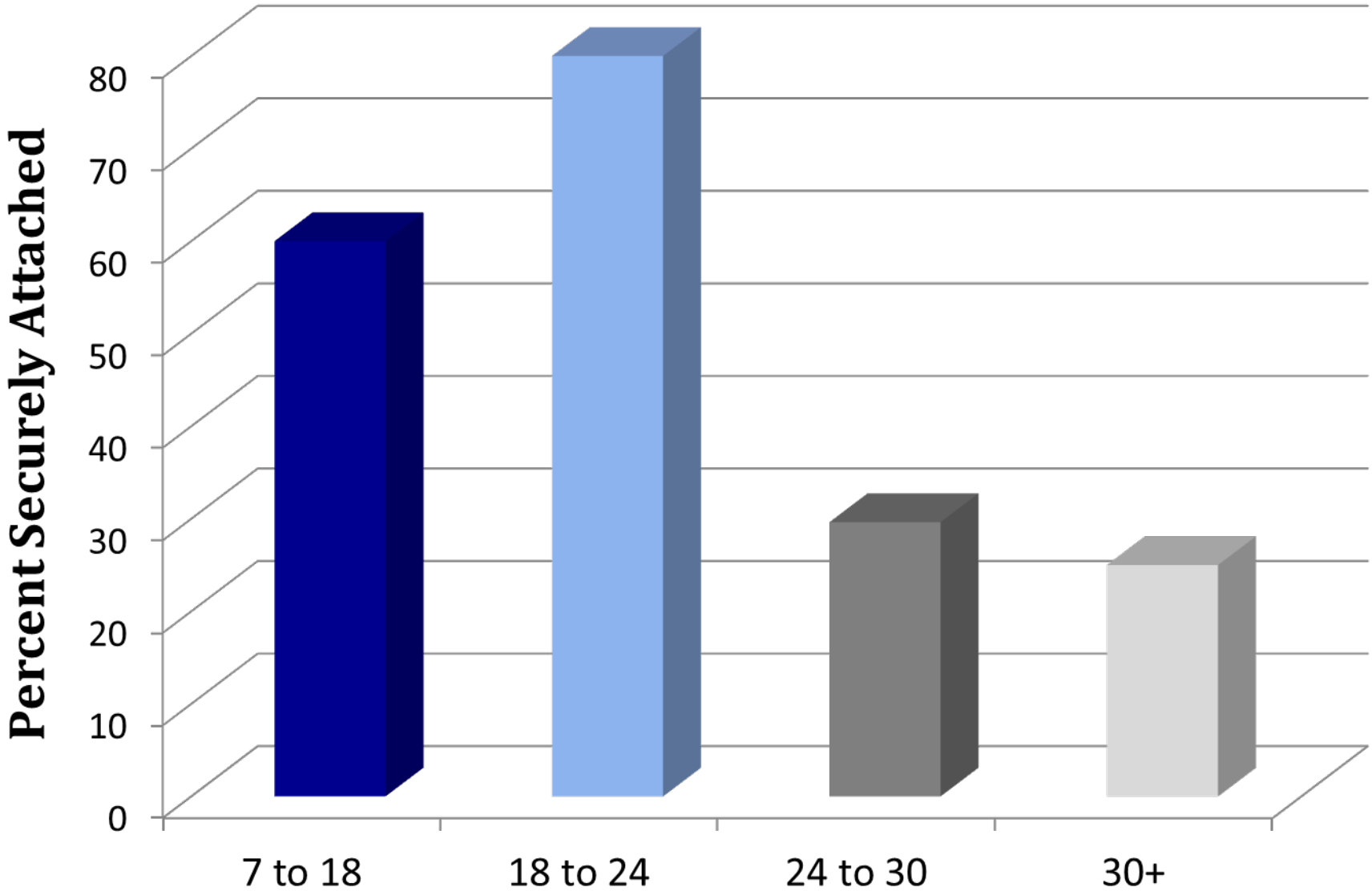
Smyke et al (2010)

ORGANIZED VS. NOT: 42 MONTHS

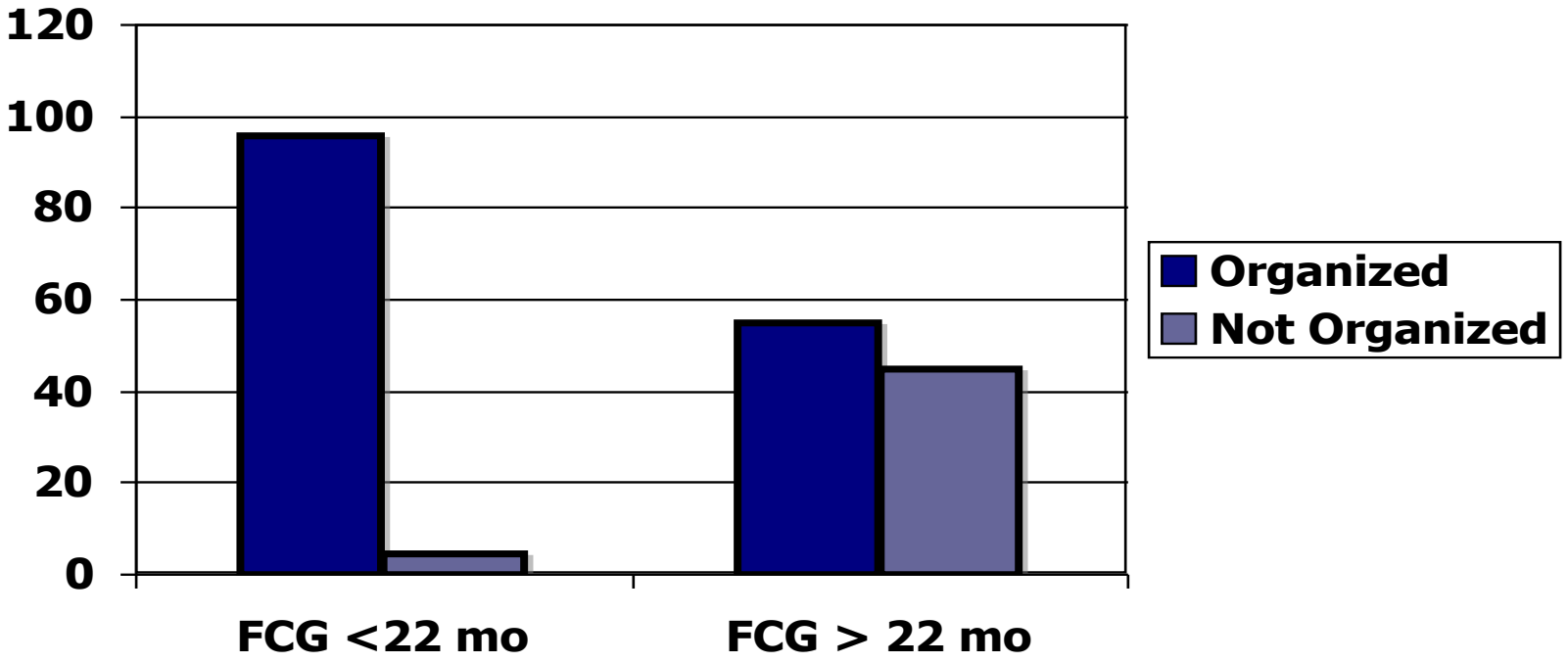


Smyke et al (2010)

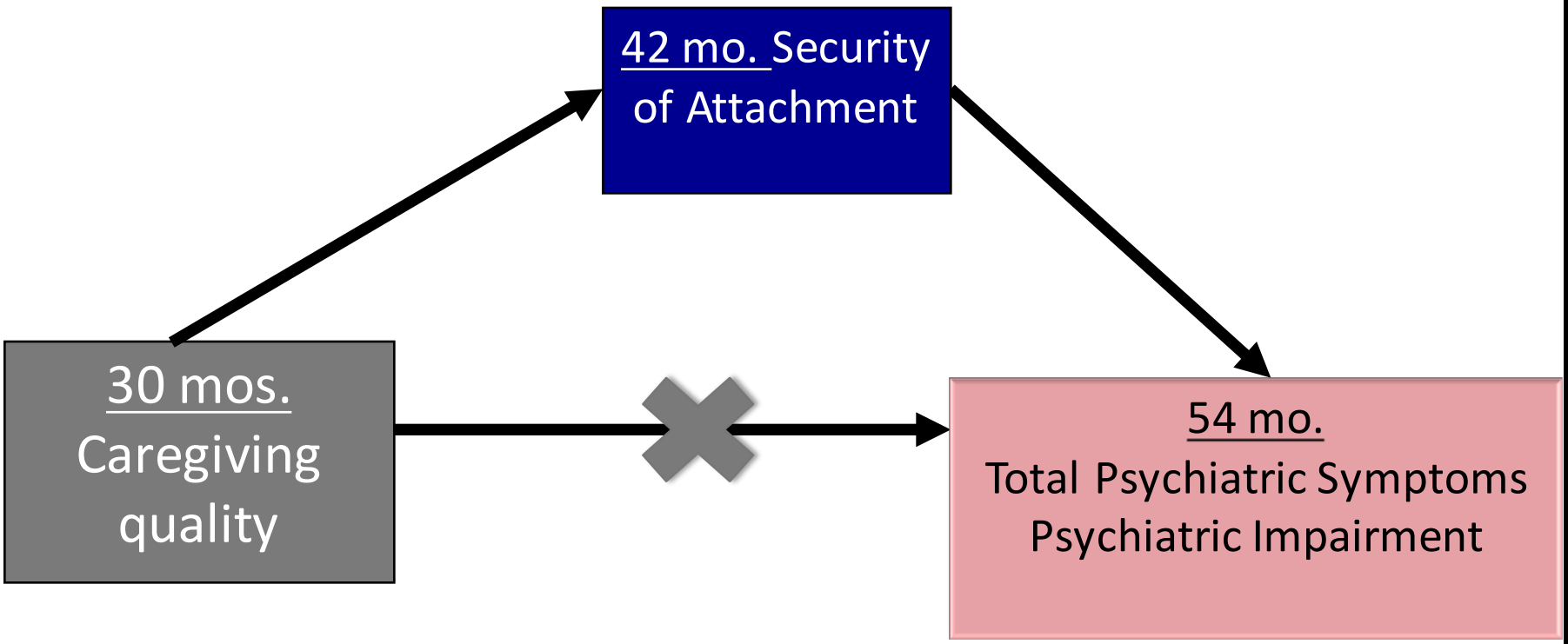
Security of attachment as a function of age of entry



Timing and Organized vs. Not Organized



ATTACHMENT MEDIATES INTERVENTION EFFECTS ON PSYCHOPATHOLOGY



McGoron et al., 2012

SUMMARY OF SSP FINDINGS

Large differences at baseline IG vs. NIG

- Security
- Organization

- Large intervention effects, but incomplete recovery

Timing effects on security and organization

- More children secure if placed before 22-24 months
- More children organized earlier they were placed

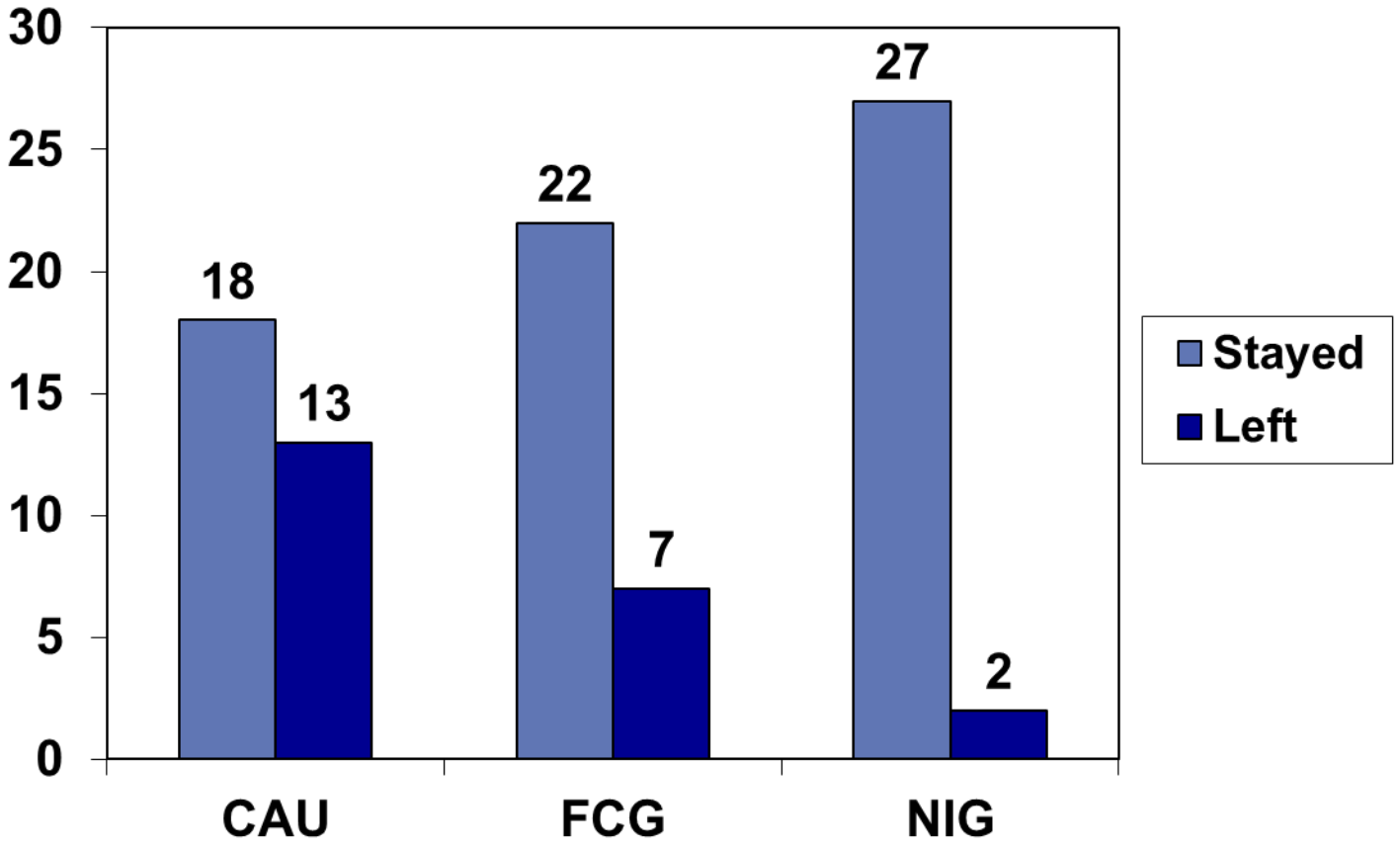
Stranger at the Door

Caregiver/mother and child answer door (pre-arranged).

RA: “Come with me, I have something to show you.”

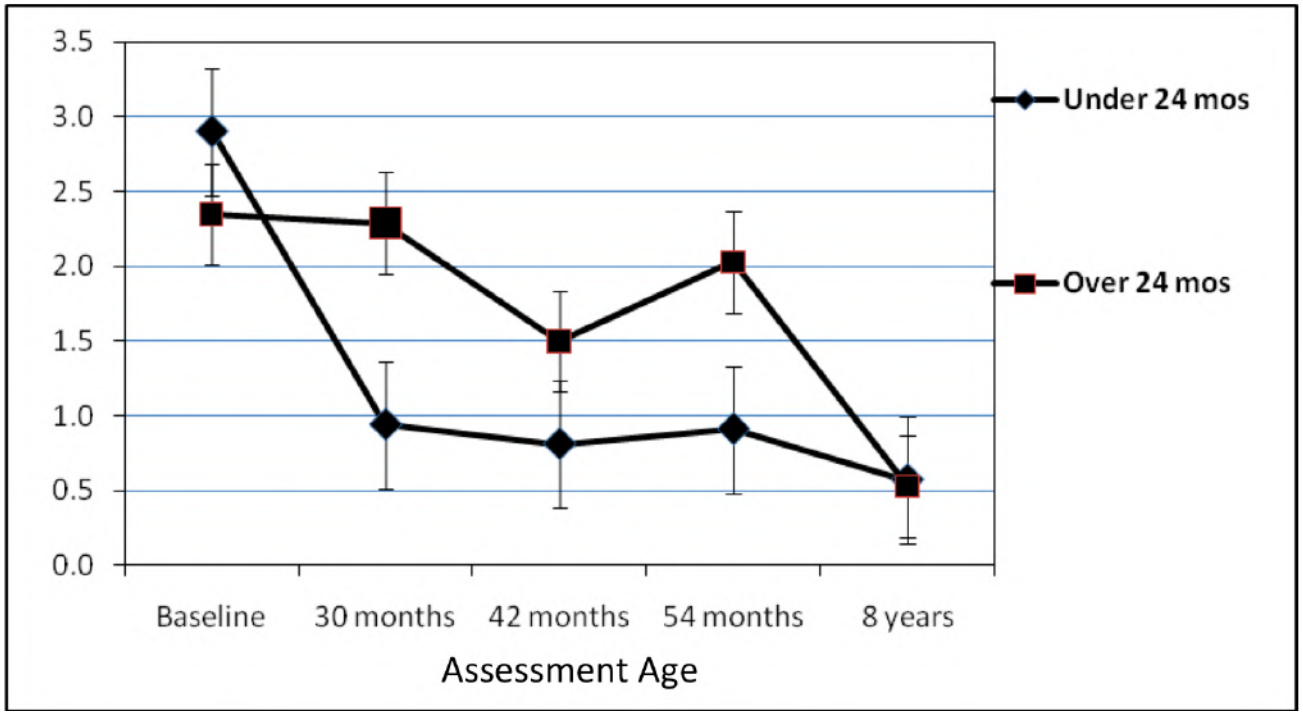
Walk out the door and around the corner to find RA from previous home visit.

STRANGER AT THE DOOR 54 MONTHS



Gleason et al (2013)

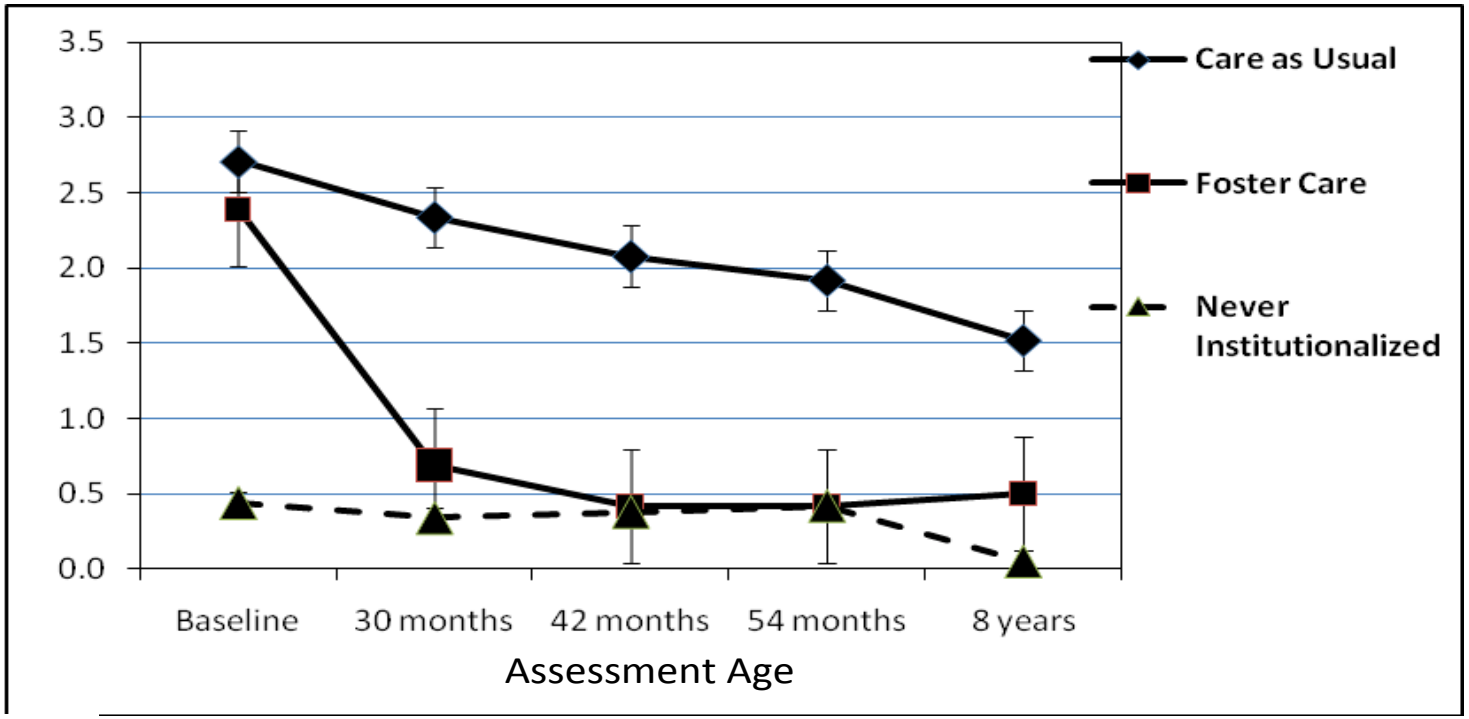
EFFECTS ON TIMING OF PLACEMENT ON INDISCRIMINATE BEHAVIOR



Children placed into families before 24 months of age showed absence of indiscriminate behavior across follow-up

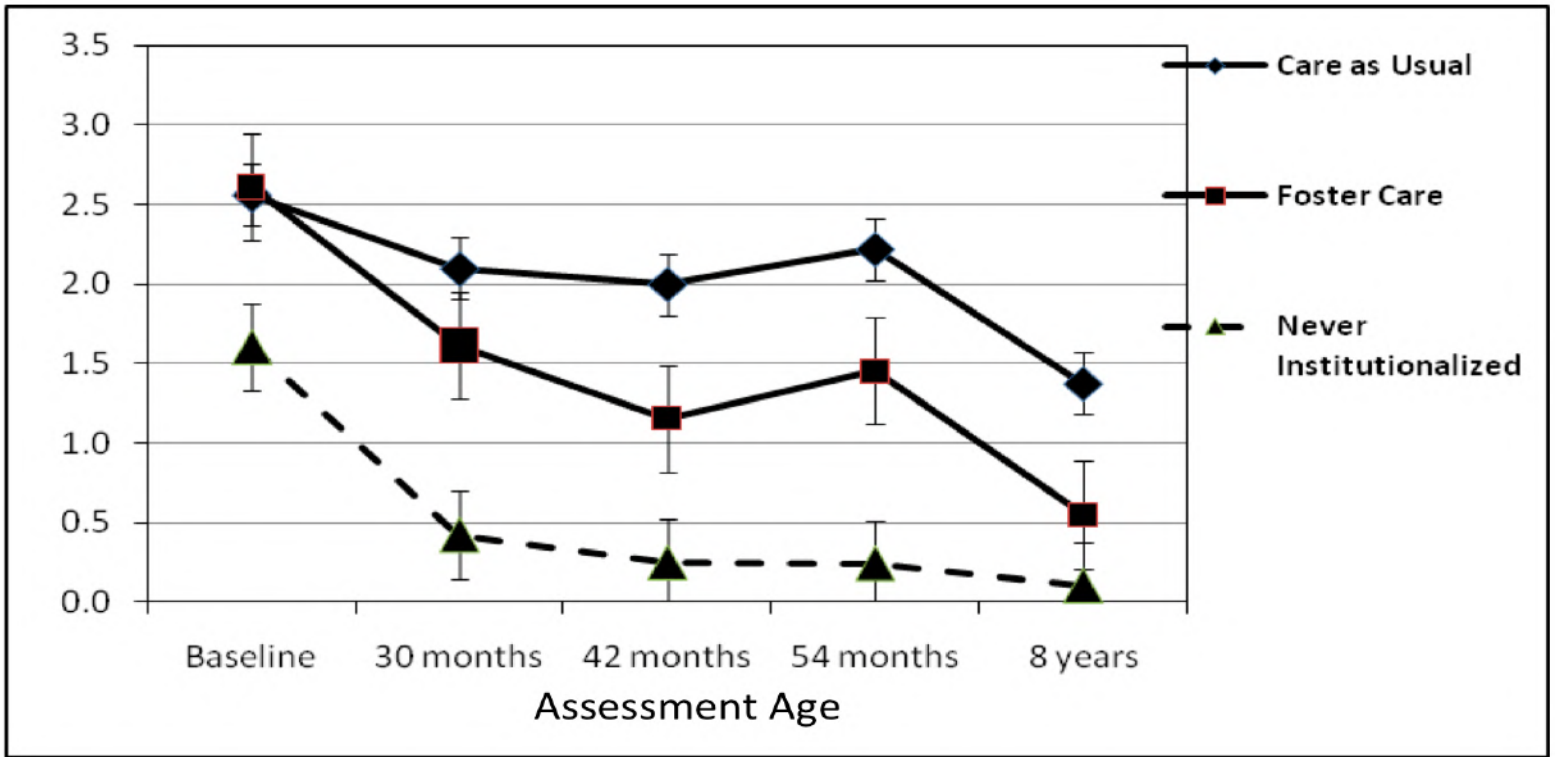
REACTIVE ATTACHMENT DISORDER: EFFECTS OF DEPRIVATION

RAD EMOTIONALLY WITHDRAWN/INHIBITED

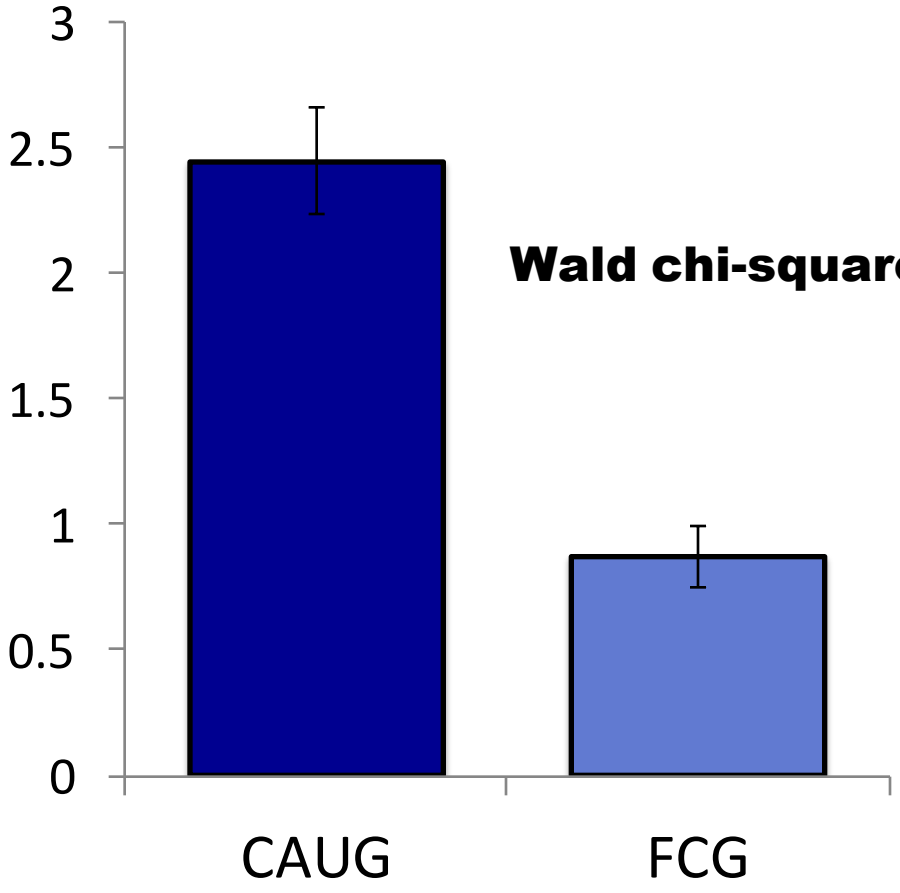


REACTIVE ATTACHMENT DISORDER: EFFECTS OF DEPRIVATION:

RAD INDISCRIMINATE/DISINHIBITED



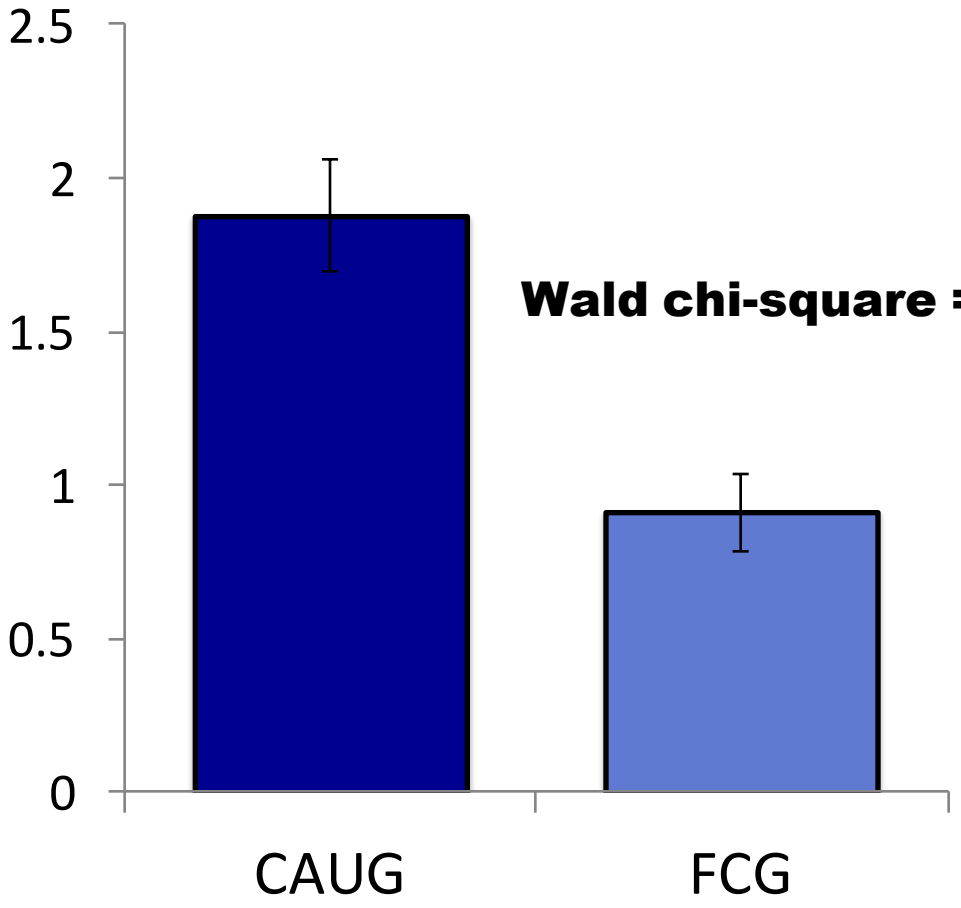
SIGNS OF REACTIVE ATTACHMENT DISORDER: INHIBITED



Wald chi-square = 37.77, *p* < .001

Humphreys et al., in press *Development and Psychopathology*

SIGNS OF DISINHIBITED SOCIAL ENGAGEMENT DISORDER



Wald chi-square = 17.75, *p* < .001

Humphreys et al., in press *Development and Psychopathology*

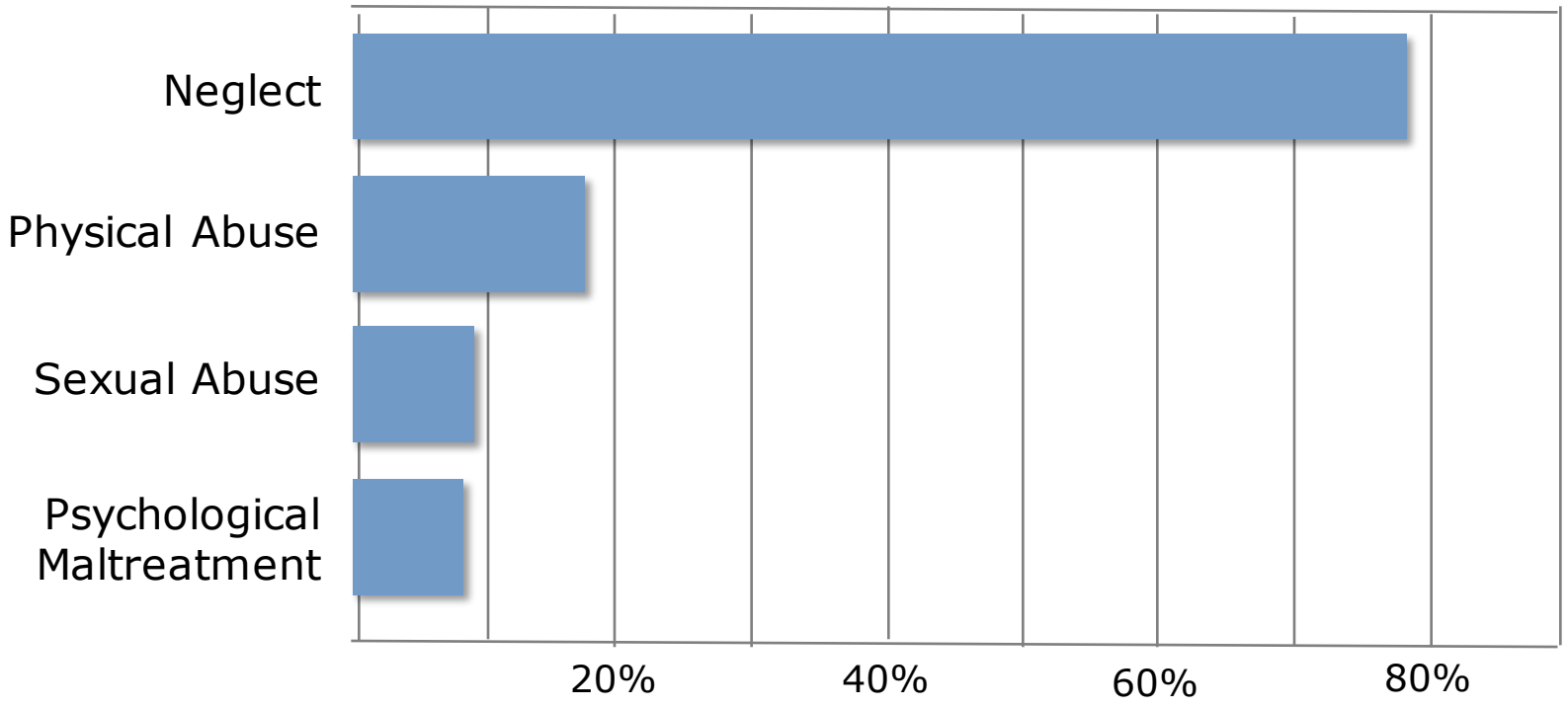
OVERALL CONCLUSIONS

Children raised in institutions during early development demonstrate significantly impaired stress responsivity and impaired attachment relationships

Insofar as we have been able to look at our data, our model of foster care as an intervention appears to effectively ameliorate many of the negative consequences of institutionalization…

There appear to be critical periods in the development of stress responsive systems and attachment that argue for early intervention for young children living in adversity

Neglect is the Most Prevalent Form of Child Maltreatment



Source: U.S. Department of Health and Human Services (2010b).

INVESTIGATIVE TEAM

Principal Investigators

Charles Zeanah, MD, Tulane University

Nathan A. Fox, Ph.D., University of Maryland

Charles A. Nelson, Ph.D., Harvard Medical School/Children's Hospital Boston

Funding:

- **John D. and Catherine T. Macarthur Foundation**
- **NIMH MH091363-01**