The Neuroscience of Birth, and the case for ZERO SEPARATION

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Disclosure of Financial Interest

• I, Nils Bergman, DO have a financial interest with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation; they are:

<table>
<thead>
<tr>
<th>Affiliation/Financial Interest</th>
<th>Name of Organization(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner / Director</td>
<td>NINO Academy</td>
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  NINO Academy produces educational and promotional materials related to Kangaroo Mother Care, and a garment for skin-to-skin contact.

COURSE OBJECTIVES:

At the conclusion of this seminar the participant should be able to:

• Summarize principles from several disciplines that impact breastfeeding.
• Describe the relevance of neuroscience to the early neonatal period.
• Explain why skin-to-skin care is so important to bonding and breastfeeding.
• Apply neurobehavioral techniques to support breastfeeding, in term and preterm infants.
• Link sleeping behavior with feeding behavior.
• Define and apply “Nurutrescience” in the NICU.

600gr, 26 w GA, 48 hrs

Even at 600gr, 26 w GA
What is going on in that brain?

The Neuroscience of Birth, and the case for ZERO SEPARATION

What is going on in that brain?

Positive Stress

- Moderate, short-lived stress responses, such as brief increases in heart rate or mild changes in stress hormone levels.
- An important and necessary aspect of healthy development that occurs in the context of stable and supportive relationships.

Slide by: Jack P. Shonkoff, M.D.

Toxic Stress

- Strong and prolonged activation of the body's stress management systems in the absence of the buffering protection of adult support.
- Disrupts brain architecture and leads to stress management systems that respond at relatively lower thresholds, thereby increasing the risk of stress-related physical and mental illness.

Slide by: Jack P. Shonkoff, M.D.
The basic science of pediatrics.

6. The consequences of significant adversity early in life prompt an urgent call for innovative strategies to reduce toxic stress within the context of a coordinated system of policies and services guided by an integrated science of early childhood and early brain development.

Figure 6.1. Summary of the current “central dogma” that underlies the analysis of all biological processes, including those that mediate basic psychobiological processes. The only major concept missing from this schematic is the environment, and these influences permeate all phases of these transactions.
The Neuroscience of Birth & Breastfeeding

Brain Architecture and Skills are Built in a Hierarchical “Bottom-Up” Sequence

- Neural circuits that process basic information are wired earlier than those that process more complex information.
- Higher circuits build on lower circuits, and skill development at higher levels is more difficult if lower level circuits are not wired properly.

Slide by: Jack P. Shonkoff, M.D.
The Neuroscience of Birth & Breastfeeding

Highly conserved neuro-endocrine behavior

“LIFE SCIENCES THEORY”

“For species such as primates, the mother IS the environment.”
Sarah Blaffer Hrdy, Mother Nature (1999)

Nothing an infant can or cannot do makes sense, except in light of mother’s body

Skin-to-skin contact
The Neuroscience of Birth & Breastfeeding

The newborn may appear helpless, but raises its own temperature, has a higher blood glucose, metabolic adaptation faster.
Attachment Theory

The BOND is made up of the sensory inputs from the parent to the infant.


REGULATION

The BOND is made up of the sensory inputs from the parent to the infant.


Through "hidden maternal regulators"...

We concluded from these surprising results that warmth provided by the mother normally maintained the pup's activity level and that her milk maintained her pup's heart rate. Maternal

- warmth → activity level
- milk → heart rate

"physiological set points"
- internal working models
- scripts - templates

Through "hidden maternal regulators"...

A mother precisely controls every element of her infant's physiology, from its heart rate to its release of hormones, from its appetite to the intensity of its activity.

(Gallagher 1992)

Warming, feeding and protection behaviours are intricately, inseparably linked to the right place.

(Alberts 1994)

Skin-to-skin "causes" breastfeeding
Warming, feeding and protection behaviours are intricately, inseparably linked to the right place.

(Alberts 1994)

### MICROBIOTA

1. IMMUNITY
2. METABOLIC FUNCTION
3. NEUROLOGICAL DEVELOPMENT

Delivery mode shapes the acquisition and structure of the initial microbiota across multiple body habitats in newborns

*Microbiota* is the collective term for all the microorganisms that live on or inside a host organism. These microorganisms can have a significant impact on the host's health and development. The microbiota's role in immune function, metabolic health, and neurological development is crucial. The acquisition of the microbiota during early life is critical for the establishment of a healthy balance of microorganisms.

**NEUROLOGICAL DEVELOPMENT**

1. Metabolism and development
2. Microbiota and development
3. Neurodevelopment

**METABOLIC FUNCTION**

1. Energy metabolism
2. Gut microbiota and metabolism
3. Microbiota and metabolic diseases

**IMMUNITY**

1. Immune system development
2. Microbiota and immune function
3. Microbiota and autoimmune diseases

**Abstract**

The infant microbiome plays an essential role in human health and its assembly is determined by maternal—offspring exchanges of microbiota. This process is affected by several practices, including Cesarean section, formula feeding, antibiotics, and skin-to-skin contact, that have been linked to increased risk of metabolic and immune disorders. This review discusses recent knowledge in this field.

**Gut:** Microbial colonisation in premature neonates predicts neonatal sepsis

Juliette C. Mudah,1 Richard Cooper-Salz,2 Shreepi S. Senera,3 Lisa Davidson,4

**The Perfect Storm for Type 1 Diabetes**

The Complex Interplay Between Intestinal Microbiota, Gut Permeability, and Mucosal Immunity

**Gastrointestinal function development and microbiota**

**Delivery mode shapes the acquisition and structure of the initial microbiota across multiple body habitats in newborns**

*Microbiome* is the collective term for all the microorganisms that live on or inside a host organism. These microorganisms can have a significant impact on the host's health and development. The microbiota's role in immune function, metabolic health, and neurological development is crucial. The acquisition of the microbiota during early life is critical for the establishment of a healthy balance of microorganisms.
Partial restoration of the microbiota of cesarean-born infants via vaginal microbial transfer

Maria G Dominguez-Bello1,2, Cassandra M De Jesus-Laboy3.

...microbiota disturbances with antibiotic use, cesarean section, and formula feeding that may contribute to obesity, asthma, and other disorders.

Published in final edited form as:


The Neuroscience of Birth & Breastfeeding

intricately, inseparably linked to the right place → ZERO SEPARATION

Activation of Olfactory Cortex in Newborn Infants After Odor Stimulation: A Functional Near-Infrared Spectroscopy Study

SMELL: vanilla / colostrum / water (control)

read NIRS activity: FRONTAL LOBE

• This was confirmed by demonstration of a statistically significant negative correlation between changes in [Hb O2] and postnatal age (r = -0.64, p < 0.001) with 95% confidence interval (Fig. 4). Those babies showing the greatest increase in [Hb O2] were between 6 and 24 h old at testing.

• In the 14 babies older than 24 h there was no significant difference between the changes in [Hb O2] during control and colostrum exposure.
The first hours after birth are a critical period. In the 14 babies older than 24 h, there was no significant difference between the changes in [Hb O2] during control and colostrum exposure. Those babies showing the greatest increase in [Hb O2] were between 6 and 24 h old at testing.

At birth, the brain has two critical sensory needs: smell and contact. Connect direct to the amygdala.

The newborn brain: skin-to-skin contact fires and wires the amygdala-prefronto-orbital cortical pathway (PFOC). Schore 2001

Social and emotional intelligence:
- Prefrontal cortex: Executive function
- Amygdala: Emotional processing unit
- CPU

Behavioral activation system reward-based (dopamine)
The newborn can imitate – Mirror neurons

As predicted, immunisation and observation of facial expressions elicited activation of fronto-parietal mirror areas (PMC, IFG, pars opercularis and IPL), STS, anterior insula, and amygdala.

Therefore, our results are in keeping with the sociogenesis theory (or mirror theory of empathy), according to which empathy is generated by the observation or actions of others.
In humans, oxytocin increases gaze to the eye region of human faces and enhances interpersonal trust and the ability to infer the emotions of others from facial cues.
The Neuroscience of Birth & Breastfeeding

- The DNA
- The Brain
- Neurodevelopment
- Evolutionary Biology

Environment → Adaptation → Experience → Reproductive Fitness

**Face Recognition Centre**

**Smell**

**Skin contact**

**Emotion Control Centre**

**Oxytocin**

- Prefrontal
- Somatosensory
- Parietal & cerebellum

**Primary Visual**

**Primary Auditory**

**Pre-Birth Bonding**

**Zero Separation**

The science behind the concept

Skin-to-skin "causes" breastfeeding

**Suckling and expression**

should start very early!

**Milk Volumes From Day 1 To 6 Weeks**

- Parker LA. J Perinatol, 2012
- Parker LA. Breastfeeding Medicine, 2015

- First hour expression (vs. hrs. 2-6) ↓ time to lactogenesis and ↑ production by 130% at 6 weeks (613.0 vs. 267.2)

**Slides thanks to Jane Morton**

**Suckling and expression**

should start very early!
The Neuroscience of Birth & Breastfeeding

Environment

Baby

BIRTH

BONDING

Beyond

Breastfeeding

Feed → Sleep Cycling

Brain

Epigenetics

Neurodevelopment

Behavior

Evolutionary Biology

Adaptation

Experience

Reproductive Fitness

The DNA

The Brain

The Behavior

The Environment

Milk making

Nutrition

Hypothalamus → Pituitary: Prolactin → Milk making Nutrition

Oxytocin

Maternal Ferocity → Protection

Amygdala: Cholecystokinin → Emotion / satiety

Hypothalamus → Cingulate: Prolactin → Maternal Ferocity

Cingulate: Maternal Ferocity

Oxytocin

→ Goze increase → Bonding

→ Gaze increase → Bonding

→ Gaze increase → Bonding

→ Gaze increase → Bonding

... infant cues - suckling, vocalisation and tactile stimulation stimulate Oxytocin release in the hypothalamus, which may result in the activation of the DOPAMINE reward pathway leading to behavioural reinforcement.

SENSITIZATION

Dose of SCC first 24 hours correlates Maternal behavior Q Sort Predicts attachment security

Maternal Behavior Q-Sort

Hours of SSC in Infants' First 24 Hours

Dose of SCC first 24 hours correlates Maternal behavior Q Sort Predicts attachment security
Dose of SCC first 24 hours correlates
Maternal behaviour Q Sort
Predicts attachment security

Dose of SCC first 24 hours correlates
NCATS (Nursing Child Assessment Teaching Scale)
Predicts cognitive outcome
SENSITIZATION

EPDS (depression) score DECREASED significantly for first two visits.
JOGNN, 41, 369-382; 2012. DOI: 10.1111/j.1552-6909.2012.01350.x

EARLY !!
... infant cues - suckling, vocalisation and tactile stimulation - stimulate OXYTOCIN release in the hypothalamus, which may result in the activation of the DOPAMINE reward pathway leading to behavioural reinforcement

PRATHIBA REEBYE
BIDIRECTIONAL !!
Affect regulation
"Human brains are RELATIONAL"
... co-creating touch... signature unique to caregiver

The first hours after birth are a CRITICAL PERIOD
mutual psycho-neuro-physiological caregivers
Critical period concept:
“Windows of opportunity in early life when a child’s brain is exquisitely primed to receive sensory input in order to develop more advanced neural systems.”

a mother’s brain ...

SENSITIZATION

Toxic Stress
• Strong and prolonged activation of the body's stress management systems in the absence of the buffering protection of adult support.
  Disrupts brain architecture and leads to stress management systems that respond at relatively lower thresholds, thereby increasing the risk of stress-related physical and mental illness.

CORTISOL

The Neuroscience of Birth & Breastfeeding
The DNA  EPIDEMIOGENICS  NEURODEVELOPMENT  EVOLUTIONARY BIOLOGY
ENVIRONMENT  ADAPTATION  EXPERIENCE  REPRODUCTIVE FITNESS
BABY  MOTHER  BONDING  SEPARATION  Tox stress

THE BRAIN  BEHAVIOUR
BIRTH  BREASTFEEDING  BEYOND

Secure attachment  Attuned parenting  Resilience  HEALTH

Slide by: Jack P. Shonkoff, M.D.

... infant cues - suckling, vocalisation and tactile stimulation - stimulate OXYTOCIN release in the hypothalamus, which may result in the activation of the DOPAMINE reward pathway leading to behavioural reinforcement.

key biological systems ... that contribute to maternal caregiving behaviour ... the oxytocinergic and dopaminergic systems.

... dopamine pathways contribute to the processing of infant-related sensory cues leading to a behavioural response.
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... dopamine pathways contribute to the processing of infant-related sensory cues leading to a behavioural response.

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**What about PITOCIN?**
(Synthetic OXYTOCIN)

Loss of myometrial oxytocin receptors during oxytocin-induced and oxytocin-augmented labour

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Association of peripartum synthetic oxytocin administration and depressive and anxiety disorders within the first postpartum year.

Kroll-Desrosiers 2016

doi: 10.1002/da.22599

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**The Neuroscience of Birth & Breastfeeding**

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The Neuroscience of Birth & Breastfeeding

• Disrupts brain architecture and leads to stress management systems that respond at relatively lower thresholds, thereby increasing the risk of stress-related physical and mental illness.

Positive Stress

• Moderate, short-lived stress responses, such as brief increases in heart rate or mild changes in stress hormone levels.
• An important and necessary aspect of healthy development that occurs in the context of stable and supportive relationships.

Tolerable Stress

• Stress responses that could disrupt brain architecture, but are buffered by supportive relationships that facilitate adaptive coping.
• Generally occurs within a time-limited period, which gives the brain an opportunity to recover from potentially damaging effects.

Toxic Stress

• Strong and prolonged activation of the body’s stress management systems in the absence of the buffering protection of adult support.

Positive Stress

Slide by: Jack P. Shonkoff, M.D.

Tolerable Stress

Slide by: Jack P. Shonkoff, M.D.

Toxic Stress

“Buffering protection of adult support”

Slide by: Jack P. Shonkoff, M.D.
Toxic Stress

- Strong and prolonged activation of the body’s stress management systems in the absence of the buffering protection of adult support.
- Disrupts brain architectures and leads to stress management systems that respond at relatively lower thresholds, thereby increasing the risk of stress-related physical and mental illness.

Slide by: Jack P. Shonkoff, M.D.
Unsafe environment activates HPA axis (autonomic nervous system, ANS).

Early stress alters gene expression, with health impact across lifespan.

Early stress alters gene expression, with health impact across lifespan.

REGULATION

In simple system
ONLY environment → reversible
ice - water - steam

In complex system - irreversible = development

(PREDICTIVE ADAPTIVE RESPONSE)
Earliest care at birth matters
Same gene at birth matters \(\rightarrow\) switched

Early stress alters gene expression, with health impact across lifespan.

Perry: Responses to threat

<table>
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</tr>
<tr>
<td>Dissociative Continuum</td>
<td>REST (Female Child)</td>
<td>AVOIDANCE (Crying)</td>
</tr>
<tr>
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<td>SUBCORTEX Limbic</td>
</tr>
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Perry: Responses to threat - FAR

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Vasopressin
Responses to threat

- Reflexive
- Freezing
- Arousal
- Fear
- Fight
- Flight

Mental State

Cognition

Brain Areas

Secondary

Primary

Adaptative Response

Rest

vigilance

Freeze

FLight

Hyperarousal Continuum

Rest

Vigilance

Resistance

Freeze

Dissociative Continuum

Rest

Avoidance

Compliance

Freeze

Primary secondary Brain Areas

NEOCortex Subcortex

Limbic

Midbrain

Cognition

Abstract

Concrete

Emotional

Mental State

Calm

Arousal

Fear

Terror

Perry: Responses to threat

REFLEXIVE

Dissociation

FREEZE

Moro reflex – often called a STARTLE REFLEX

because it occurs when a baby is startled by a loud sound or movement

Perry: Responses to threat

SSHHH!

Rising Sound Intensity: An Intronic Warning Cue Activating the Amygdala

amygdala and left temporal areas. This provides direct evidence for the warning properties of rising sound intensity. SFS and
Jacksonian Dissolution

The more threatened the individual, the more 'primitive' (or regressed) becomes the style of thinking and behaving.

Perry 1995

NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD

Toxic Stress

- Strong and prolonged activation of the body’s stress management systems in the absence of the buffering protection of adult support.
- Disrupts brain architecture and leads to stress management systems that respond at relatively lower thresholds, thereby increasing the risk of stress-related physical and mental illness.

Slide by: Jack P. Shonkoff, M.D.

Primate separation studies

Amygdala Gene Expression Correlates of Social Behavior in Monkeys Experiencing Maternal Separation

Children exposed to early parental loss from death or separation are at great risk for developing later psychiatric disorders, such as major depression and anxiety. Maternal separation paradigm: Maternal separation at 1 week of age leads to social behavioral and an increase in self-soothing behavior (e.g., thumb sucking) in the developing primate. In contrast, monkeys experiencing maternal separation at 1 week of age show increased levels of social contact later in life. We sought to identify neural systems that underlie these differences.

Maternal Separation Paradigm

<table>
<thead>
<tr>
<th>Condition</th>
<th>Maternal Separation</th>
<th>1w</th>
<th>2w</th>
<th>3w</th>
<th>4w</th>
<th>5w</th>
<th>6w</th>
<th>12w</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>No maternal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>Maternal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td>Maternal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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Gene specific for the AMYGDALA (GUC1A3)

Separated at 1 week:

- LOW gene expression
- Increased self soothing → Anxiety
- Decreased sociality → Depression

Prolonged institutional rearing is associated with atypically large amygdala volume and difficulties in emotion regulation
Primate separation studies

Primate Early Life Stress Leads to Long-Term Mild Hippocampal Decreases in Corticosteroid Receptor Expression

Depression is predicted by prior early life stress (ELS), such as parent-infant/child neglect or abuse (1,2), but mediating mechanisms and processes are not well-

Maternal Separation Paradigm
Early Deprivation (ED) vs control (CON)
ED n 11
CON n 4

Repeated short separations:
LOW gene expression
Correlate to human adult depression

Maternal support in early childhood predicts larger hippocampal volumes at school age

Adults with depression, suicides:
LOW gene expression
smaller hippocampal volume
reduced expression frontal lobe

Epigenetic regulation of the glucocorticoid receptor in human brain associates with childhood abuse

These findings translate previous results from rats / monkeys to humans

Adults with depression, suicides:
LOW gene expression
smaller hippocampal volume
reduced expression frontal lobe

Increased methylation of glucocorticoid receptor gene (NR3CI) in adults with a history of childhood maltreatment: a link with the severity and type of trauma

Fig. 2: Hippocampus volume by preschool depression severity and maternal support.
DOHAD
Developmental Origins of Health and Adult Disease

Early stress alters gene expression, with health impact across lifespan.

... very early, once off, and forever.

SAFE  UNSAFE
Early stress alters gene expression, with health impact across lifespan.

**RESILIENCE**

(= STRESS RESISTANCE)

"capacity to maintain healthy emotional functioning in the aftermath of stressful experiences"

Social control becomes rewarding... in both mother and baby.
... there is considerable overlap in the brain structures associated with these neural mechanisms ... functional interactions among the circuits.

An overly responsive fear circuit ... may negatively influence functioning of the reward system.

... a properly functioning reward circuit may be necessary for ... positive social behaviors.

Maternal separation produces lasting changes in cortisol and behavior in rhesus monkeys. Plasma cortisol response to stress (2y).

CONCLUSIONS
Scientific findings do not support the perceived benefits of permanent, preweaning mother-infant separation.

RESILIENCE
(= STRESS RESISTANCE)
“capacity to maintain healthy emotional functioning in the aftermath of stressful experiences”
The Neuroscience of Birth & Breastfeeding

The science behind the concept

1 Maternal insensitivity to cues
2 Maternal OXT receptor dysfunction,
3 Maternal depression
4 Neonatal cortisol receptor decrease
5 Neonatal limbic brain: loss resilience
6 Neonatal feeding problems, DOHAD
7 etc, SEPARATION → HARM !!!

ZERO SEPARATION
the science behind the concept

1 Transition
2 Regulation
3 Breastfeeding
4 Microbiota
5 Bonding
6 Sensitization
7 SEPARATION → HARM !!!

The Neuroscience of Birth & Breastfeeding

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The Neuroscience of Birth & Breastfeeding

1 Maternal insensitivity to cues
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5 Neonatal limbic brain: loss resilience
6 Neonatal feeding problems, DOHAD
7 etc
IT MATTERS HOW WE ARE BORN

SEPARATION IS A STRESSOR FOR FULL TERM NEONATES

Preterms have less resilience:

SEPARATION IS A SEVERE STRESSOR FOR PRETERMS

TOXIC STRESS = absence of the buffering protection of adult support.

ZERO SEPARATION

SEPARATION = absence of the buffering protection of adult support.

REGULATION vs STIMULATION

Expected vs Unexpected
Ecologic salience vs Potential threat
Resource growth vs Threat readiness

OXYTOCIN vs CORTISOL
HOMEORHESIS vs HOMEOSTASIS
MOTHER vs OTHER

Our NORMAL biology

Skin-to-skin contact IS MORE essential for premature newborns!

Our NORMAL biology

TOXIC STRESS = levels of stress in neonates

- Eustress (good stress)
- Nurtures stress (induces compensatory mechanisms)
- Preterms’ eustress level is <150mg/dl of circulating cortisol (a glucocorticoid steroid hormone)
- Preterms’ stress level is usually very high, often exceeding 3500mg/dl (Coia et al., 1998)
- Acute eustress causes phasical release of cortisol
- The half-life is one full hour (Dwars, 1995)
- Acute stress and gender effects on cortisol response in preterm infants

Slide courtesy of Susie Ludington-Hoe
“Non-pharmacological reduction of hypercortisololaemia in preterm infants”

Preterm infants experience prolonged severe stress with tenfold increases in stress hormones.
Stress hormones at such levels are neurotoxic.

RCT on methods to reduce stress (at one hour):

<table>
<thead>
<tr>
<th>Method</th>
<th>Hormone Reduction</th>
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<tbody>
<tr>
<td>Cortisol</td>
<td>Slightly lower</td>
</tr>
<tr>
<td>Endorphin</td>
<td>No change</td>
</tr>
<tr>
<td>Massage</td>
<td>No change</td>
</tr>
<tr>
<td>Soft music</td>
<td>No change</td>
</tr>
<tr>
<td>Skin-to-skin</td>
<td>66% lower 74% lower</td>
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SSC – RESEARCH protection

Separation from mother is stressful for humans. Salivary cortisol is a good measure of stress.

RCT (Anderson et al 1998): Separation from mother, both groups given best care, only one-separated from mother at one hour.
Cortisol level measured every hour.

Cortisol separate = 9
Cortisol with mom = 4

CORTISOL

SSC – PROTECTION

Preterm infants experience prolonged severe stress with tenfold increases in stress hormones.
Stress hormones at such levels are neurotoxic.

SEPARATION RAISES STRESS HORMONES

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CORTISOL

STATE-OF-THE-ART

Trauma-informed care in the newborn intensive care unit: promoting safety, security and connectedness.

Both babies and their parents may experience a stay in the newborn intensive care unit (NICU) as a traumatic or ‘toxic stress,’ which can lead to dysregulation of the hypothalamic–pituitary–adrenal axis and ultimately to poorly controlled cortisol secretion.

... strongly linked to poor health outcomes

... trauma-informed care is an approach to caregiving based on the recognition of this relationship.

The Science behind Family Centred Care

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<th>Behaviour</th>
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<td>MOTHER</td>
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Disordered attachment

February 19, 2018

Cognitive Outcomes of Children Born Extremely or Very Preterm Since the 1990s and Associated Risk Factors
A Meta-analysis and Meta-regression

E. Salome, Sexbach, M., Veenstra, M. H., Moed, M., John F. de Weerth, M.D., PhD, et al.
Meaning: Despite advancing perinatal care, cognitive outcomes of children born extremely or very preterm did not improve between 1990 and 2008; preventative strategies to reduce the incidence of bronchopulmonary dysplasia may be crucial to improve outcomes after extremely or very preterm birth.

February 19, 2018

Cognitive Outcomes of Children Born Extremely or Very Preterm Since the 1990s and Associated Risk Factors: A Meta-analysis and Meta-regression

J. Selene Salihu, MD, MSc, Infants M. Waked, MD, MSc, and I. de Vries, MD, MSc, PhD

CONCLUSIONS

This study demonstrated a reduction in total length of hospital stay for infants born prematurely by providing facilities for parents to stay in the NICU 24 hours/day from admission to discharge. Analyses of secondary outcomes also suggested a reduction in pulmonary morbidity, such as moderate-to-severe BPD.

The Stockholm Neonatal Family Centered Care Study: Effects on Length of Stay and Infant Morbidity

n = 366

CONCLUSIONS

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The Science behind Family Centred Care

February 19, 2018

Cognitive Outcomes of Children Born Extremely or Very Preterm Since the 1990s and Associated Risk Factors: A Meta-analysis and Meta-regression

J. Selene Salihu, MD, MSc, Infants M. Waked, MD, MSc, and I. de Vries, MD, MSc, PhD

CONCLUSIONS

This study demonstrated a reduction in total length of hospital stay for infants born prematurely by providing facilities for parents to stay in the NICU 24 hours/day from admission to discharge. Analyses of secondary outcomes also suggested a reduction in pulmonary morbidity, such as moderate-to-severe BPD.
Early Experience and the Development of Stress Reactivity and Regulation in Children (Gunnar 2010)

Early stress alters gene expression, with health impact across lifespan.
**Nurturescience**

Essentially ecological:

- **ENVIRONMENT** → **ADAPTATION**, **EXPERIENCE**, **REPRODUCTIVE FITNESS**
- **BABY** → **MOTHER**
  - **BONDING** → Sensitization

The branch of biology that deals with the relations of organisms to one another and to their physical surroundings.

(from Greek: οἶκος, "house", or "environment"; λογία, "study of")

---

**Nurturescience**

3 primary occupations:

- **BABY**
  - BREASTFEEDING
  - SLEEPING
  - CONNECTING

- **MOTHER**
  - BREASTFEEDING
  - SLEEPING
  - CONNECTING

---

**Nurturescience**

Neuroscience developed in the old paradigm of maternal–infant separation.

---

**Nurturescience**

Nurturescience now engulfed or embedded in current neuroscience paradigms.

Needs dissecting out →

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**Comparison of nurturescience and neuroscience**

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**Immediate**

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INTRODUCTION

“It is easier to build strong children than to repair broken men.”

Frederick Douglass (1817–1895)