Dr Robert D White

In the early stages of NICU design as life-and-death treatments were being refined, the impact of light, noise, movement and other sensory stimuli was considered of minor importance.

Gunnar Sedin

“Air, warmth and water”

Early neonatology focused on warmth and cardio-respiratory outcomes

“If CVS and oxygenation okay = brain okay”

High BP → IVH
Low BP → PVL

Rumaisa went home 9th February 2005

Sequelae are in fact huge

Gunnar Sedin

Focus on ELBW "increasing survival" decreasing sequelae

Current record 21 wk GA
Current record 244 g
Rumaisa went home 9th February 2005

Sequelae are in fact huge

Late Preterm Infant (LPI)

Early Dysregulation
Later adverse outcome

Dr Robert D White

As long-term developmental status has replaced the survival rate as the focal point for evaluation of the quality of neonatal care, interest in the impact of the physical environment on the developing premature brain has accelerated.
"It is a serious mistake to assume that the principles derived from careful animal studies do not apply to human infants. The risk of suppression or disruption of needed neural processes ... is very significant and potentially lasts a lifetime.

First 1000 days =

270 → 365 + 365

in its mother's arms ..."

(White 2004)
"Phenotype" - specimen resulting from gene - environment interaction

Neuronal migration

The Neuroscience of Birth & Breastfeeding
The DNA
EPIGENETICS
NEURODEVELOPMENT
EVOLUTIONARY BIOLOGY
ENVIRONMENT
ADAPTATION
EXPERIENCE
REPRODUCTIVE FITNESS

"Phenotype" - specimen resulting from gene - environment interaction
One million new synapses/second at 1 year!

fetal REM sleep (or active sleep) seems to be particularly important to the developing organism ... spontaneous synchronous firing

Marks et al 1995

Neurons that fire together wire together while those which don’t, won’t” Hebb/Carla Shatz

Early wiring phase
Pruning of excess
Adult stage (efficient)
Optimal neural pathways are selected - J-P Changeux

BRAIN WIRING

Fig 4. Schematic representation of the interaction between sensory receptors and CNS functions within the framework of the sleep-wake cycle. Neurotransmitters with proven effects on sensory receptors and/or cortical processing are included (PUPA, polymethonarry fatty acids, Zn, Na, K, P, proline).
Getting rhythm: how do babies do it?

### Brain orexins and wake regulation

Orexin activates brain, motivation, but accumulates “sleep pressure”, and a flip-flop switch controls the diurnal circadian rhythm.

### Mother-infant synchrony

**Infant:** sleep cycles begin to block on diurnal rhythms

- **at 12 weeks** (circadian)
- **START at 3 months**
- Can be “adult-like” at 6 months.

**Mother-infant synchrony**

- **at 12 weeks**

**Thomas 2014**

**Infant sleep cycling**

- critical for brain development,
- BUT is also determined by brain requirements:

- **TEMPERAMENT**
- **PERSONALITY**
- **OREXIN METABOLISM**

- “MORE SLEEP → MORE WIRING”
**SMELL**

*modulates state organisation*  
*elicits emotional behaviours*

*activates pre-feeding actions*  
*anticipatory digestive physiology*  
*regulates pace of ingestive behaviour*

---

**Bennion 2015**

- **CORTISOL** protects from negative embedding in REM
- **GROWTH HORMONE**
- **MELATONIN**

---

**Doucet 2009**

*The secretion of Areolar (Montgomery’s) Glands*  
*activate oral activity on the nipple that releases a cascade of behavioral, neural, neuroendocrine and endocrine processes in the newborn and the mother.*

*In early ontogeny the sleeping brain may thus remain sentient of an organism’s odor environment.*
BRAIN WIRING ➔ SMELL

REM
NR1
NR2
NR3
SWS

ACQUISITION
poly-sensory input
short-term memory
stored cortex

CONSOLIDATION
transfer information
"SNR" strong signals
amygdala / hippocampus

MEMORY FORMATION
P waves connected to neocortex: organized REM

Awake and REM
Stanley Graven 2006

SCHER ... LUDINGTON-HOE

Neurophysiological assessment of brain maturation after an 8-week trial of skin-to-skin contact on preterm infants

SSC ➔ sleep cycling accelerates maturation

1995) as a strategy of neuroprotection. SSC appears to accelerate EEG-sleep state organization and maturation as a non-pharmacological neuroprotective intervention when compared with two non-SSC cohorts. The prolonged benefits of these non-pharmacolog-

Skin-to-skin can improve the integrity of sleep

ENDOCRINE SYSTEMS

ENVIRONMENT

The Neuroscience of Birth & Breastfeeding

The DNA
EPIGENETICS
NEURODEVELOPMENT
BEHAVIOUR
EVOLUTIONARY BIOLOGY

- 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.

Table 1: Definition of phases/behaviours identified

<table>
<thead>
<tr>
<th>Phases</th>
<th>Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth cry</td>
<td>Intense crying just after birth</td>
</tr>
<tr>
<td>Relaxation phase</td>
<td>Infant rooting/recovering. No activity of mouth, head, arms, leg, or body</td>
</tr>
<tr>
<td>Awakening phase</td>
<td>Infant begins to show signs of activity. Small thrusts of head, up, down, from side-to-side. Small movements of limbs and shoulders</td>
</tr>
<tr>
<td>Active phase</td>
<td>Infant moves limbs and head, is more determined in movements. Rooting, activity, &quot;pushing&quot; with limbs without lifting body</td>
</tr>
<tr>
<td>Crawling phase</td>
<td>&quot;Pushing&quot; which results in shifting body</td>
</tr>
<tr>
<td>Rearing phase</td>
<td>Infant rests, with some activity, such as mouth activity, sucks on hands</td>
</tr>
<tr>
<td>Familiarization</td>
<td>Infant has reached a new nipple with mouth positioned to brush and licks nipple</td>
</tr>
<tr>
<td>Sucking phase</td>
<td>Infant has taken nipple in mouth and commence sucking</td>
</tr>
<tr>
<td>Sleeping phase</td>
<td>The baby has closed its eyes</td>
</tr>
</tbody>
</table>
The neurobiology of infant maternal odor learning

Locus coeruleus norepinephrine is required for the olfactory bulb learning changes.

These data indicate that pups have a unique learning circuit relying on the olfactory bulb for neural plasticity and on the hyperfunctioning noradrenergic locus coeruleus flooding the olfactory bulb with norepinephrine to support the neural changes.

**APPROACH RESPONSE**

...learned prenatally, reinforced both during the birth process and repeatedly throughout the postnatal period, supported by a unique neural framework...a system that ensures rapid and robust maternal odor learning.

**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**

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

(Widstrom 1987)
**METABOLIC ADAPTATION**

SSC started in the first 20 minutes after birth

<table>
<thead>
<tr>
<th></th>
<th>SSC</th>
<th>Cot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood glucose (1 hr)</td>
<td>3.17</td>
<td>2.56</td>
</tr>
<tr>
<td>Base excess drop</td>
<td>3.4</td>
<td>1.8</td>
</tr>
</tbody>
</table>

(Christenson 1992)

**The Neuroscience of Birth & Breastfeeding**

**Awake at birth**

Noradrenergic neurons from LOCUS COERULEUS may activate the whole brain during wakefulness.

**You can never reach the same high levels of catecholamine levels during your whole life as at birth**

Reduced catecholamine surge after C-section

catecholamine surge required to activate (epithelial sodium channel) pump to get lung liquid clearance

Riccardo Pfister
The newborn brain consumes 50% of all the blood glucose.

In the adult 20%.

Scientific American 2010

The infant brain is not blank!

Resting activity -

"stream of consciousness"

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.

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

Simulation theory: EMPATHY is generated by inner imitation of actions of others.
Learning affective values for faces is expressed in amygdala and fusiform gyrus

Prefrontal Activation Associated with Social Attachment: Facial-Emotion Recognition in Mothers and Infants

Neural language networks at birth

Temporal and Spatial Evolution of Brain Network Topology during the First Two Years of Life

Psychobiological Roots of Early Attachment
**SENSATIONS THAT WIRE BRAIN**

- SEES
  - Mum's eyes
- SMELLS
  - Mum's milk
- TASTES
  - Mum's milk
- TOUCHS
  - Hand
- CONTACTS
  - Skin-to-skin
- EAR
  - Hears
  - Mum's voice
- SKIN
  - Mum's skin
- BACK
  - Feels
  - Mum's arm
- WARMED
  - On Mum's front

**BONDING components**

- ANS
  - Emotional
- Social
- Physical

**BONDING consequence**

- Child: Insecure attachment
- Adult: Higher CORTISOL and lower immunity (CD4 cells)
- Social: Anxiety to partner
- ANS: Emotional
- Physical: CORTISOL

**The Neuroscience of Birth & Breastfeeding**

- The DNA
- Environment
- Experience
- Reproductive Fitness

**The Brain**

- Neurodevelopment
- Behaviour
- Evolutionary Biology

**BIRTH**

- BONDING
- Sensitization
- Attuned parenting

**BEYOND**

- Feed → Sleep Cycling
- Mother → Baby Bonding

**Critical period concept**: "Windows of opportunity in early life are essential for brain development by providing critical sensory input to allow the brain to develop more advanced neural systems.

**OXYTOCIN**

- Cingulate
- Suppressed
- Protection

- Hypothalamus
  - Prolactin
  - Milk making
  - Nutrition

- Amygdala
  - Cholecystokinin
  - Emotion / satiety

- Hypothalamus
  - Gaze increase
  - Bonding

**SENSITIZATION**
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

The Neuroscience of Birth & Breastfeeding
The DNA  The Brain  Behaviour
EPIDEMIOLOGY  NEURODEVELOPMENT  EVOLUTIONARY BIOLOGY
ENVIRONMENT  ADAPTATION  EXPERIENCE  REPRODUCTIVE FITNESS

Can this be influenced??
Vaginal birth → unique pattern
→ sensory processing, empathy, arousal, motivation, reward and habit-regulation circuits...
MORE SENSITIVE
Oxytocin surge absent in Caesarean
may contribute to mental health risks & RESILIENCY in the mother–infant dyad

Maternal brain response to own baby-cry is affected by cesarean section delivery

Specifying the Neurobiological Basis of Human Attachment: Brain, Hormones, and Behavior in Synchronous and Intrusive Mothers

Well-adopted parenting...
reward-related motivational mechanisms,
temporal organization,
→ anxious parenting...
mediated by stress-related mechanisms
and greater neural disorganization.
Oxytocin, prolactin, milk production and their relationship with personality traits in women after vaginal delivery or Cesarean section.

Social desirability and oxytocin pulsativity were also correlated with the amount of milk transferred from the mother to the baby. The correlations indicate that central oxytocin ... may be involved in behavioral adaptations to the maternal role.
Unsafe environment activates HPA axis (autonomic nervous system, ANS).

**Psychobiology and molecular genetics of resilience**

Adriana Feder*, Eric J. Nestler‡, and Dennis S. Charney‡

*Nat Rev Neurosci. 2009 June; 10(6):446–457. doi: 10.1038/nrne2649

---

**Earliest care at birth matters**

Same gene \(\rightarrow\) switched

The Place \(\rightarrow\) FITNESS \(\rightarrow\) EXPERIENCE \(\rightarrow\) ADAPTATION

**Gene specific for the AMYGDALA (GUYC1A3)**

Separated at 1 week:

LOW gene expression

Increased self soothing \(\rightarrow\) Anxiety

Decreased sociality \(\rightarrow\) Depression

---

**Primate separation studies:**

Development/Plasticity/Repair

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

Children exposed to early parental loss through death or separation carry a greater risk for developing future psychiatric illnesses, such as major depression and anxiety. Monkeys experiencing maternal separation at 1 week of age show fewer social behaviors and an increased in self-soothing behaviors. The same is true in contrast, monkeys experiencing maternal separation at 1 month of age show increased levels of social contact later in life. We sought to identify neural systems that may mediate these effects.
**Primate separation studies**

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


**Maternal Separation Paradigm**

**Early Deprivation (ED) vs control (CON)**

- **ED n 11**
  - Mat 0 d → 2 d → 28 d → 48 w
  - 30 - 120 min daily

- **CON n 4**
  - Mat → → → → 48 w

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

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

- **Fig. 2.** Hippocampus volume by preschool depression severity and maternal support.

**Increased methylation of glucocorticoid receptor gene (NR3C1) in adults with a history of childhood maltreatment: a link with the severity and type of trauma**

**Adults with depression, suicides:**

- **LOW gene expression**
  - Smaller hippocampal volume
  - Reduced expression frontal lobe
Adults with depression, suicides:
LOW gene expression
smaller hippocampal volume
reduced expression frontal lobe.

These findings translate previous results from rats / monkeys to humans.

These findings translate previous results from rats / monkeys to humans.

The DNA (endogenous) specifically for negative memory!!
Embedded in vmPFC and amygdala.

Noradrenergic neurons from LOCUS COERULEUS may activate the whole brain during wakefulness.

“Sleep and cortisol interact to support memory consolidation”
CORTISOL (endogenous) + CORTISOL (exogenous)
Slow Wave Sleep
specifically for negative memory!!

Bennion 2015
RESILIENCE
(= STRESS RESISTANCE)

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

EMOTION
CONTROL CENTRE

ALLOSTASIS

ANY STRESS:
Psychological
Neurological
Endocrine
Immune

PERCEPTIONS
“NEUROCEPTION”

STRESS → RESPONSE

+ RESISTANCE / SENSITIVITY ↔

ALLOSTATIC STATE

ALLOSTATIC LOAD

HEALTH

elevated activity - sustained over time, or severe → changes the “set points” for homeostasis (e.g. increasing blood pressure, change in cholesterol level)


http://www.imr.no/copewell/work_packages/wp3/en

NEUROSCIENCE
The DNA
Everything else
EVOLUTIONARY BIOLOGY
The Brain
EPIGENETICS
The Place
ENVIRONMENT
EXPERIENCE
FITNESS
ADAPTATION

CORTISOL
**ALLOSTASIS**

ANY STRESS:
- Psychological
- Neurological
- Endocrine
- Immune

STRESS ➔ RESPONSE ➔ ALLOSTATIC STATE ➔ ALLOSTATIC LOAD ➔ ALLOSTATIC OVERLOAD

**HEALTH** ➔ VULNERABILITY ➔ RESILIENCE

WELL-BEING ➔ SUSCEPTIBILITY ➔ MORBIDITY ➔ MORTALITY

---

**OXYTOCIN DURING LABOUR**

CHANGES MOTHER'S BRAIN!!

This brain responds to baby's cry differently:

- **Amygdala** - The emotional brain - to love her baby - relationship - to focus on care for baby
- **Cingulate** - (inhibition) switched off - makes ferocity for defence
- **Thalamus** - activity coordinating centre of brain - to focus on care for baby
- **Hypothalamus** - activates arousal response to respond

---

**OXYTOCIN DURING LABOUR**

Orbitofrontal cortex - activates approach

Nucleus accumbens - Reward and pleasure motivation - (dopamine)

Fusiform gyrus - (face coding unit of brain) seeks her baby's face

---

**OXYTOCIN DURING LABOUR**

CHANGES MOTHER'S BRAIN!!

Same brain circuits as RESILIENCE, "highly conserved neuro-endocrine behavior"
**Resilience:** "capacity to maintain healthy emotional functioning in the aftermath of stressful experiences"
Any intervention should be subject to RANDOMISED CONTROLLED TRIAL and meta-analysis ...
THE PLACE MODEL
SKIN-TO-SKIN CONTACT

BREAST-MOTHER
VAGAL
(PSNS)
GROWTH

OTHER
PROTEST-, STRESS,
SURVIVAL or
DESPAIR
(SENS)

SEPARATION

Reference

RCT of skin-to-skin contact from birth versus conventional incubator care for physiological stabilisation in 1200- and 2199-gram newborns.


Results

Minimization technique ensured groups balanced for confounders.

(n = 34)

<table>
<thead>
<tr>
<th></th>
<th>KMC</th>
<th>CMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean weight</td>
<td>1813g</td>
<td>1866g</td>
</tr>
<tr>
<td>Mean GA</td>
<td>34.2w</td>
<td>35.3w</td>
</tr>
<tr>
<td>Approp' GA</td>
<td>65%</td>
<td>64%</td>
</tr>
<tr>
<td>Male</td>
<td>60%</td>
<td>50%</td>
</tr>
</tbody>
</table>

(p 783)

KMC

Control

Intervention

BAILOUT points

"physiological parameters exceeding normal limits, requiring medical assessment and or intervention"

1. Skin temp consistently <35.5°C
2. Heart rate <100; or >180 bpm
3. Apnoea longer than 20 seconds
4. O₂ sats below 89% (x2), (CPAP/60% O₂)
5. Blood glucose < 2.6mmol/l, (laboratory)

Bergman et al 2004

H1b (SPECIFIC)

Doctor Stable
summoned:

INCUBATOR 92% 8%
SKIN-TO-SKIN 17% 83%

Bergman et al 2004

"Stability of Cardio-Respiratory system in Preterm Infants"

<table>
<thead>
<tr>
<th>SCRIP SCORE</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td>Regular</td>
<td>Deceleration to 80-100</td>
<td>Rate 180 or &gt;200 bpm</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>Regular</td>
<td>Apnoea ≤5s or periodic breathing</td>
<td>Apnoea &gt;5s</td>
</tr>
<tr>
<td>Oxygen saturation</td>
<td>Regular &gt;87%</td>
<td>Any fall to 80-87%</td>
<td>Any fall below 80%</td>
</tr>
</tbody>
</table>

Score allocated for a five minute period of continuous observation, maximum six for period

Fischer et al. 1988

STABILITY
"100% SCRIP STABILITY"

<table>
<thead>
<tr>
<th>1200g to 2200 g</th>
<th>S S C C M C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 6h</td>
<td>56%</td>
</tr>
<tr>
<td>@ 6h</td>
<td>100%</td>
</tr>
<tr>
<td>1200g to 1800g</td>
<td>44%</td>
</tr>
<tr>
<td>@ 6h</td>
<td>100%</td>
</tr>
</tbody>
</table>

INCUBATORS DE-STABILISE NEWBORNS


PROTEST – DESPAIR

9.4.1. Separation of infants: causes

The impact of separation from the mother is most profound in the infant primate and is well-documented in infant macaques. They typically display a biphasic response characterised by an initial stage ("protest") of hypersensitivity associated with distress vocalisations, followed by a depressive stage ("despair") characterised by social withdrawal, a decrease in play, and the development of a typical hunched posture (Minadea and Simon, 1978; Capitanu, 1986). This is accompanied by physiological disturbances in the regulation of heart rate, body temperature, sleep patterns, cortisol secretion and the immune system (Laurencem et al.,

DYSREGULATION

REGULATION vs STIMULATION

Expected vs Unexpected
Ecological salience vs Potential threat
Resource growth vs threat readiness

OXYTOCIN vs CORTISOL
HOMEORHESIS vs HOMEOSTASIS
MOTHER vs OTHER

WHY IS EARLY MATERNAL SEPARATION STRESSFUL?

SEPARATION DYSREGULATES CORTISOL

Fig. 2. Schematic representation of the dynamics of early-separation response resulting from the loss of regulatory interactions within the mother-infant relationship.

The Neuroscience of Birth & Breastfeeding

intricately, inseparably linked to the right place.

(ALBERTS 1994)
"It is a serious mistake to assume that the principles derived from careful animal studies do not apply to human infants. The risk of suppression or disruption of needed neural processes... is very significant and potentially lasts a life time.
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.

**Perry: Responses to threat**

<table>
<thead>
<tr>
<th>Adaptive Response</th>
<th>REST (Adult Male)</th>
<th>VIGILANCE (Male Child)</th>
<th>FREEZE (Crying)</th>
<th>RESISTANCE (Freeze)</th>
<th>DEFIANCE (Posturing)</th>
<th>AGGRESSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperarousal</td>
<td>VIGILANCE (Crying)</td>
<td>FREEZE (Adult Male)</td>
<td></td>
<td>RESISTANCE (Freeze)</td>
<td>DEFIANCE (Posturing)</td>
<td>AGGRESSION</td>
</tr>
<tr>
<td>Dissociative</td>
<td>COMPLIANCE (Crying)</td>
<td></td>
<td></td>
<td>RESISTANCE (Freeze)</td>
<td>DEFIANCE (Posturing)</td>
<td>AGGRESSION</td>
</tr>
<tr>
<td>Brain Areas</td>
<td>DISORIENTATION (Numbing)</td>
<td>FREEZE (Female Child)</td>
<td></td>
<td>RESISTANCE (Freeze)</td>
<td>DEFIANCE (Posturing)</td>
<td>AGGRESSION</td>
</tr>
<tr>
<td>PRIMARY Brain Areas</td>
<td>FAINTING (MINI)</td>
<td>FREEZE (Female Child)</td>
<td></td>
<td>RESISTANCE (Freeze)</td>
<td>DEFIANCE (Posturing)</td>
<td>AGGRESSION</td>
</tr>
</tbody>
</table>

**Cognition**

- ABSTRACT
- CONCRETE
- EMOTIONAL

**Mental State**

- CALM
- AROUSAL
- FEAR
- TERROR

**REFLEXIVE**

- **Evolutionary survival machine**

- **EEG → BAS autonomic upstream**
- **HRV → autonomic MEDIATOR downstream**
Babies
2 days old
MNS, 1 hr
n 16

HRV produces IBI
(Inter Beat Interval)
frequency domain (PDS)
FFT / AR / wavelet
• social vagus (validated)
• sympathetic (accepted)

AUTONOMIC STATE
COMPONENTS:
GREEN = VLF
RED = SNS SYMPATHETIC
BLUE = NEW SOCIAL VAGUS

Skin-to-skin contact = *NORMAL* PLACE
7 x more QS is SS/C
(one seventh of QS in MNS)
3 x more ANS in MNS

Discussion:
Quiet Sleep latency long in MNS
Anxious Arousal
Aaron Jones et al. (2004) conducted a study of four groups of mother–infant dyads: EEG done on baby at 1 month of age. The first group was Depressed-Bottlefed EEG asymmetry correlates as expected ...

Jacksonian Dissolution
The more threatened the individual, the more ‘primitive’ (or regressed) becomes the style of thinking and behaving. (Perry 1995)

Maternal & Preterm Skin-to-Skin Contact Enhances Child Physiologic Organization and Cognitive Control Across the First 10 Years of Life
Ruth Feldman, Zehava Rosenthal, and Arthur I. Eidelman

NILS’ TRANSLATION: MATERNAL SEPARATION IS TOXIC STRESS!!
Maternal separation may be a stressor the human neonate is not well-evolved to cope with, and may not be benign.

Separated neonates experience disturbances of sleep cycling.

BONDING consequence
Child: Insecure attachment CORTISOL
Adult: Higher CORTISOL and lower immunity (CD4 cells)

Adult: Attachment Anxiety to partner

Social Emotional Physical

Maternal-Preterm Skin-to-Skin Contact Enhances Child Physiologic Organization and Cognitive Control Across the First 10 Years of Life
Ruth Feldman, Zehava Rosenthal, and Arthur I. Eidelman

BIOL PSYCHIATRY 2014;75:56–64
Maternal-Preterm Skin-to-Skin Contact Enhances Child Physiologic Organization and Cognitive Control Across the First 10 Years of Life

Results: KC increased autonomic functioning (respiratory sinus arrhythmia, RSA) and maternal attachment behavior in the postpartum period.
• Reduced maternal anxiety, enhanced child cognitive development and executive functions from 6m to 10y.

By 10... attenuated stress response, improved RSA, organized sleep, and better cognitive control.

RSA and maternal behavior dynamically interrelated over time... improved physiology, executive functions, and mother-child reciprocity at 10 years.
SPECIFICITY
(1) Intervention impacts key process: does not affect other processes

SENSITIVE PERIOD
(2) Intervention may be small...but has major effect

STABLE COMPONENT
(3) Component is key building block & exerts long term effect

BIOLICALCLOCKS
(oscillators)

MECHANISM
(4) Continuity in small steps

MATERNAL CONTACT
• Newborn-Maternal regulation-interaction
• Last trimester

USERS
(5) Cortisol, reactivity

 Physiological function
(6) Sleep, wake

MOMENTS
(7) HRV, cardiac vagal tone, milliseconds, moments, hours, days, months, years

TOXIC STRESS
(8) Cortisol, endorphin
• Prolonged stress hormones
• Prolonged severe stress
- Stress management

SEPARATION
(9) Skin-to-skin contact
• Skin-to-skin 74% lower

POLICY STATEMENT
Early Childhood Adversity, Toxic Stress, and the Role of the Pediatrician: Translating Developmental Science Into Lifelong Health

Garner 2011

"Non-pharmacological reduction of hypercortisolalaemia in preterm infants" (Mold & Geller 1999, Monson et al. 1997)

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):
- Cortisol
- Endorphin
- Massage
- Music
- Skin-to-skin

Results:
- Cortisol: slightly lower
- Endorphin: no change
- Music: no change
- Skin-to-skin: 66% lower, 74% lower

"Reducing toxic stress IS VERY EASY!!"
An ecobiodevelopmental framework for early childhood policies and programs.

**BERGMAN COMMENTARY – NEWBORN**
Reducing toxic stress IS VERY EASY!!

**Innovative strategies ...**
... reduce toxic stress

**Creative new strategies**

“compelling need for bold new strategies”