

PERINATAL NEUROSCIENCE and SKIN-TO-SKIN CONTACT

NWA 2014 Annual Education and Networking Conference

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Cape Town, RSA

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PERINATAL NEUROSCIENCE and SKIN-TO-SKIN CONTACT

Speaker Disclosure

Under ACCME guidelines:

- I am the South African distributor of
MIRIS : Human Milk Analyzer
- My wife and I are owners and directors of
NINO Academy (Tendotouch Pty Ltd)
produce educational & promotional goods and materials
related to the talk content.

First 1000 days =

Gestation	270
year one	365
year two	365
TOTAL	1000 days

270 → 365 + 365

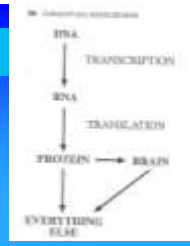
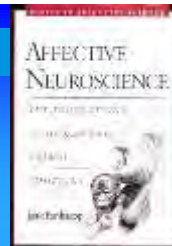


Figure 6.1. Summary of the current "central dogma" that underlies the analysis of all biological processes, including those that mediate basic psychobiological processes. The only major concept missing from this schematic is the environment, and these influences permeate all phases of these transactions.

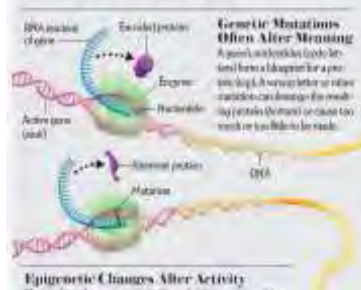
The Neuroscience of Birth & Breastfeeding



ENVIRONMENT ADAPTATION → EXPERIENCE → REPRODUCTIVE FITNESS

Genetics vs. Epigenetics

Many new insights into mental illness have come from studying epigenetic modifications of genes, which differ from genetic mutations (below). Both kinds of alterations can disturb the functioning of the brain and other tissues.



INK

Scientific
American,
December 2011

... highly conserved neuro-endocrine behaviors

"Genome" - genes of species

"Genotype" - genes in specimen

INK



Epigenetic Changes Alter Activity

Genes are turned on or off by chemical groups called methyl groups. These groups are attached to DNA and can be added or removed. This process is called epigenetics. Epigenetic changes can be passed on to offspring.

Gene off: Genes are turned off by methyl groups. This is like turning off a light switch. The gene is still there, but it's not working.

Gene on: Genes are turned on by methyl groups. This is like turning on a light switch. The gene is working.

Other methyl groups: Other methyl groups can be added to DNA, which can also affect gene activity.

PENCIL

... highly conserved neuro-endocrine behaviors

"Genome" - genes of species

"Genotype" - genes in specimen

INK

"Phenotype" - specimen resulting from gene - environment interaction

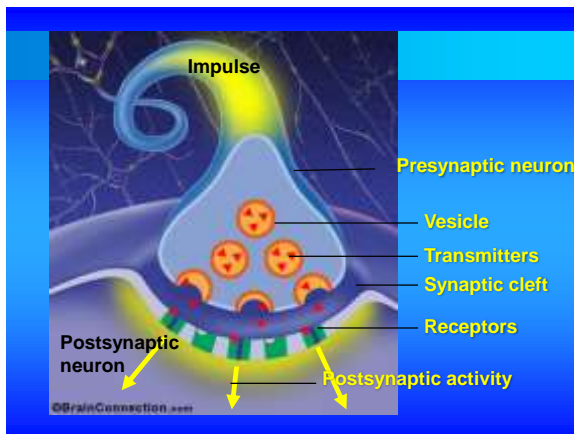
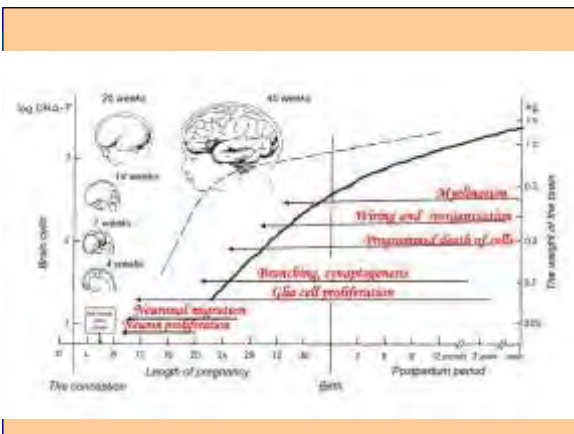
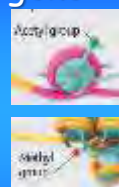
Pencil

EPIGENES ...

controls on the DNA/gene "switches in the mind"

G x E

"Phenotype" - specimen resulting from gene - environment interaction



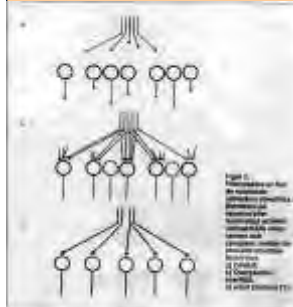
fetal REM sleep

(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

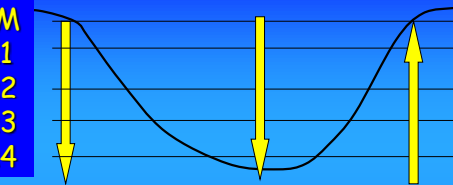
Pruning of excess

Adult stage (efficient)

Optimal neural pathways are selected
- J-P Changeux

BRAIN WIRING

REM
NR1
NR2
NR3
NR4



ACQUISITION

poly-sensory input
short-term memory
stored cortex

CONSOLIDATION

transfer information
"SNR" strong signals
amygdala / hippocampus
NREM stage 4

MEMORY FORMATION

P waves
returns info to neocortex
organized
REM

Awake and REM
Stanley Graven 2006

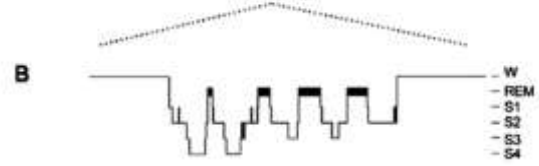
Sleep, Hormones, and Memory



Journal of Clinical Investigation 2009; 119: 820-827

This article follows the hypothesis that a primary function of sleep pertains to the consolidation of memory. In recent years, this view has received substantial support from a rapidly growing number of experiments performed in various species and at different levels of behavioral, cellular, and molecular analysis.

Sleep



BRAIN WIRING



Peirano 2003

BRAIN WIRING



PATHWAYS
→ CIRCUITS
→ NETWORKS



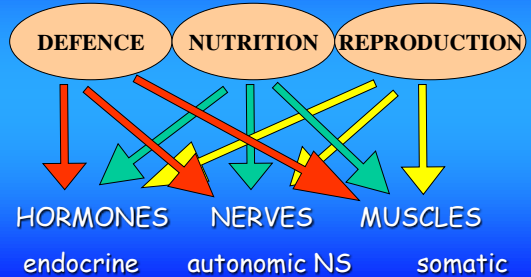
Brain Architecture and Skills are Built in a Hierarchical “Bottom-Up” Sequence

- 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.



HIGHLY CONSERVED NEURO-ENDOCRINE BEHAVIOR



Newborn behaviour to locate the breast when skin-to-skin: a possible method for enabling early self-regulation

Journal of Maternal Psychology and the Infant, 2010, 25(1), 1-10



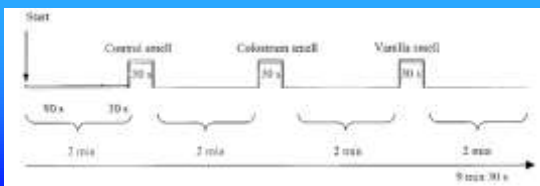
Table 1 Definition of phases/behaviours identified:

Phases	Behaviour
Birth cry	Intense crying just after birth
Relaxation phase	Infant resting/recovering, no activity of mouth, head, arms, legs or body
Awakening phase	Infant begins to show signs of activity. Small thrusts of head: up, down, from side-to-side. Small movements of limbs and shoulders
Active phase	Infant moves limbs and head, is more determined in movements. Rooting activity, 'pushing' with limbs without shifting body
Crawling phase	'Pushing' which results in shifting body
Resting phase	Infant rests, with some activity, such as mouth activity, sucks on hand
Familiarization	Infant has reached areola/nipple with mouth positioned to brush and lick areola/nipple
Sucking phase	Infant has taken nipple in mouth and commences suckling
Sleeping phase	The baby has closed its eyes

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

MARCO BARTOCCI, JAN AYUBBERG, CAROLINA RUCARUCCI, LENA L. BERGQVIST, GIOVANNI FERRA, AND DRUG-LASERUKANTZ

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

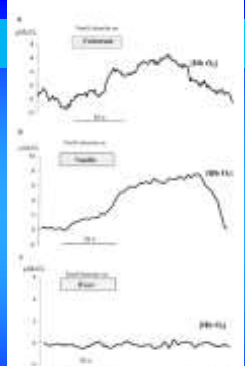
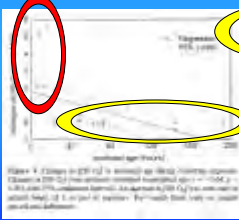


Figure 4. Changes in [Hb O₂] during exposure to odors: control, colostrum, and vanilla in each age group. The percentage change (mean ± SD) in [Hb O₂] during exposure to odors is shown for each age group. The x-axis is time in minutes and the y-axis is [Hb O₂] in percent. Values are mean ± SD.

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

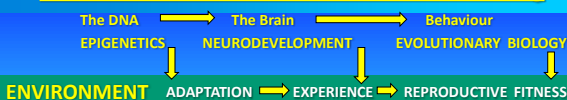
	SSC	Cot
Blood glucose (1 hr)	3.17	2.56
Base excess drop	3.4	1.8

(Christenson 1992)

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

(Alberts 1994)

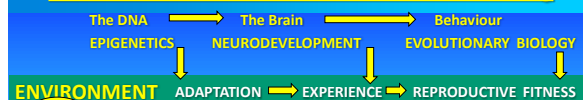
The Neuroscience of Birth & Breastfeeding



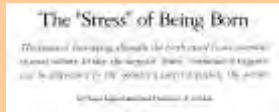
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(Alberts 1994)

The Neuroscience of Birth & Breastfeeding

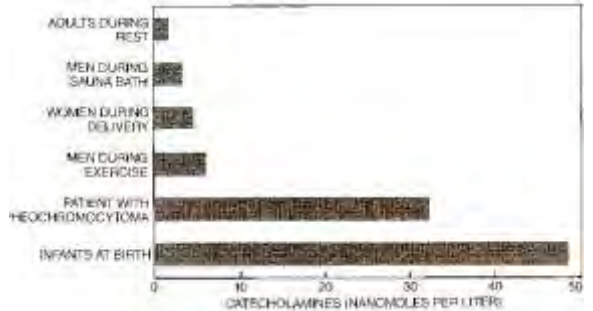


When does the infant become conscious?

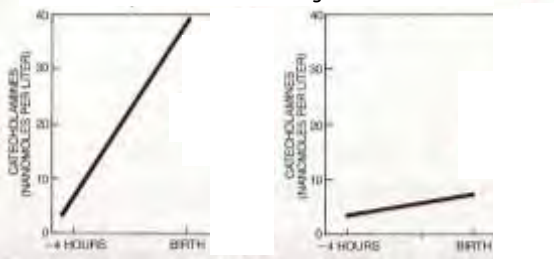


Scientific American 1986
 Scientific American Mind 2009

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



Reduced catecholamine surge after C-section



Vaginal delivery

Elective C-section

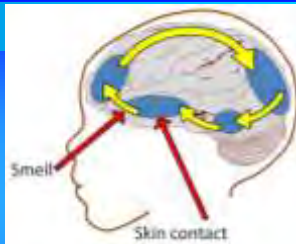
The newborn brain consumes 50% of all the blood glucose
 -
 In the adult 20%

Scientific American 2010

The infant brain is not blank!
 Resting activity
 -
 "stream of consciousness"

AT BIRTH,

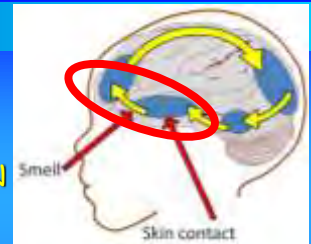
the brain has TWO CRITICAL SENSORY NEEDS:



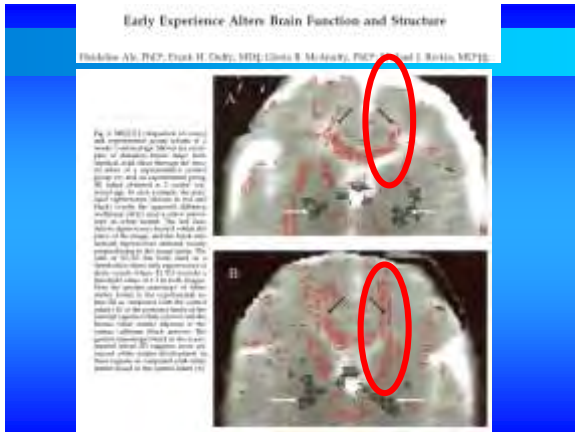
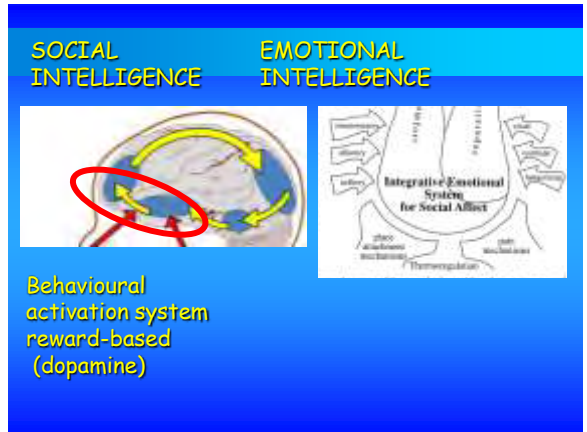
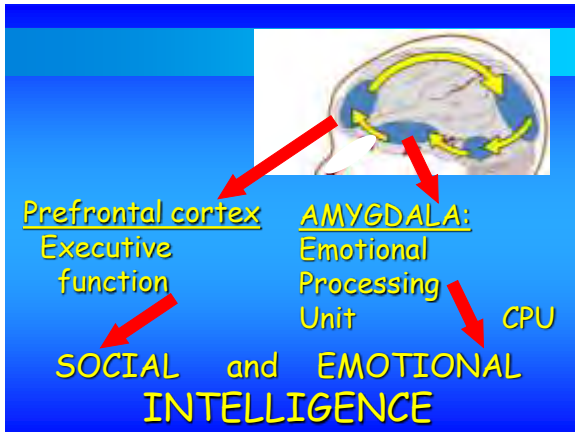
SMELL & CONTACT connect direct to the amygdala

THE NEWBORN BRAIN

SKIN-TO-SKIN CONTACT fires and wires



the amygdala-prefronto-orbital cortical pathway (PFOC)



OXYTOCIN

Interpersonal awareness
Emotions

Kerstin Uvnäs-Moberg

Ross 2009

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.

Neural Basis of Imitation and Emotional Expression Processing during Infant Imitation Stages

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

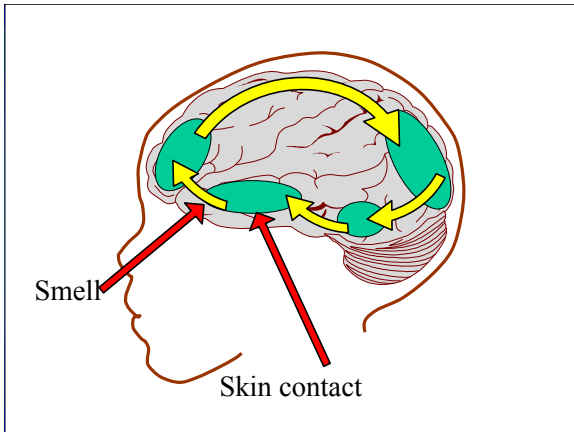
Simulation theory:
EMPATHY is generated by inner imitation of actions of others

Learning affective values for faces is expressed in amygdala and fusiform gyrus

Predrag Petrovic, Raffael Kalisch, Matthias Poser, Tania Singer, and Raymond J. Dolan

To evaluate the environment for social threat humans must build affective evaluations of others. These evaluations are stable and to a high degree shaped by responses engendered by specific social processors. The precise neuronal mechanisms by which these evaluations are constructed is poorly understood. We tested a hypothesis that conjoint activity in amygdala and fusiform

Morphing emotion **AMYGDALA ↔ FUSIFORM GYRUS**



Psychobiological Roots of Early Attachment

Wenxian A. Healy

REGULATION

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

Fig. 1. Schematic representation based on the work of John Bowlby (Bowlby, 1969, 1973, 1980)

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)

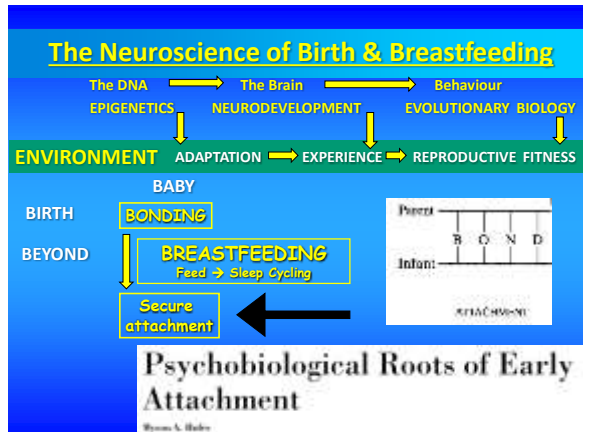
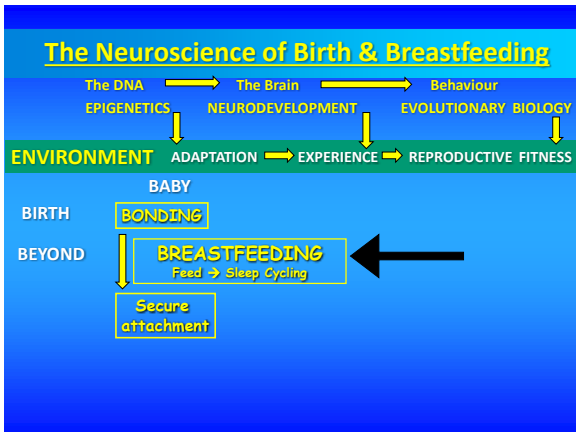
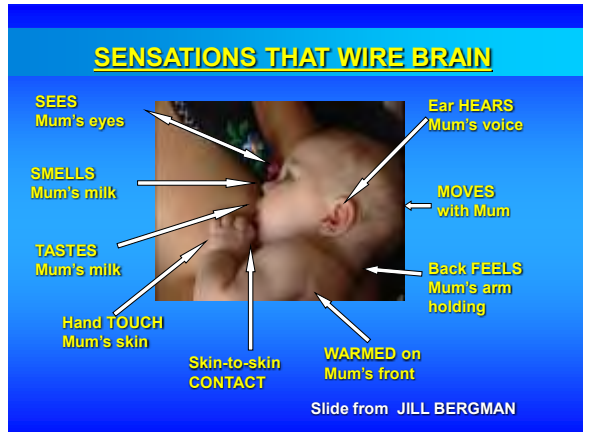
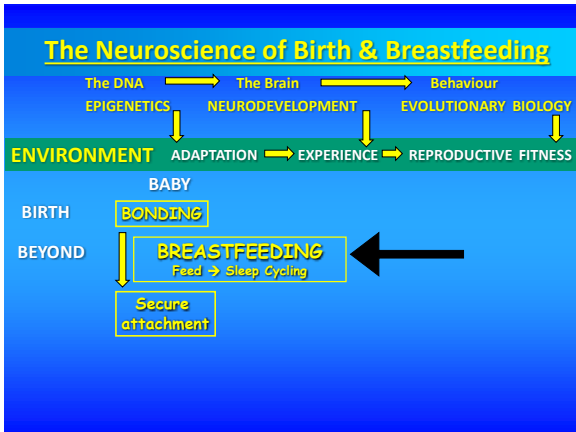
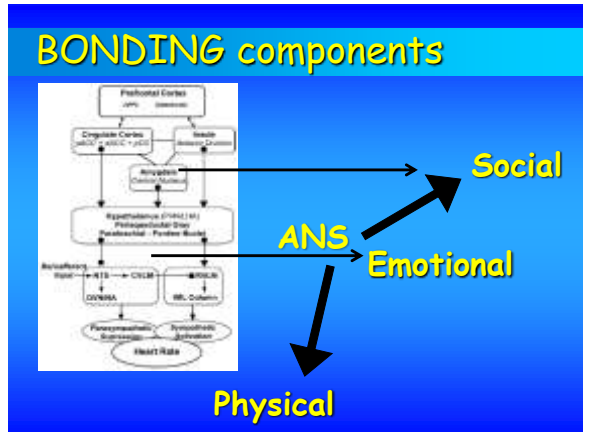
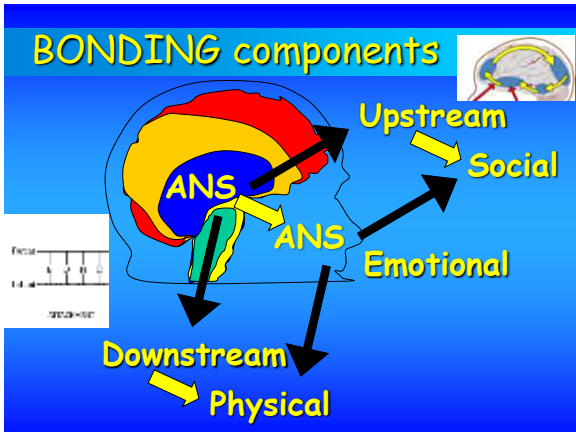
Clinics in Perinatology, June 2004, Vol 31(2) page 210
Stanley Graven,
Early neurosensory visual development of fetus and newborn.

"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.

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BIRTH **BONDING**

"needed neural processes"

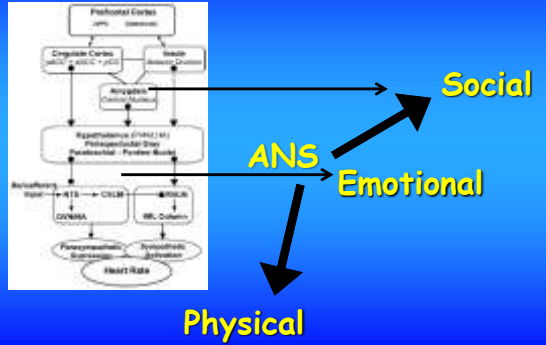


John Bowlby

secure attachment
 "a safe base from which to explore the world".

- Safe Haven
- Secure base
- Proximity maintenance
- Separation distress

BONDING components



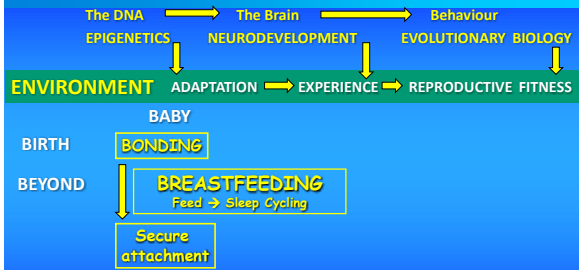
Psalm 22 v 9

"I learnt trust on my mother's breasts"

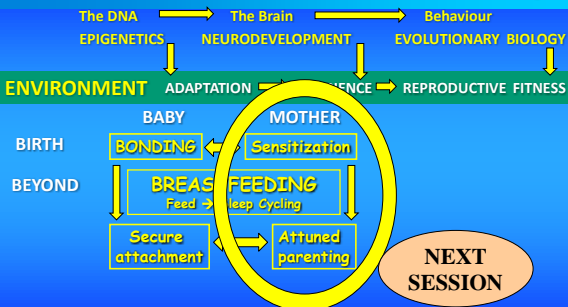
Neural circuitry of bonding



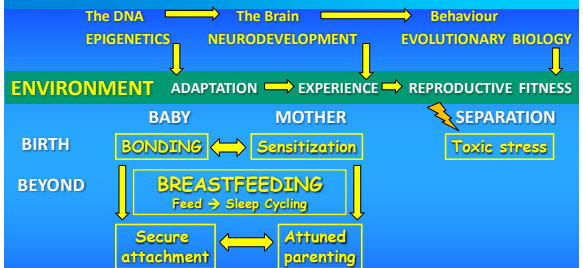
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The Neuroscience of Birth & Breastfeeding



The Neuroscience of Birth & Breastfeeding



Pediatrics 2012;129:e224; originally published online December 26, 2011;
DOI: 10.1542/peds.2011-2662

POINT-STATEMENT

Early Childhood Adversity, Toxic Stress, and the Role of the Pediatrician: Translating Developmental Science Into Lifelong Health
Garner 2011

TOPICAL REPORT

The Lifelong Effects of Early Childhood Adversity and Toxic Stress
Jack P. Shonkoff, Andrew S. Garner, THE COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH, COMMITTEE ON EARLY CHILDHOOD ADOPTION AND DEPENDENT CARE, AND SECTION ON DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS, Benjamin S. Siegel, Mary I. Dobbins, Miriam F. Earls, Andrew S. Garner, Laitia McGinty, John Piacentini, and David L. Wood
Pediatrics 2012;129:e232; originally published online (December 26, 2011)
DOI: 10.1542/peds.2011-2663

INTRODUCTION

Of a good beginning cometh a good end.
John Heywood, Proverbs (1948)

Shonkoff 2012

The United States, like all nations of the world, is facing a number of social and economic challenges that must be met to secure a promising future. Central to this task is the need to produce a well-

PEDIATRICS ©2012 by American Academy of Pediatrics

The basic science of pediatrics.

Shonkoff J P et al. Pediatrics 2012; 129:e232-e246

The Neuroscience of Birth & Breastfeeding

NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD

Positive Stress

- Moderate, short-lived stress responses, such as brief increases in heart rate or mild changes in stress hormone levels.

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

DEVELOPMENTAL OUTCOME

- 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.

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.

CORTISOL

Psychobiological Roots of Early Attachment

Wenxin A. Hales

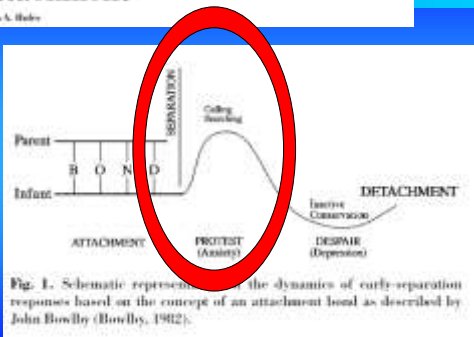


Fig. 1. Schematic representation of the dynamics of early-separation responses based on the concept of an attachment bond as described by John Bowlby (Bowlby, 1982).

Mary Ainsworth (1913 - 1999)

... provide scientific evidence for Bowlby's theories.

Strange Situation Test:

- secure attachment
- insecure ambivalent (anxious)
- insecure avoidant

WHY IS EARLY MATERNAL SEPARATION STRESSFUL?

SEPARATION DYSREGULATES

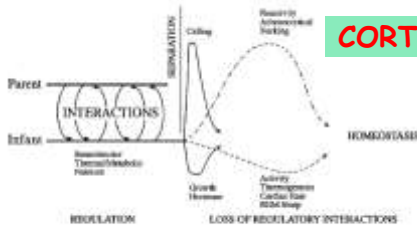
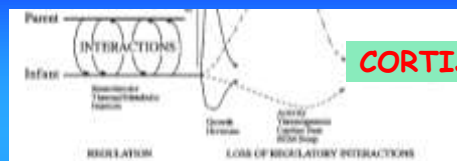


Fig. 2. Schematic representation of the dynamics of early-separation responses resulting from the loss of regulatory interactions within the mother-infant relationship.

WHY IS EARLY MATERNAL SEPARATION STRESSFUL?



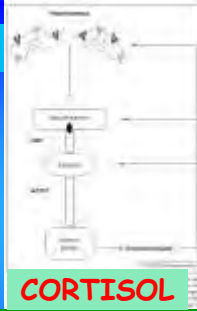
components (e.g., nutrient, thermal/metabolic, or sensorimotor) of the infant's previous interaction with its mother and that the complex response to separation was due to the withdrawal of all these components at once.

MICHAEL MEANEY

Maternal care as a model for experience-dependent chromatin plasticity?

Michael J. Meaney and Marie Boyl

"In response to stress, CRF ... and vasopressin are released ... anterior pituitary ... synthesis release ACTH ... glucocorticoids → "



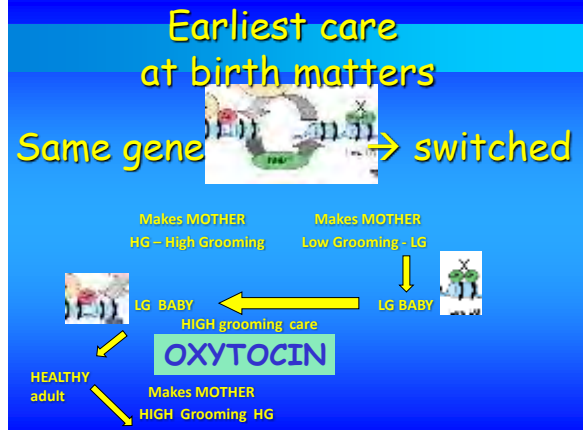
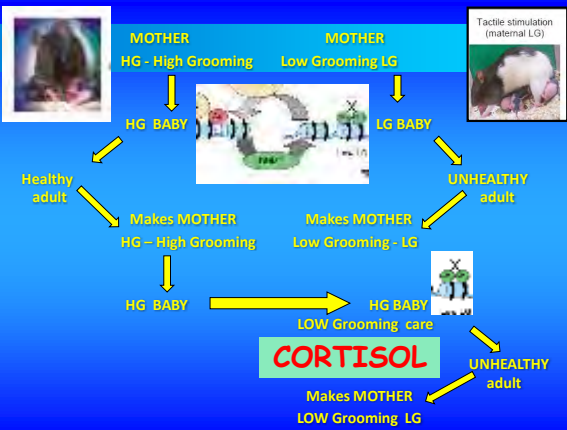
CORTISOL

Unsafe environment activates HPA axis (autonomic nervous system, ANS).

MICHAEL MEANEY epigenetics



Tactile stimulation (maternal LG)



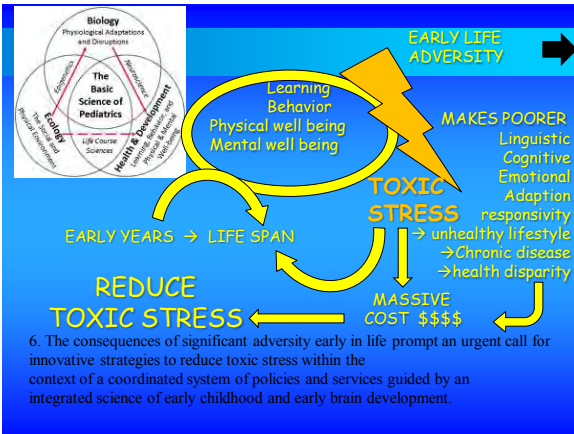
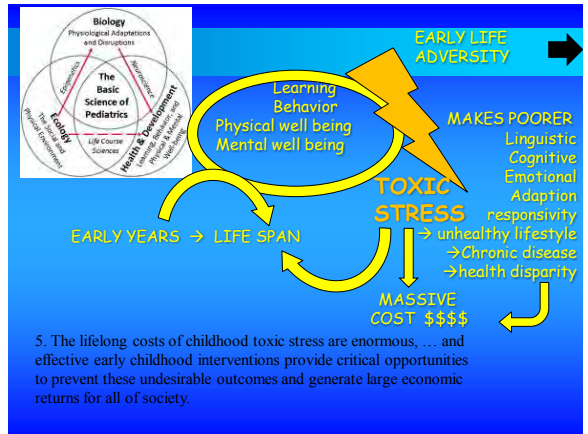
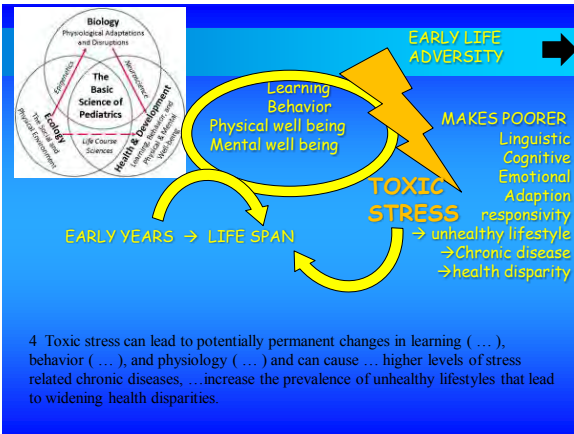
MICHAEL MEANEY epigenetics

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

BONDING components



Social
Emotional
Physical



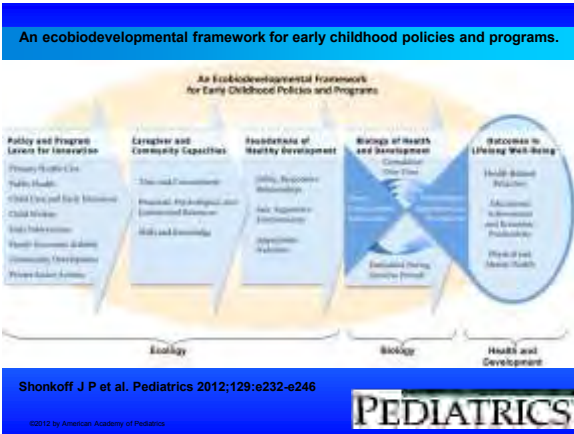
AP is committed to leveraging science to inform the development of innovative strategies to reduce the precursors of toxic stress in young children and to mitigate their negative effects on the course of development and health across the lifespan. *Pediatrics* 2012;129:e232-e241

Innovative strategies ...
... reduce toxic stress

Creative new strategies

"compelling need for bold new strategies"

... bold and timely because the call for a broader, contextual approach to health care needs and the track record of making medicine with evidence-based is limited, there is a compelling need for bold, new thinking to translate advances in developmental science into more effective interventions.



"Of a good beginning cometh a good end" →
John Heywood, Proverbs (1546)

When is the beginning?

INTRODUCTION:
Of a good beginning cometh a good end.
John Heywood, Proverbs (1546)

The United States, like all nations of the world, is facing a number of social and economic challenges that must be met to secure a promising future. Central to this task is the need to produce a well-

An ecobiodevelopmental framework for early childhood policies and programs.



Shonkoff J P et al. Pediatrics 2012;129:e232-e246



©2012 by American Academy of Pediatrics

AP is committed to leveraging science to inform the development of innovative strategies to reduce the precipitants of toxic stress in young children and to mitigate their negative effects on the course of development and health across the life span. Pediatrics 2012;129:e226-231

Innovative strategies ...
... reduce toxic stress

Creative new strategies

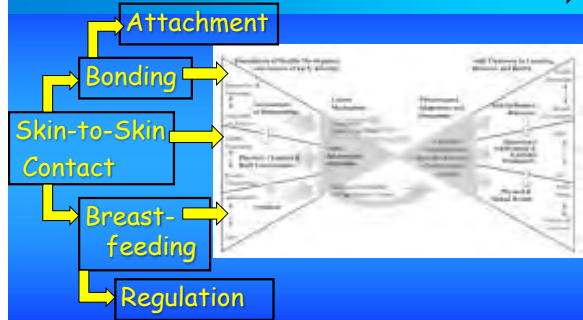
... and boldly, because this call for a broader, conceptual approach to health care, one that the stark record of making medicine with evidence-based care is limited, there is a compelling need for bold, new thinking to translate advances in developmental science into more effective interventions.

"compelling need for bold new strategies"

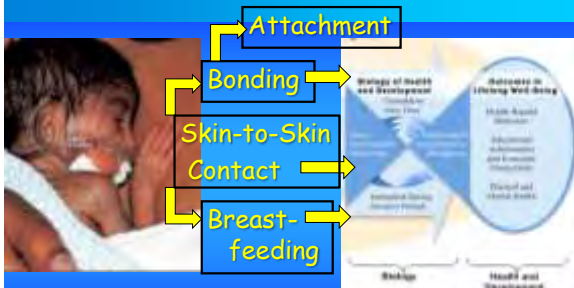


"compelling need for bold new strategies"
National Research Council 2000

Shonkoff 2010



An ecobiodevelopmental framework for early childhood policies and programs.



BERGMAN COMMENTARY - NEWBORN
Reducing toxic stress IS VERY EASY !!

PERINATAL NEUROSCIENCE and SKIN-TO-SKIN CONTACT

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

INTRODUCTION

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

Frederick Douglass (1817-1895)

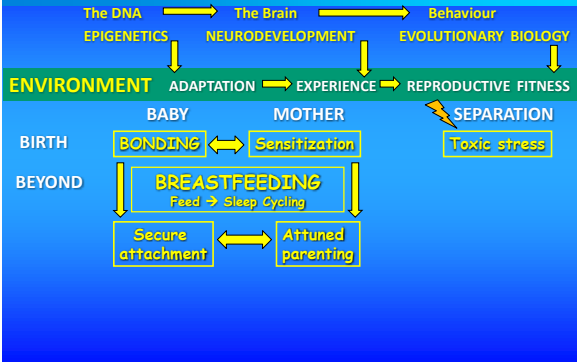
www.skintoskincontact.com

MOTHER

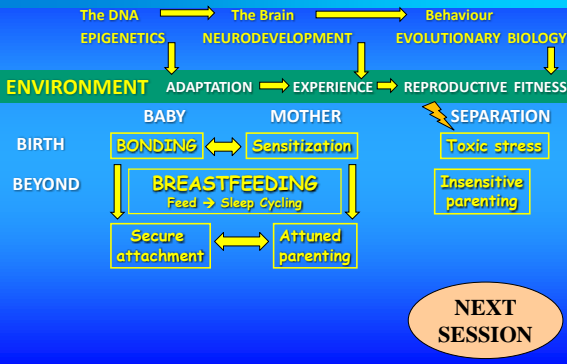
ENVIRONMENT ADAPTATION → EXPERIENCE → REPRODUCTIVE FITNESS

is the key to neurodevelopment ...
... because she is the RIGHT PLACE !!

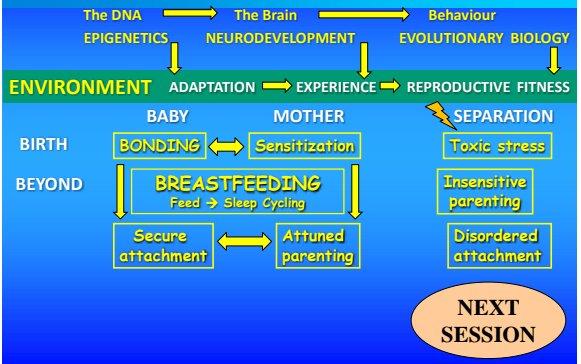
The Neuroscience of Birth & Breastfeeding



The Neuroscience of Birth & Breastfeeding



The Neuroscience of Birth & Breastfeeding



Attachment

Contingent infant directed



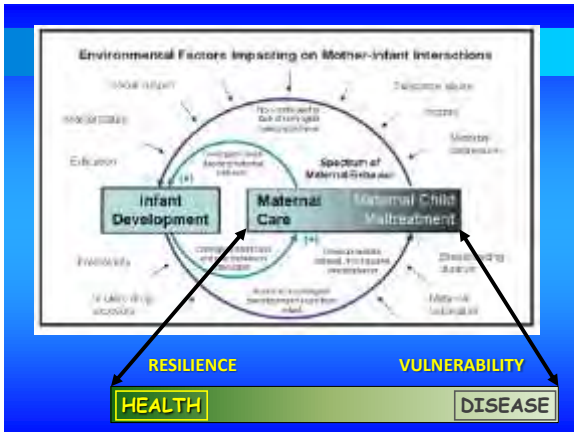
Attunement

Synchronous Sensitive

Non-contingent



Intrusive Insensitive



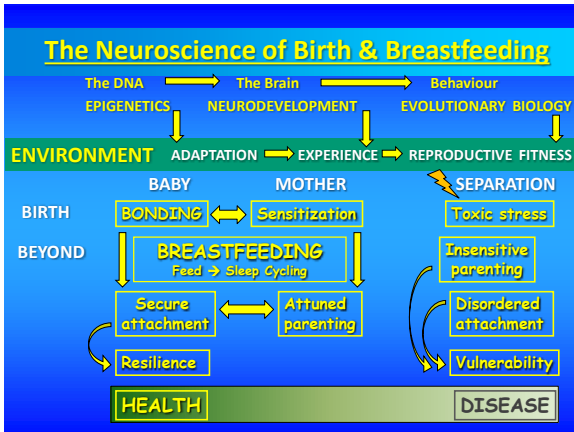
PROTECTIVE AND DAMAGING EFFECTS OF STRESS MEDIATORS
BRUCE S. MCEWEN, Ph.D.

RESILIENCE

(= STRESS RESISTANCE)

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

Resilience → HEALTH
Vulnerability → DISEASE



SEPARATION

ENVIRONMENT → ADAPTATION → EXPERIENCE → REPRODUCTIVE FITNESS

VIOLATES

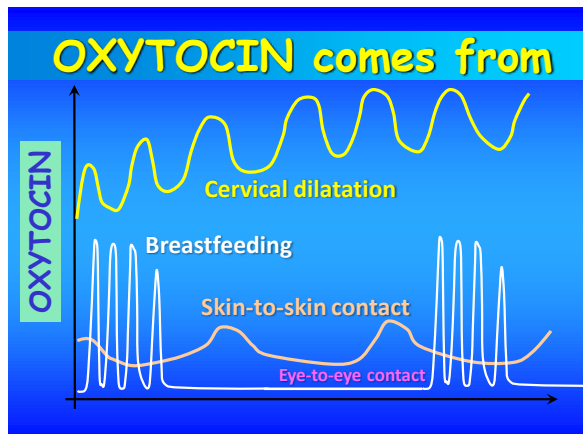
the innate agenda of mother and baby

SEPARATION leads to Toxic stress, In insensitive parenting, Disordered attachment, and Vulnerability, which leads to DISEASE.

SEPARATION → **CORTISOL**

↑ OPPOSITES ↓

SKIN-TO-SKIN CONTACT → **OXYTOCIN**



Doula:

An ancient Greek word meaning "handmaid."

This term has come to represent a compassionate, experienced woman who provides physical, emotional, educational and practical support to another woman and her family during all the events surrounding childbirth.

birthdoulasofpittsburgh.com

Birth companion

... constant uninterrupted presence of another woman

birthdoulasofpittsburgh.com

Issues in support of Baby Friendly Hospital Status

protect
OXYTOCIN
during
labour.

protect
OXYTOCIN
after
birth.

"ECD" Early Childhood Development

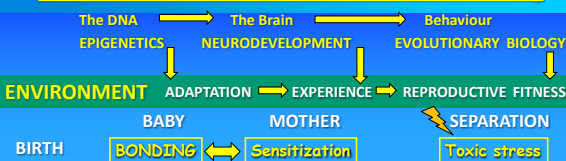
First 1000 days =

gestation	270
year one	365
year two	<u>365</u>
total	<u>1000 days</u>

NINO application

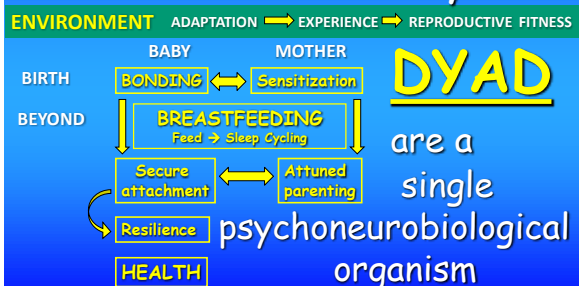
First 1000 hrs = 1st six weeks
 First 1000 min = 16,6 hours = 1st day
 First 1000 sec = 16 minutes = 1st hour

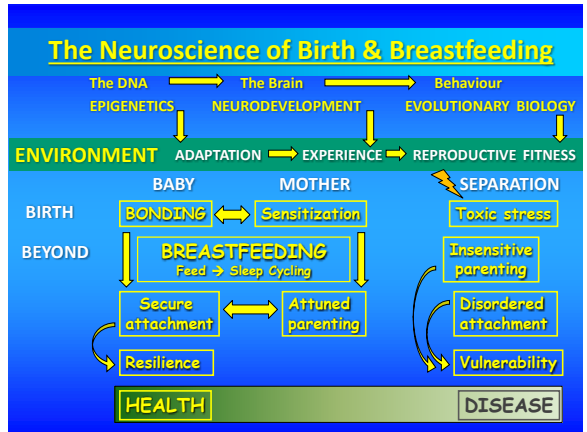
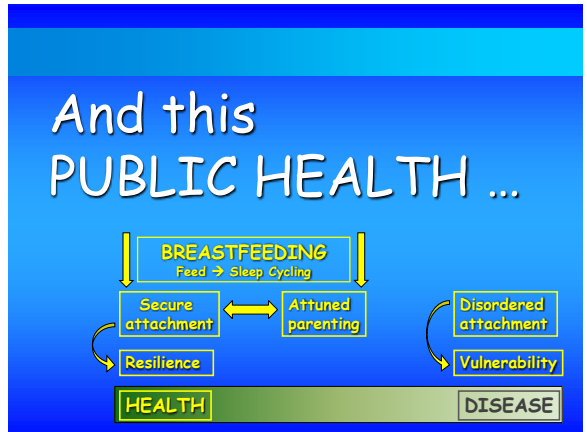
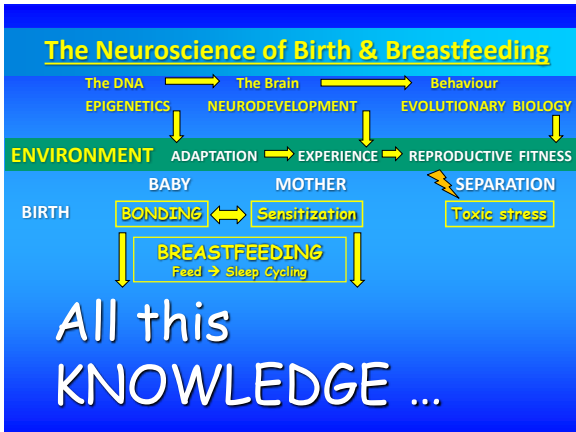
The Neuroscience of Birth & Breastfeeding



IT MATTERS
 HOW WE ARE BORN

A mother and baby





BIRTH COMPANION

FATHER AT BIRTH

ZERO SEPARATION

Looking Back, Moving Forward
 WIC: Strengthening Families for 40 Years

Nelson Mandela

... in describing the measure of a nation, he has argued that:

"There can be no keener revelation of a society's soul than the way in which it treats its children."