

## Your Baby's Brain: the latest neuroscience



Nils & Jill Bergman

Cape Town, South Africa

[www.kangaroomothercare.com](http://www.kangaroomothercare.com)

## Your Baby's Brain: the latest neuroscience

1. How your baby's brain WORKS
2. What HARMS your baby's brain
3. What HELPS your baby's brain
4. YOUR parenting brain

[www.kangaroomothercare.com](http://www.kangaroomothercare.com)

## Your Baby's Brain: the latest neuroscience

1. How your baby's brain WORKS

Basic brain function, like a computer!  
Amazing behaviour of baby at birth  
Brain's own timetable for development

## NEUROSCIENCE

90% of what we know  
about the brain has  
been discovered in  
**the last 15 years**

Society of Neuroscience estimate  
Dr Sandra Witelson, McMaster

## FETAL BRAIN DEVELOPMENT

The first 10 - 14 weeks,  
fetal brain growth is  
determined by  
genes (the DNA)



Thereafter, brain  
growth is an  
active process.

## FETAL BRAIN DEVELOPMENT

Neuron = chief actor

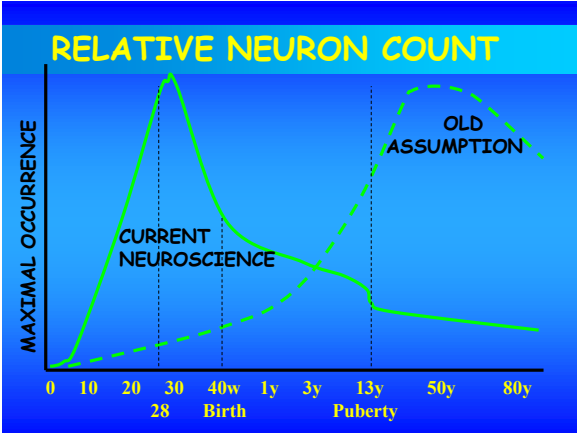
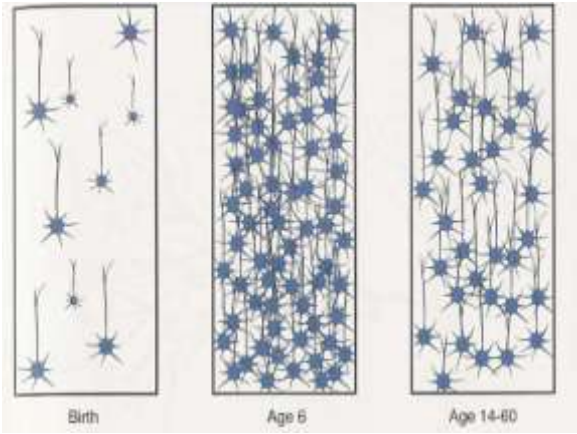
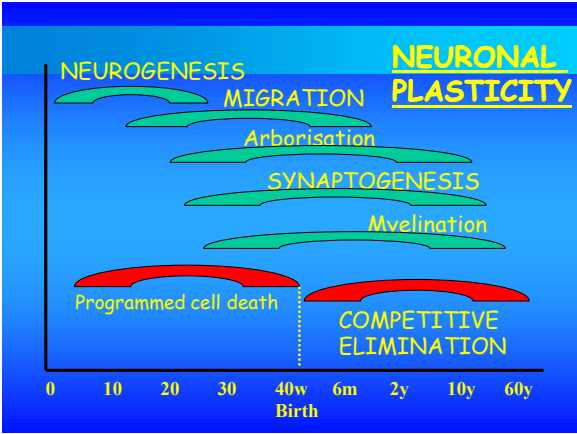
Neurons push out a  
tree of connections  
(dendrification)

The also migrate ...

*"Cells which  
**FIRE TOGETHER,  
 WIRE TOGETHER,**  
 and those which  
 don't, won't."*  
 Carla Shatz

SECOND COMMANDMENT OF NEUROSCIENCE

**USE IT,  
 OR  
 LOSE IT**



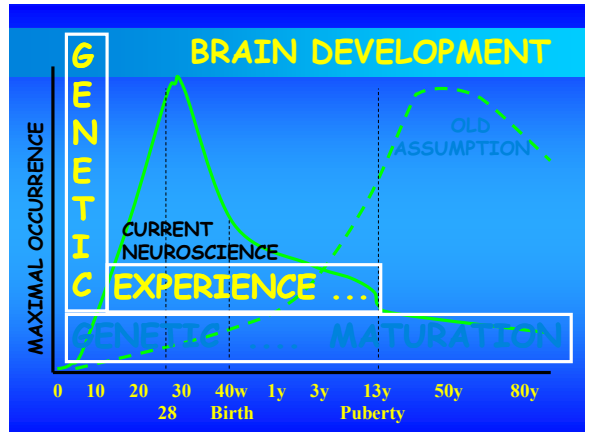
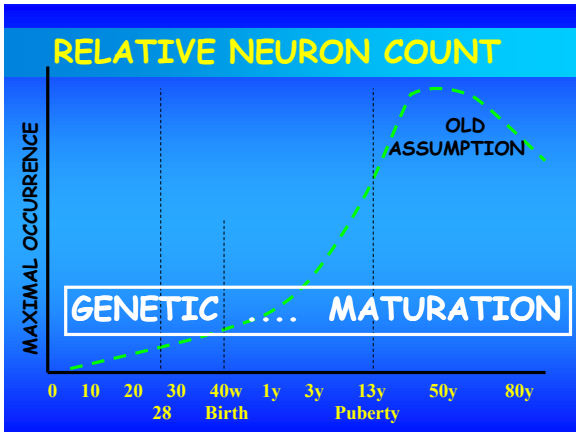
EARLY DEVELOPMENT

Gestational age  
 20w all structures completed

**parallel development  
 of structure & function**

(Hugo Lagercrantz 2004)

**Brain growth  
 depends on experiences !!**



### EARLY DEVELOPMENT

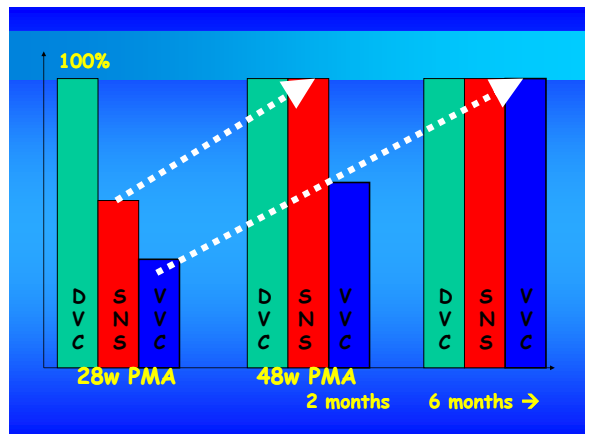
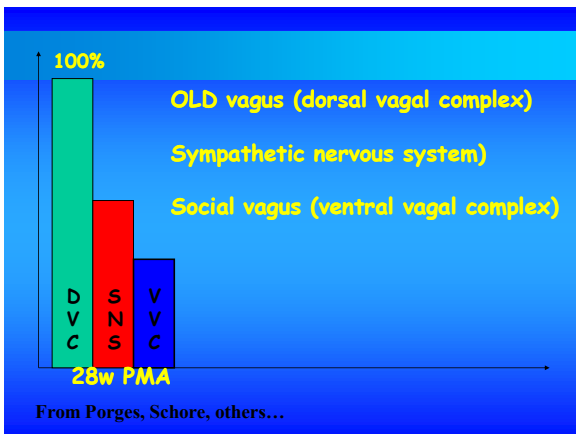
"The brain is not a computer, it is a jungle."

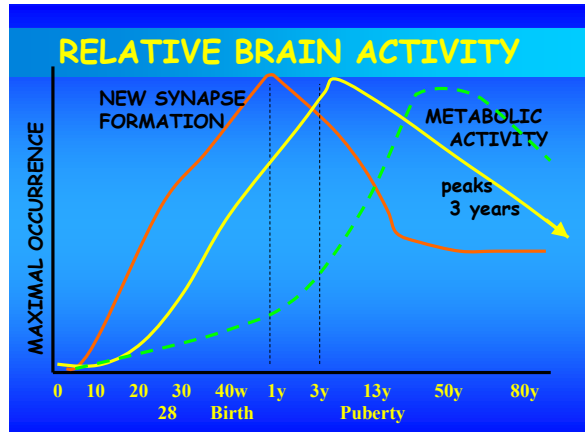
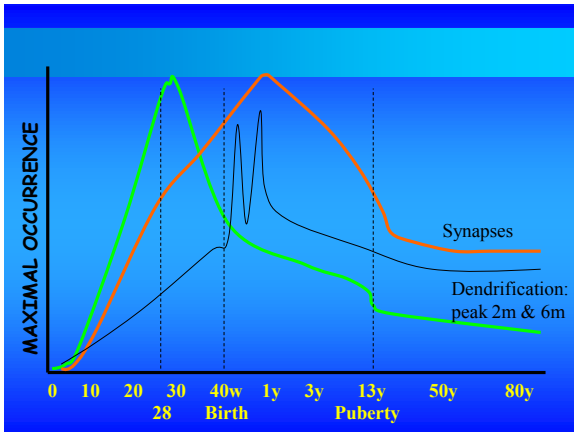
100 billion neurons x 20000 synapses .....

"The perinatal sensorium is never in chaos ....

DEVELOPMENT IS → EVER MORE ORDERED

1 <sup>st</sup>	28w	unmyelinated
		immobilise
2 <sup>nd</sup>	2 m	sympathetic
		fight or flight
3 <sup>rd</sup>	6 m	myelinated vagus
		engage/disengage





The brain is a

# SENSORY ORGAN

DATA ACQUISITION UNIT

## SYNAPSE DEVELOPMENT

At birth, the human being has more synapses in its brain than at any other stage of life.

## The HARD DISK

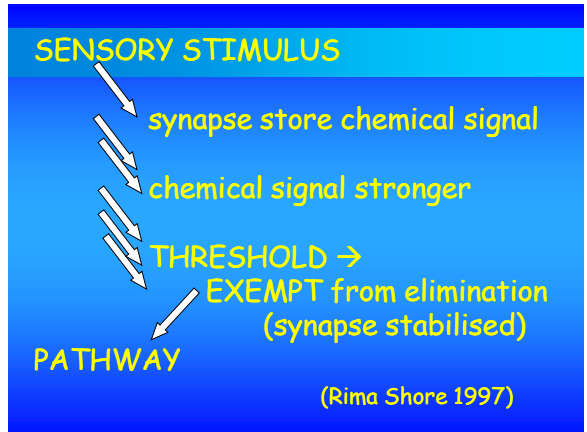
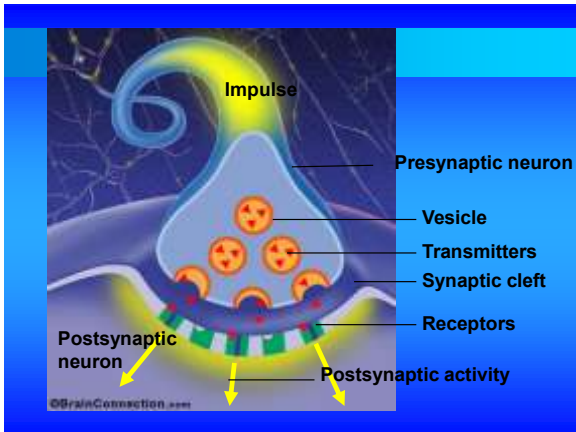
Computer has 500 GB  
= 500 000 000 000 b

Brain connections  
= 500 000 000 000 000 000 000

50 billion neurons, 50000 synapses, 2000 neuron networks

## SYNAPSE DEVELOPMENT

Development is a process of "pruning" some, and developing other synapses - creating "neural pathways".



**STIMULATION**  
... fires and wires brain

In utero:  
 from 8w ? ... → 20 weeks

Sensory experience ... ??

auditory, olfactory, contact, position  
 MUTED: visual, other sensory

... the activity occurring during **neonatal REM sleep** (or active sleep) seems to be **particularly important** to the developing organism

**(spontaneous synchronous firing)**

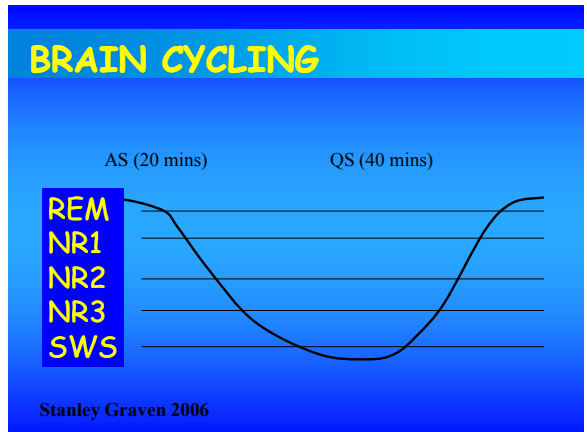
Marks et al 1995

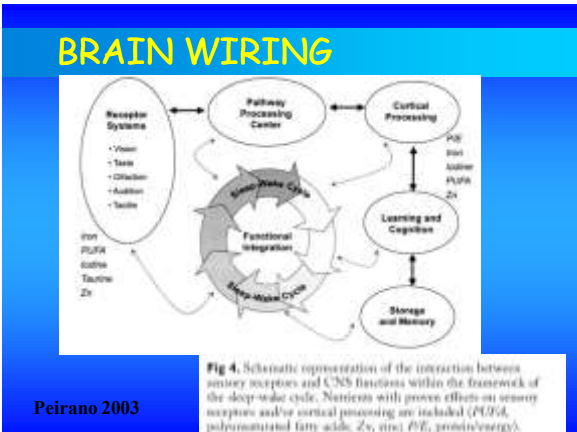
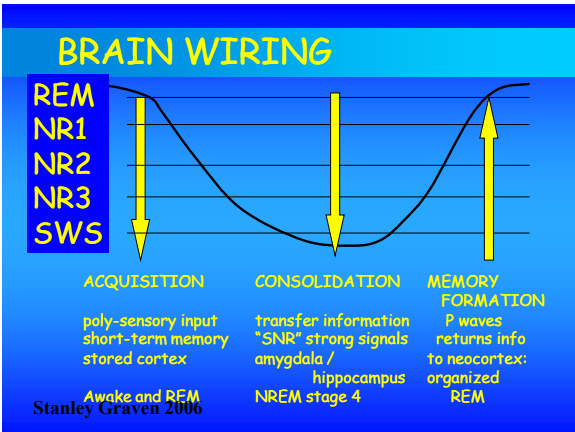
**deprivation of REM sleep**  
 early in life can result in behavioral problems, permanent sleep disruption,

decreased brain mass

more neuronal cell death.

Marks et al 1995





## RAM

Modern Computer  
has 2 RAMs  
= 2 x 100 000 000 b

Brain neocortex  
has 6 layers  
= 6 x 100 000 000 000 000 000

## How Your Baby's Brain Works

**Key concepts:**  
neurons, synapses  
fire and wire,  
two kinds of sleep  
layers, hierarchy

## R Shore

**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."

## Schore

Critical period :

"Early interpersonal events positively and negatively impact the **structural organisation of the brain.**"

## 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)**

## CPU

Prefrontal cortex  
Executive  
function

### AMYGDALA:

Emotional  
Processing  
Unit

Amodio 2008

efficiently  
regulated and  
organised  
right brain

Behavioural  
activation system  
reward-based  
(dopamine)

### AMYGDALA:

fear and emotion

Prefrontal cortex  
approach / avoid

Amodio 2008

Cerebral Cortex February 2009;19:284-292  
doi:10.1093/cercor/bhn081  
Advance Access publication May 30, 2008

Yoshida Shoji<sup>1</sup>, Kuroki Yoko<sup>1,2</sup>, Inoue Mami<sup>1,2</sup>, Sugita Tomoko<sup>1</sup>,  
Kawachi Satoru<sup>1</sup>, Kuroki Yukihiko<sup>1,2</sup> and Akemi Kodoh<sup>1,2</sup>

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

...ing of the pleasant mood of infants. Furthermore, our study revealed that the infants' prefrontal activation around the anterior OFC is specific to viewing their mothers' smile. These results



## THE NEWBORN BRAIN

the first essential  
part of efficiently  
regulated and  
organised  
right brain →

Emotional & Social  
intelligence

## Schore

In early postnatal life, maintenance of critical levels of tactile input ... is important for normal brain maturation.

Areas of the amygdala .... are in a critical period of maturation, ... in the first two months of life

## NEWBORN DEVELOPMENT

### skin-to-skin contact

Tactile stimulations build the amygdala - preorbital cortical tract during the first 8 weeks

The next pathway requires eye-to-eye contact

This is the basis of healthy right brain development!

Interpersonal  
awareness  
Emotions

Brain-to brain  
Face-to-face  
Eye-to-eye  
voice,  
hands,  
movements

"Carly & Ethan"  
photo Jean Ridler

## NEWBORN DEVELOPMENT

Tactile stimulations facilitate "the flow of affective information from the infant ... to the mother" "the language of mother and infant consists of signals produced by the autonomic nervous system of both parties".

This is the basis of healthy development!

Schore 2001a

## Myron Hofer

... the private realm of sensory stimulation constructed by the mother and infant from numberless exchanges of subtle clues.

(Gallagher 1992)

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)



Through  
"hidden maternal regulators" ...

" physiological set points "

" internal working models'

" scripts - templates"

## REGULATION

the objective is to achieve the ability to establish:

'STABILITY THROUGH CHANGE'

The foundation for  
INFANT MENTAL HEALTH

### SENSORY STIMULATION

EMOTIONAL EXCHANGES

AUTONOMIC  
BODY CONTROL

WELL-BEING

HEALTH

The First Idea: How Symbols, Language,  
and Intelligence Evolved from our  
Primate Ancestors to Modern Humans  
Stanley I. Greenspan & Stuart G. Shanker

### The First Idea

"It is necessary for a child to be engaged in a series of affective (emotional) interactions that give rise to the development of motor sensory and social capacities, which, when combined with symbol formation, lead to language.

Greenspan & Shanker 2006, p39

### The First Idea (p39)

"The symbolic use of language, in turn, creates the foundation for more advanced social and intellectual capacities, including higher and higher levels of reflective thinking.

Greenspan & Shanker 2006, p39

### SENSORY STIMULATION

EMOTIONAL EXCHANGES

AUTONOMIC  
BODY CONTROL

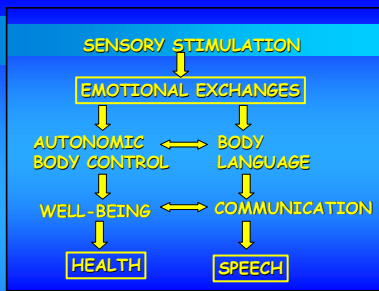
BODY  
LANGUAGE

WELL-BEING

COMMUNICATION

HEALTH

SPEECH



## DUAL CODING REGULATION - ATTACHMENT

Greenspan & Shanker 2006

## ATTACHMENT - REGULATION

the objective is to achieve the ability to establish an efficiently regulated right brain:

'STABILITY THROUGH CHANGE

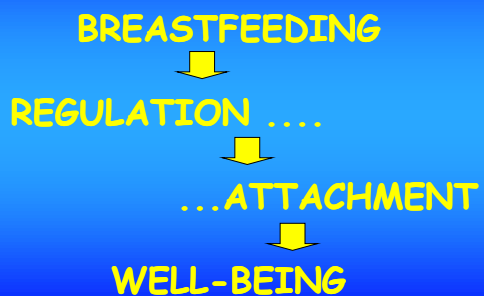
The foundation for  
INFANT MENTAL HEALTH

Schore 2001a

## RESILIENCE (= STRESS RESISTANCE)

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

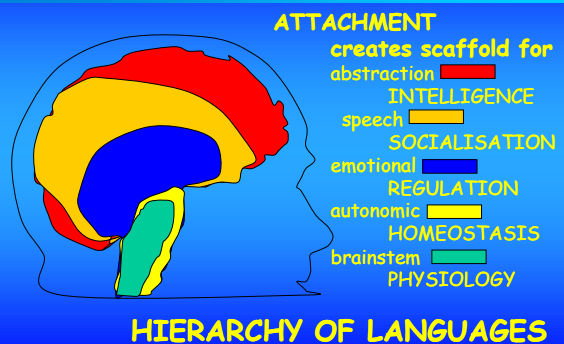
## SKIN-TO-SKIN CONTACT



## WELL-BEING created defined



## CONCEPTUAL VIEW OF DEVELOPMENT

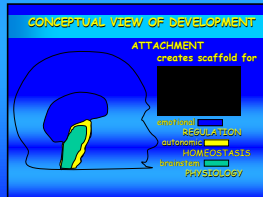


## Neuronal Plasticity

"the first three years are decisive"

The cortex retains some plasticity throughout life ...

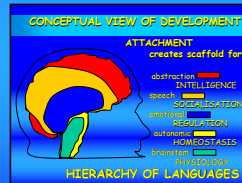
But limbic system and the midbrain are fixed after the age of three years



## Neuronal Plasticity

"the first three years are decisive"

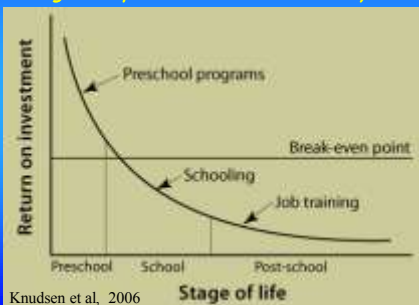
→ platform for subsequent development of higher cognitive functions.



Stanford Report, July 12, 2006

**Forget the latest toys: All kids really need is love**

*Authors say public policy should focus on helping children have good experiences in their earliest years*



"The brain

is designed to be sculpted into its final configuration by the effects of early experiences"

The brain is "formatted" .....

"The brain

is designed to be sculpted into its final configuration by the effects of early experiences"

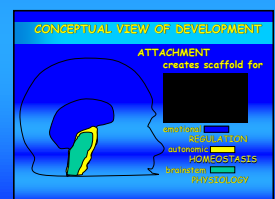
These experiences are embedded in the attachment relationship.

## Neuronal Plasticity

"the first three years are decisive"

The cortex retains some plasticity throughout life ...

But limbic system and the midbrain are fixed after the age of three years



## MOTHERBOARD

Motherboard is the hardware platform to build the computer.

The limbic brain is the "platform for higher cognitive functions"

## How Your Baby's Brain Works

Learning requires neurons to fire and wire, to make pathways that make up ever higher circuits

## How Your Baby's Brain Works

**MATERNAL SENSATIONS FIRE and WIRE BABY'S BRAIN**

# MOTHER

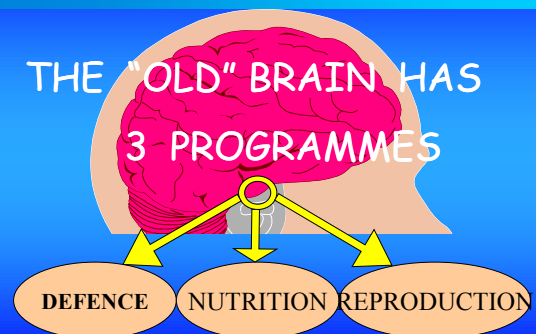
is the KEY for NEURODEVELOPMENT

## Your Baby's Brain: the latest neuroscience

1. How your baby's brain WORKS

Amazing behaviour of baby at birth  
Brain's own timetable for development

THE "OLD" BRAIN HAS 3 PROGRAMMES



The neurobehavioural programmes originate in the **LIMBIC SYSTEM**

Expressed through

**hypothalamus**

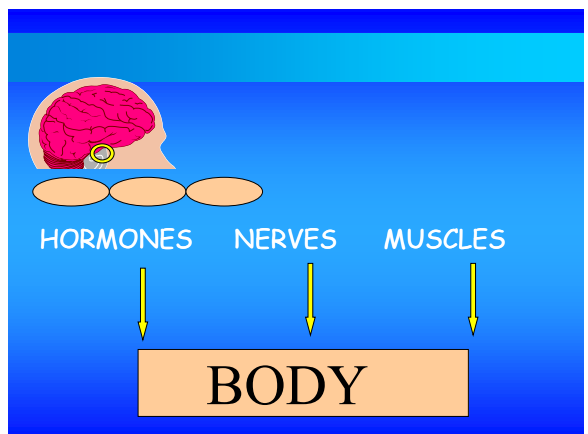
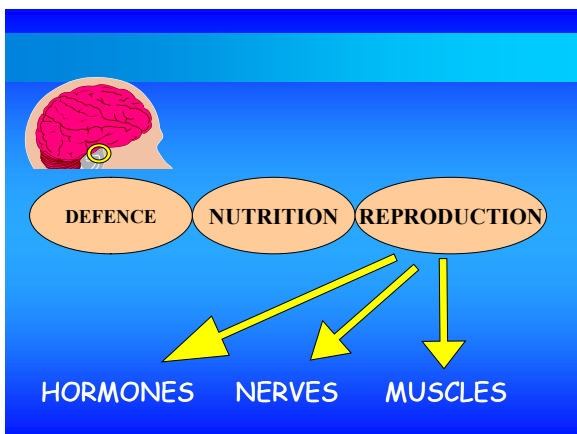
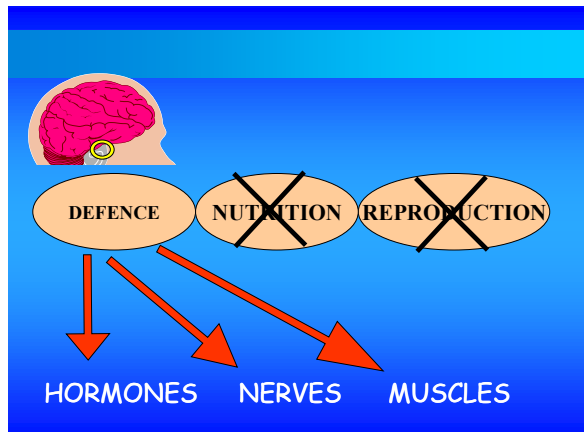
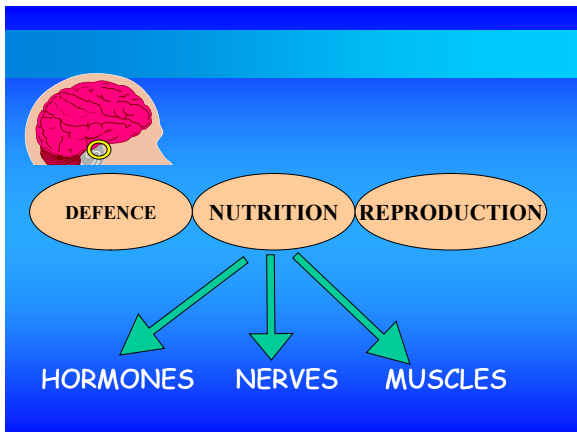
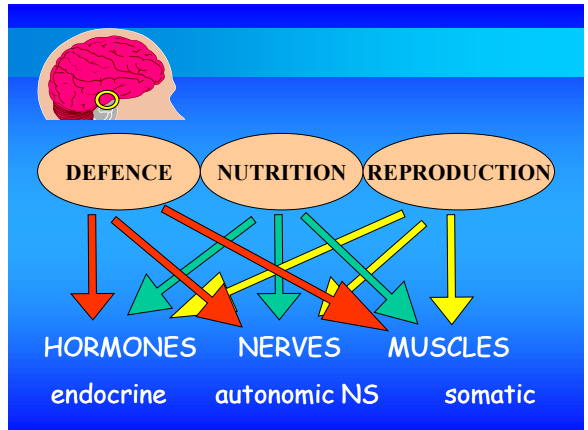
(autonomic nervous system)

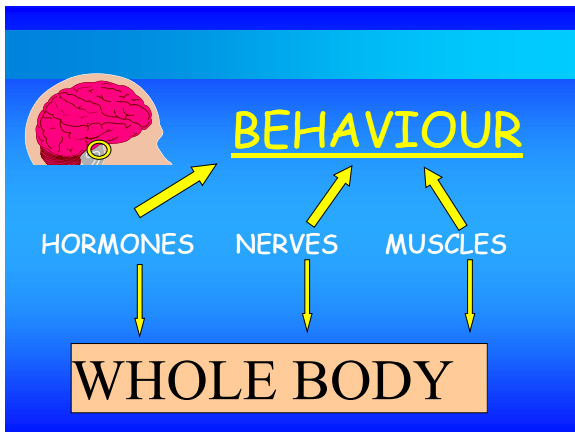
**hypophysis**

(endocrine system, hormones)

**cerebellar connections**

(somatic system)





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.

All mammals have set sequence of behaviours at birth .....



..... All with a single purpose : to **BREASTFEED**

After birth, events are determined ...  
 ... by the neonate stimulating the mother!  
 (Rosenblatt 1994)

Breast-feeding is “established through a set of mutual, complex sensory stimulations in mother and child.”  
 (Kjellmer & Winberg 1994)

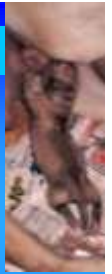
**HABITAT  
 DETERMINES  
 BEHAVIOUR**

# BEHAVIOUR ENSURES BIOLOGICAL NEEDS

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

(Alberts 1994)

= **NUTRITION PROGRAMME**



In all mammals .....

..... the **newborn is responsible** for initiating breastfeeding,  
not the mother !!

**EXCEPT IN HUMAN ???**

## Sequence human newborn breast-feeding

Pre-requisite = habitat  
hand to mouth  
tongue moves  
mouth moves  
eye focuses nipple  
crawls to nipple  
latches to nipple  
suckles

(Widstrom et al 1994)

“The newborn may appear helpless, but displays an impressive and purposeful motor activity which, **without maternal assistance**, brings the baby to the nipple.

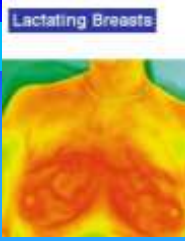
(Michelson et al 1996)

“The newborn may appear helpless, but

**raises its own temperature, has a higher blood glucose, metabolic adaptation faster.**

(Widstrom 1987)

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



(Alberts 1994)

Through  
"hidden maternal regulators" ...

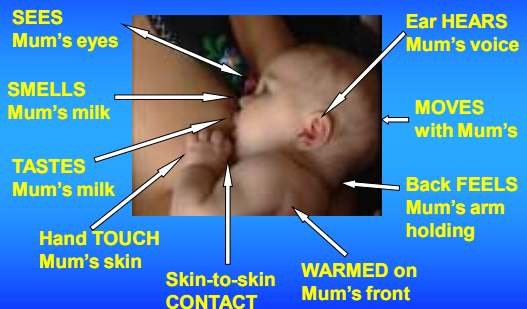
" physiological set points "

" internal working models'  
" scripts - templates"

a kind of invisible hothouse

"the wiring of the brain's pathways is best supported when it can integrate quality sensory input through several pathways at once, particularly during critical periods of development." (McCain 1999)

### SENSATIONS THAT WIRE BRAIN



The brain is a

**SENSORY ORGAN**  
**BREAST - FEEDING**  
**=**  
**BRAIN - WIRING**  
**SOCIAL ORGAN**

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## BIRTH SKIN-TO-SKIN CONTACT PLACE DEPENDENT COMPETENCE

The first hours after birth are a  
**CRITICAL PERIOD**

mutual  
psycho-physiological  
caregivers

BIRTH SKIN-TO-SKIN CONTACT  
CRITICAL PERIOD BEHAVIOUR

“The newborn may  
appear helpless, but  
skin-to-skin contact  
stimulates prolactin  
ensures nutrition  
stimulates oxytocin  
ensures protection  
stimulates cholecystokinin  
ensures wellbeing bonding

R Shore

### 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.”

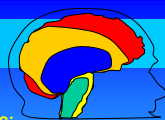
**Success depends on a good start !!!**

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The risk of suppression or disruption of  
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significant and potentially lasts a life time.

Clinics in Perinatology,  
June 2004, Vol 31(2) p293  
Joy Browne

“Early relationship environments:  
physiology of skin-to-skin contact  
for parents and their preterm infants”



The mother and infant at birth are  
ready to develop optimal attachment  
relationships and to work together  
toward organised cognitive, social  
and emotional development.

Joy Browne 2004

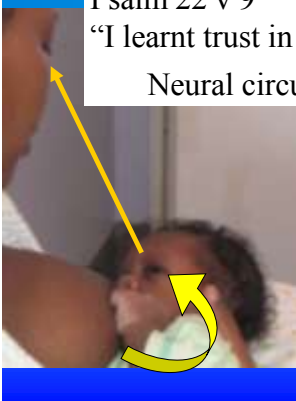
### How Your Baby's Brain Works

**Birth is a critical  
time, requires a  
SAFE PLACE  
to brain-wire and  
get basic needs,  
mostly from breast**

*Personally I feel that one of the biggest discoveries in the field of pediatrics in my time is the concept that the newborn child is a small human being with all its senses developed open and receptive."*  
 (John Lind, 1979)

... the newborn child is a small human being, with all its senses developed, open and receptive.  
 (John Lind, 1979)

Psalm 22 v 9  
 "I learnt trust in my mother's arms"  
 Neural circuitry of bonding



**TIMETABLE for DEVELOPMENT**

ATTACHMENT scaffold for

abstraction		INTELLIGENCE	INTEGRATION
speech		SOCIALISATION	RELATIONSHIP
emotional		REGULATION	BEHAVIOUR
autonomic		HOMEOSTASIS	FUNCTION
brainstem		PHYSIOLOGY	STRUCTURE



parallel development of structure & function & ....  
 (Hugo Lagercrantz 2004)