

## Your Baby's Brain: the latest neuroscience



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[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

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4. **YOUR parenting brain**

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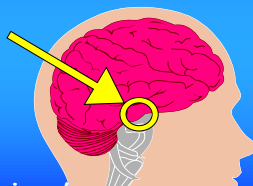
## Your Baby's Brain: the latest neuroscience

4. YOUR parenting brain

Baby's brain is wired by Mother !  
Father's role in this neuroscience  
Attachment and  
"developmental parenting"

### IN ALL MAMMALS :

The brain events  
originate in the  
old mammalian  
brain - "innate  
programmed behaviour"



The reproductive programme  
is in the mother and the baby

DEFENSE

NUTRITION

REPRODUCTION

HORMONES

NERVES

MUSCLES

## MICE



the mother must overcome the fear of leaving the nest to forage and hunt, all so more efficiently, and return to her nest and suckle offspring as quickly as possible, lest her own pups become prey for other predators. Our data suggest that the hormones of

### Reproduction-Induced Neuroplasticity: Natural Behavioural and Neuronal Alterations Associated with the Production and Care of Offspring

Byng D. Woodford and Ruby H. Lambert

Estrogen peaks  
Progesterone falls

→

Increased spines  
(dendrification)

Pup stimulation  
Rich environment

→

New circuits =  
enhanced learning

↓

New circuits =  
enhanced learning

↙

Amygdala

→

Less fear / anxiety

Hippocampus

→

Better learning / memory

Hypothalamus

→

Better stress tolerance

↓

Maternal neurobehaviour

↓

Maternal neurobehaviour

↓

Enhanced foraging

↓

Stress responsiveness

↓

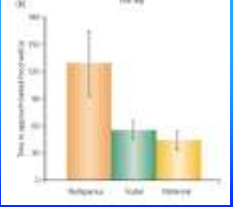
Enhanced problem solving

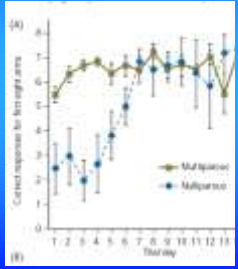
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More emotional resilience

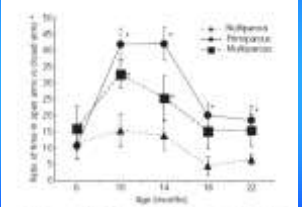
### Enhanced problem solving

Enhanced foraging



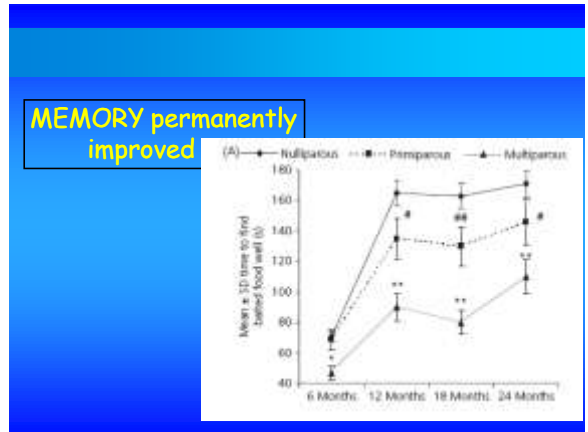
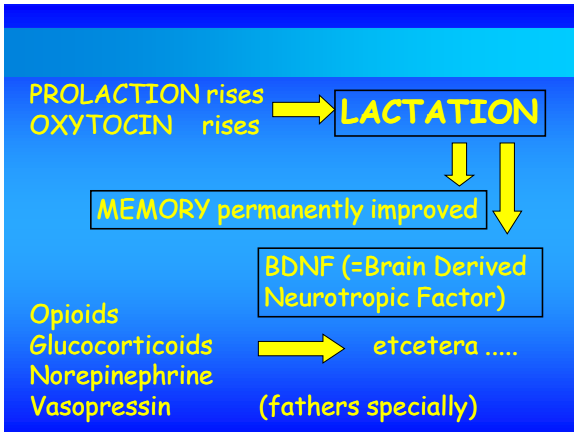


### Stress responsiveness



More  
emotional  
resilience

Fig. 3. Ratio (percentage) of time spent in the open arms to the closed plus that in age-matched nulliparous (NP), parous (P) and multiparous (MP) Long-Evans female rats at various ages, postnatalization in PP and MP. Values significantly differ from NP values (P < 0.05).



**BDNF (=Brain Derived Neurotrophic Factor)**

"The picture that begins to emerge is one of a healthy, "protected" brain that may provide benefits to its owner well into senescence." (p517)

The combination of hormonal and environmental alterations accompanying the maternal experience has also been proposed as a form of environmental enrichment. Studies partitioning out the various aspects of the maternal experience (e.g. pup exposure, pregnancy, lactation) suggest that the combination of these experiences converge to produce the most dramatic results in the maternal animal (3, 82). Viewing the maternal experience as an enriching complex experience for the animals suggests that the effects on brain and behaviour may be real, meaningful, pervasive and persistent.

**"The combination of these ... converge to produce the most dramatic results ..."**

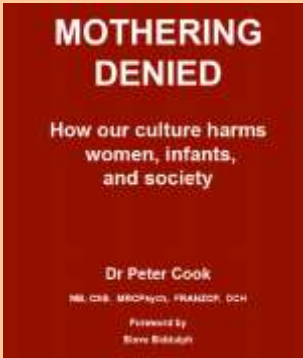
Maternal neuro-behaviour

- More emotional resilience
- Enhanced problem solving
- Better stress tolerance
- **MEMORY permanently improved.....**

😊 not so sure!

Viewing the maternal experience as an enriching complex experience ...suggests that the effects on brain and behaviour may be real, meaningful, pervasive and persistent.....  
(Rats, how much more for people!!!)

<http://www.imhaanz.org.nz/peter-cooks-mothering-denied-available-internet>



'MOTHERING' =  
politically incorrect terminology ...  
(parenting, care-giving)  
culturally not valued ...  
BUT  
neuroscience provides new  
understanding and definitions ..  
biologically based survival requirement →

'MOTHERING' = biological  
definition

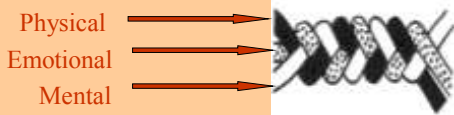
basic needs of infants  
arise from their biology  
**Mothering is biology**

'MOTHERING'  
... we can aim to bring our society,  
that we can change,  
into better harmony with  
our biological "givens"  
that we cannot change ...

It is necessary to work with Nature and not against her if we are to promote health and wellbeing in young children, their mothers, and society. A normal mother-child relationship is a love affair that needs the right conditions to flourish. Infancy cannot be re-run later.

**We need to integrate these aspects for baby:**

Development of:



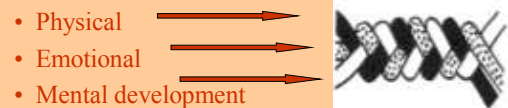
and Social, cultural, spiritual....

& help parents to do so! HOW? Practically?

**Skin-to-skin contact or KMC**

**WHY IS IT SO IMPORTANT??**

To get the start of life right for  
stability and growth of:



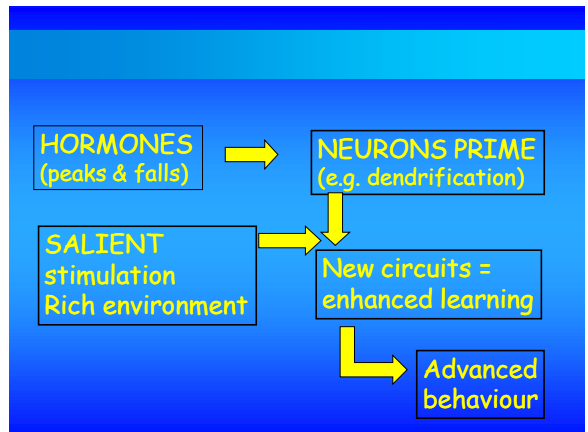
To help the baby set healthy balance for life!

This only happens if the baby feels

**SAFE**

'MOTHERING' = biological definition  
 breastfeeding  
 carrying  
 secure attachment  
 mutual reward  
 enjoyment and empathy  
 mutual playfulness and joy

ALL have evidence-based science



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

mutual  
 psycho-neuro-physiological  
 caregivers

**Target #1 for 2005:**

Report that 65% of infants are  
 placed and remain in

**direct skin to skin contact**  
 with their mothers

**for at least one hour**  
 during the first 3 hours after birth.



More skin-to-skin → more breastfeeding

“The newborn may  
 appear helpless, but  
 skin-to-skin contact  
**stimulates prolactin**  
 ensures nutrition  
**stimulates oxytocin**  
 ensures protection  
**stimulates cholecystinin**  
 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."

Centrally released oxytocin coordinates the onset of maternal nurturing behavior at parturition and plays a role in mother-infant bonding.

related brain regions (Ferris et al., 2005). Studies of human mothers have demonstrated that infant cues, such as facial expressions and cries, activate similar brain reward regions to cocaine, including the ventral tegmental area/substantia nigra region, nucleus accumbens, cingulate and prefrontal cortex. Thus,

Ross 2009

Interpersonal awareness  
Emotions

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

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 Maternal Communication and Emotional Expression during Infant Preverbal Stage

Infant self. Distress mothers underwent functional magnetic resonance imaging while observing and mirroring faces of their own child and those of someone else's child. We found that the mirror neuron system, the amygdala and amygdala were more active during emotional expressions that this circuit is engaged to a greater extent when interacting with one's own child, and that it is correlated with maternal reflective function (a measure of empathy). We also found by comparing single mothers with each

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

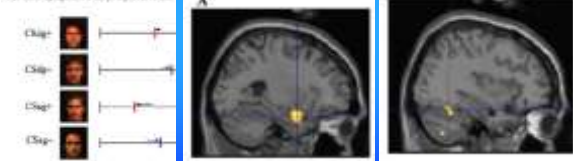
Therefore, our results are in keeping with the *simulation theory* (or motor theory of empathy), according to which empathy is generated by inner imitation of actions of others (Gallese & Goldman-Rakic, 1999).

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

Przemyslaw P. Tomkowiak, Raffael Kalisch, Mathias Poeschl, Tania Singer, and Raymond J. Dolan  
MRC Social, Genetic, Developmental Psychiatry Centre, University College London, 12 Queen Square, London, WC1E 7BU, UK

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

A. Face expressions do not passively film



Psalm 22 v 9

"I learnt trust on my mother's breasts"

### Neural circuitry of bonding



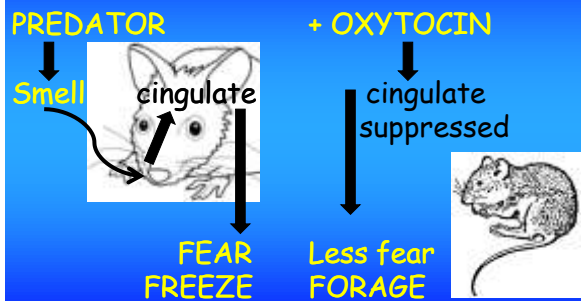
Psalm 22 v 9

"I learnt trust on my mother's breasts"

"trust" (אֱמוּנָה)   
 to *hies* for refuge; figuratively to *trust*,   
 be bold (confident, secure, sure),   
 (make to hope, make to trust.)

"breast" (שָׁדַי)   
 the *breast* of a woman   
 or animal (as *bulging*):   
 - breast, pap, teat.

When oxytocin is released within the brain,   
 its effects are to diminish fearfulness:



When oxytocin is released within the brain,   
 its effects are to diminish fearfulness:   
 this not only encourages social investigation of   
 newcomers, but also may enhance a tendency to   
 express aggression toward an intruder. Leng 2008

Measure of   
 "good mammal mother" :   
 FEROCITY OF   
 DEFENCE OF YOUNG.

After a lengthy bureaucratic struggle,   
 Margaret and Yves became the first par-   
 ents in New York and the second parents   
 in the U.S. to take home a child on life sup-   
 port. "The process transformed my per-   
 sonality," says Margaret. "I had been a shy   
 and timid person, and I became brassy and   
 obnoxious. I changed into a beast to pro-   
 tect my child."

<http://www.time.com/time/magazine/article/0,9171,1625193,00.html>

Margaret Mikol

"I changed into a beast   
 to protect my child"

Measure of a "good mammal mother" :

FEROCITY OF DEFENCE OF YOUNG

Sodersjukhuset, Stockholm  
Randomisation to new and old unit

Modern day maternal ferocity ???

Replaced by   
 subservient inheritance !   
 thankfulness, staff "own the baby"

Personal testimony of a   
 mother   
 at International KMC   
 Workshop

"The instinct of a   
 mother to hold and   
 care for her baby   
 is primordial and   
 primitive, and an   
 overwhelmingly   
 powerful feeling."

Jane Davis, Bogota, Dec 1998

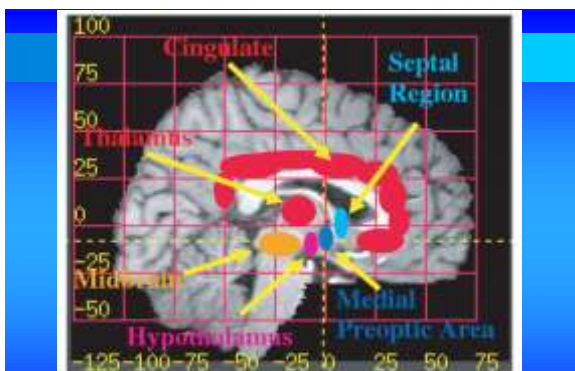
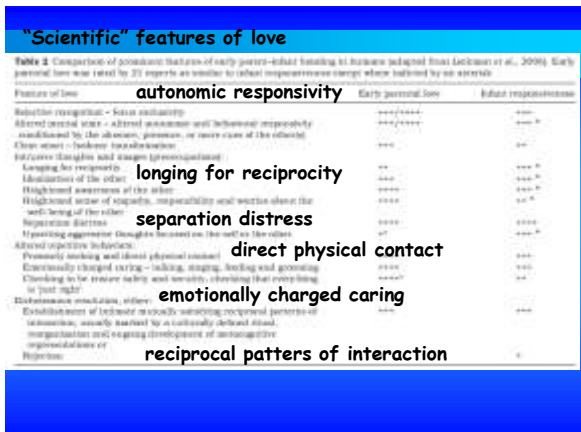
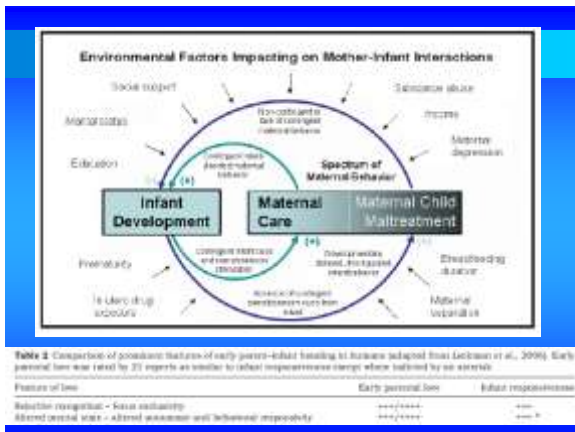


In the **FIRST HOUR** .....  
 .... the newborn  
**ELICITS CARE GIVING**  
**INSTINCTUAL**  
**BEHAVIOUR FROM**  
**THE MOTHER !!**

**Brain basis of early parent–infant interactions: psychology, physiology, and *in vivo* functional neuroimaging studies**

James E. Swain,<sup>1</sup> Jeffrey P. Leberbauer,<sup>2,3</sup> Sannet Koss,<sup>4</sup> and Lane Statherae<sup>1,6</sup>  
<sup>1</sup>Child Study Center, Yale University, New Haven, CT, USA, <sup>2</sup>Psychology Department, Penn State University – Berks, Pottsville, PA, USA, <sup>3</sup>Brain Stimulation Laboratory, Medical University of South Carolina, Charleston, SC, USA, <sup>4</sup>Neuro Center for Developmental Pediatrics, Baylor College of Medicine, Houston, TX, USA, <sup>5</sup>Neuroimaging Laboratory, Baylor College of Medicine, Houston, TX, USA

The psychology of human parent–infant relationships  
 Parenting is regulated by key hormones and neurotransmitters  
 Neuroanatomical circuits of parenting  
 Integrative physiology of normal parenting behaviours  
 Brain imaging of human parent–infant relationships  
 The neurobiology of empathy and parenting  
 Conclusions and critical summary  
 (Swain et al., 2007)



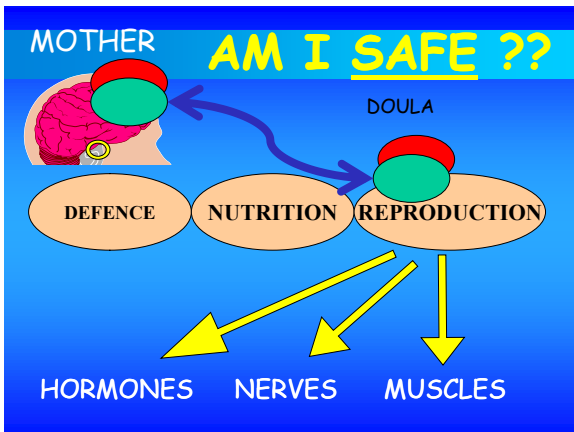
**Figure 2** Human parental brain areas. Brain regions expected to be important to human parenting, based on

In early parental love, initial data suggests that parents frequently feel compelled to shape their own behavior to the perceived needs of the baby (Leckman et al., 1999). Frequently, these behavioral responses have a 'just right' character, such that they need to exactly fit the apparent needs of the baby.

This heightened sense of responsibility that usually accompanies this state may lead to increased vigilance, repeated behaviors aimed at ensuring the safety of the infant (Leckman et al., 2004) and increased sensations of reward.

Healthy parent–infant interactions, which may themselves be addiction-like (Insel, 2003), are disrupted by artificial stimulants of the dopaminergic system, such as cocaine which may act as a highly reinforcing infant substitute (Meaney, Brake, & Gratton, 2002).

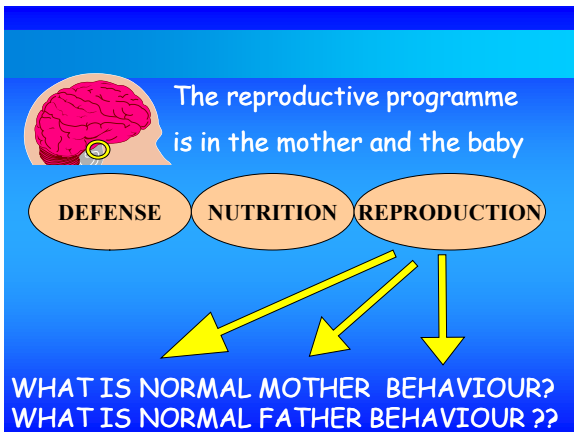




## Your Baby's Brain: the latest neuroscience

### 4. YOUR parenting brain

Baby's brain is wired by Mother!  
Father's role in this neuroscience  
Attachment and  
"developmental parenting"



### WHAT IS NORMAL FATHER BEHAVIOUR ??

#### THE HUNTER GATHERER

Homo sapiens evolved as a  
"tropical hunter gatherer".  
Anthropological studies of current  
tropical societies:  
20% of diet from hunting mammals,  
40-60% from gathering foods  
Both hunting and gathering require mobility.

#### THE HUNTER GATHERER (cont)

Infant care patterns in such societies  
(which are closest to our origins):

- 1 Infant carried most of time
- 2 Mother sleeps with infant same bed
- 3 Immediate feeding response to crying
- 4 Breastfeeding 24 months or more
- 5 Father frequently and closely involved ...

parental  
behavior

### Fathers ?

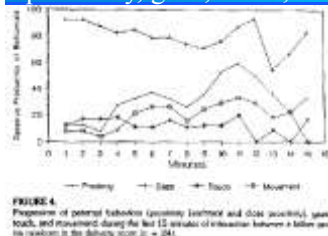
involves  
homologous  
neuroendocrine  
circuits in  
male and  
females.

- The behavior exhibited by human fathers at their first contact with the young was studied on 15 fathers of full-term infants delivered by cesarean section. The naked infant was presented to the father approximately 15 min after delivery, and photographs were taken every second during the first 7 min of contact.

## Fathers ??

- An orderly progression of behavior was observed: the father began touching the extremities, and then proceeded to touch the infant with his fingers and fingertips,
- then to use his palms and finally the dorsal side of his fingers.
- An increase in eye-to-eye contact over time was observed.
- It was concluded that the father displayed a very similar behavior, in his first contact with the young, as has been described previously for the mother

proximity, gaze, touch, and movement.



The analysis showed that proximity and gaze were high-frequency behaviors and touch and movement were low-frequency behaviors.

### Prem birth:

Mothers experienced a need to regain the temporarily lost relationship with their child, whereas the fathers experienced the beginning of a new relationship.

### Taken by surprise:

For mothers, the premature birth created a feeling of powerlessness and they experienced the immediate postnatal period as surreal and strange. The fathers experienced the birth as a shock, but were ready to be involved immediately.

Mothers engaged in more caregiving, talking, and holding during initial contacts, but the disparity in maternal and paternal interactions decreased with time.

Except for caregiving, in which mothers still surpassed fathers, fathers equaled mothers in all other activities at the time of the infants' discharge from the hospital.

Fathers consistently surpassed mothers in playing and stimulating.

### After C/S

29 pairs skin-to-skin with father or next to father in cot.

Father infants cried less ( $p < 0.001$ )

Crying stopped within 15 minutes.

Father infants drowsy within 60 minutes,

infants in a cot reached after 110 minutes.

Rooting activity was more frequent in the cot group than in the skin-to-skin group ( $p < 0.01$ ), as were sucking activities ( $p < 0.001$ )

**both mothers and fathers rated their experiences of love significantly higher** when holding their infants skin to skin than when holding their infants wrapped in blankets

Differences two types of holding:  
mothers  $p=0.0002$   
fathers  $p=0.0001$

one. Hormone concentrations were correlated between partners. This pattern of hormonal change in men and other, paternal mammals, and its absence in nonpaternal species, suggests that certain hormones also play key roles in priming males to provide care for their young (Storey, Walsh, Quinton, & Wynne-Edwards, 2000).

## Title:

**Prolactin and testosterone levels in first-time fathers with skin-to-skin contact with their babies soon after birth.**

### Hypothesis

skin-to-skin contact with their new-born babies should elicit a prolactin spike in human fathers, and also decrease serum levels of testosterone.

**Spike seen once !!**  
**Prolactin half life very short**  
**Indwelling cannula, every 15min**

**NOW RECRUITING !!!!!!!**  
**Please contact Nils**

80

Chapter 12. What conclusions may we draw?

### Fathers' natural roles

Fathers are certainly important and can share with mothers as partners, playmates, parents, protectors and providers. But, as in all other mammals, the roles of the two parents are different. Only mothers can breastfeed. We have seen how in primates this is associated with the carrying and co-sleeping that promote secure attachment, and in which fathers can participate. Our society needs to recognize the far-reaching developmental importance of breastfeeding and close, responsive mother-infant and father-infant relationships in the early years, and seek to create social settings that facilitate and support them. While breastfeeding gives the mother a unique role during infancy, we need to value the development of involved fathering at each stage. As the child grows and is weaned, many roles of mothers and fathers become increasingly interchangeable, according to individual personalities and circumstances.

**PARTNERS ??**

**PLAYMATES ??**

Fathers consistently surpassed mothers in playing and stimulating.  
Levy-Schiff 1989

**PARENTS ??**

**PROTECTORS??**

Birth period →  
Keep intruders away during bonding ....

## PROVIDERS ??

Maternity leave ??  
Take baby to work !!

schooling etc

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### Promoting parenting skills (Both Mum and Dad!)

Holding & carrying  
Bonding  
Eye contact  
Playing games  
Peek-a-boo, stories, etc

Attachment starts with Mum...

Mothers ANS helps the Baby's ANS to find healthy set points. Baby needs mothers presence and safety to do this!

When these are settled the baby will be able to SELF REGULATE or reach stability on her own. She can cope with change and come back to

### 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

"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.

## Neurodevelopment

### Skin-to-Skin Contact

promotes **APPROACH** behaviour

Separated babies show **AVOIDANCE**

poorer resilience → **HARM**

## SEPARATION CAUSES STRESS/HARM

IN ALL NEWBORNS, ESPECIALLY FOR PREMS WHO ARE MORE FRAGILE

- Babies should NOT be left to cry themselves to sleep...
- “Sleep training” is a modern idea and “works”. But there is no scientific evidence on what effect it has on the baby’s brain.
- For a tiny baby crying can be dangerous.

“It is an ultimate irony that at the time when the human is most vulnerable to the effects of trauma - during infancy and childhood - adults generally presume the most resilience.

Perry et al 1995

## **DYADIC CARE-GIVING**

Nurse to support, explain, then leave the mum and baby to settle into their own routine together, to get to know each other, with dad. Old-fashioned idea of “cloistering”. **REST!**

- If we want to:
- raise secure children
- decrease violence
- Maximise each child’s best brain potential

Babies need **BUILD** BONDING TIME!

- First bond/relationship
- Most important bond
- Foundation to all other bonds
- Essential bond!

The Relation of Early Mother-Infant Skin-to-Skin Contact to Later Maternal Sensitivity in South African Mothers of Low Birth Weight Infants

Ann E. Bigelow, et al ( )

From Bergman et al 2004 RCT  
SSC time first 24 hr correlated with SSC time first month.

Bigelow study: filmed Mum & baby interactions .mum's emotional sensitivity helped baby be secure.

Also test for stimulation and stretching baby(cognitively):  
mum was sensitive not to overwhelm baby

Baby/infant can meet the world from a safe place.  
Shy → confident. Needs mum's sensitivity to baby's cues for rest and play. BALANCE!

Peekabo, blocks, trains, puzzles,  
WITH the child...  
ball games, (BE completely there!)  
as they grow AT THE CHILD'S PACE  
hockey...rugby  
Read stories...  
Development...

ENJOY being parents!!



NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD

Relationships are the "Active Ingredients" of Early Experience

- Nurturing and responsive interactions build healthy brain architecture that provides a strong foundation for later learning, behavior, health.

Jack P. Shonkoff, M.D.



NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD

- "When protective relationships are not provided, persistent stress results in elevated cortisol levels that disrupt brain architecture by impairing cell growth and interfering with the formation of healthy neural circuits"

Jack P. Shonkoff, M.D.

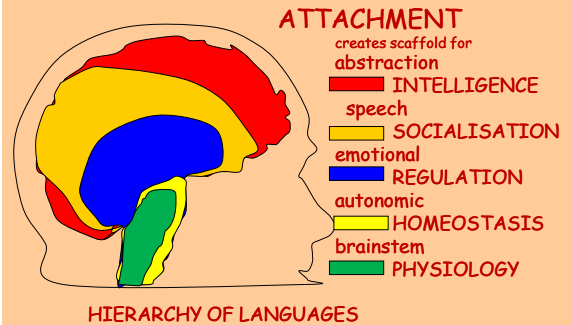
## Daycare for tiny babies and infants (pre-speech)

-causes increased anxiety

love your infant—as in an all-or-none relationship. However much a parent may go on loving a child, an infant cannot experience this if the parent is not there, for feelings and arrangements

- Increased cortisol
- increased aggression and disobedience
- Caused problems when they went to preschool and affected others in class
- Teacher stress
- Society stress

## CONCEPTUAL VIEW OF DEVELOPMENT



## The First Idea (p39)

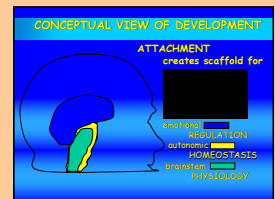
"The symbolic use of language, in turn, creates the foundation for more advanced social and intellectual capacities, including higher and higher levels of reflective thinking

## Neuronal Plasticity

"the first three years are decisive"

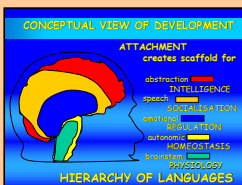
The cortex keeps some plasticity throughout life ...

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.

## Maslow's HIERARCHY of needs



represented as a pyramid with the more primitive needs at the bottom





PLACE    RELATIONSHIP

Fetus	Uterus	Mother
Newborn	Chest	Mother
Infant	Home	Father
Toddler	Home	Family
Child	Village	Community
Youth	Country	Nation
Adult	World	Humanity

We are not just looking at individual babies, we are looking at healthy families,  
 → healthy communities,  
 → healthy societies,  
 → healthy countries  
 → A healthy world!



How do we make choices??



How to make choices when reality is not easy?! IDEAS??

- When you can't breastfeed... Feed at the breast
- When you have to work....can you take your baby to work?
- Or work part time? from home?
- Can you express breastmilk if have to leave your baby?
- Can you give extra skin-to-skin contact by cosleeping?
- Can you try to make play time?

What does my baby's basic biology need ?

MUM!! 😊 and Dad!!

Skin-to-skin contact → SAFE → growth for brain-wiring

Sleep - completing brain circuits

Breastmilk

Small feeds often (every 60-90 mins)

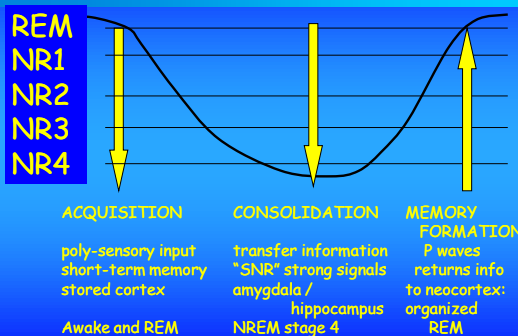
Bottle gets too much too fast → reflux/colic?

Bonding and attachment

No separation,

no prolonged crying

BRAIN WIRING



**PLAY**  
(=Sensory acquisition)  
should be EVERY HOUR

**BREASTFEEDING**  
(=BRAINWIRING)  
should be EVERY HOUR

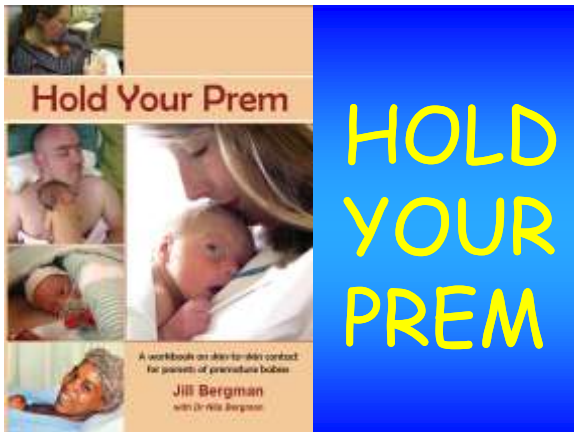
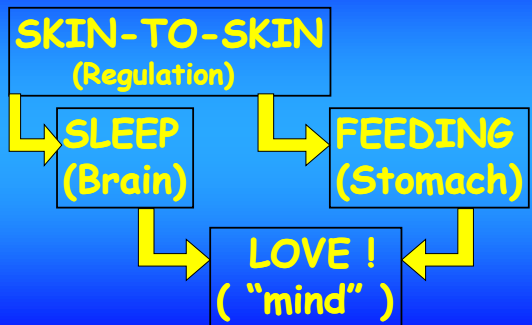
**DEEP SLEEP**  
(= Emotional connection)  
should be EVERY HOUR

Gentle self-waking  
(= REM memory formation)  
should be EVERY HOUR

Sensory "hothouse"

PLAY → FEED      PLAY → FEED  
SLEEP → SLEEP

## SUMMARY !!



“Parenting is the most varied, demanding and the most rewarding job that you will ever do in your life. You can be a nurse, counsellor, referee, cook, judge, teacher and playmate all in one! You are helping a person grow !!” JB