

MATERNAL PERINATAL NEUROBEHAVIOR.



Dr Nils Bergman

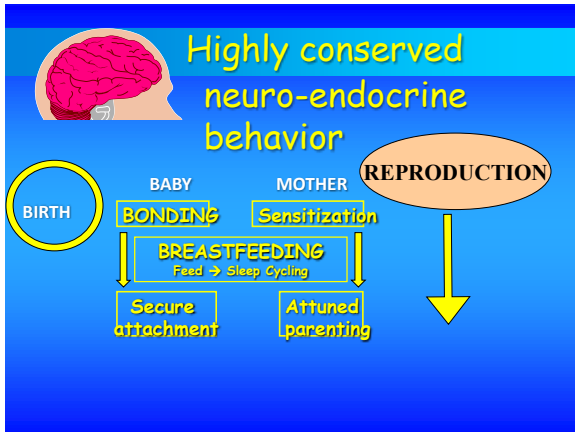
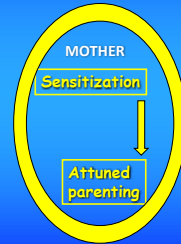
"M.D., D.C.H., M.P.H., Ph.D."

M.B.Ch.B., M.P.H., M.D.

Cape Town, South Africa

www.ninobirth.org

MATERNAL PERINATAL NEUROBEHAVIOR.



Journal of Neuroendocrinology 33: 443-450
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REVIEW ARTICLE

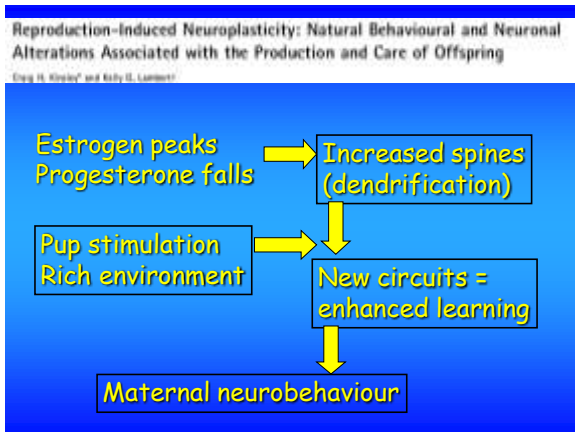
Reproduction-Induced Neuroplasticity: Natural Behavioural and Neuronal Alterations Associated with the Production and Care of Offspring

Daigui H. Kinley* and Kelly G. Lambert†

†Department of Psychology, Oneet At Neuroscience, University of Richmond, Richmond, VA, USA
*Department of Psychology, Adelphi-Moore College, Westport, VA, USA

MICE

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



Enhanced foraging

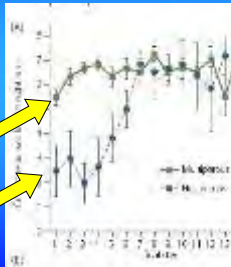
Time to find a baited food well:

Non-mother 130 sec

Mother mouse 40 sec

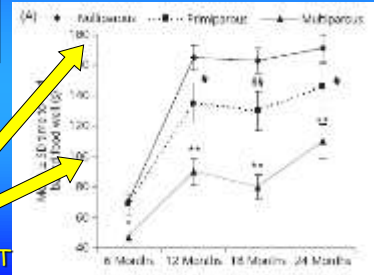
Enhanced problem solving

A maze with food
At end:
Mother mouse
learns her
way through
ONE DAY
Non-mother
ONE WEEK



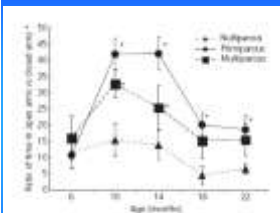
MEMORY permanently improved

Same MAZE,
TWO YEARS LATER:
Mother mouse
REMEMBERS TWICE AS FAST



Stress responsiveness

"Open Arm" - exposed and scary for mouse,
"Closed arm" - secluded and safer, less anxiety.



Mother mouse
30 - 40 %

Non-mother
5 - 10%

**More emotional resilience
LESS ANXIETY**

Maternal neurobehaviour

Enhanced foraging

Stress responsiveness

Enhanced problem solving

More emotional resilience

PROLACTIN rises → **LACTATION**

OXYTOCIN rises → **OXYTOCIN**

MEMORY permanently improved

BDNF (=Brain Derived Neurotrophic Factor)

Opioids
Glucocorticoids
Norepinephrine
Vasopressin → etcetera
(fathers specially)

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

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

" the totality and natural ramifications of reproductive experience
enhancements ... neuroplasticity ...
(p522)

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

Deag H. Kibbey¹ and Kelly G. Lambert¹

BDNF (=Brain Derived Neurotrophic Factor)

... The brain's own natural plasticity, we have reported an up-regulation of BDNF after exposure to a brief lactation to new-born mice, which is not normally expected for adult mice and IGC. This plasticity might be crucial to one of a mother's "protected" brain that may provide benefits to its owner well into senescence.

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

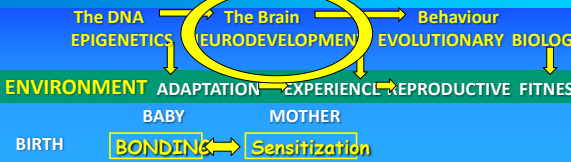
Clinics in Perinatology,
June 2004, Vol 31(2) page 210
Stanley Graven

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.

The Neuroscience of Birth & Breastfeeding



"needed neural processes"

Responses to Laboratory Psychological Stress in Postpartum Women

Monique Arntsen, MD, Linda S. Brown, PhD, Victoria Linn, PhD, Daniel A. Pitt, PhD, Thomas W. Thayer, PhD, and C. Sue Carter, PhD

SUE CARTER

Mock job interview:

Breastfeeding mothers have

HIGHEST VAGAL TONE
→ Stress Resistance

LOWER systolic blood pressure
→ Stress tolerance

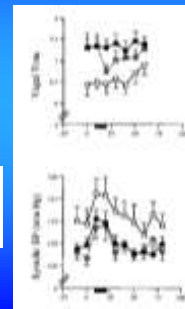
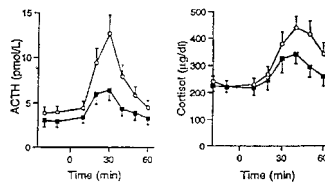


FIG. 1. Hormonal and metabolic responses to treadmill exercise in lactating (■) and nonlactating (○) women. Values are means ± SEM. Ten subjects in each group performed 20 min of graded maximal treadmill exercise. Significant differences between groups in pattern of response over time were found for adrenocorticotropic ($P < 0.001$), cortisol ($P < 0.05$), glucose ($P < 0.001$), and prolactin ($P < 0.001$).

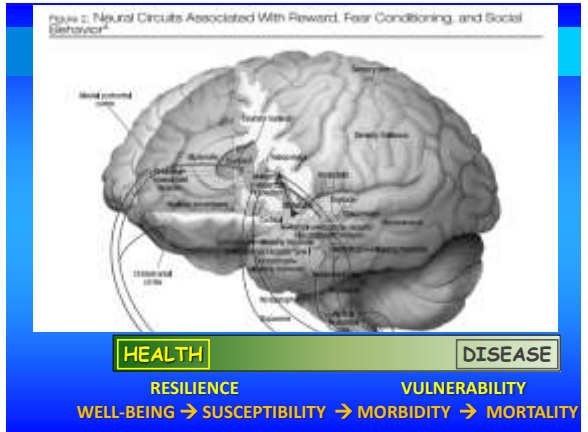
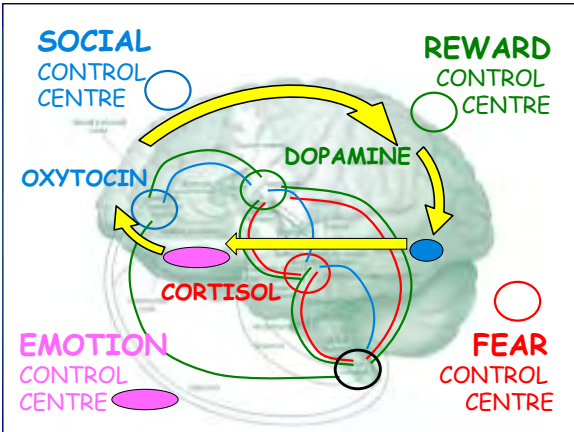
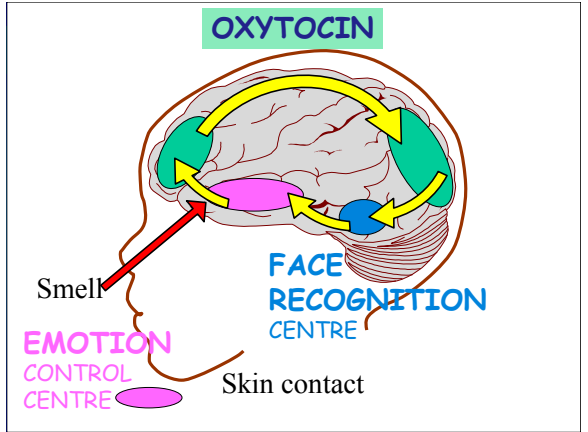
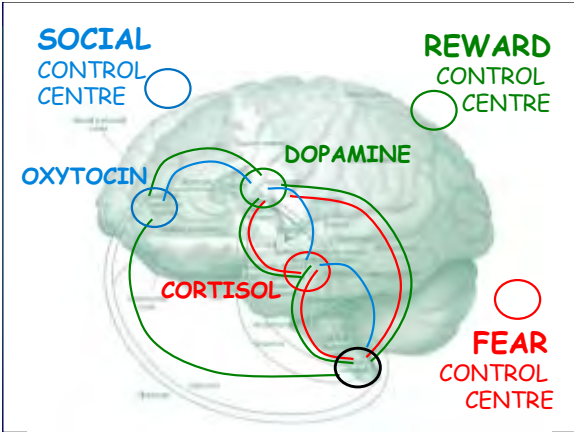
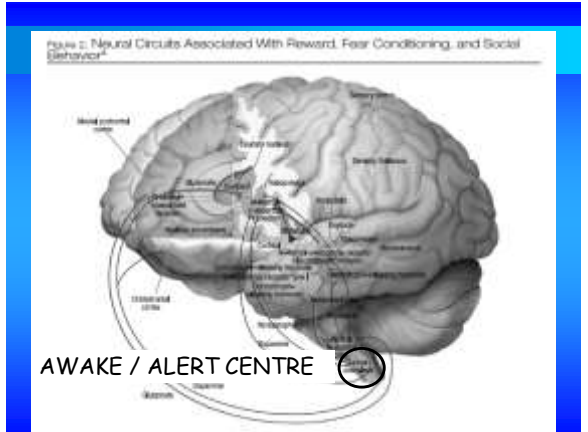
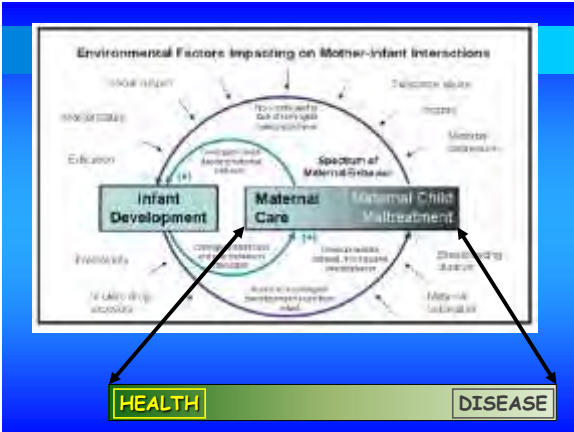


- In lactating women,
- these phenomena could theoretically
- # conserve energy required for lactation
- # protect against stress associated inhibition of lactation,
- # relieve psychological stress, and
- # enhance immune function

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

James E. Swain,¹ Jeffrey P. Loebermann,^{2,3} Janet Koen,⁴ and Leon Struchiner^{1,5}

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)



David S. Charney, M.D.

Psychobiological Mechanisms of Resilience and Vulnerability: Implications for Successful Adaptation to Extreme Stress

... there is considerable overlap in the brain structures associated with these neural mechanisms ... functional interactions among the circuits.

HEALTH **DISEASE**

RESILIENCE VULNERABILITY

WELL-BEING → SUSCEPTIBILITY → MORBIDITY → MORTALITY

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

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

HEALTH **DISEASE**

RESILIENCE VULNERABILITY

WELL-BEING → SUSCEPTIBILITY → MORBIDITY → MORTALITY

RESILIENCE

(= STRESS RESISTANCE)

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

HEALTH **DISEASE**

RESILIENCE VULNERABILITY

WELL-BEING → SUSCEPTIBILITY → MORBIDITY → MORTALITY

OXYTOCIN

→ EMOTIONAL / SOCIAL

CORTISOL

→ STRESS (threat & pain)

DOPAMINE

→ REWARD / SEEKING

RESILIENCE

(= STRESS RESISTANCE)

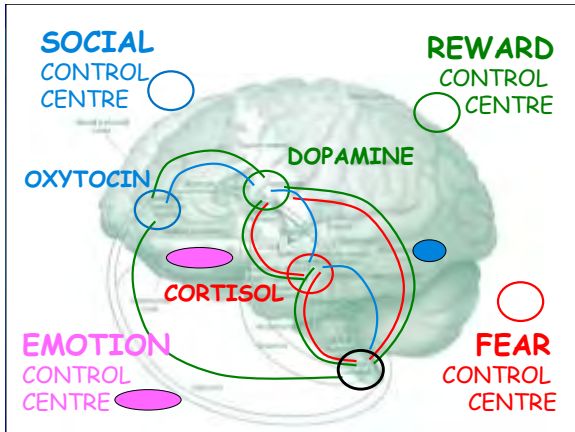
"capacity to maintain healthy emotional functioning in the aftermath of stressful experiences"

McEwen 1998

OXYTOCIN Interpersonal awareness
Emotions

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.



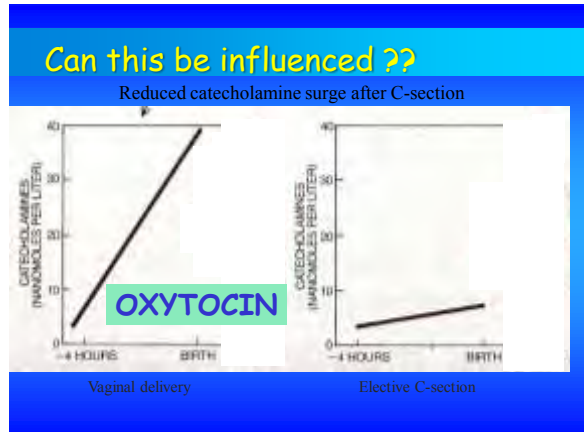
With permission from Kerstin Uvnäs Moberg

Oxytocin release mechanisms

- Via the parvocellular neurons of the PVN and SON into the brain (as a neurotransmitter)
- Via the neurohypophysis into the blood stream (hormonal action)
- Directly via cell bodies and dendritic parts of the neuron by volume transmission

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

Ross 2009

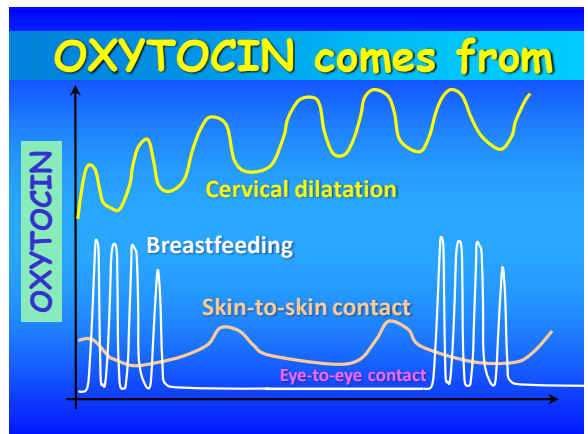


Can this be influenced ??

OXYTOCIN

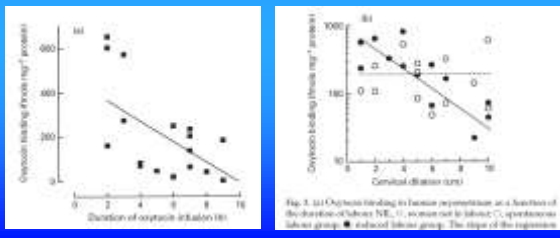
FERGUSON REFLEX

Head stretches loweruterine segment → Positive feedback loop of oxytocin



What about PITOCIN ? (Synthetic OXYTOCIN)

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



What about PITOCIN ? (Synthetic OXYTOCIN)

Olza 2012 Acta Paed 101 (7): 749-754

... intrapartum exogenous oxytocin seems to disturb sucking and breastfeeding duration

Effects of doula care

	No doula	Doula
USA (Kennell et al 1991)		
Epidural	55%	8%
Caesarean section	18%	8%
Forceps delivery	26%	8%
Fetal distress	24%	10%

Effects of doula care

	No doula	Doula
USA (Kennell et al 1991)		
Caesarean section	18%	8%
Cost of C/S	= R3600	
Cost of NVD	= R1800	
Halved C/S rate saving	= R2.2 m	
One doula every delivery	= R1.6 m	

Birth Findings - review

- 50% less Caesar Rate
- 30% less Medication
- 60% reduction in Epidurals
- 40% reduction in Forceps

"If a Doula was a drug,
it would be unethical
not to use it"

Dr. John Kennell

MICHEL ODENT
 Summarizing his knowledge:
 "Oxytocin is a shy hormone"

Porges proposes term :
 "neuroception"
 → neural process that
 evaluates risk

safe
 dangerous
 life threatening

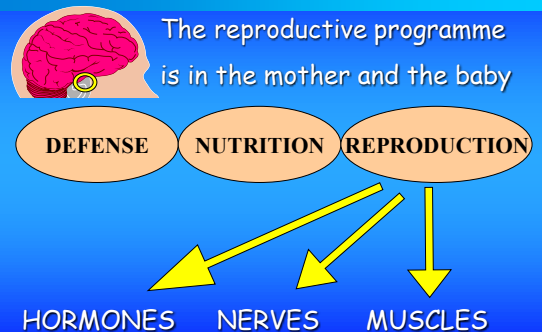
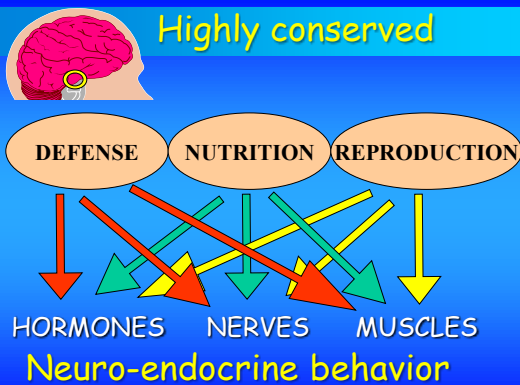
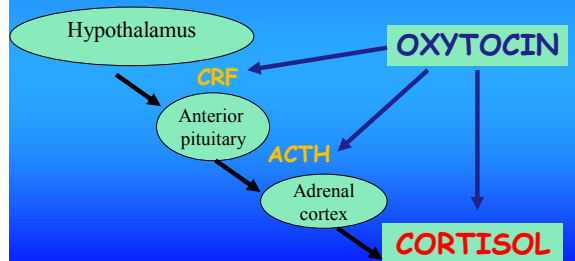
Porges →
 same neural circuitry,
 adapted to circumstance



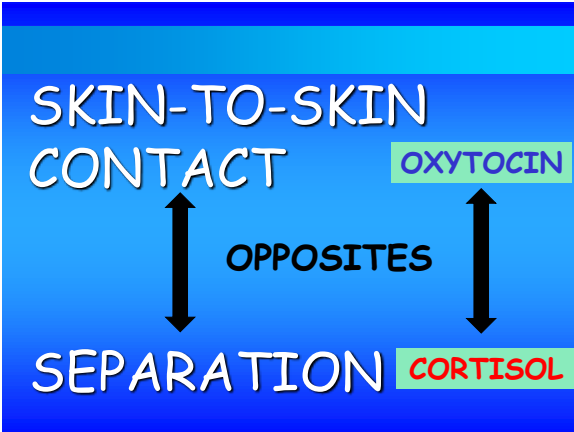
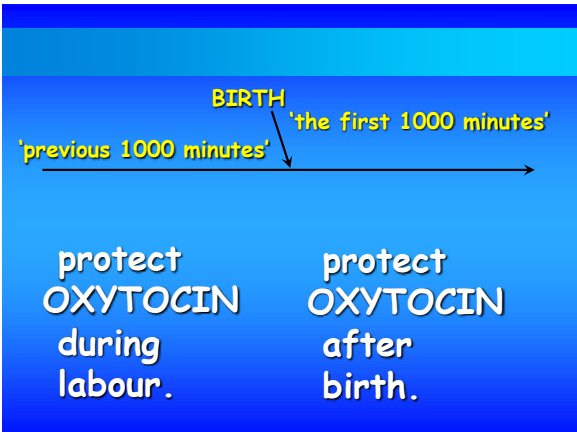
Oxytocin | Vasopressin → Cortisol

With permission from Kerstin Uvnäs Moberg

HPA axis



OXYTOCIN comes from
 VAGINAL BIRTH
 BREASTFEEDING
 SKIN-TO-SKIN
 CONTACT **OXYTOCIN**



ANTICIPATORY →

OXYTOCIN ... **OXYTOCIN**
 good for pregnancy
 good for labour
 good for birth
 good for everything

CORTISOL **CORTISOL**
 BAD for everything
 (nearly)

ANTICIPATORY → Doula

Protect my
 OXYTOCIN! **OXYTOCIN**

- birth hormone
- breastfeeding hormone
- LOVE hormone
- FRIENDSHIP hormone

birthdoulasofpittsburgh.com

Doula:
 An ancient Greek word
 meaning "handmaid."

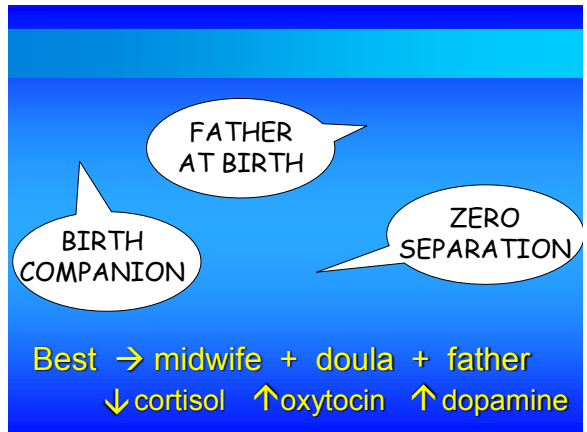
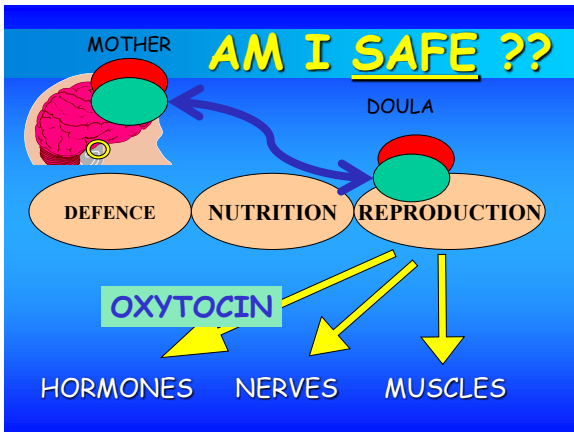
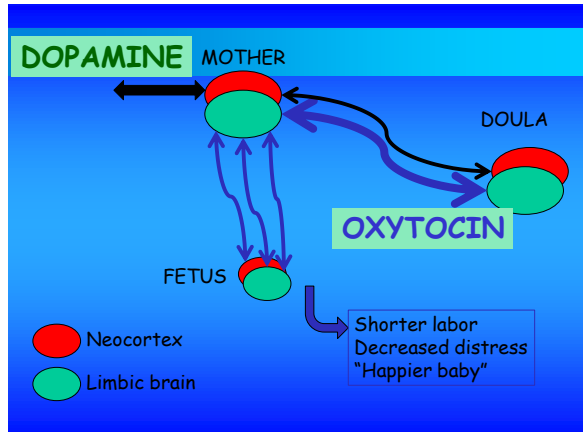
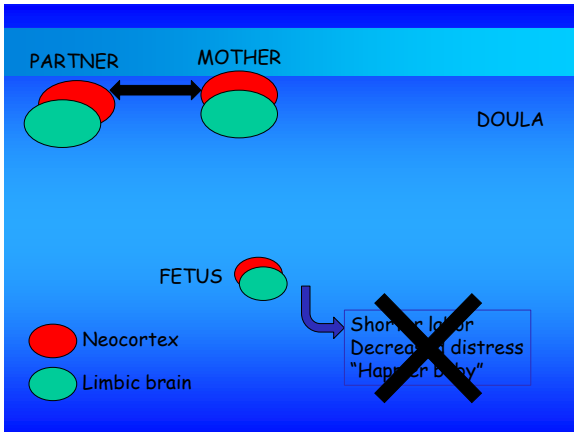
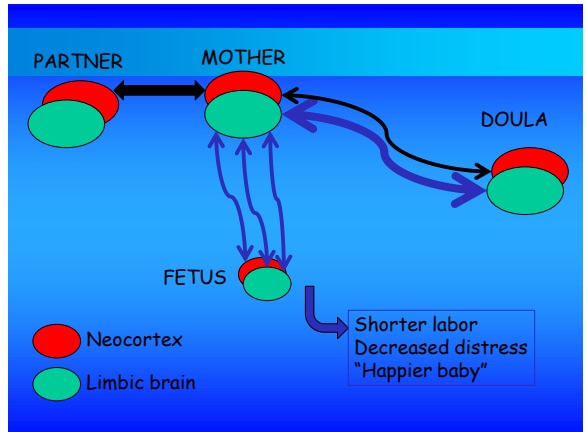
This term has come to represent
 a compassionate, experienced woman
 who provides physical, emotional,
 educational and practical support to
 another woman and her family during
 all the events surrounding childbirth.

birthdoulasofpittsburgh.com

Birth companion

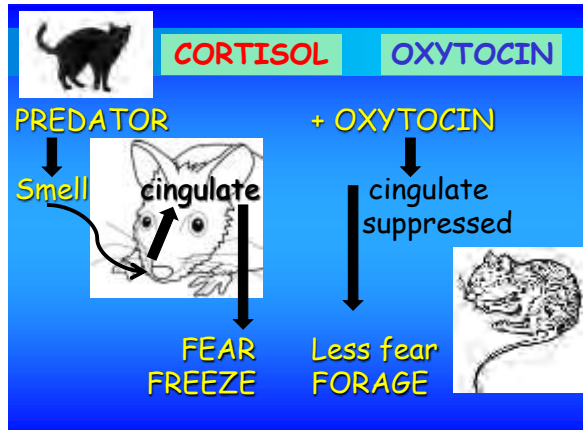
... constant uninterrupted presence of another woman

birthdoulasofpittsburgh.com



**Fight or flight versus
TEND AND BEFRIEND**

... tendency is to AFFILIATE, to come together in groups in threatening times.
 ... there is an AFFILIATIVE NEUROCIRCUITRY that prompts affiliation in response to stress.
 ... basis for this regulation ... OXYTOCIN.

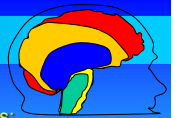


When oxytocin is released within the brain, its effects are to diminish fearfulness; this not only encourages social investigation of newcomers, but also may enhance a tendency to express aggression toward an intruder. Leng 2008

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

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

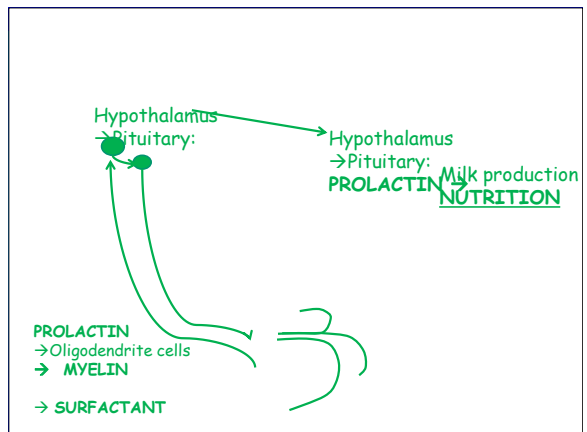
Is this feeding ??

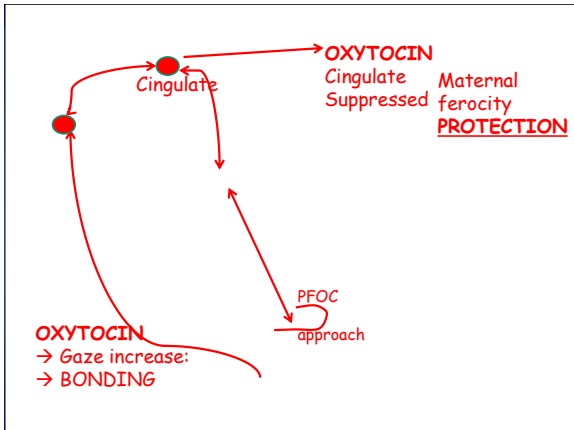


The reproductive programme is in the mother and the baby



"Needed neural processes" apply to parents' brains also.





EYE CONTACT

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

Ross 2009

In the **FIRST HOUR**
 the **newborn**

ELICITS CARE GIVING

INSTINCTUAL

BEHAVIOUR FROM THE MOTHER !!

Measure of a "good mammal mother" :

FEROCITY OF DEFENCE OF YOUNG.

Sodersjukhuset, Stockholm
 Randomisation to new and old unit

Personal testimony of a mother at international KMC meeting

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

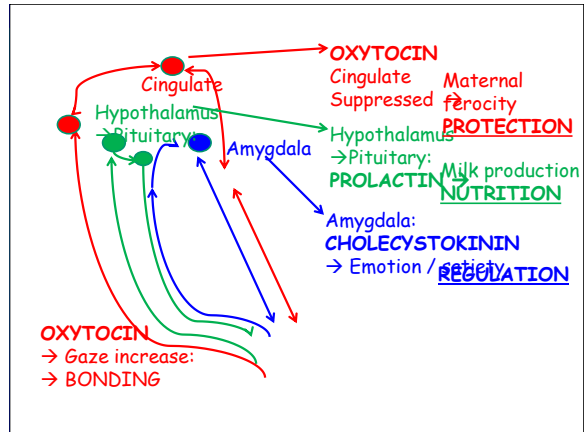
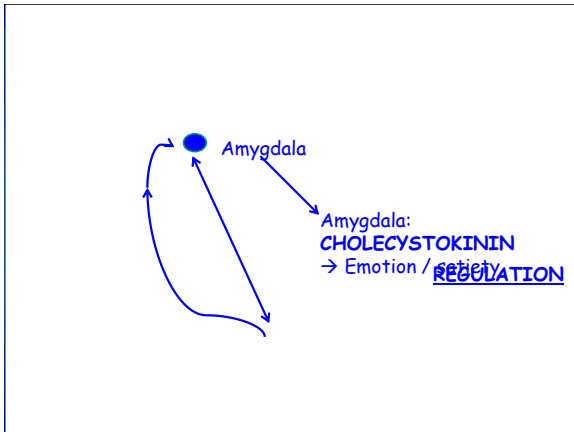
Jane Davis, Bogota, Dec 1998

In the **FIRST HOUR**
 the **newborn**

ELICITS CARE GIVING

INSTINCTUAL

BEHAVIOUR FROM THE MOTHER !!



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

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

mutual psycho-neuro-physiological caregivers

Critical period concept :

“Windows of opportunity in early life when a child's brain is exquisitely primed to receive sensory input in order to develop more advanced neural systems.”

a mother's brain ...

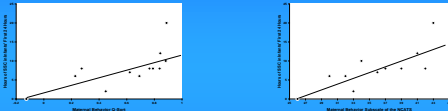
SENSITIZATION

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

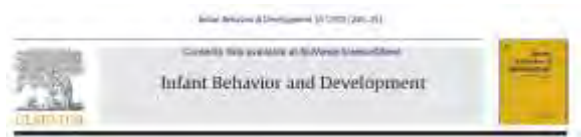
Ann E. Bigelow, et al ()

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

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

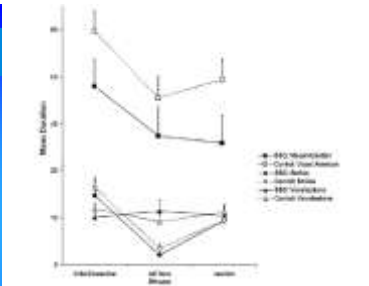


The effect of mother-infant skin-to-skin contact on infants' response to the Still Face Task from newborn to three months of age

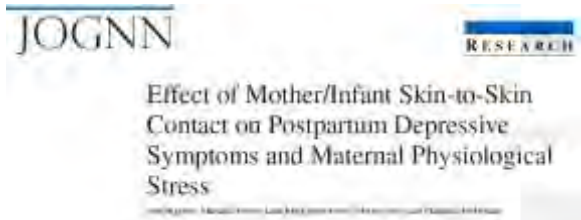
Ann E. Bugeloff, Michelle Power

Department of Psychology, St. Louis University, St. Louis, Missouri

Skin-to-skin contact accelerated infants' social expectations for their mothers' behavior and enhanced infants' awareness of themselves as active agents in social interactions.



At 3 months, infants with skin-to-skin contact increased their non-distress vocalizations during the still face phase, suggesting social bidding to their mothers.



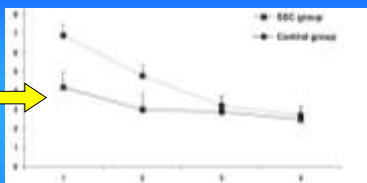
Conclusion:

Mother/infant SSC benefits mothers by reducing their depressive symptoms and physiological stress in the postpartum period.

JOGNN, 41, 369-382; 2012. DOI: 10.1111/j.1552-6909.2012.01350.x

Control

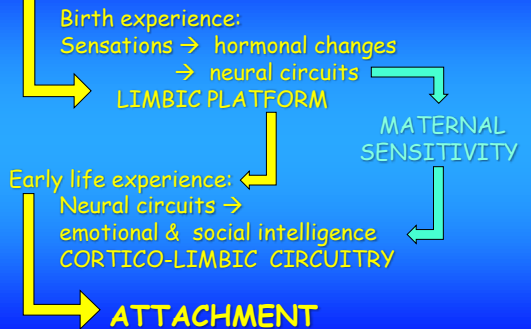
SSC

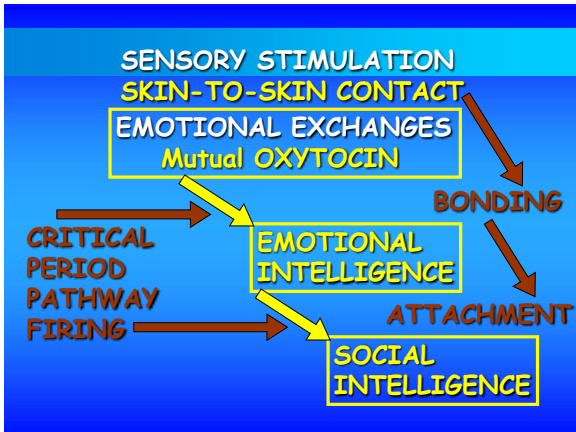


EPDS (depression) score DECREASED significantly for first two visits.

JOGNN, 41, 369-382; 2012. DOI: 10.1111/j.1552-6909.2012.01350.x

BONDING (Bergman mini-model)





PRATHIBA REEBYE

BIDIRECTIONAL !!

Affect regulation

BONDING ↔ Sensitization

Secure attachment ↔ Attuned parenting

... co-creating touch

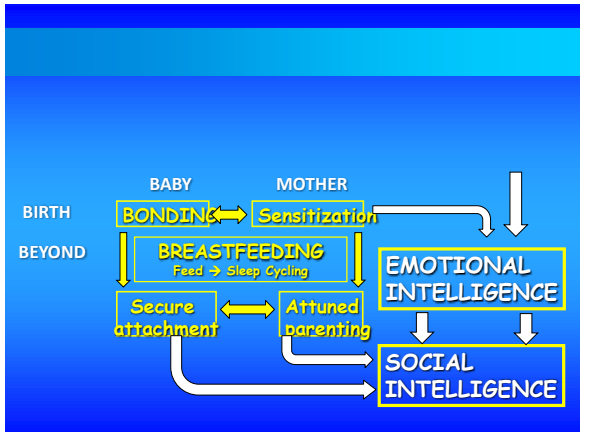
... signature unique to caregiver

ANGELA UNDERDOWN

Affective communication

- Mirroring
- Attunement
- Reciprocity
- Rupture / repair
- Containment

Reflective function
 Mind-mindedness
 Mentalisation



BRAIN WIRING

PATHWAYS

BABY

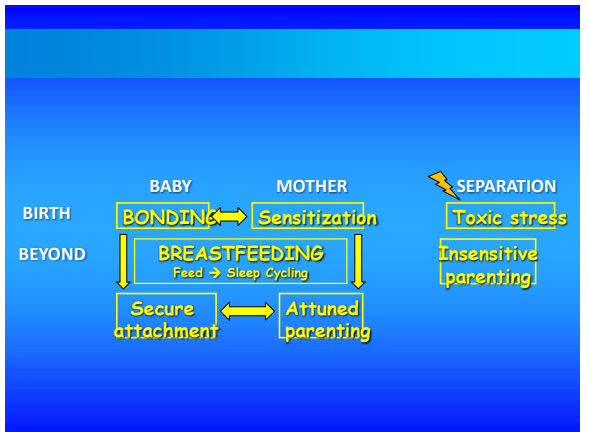
MOTHER

BONDING ↔ Sensitization

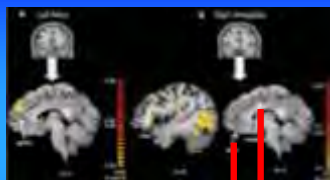
BREASTFEEDING
 Feed → Sleep Cycling

Secure attachment ↔ Attuned parenting

→ CIRCUITS → NETWORKS



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



SEPARATION
Toxic stress
Insensitive parenting

... anxious parenting ... mediated by stress-related mechanisms and greater neural disorganization.

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

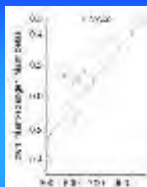


Well-adapted parenting ... reward-related motivational mechanisms, temporal organization,

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



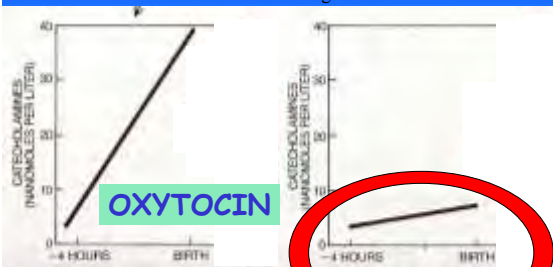
Well-adapted parenting ... reward-related motivational mechanisms, temporal organization, and affiliation hormones



OXYTOCIN

Can this be influenced ??

Reduced catecholamine surge after C-section



Vaginal delivery

Elective C-section

Can this be influenced ??

OXYTOCIN

FERGUSON REFLEX

Head stretches lower uterine segment → Positive feedback loop of oxytocin

Can this be influenced ??

Oxytocin surge absent in Caesarean

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

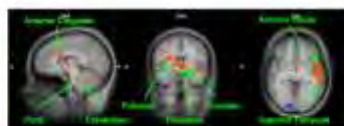


Figure 3. Maternal brain activity of VD vs. CSd baby-cry vs. Control-birth ($n = 7$, $p = .3$, $k = 4$). These are example slices of the group (overall between vaginal delivery $n = 11$ and Caesarian section delivery $n = 9$) for the normal own baby-cry + control-sound ($p < .005$, uncorrected). Please see Table 1 for a detailed list of cerebral coordinates.

Can this be influenced ??

OXYTOCIN

Vaginal birth → unique pattern
 → sensory processing, empathy, arousal,
 motivation, reward and habit-regulation
 circuits ... MORE SENSITIVE

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

James E. Swain,¹ Ezra Yaglin,² Linda C. Mayes,^{1,3} Ruth Feldman,^{1,4}
 R. Todd Constable,² and James F. Leckman¹

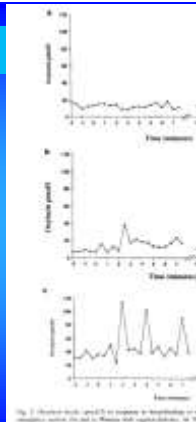
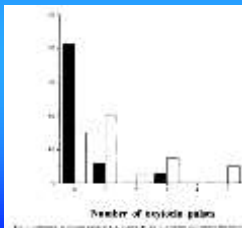
CORTISOL

Brain differences
 between VD
 & CSD mothers ...

may contribute to mental health risks &
RESILIENCY in the mother-infant dyad.

Different patterns of oxytocin, prolactin but not cortisol release during breastfeeding in women delivered by Caesarean section or by the vaginal route

Eva Nissen^{1,2,3,4}, Kerstin Uvnäs-Moberg⁵, Kristina Svensson⁶, Solveig Söck⁷, Ann-Marie Waldström⁸, Jan Winberg⁹



J Psychosom Obstet Gynaecol. 1998 Mar ;19 (1):49-58

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.

OXYTOCIN-RICH MUM	"CORTISOL" MUM
SYNCHRONOUS or "in-tune" mum	INTRUSIVE not in tune with baby
SENSITIVE to approach crying baby	ABLE TO IGNORE her crying baby, is distant
REWARD related motivation	STRESS DRIVEN response to Baby's cry
COMPASSION and empathy for baby	ANXIETY AND WORRY as to how to care for baby
INSTINCTIVE care	INTELLECTUAL care
CARE IS EASY and natural	CARE IS HARD WORK though can be very good

Attachment

Contingent infant directed



Attunement

Synchronous Sensitive

Attachment



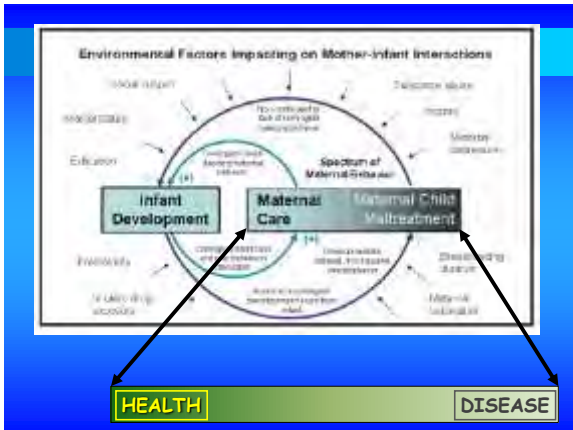
Attunement

Synchronous Sensitive

Non-contingent



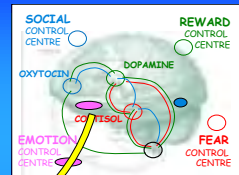
Intrusive Insensitive



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

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

Cingulate - (inhibition) switched off - makes ferocity for defence

Thalamus - activity coordinating centre of brain - to focus on care for baby

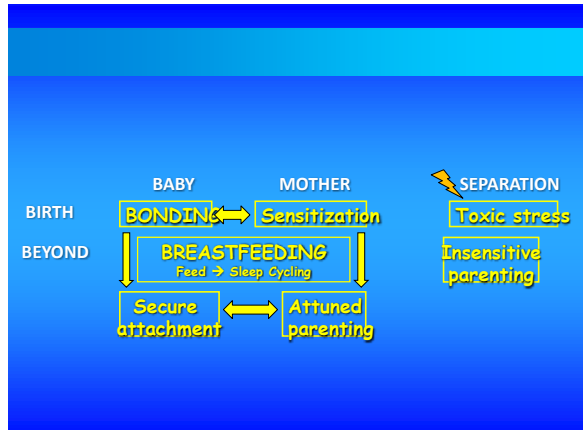
Hypothalamus - activates arousal response to respond

OXYTOCIN DURING LABOUR

CHANGES MOTHER'S BRAIN !!

NOTICE:

Same brain circuits ...
as RESILIENCE,
"highly conserved
neuro-endocrine behavior"



MOTHER

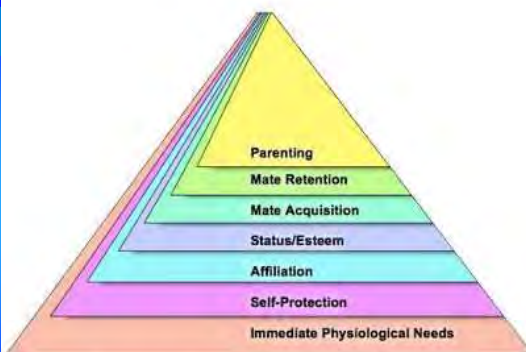
is the KEY for
NEURODEVELOPMENT

Douglas KENRICK (2010)

"We revisit the idea of a motivational hierarchy in light of theoretical developments at the interface of evolutionary biology, anthropology, and psychology."



http://www.psychologicalscience.org/journals/pps/5_3_inpress/Kenrick.pdf



Revised pyramid of needs

Fathers ??

Currently available data are broadly consistent with a working hypothesis that the expression of parental behavior will involve homologous neuroendocrine circuits in male and females.

Wynne-Edwards 2001

After C/S
29 father-infant pairs participated either skin-to-skin with their father or next to the father in a cot.

SSC infants became drowsy within 60 min after birth,

infants cared for in a cot reached the same stage after 110 minutes.

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.

OXYTOCIN

→ EMOTIONAL / SOCIAL

CORTISOL

→ STRESS (threat & pain)

DOPAMINE

→ REWARD / SEEKING

Fathers' natural roles

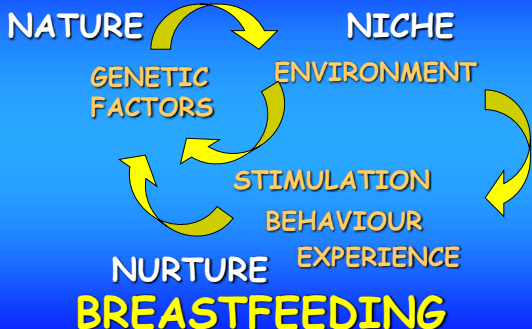
Fathers are certainly important and can share with mothers as partners, playmates, protectors and providers. But, as in all other mammals, the roles of the two parents are different. Only mothers can breastfeed. We have seen how in primates this is associated with

Fathers consistently surpassed mothers in playing and stimulating.

PETER COOK:

1. PLAYMATES
2. PARTNERS
3. PARENTS
4. PROTECTORS
5. PROVIDERS

BREASTMILK **MOTHER**



MOTHER

is the **KEY** for
NEURODEVELOPMENT

MOTHERING DENIED

'MOTHERING'

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

MOTHERING DENIED

"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."

BIRTH COMPANION

Stays 1000 minutes - prevent SEPARATION

Mother NEVER ALONE

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

FATHER AT BIRTH

Should also do skin-to-skin contact - and STAY !!

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

... continue until goes home, then until baby says "enough, thanks"

ZERO SEPARATION

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

Looking Back, Moving Forward

WIC: Strengthening Families for 40 Years

"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."

Infancy cannot be re-run later.