MATERNAL PERINATAL NEUROBEHAVIOR.

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MATERNAL PERINATAL NEUROBEHAVIOR.

Highly conserved neuro-endocrine behavior

REPRODUCTION

MOTHER
Sensitization
Attuned parenting

BIRTH
BABY
BONDING
Secure attachment

MOTHER
Sensitization
Attuned parenting

BREASTFEEDING
Feed & Sleep Cycling

REVIEW ARTICLE

MATERNAL PERINATAL NEUROBEHAVIOR.

Estrogen peaks
Progesterone falls

Pup stimulation
Rich environment

Increased spines (dendrification)

New circuits = enhanced learning

Maternal neurobehaviour

Enhanced foraging
Time to find a baited food well:
Non-mother 130 sec
Mother mouse 40 sec

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

Highly conserved neuro-endocrine behavior

MICE

Estrogen peaks
Progesterone falls

Pup stimulation
Rich environment

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 MEMORY permanently improved

Opioids
Glucocorticoids
Norepinephrine Vasopressin (fathers specially)

BDNF (= Brain Derived Neurotropic Factor)
Oxytocin
"The combination of these ... converge to produce the most dramatic results ...

"The totality and natural ramifications of reproductive experience .... enhancements .... neuroplasticity ...

(p522)
BDNF (=Brain Derived Neurotropic 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 Neuroscience of Birth & Breastfeeding**

**The Brain**

**NEURODEVELOPMENT**

**EVOLUTIONARY BIOLOGY**

**ENVIRONMENT**

**ADAPTATION**

**EXPERIENCE**

**REPRODUCTIVE FITNESS**

"needed neural processes"

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

Breastfeeding mothers have
- HIGHEST VAGAL TONE → Stress Resistance
- LOWER systolic blood pressure → Stress tolerance

Responds to Laboratory Psychosocial Stress in Postpartum Women

Mock job interview:

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 lifetime.”

Swain et al., 2007
... there is considerable overlap in the brain structures associated with these neural mechanisms ... functional interactions among the circuits.

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.

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... a properly functioning reward circuit may be necessary for ... positive social behaviors.
Oxytocin release mechanisms
- Via the parvocellular neurons of the PVN and SON into the brain (as a neurotransmitter)
- Via the neurohypophysis into the bloodstream (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.

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Can this be influenced??
Reduced catecholamine surge after C-section

Can this be influenced??
OXYTOCIN
FERGUSON REFLEX
Head stretches loweruterine segment → Positive feedback loop of oxytocin

Can this be influenced??
OXYTOCIN comes from
Cervical dilatation
Breastfeeding
Skin-to-skin contact
Eye-to-eye contact
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

<table>
<thead>
<tr>
<th></th>
<th>No doula</th>
<th>Doula</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA (Kennell et al 1991)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epidural</td>
<td>55%</td>
<td>8%</td>
</tr>
<tr>
<td>Caesarean section</td>
<td>18%</td>
<td>8%</td>
</tr>
<tr>
<td>Forceps delivery</td>
<td>26%</td>
<td>8%</td>
</tr>
<tr>
<td>Fetal distress</td>
<td>24%</td>
<td>10%</td>
</tr>
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 Effects of doula care

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<tr>
<td>Caesarean section</td>
<td>18%</td>
<td>8%</td>
</tr>
<tr>
<td>Cost of C/S</td>
<td>= R3600</td>
<td></td>
</tr>
<tr>
<td>Cost of NVD</td>
<td>= R1800</td>
<td></td>
</tr>
<tr>
<td>Halved C/S rate saving</td>
<td>= R2.2 m</td>
<td></td>
</tr>
<tr>
<td>One doula every delivery</td>
<td>= R1.6 m</td>
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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

1922-2013
Marshall Klaus & 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

Highly conserved

The reproductive programme is in the mother and the baby

HORMONES NERVES MUSCLES
Neuro-endocrine behavior

HPA axis

Hypothalamus
CRF
Anterior pituitary
ACTH
Adrenal cortex
CORTISOL

OXYTOCIN

DEFENSE NUTRITION REPRODUCTION

DEFENSE NUTRITION REPRODUCTION

HORMONES NERVES MUSCLES
**OXYTOCIN** comes from **VAGINAL BIRTH**, **BREASTFEEDING**.

**SKIN-TO-SKIN CONTACT**

During *labour*, **protect** **OXYTOCIN**.

After *birth*, **protect** **OXYTOCIN**.

'previous 1000 minutes' vs. 'the first 1000 minutes'

**SKIN-TO-SKIN CONTACT**

**OPPOSITES**

**SEPARATION**

**CORTISOL**

**OXYTOCIN**

**ANTICIPATORY**

**OXYTOCIN**

- good for pregnancy
- good for labour
- good for birth
- good for everything

**CORTISOL**

BAD for everything (nearly)

**ANTICIPATORY → Doula**

Protect my **OXYTOCIN**!

Doula:

An ancient Greek word meaning “handmaid.”

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

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

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

"Needed neural processes" apply to parents' brains also.
In the FIRST HOUR ……

..... the newborn
ELICITS CARE GIVING
INSTINCTUAL
BEHAVIOUR FROM
THE MOTHER!!

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

EYE CONTACT

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

Ross 2009
"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

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**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**

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**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

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.

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

Birth experience:
Sensations → hormonal changes
→ neural circuits
LIMBIC PLATFORM

Early life experience:
Neural circuits → emotional & social intelligence
CORTICO-LIMBIC CIRCUITRY
ATTACHMENT

Dose of SCC first 24 hours correlates
NCATS (Nursing Child Assessment Teaching Scale) Predicts cognitive outcome
SENSITIZATION
Human brains are RELATIONAL.

- Sensory stimulation
  - Skin-to-skin contact
  - Emotional exchanges
    - Mutual oxytocin

- Bonding
  - Critical period
  - Pathway firing
  - Emotional intelligence
  - Attachment

- Emotional intelligence
  - Pathway firing

- Affect regulation

- Bonding sensitization
  - Secure attachment
  - Attuned parenting

- Co-creating touch
- Signature unique to caregiver

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

- Reflective function
  - Mind-mindedness
  - Mentalisation

- Brain wiring
  - Pathways
  - Circuits
  - Networks

- Birth beyond breastfeeding
  - Feed to sleep cycling

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

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

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
Can this be influenced??

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

OXYTOCIN

Oxytocin, prolactin, milk production and their relationship with personality traits in women after vaginal delivery or Cesarean section.

Social desirability and oxytocin pulsatility 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.

CORTISOL

Brain differences between VD & CSD mothers … may contribute to mental health risks & RESILIENCY in the mother-infant dyad.


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**OXYTOCIN-RICH MUM**

SYNCHRONOUS or “in-tune” mum

<table>
<thead>
<tr>
<th>&quot;CORTISOL&quot; MUM</th>
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<tbody>
<tr>
<td>INTRUSIVE not in tune with baby</td>
</tr>
<tr>
<td>ABLE TO IGNORE her crying baby, is distant</td>
</tr>
<tr>
<td>STRESS DRIVEN response to Baby’s cry</td>
</tr>
<tr>
<td>ANXIETY AND WORRY as to how to care for baby</td>
</tr>
<tr>
<td>INTELLECTUAL care</td>
</tr>
<tr>
<td>CARE IS HARD WORK though can be very good</td>
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**ATTACHMENT**

Contingent infant directed

**ATTUNEMENT**

Synchronous Sensitive
Attachment
Synchronous  Sensitive

Non-contingent
Intrusive  Insensitive

Oxytocin During Labour
Chances 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

Orbitofrontal cortex - activates approach
Nucleus accumbens - Reward and pleasure motivation (dopamine)
Fusiform gyrus - (face coding unit of brain) seeks her baby's face

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

Fathers ??
Currently available data are broadly consistent with a working hypothesis that the expression of parental behavior will involve homologous neuro-endocrine 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.

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OXYTOCIN  ➔ EMOTIONAL / SOCIAL
CORTISOL  ➔ STRESS (threat & pain)
DOPAMINE  ➔ REWARD / SEEKING

Fathers consistently surpassed mothers in playing and stimulating.

PETER COOK:
1. PLAYMATES
2. PARTNERS
3. PARENTS
4. PROTECTORS
5. PROVIDERS

MOTHER
is the KEY for NEURODEVELOPMENT

BREASTMILK  MOTHER
NATURE  NICHE
GENETIC FACTORS  ENVIRONMENT
STIMULATION  BEHAVIOUR
NURTURE BREASTFEEDING

BREASTMILK is the KEY for NEURODEVELOPMENT
‘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.”

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Infancy cannot be re-run later.