Kangaroo Mother Care and Brain Development

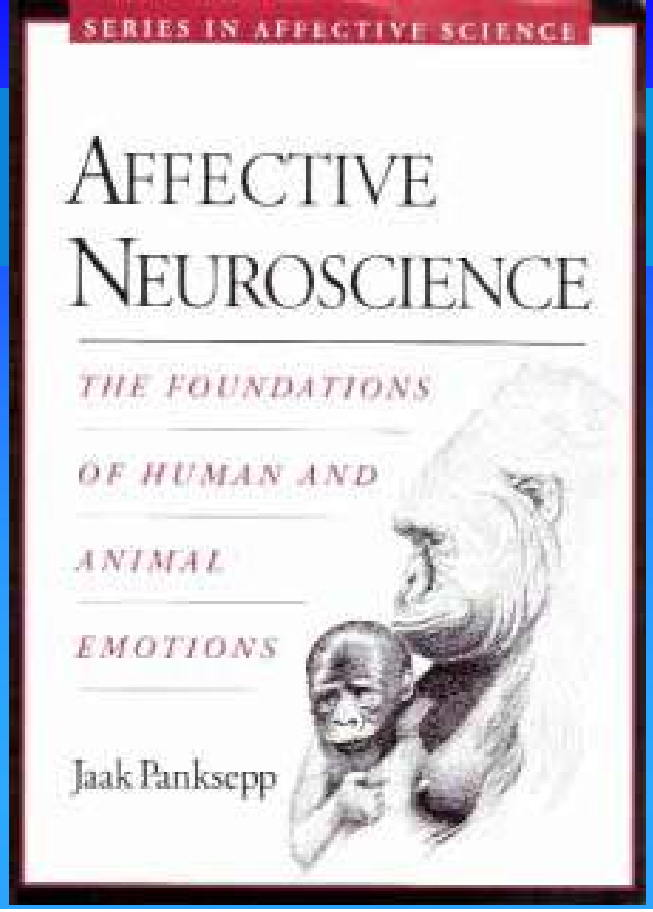
Dr Nils Bergman

MB ChB, DCH, MPH, MD

(USA equiv: MD, MPH ,PhD)

Cape Town, RSA

www.skintoskincontact.com



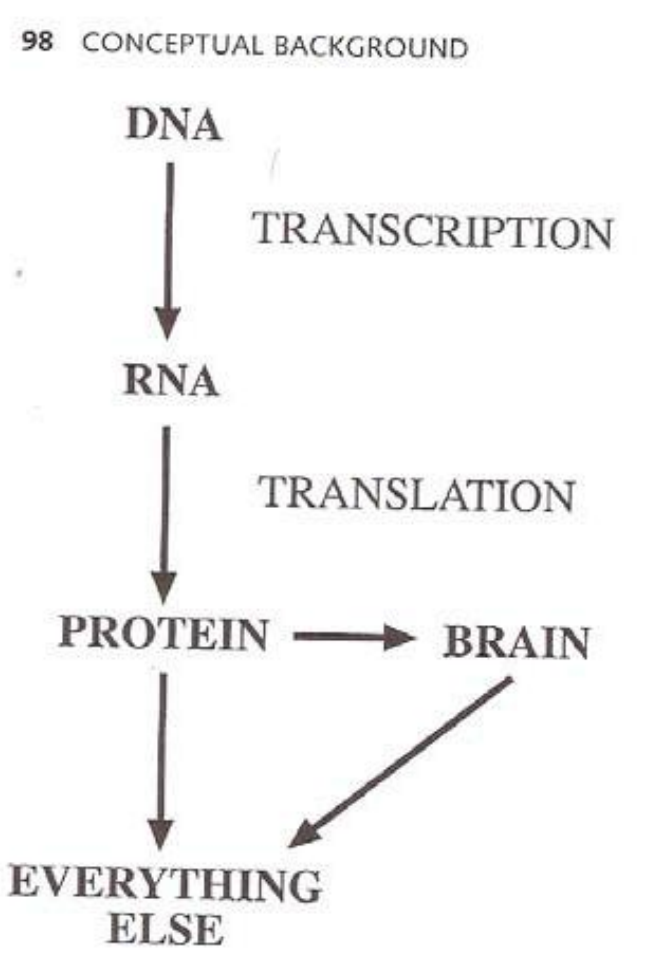
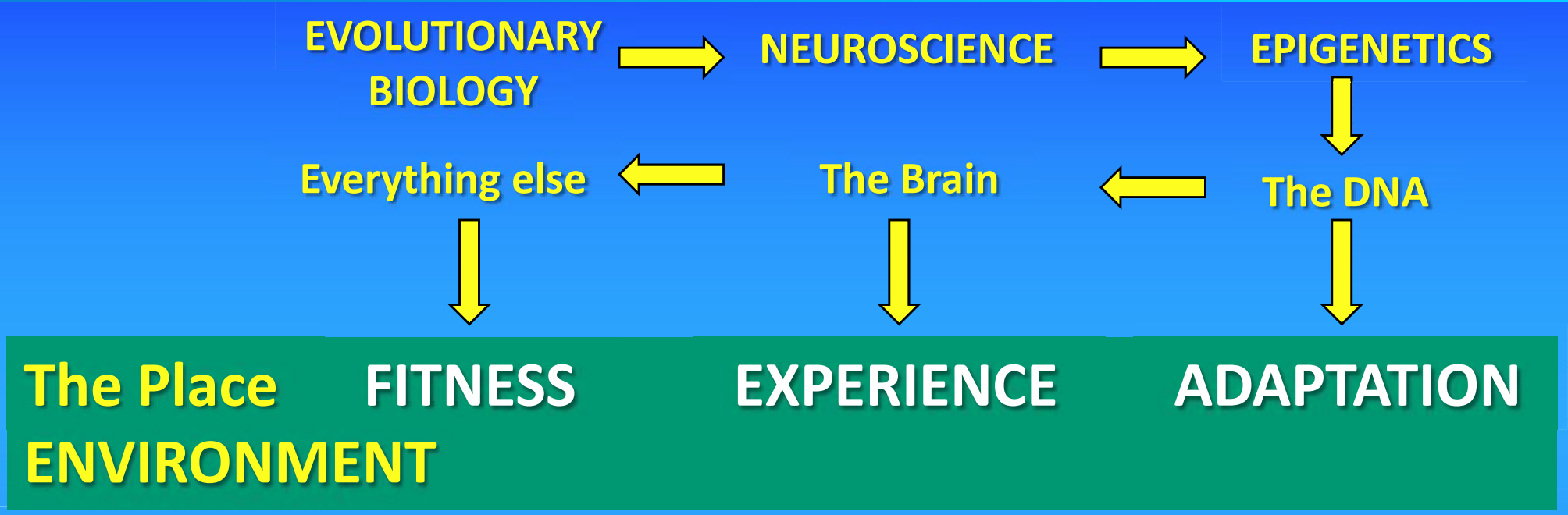


Figure 6.1. Summary of the current "central dogma" that underlies the analysis of all biological processes, including those that mediate basic psychobiological processes. The only major concept missing from this schematic is the environment, and these influences permeate all phases of these transactions.

“Scientific foundation” … a synthesis



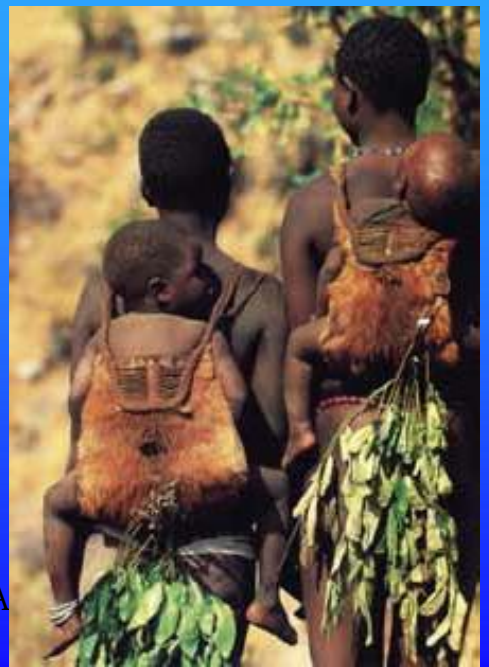
Babies Celebrated, Beatrice Fontanel and Claire D'Harcourt, © 1998 Harry N. Abrams, Inc.

"For species such as primates, the mother IS the environment."

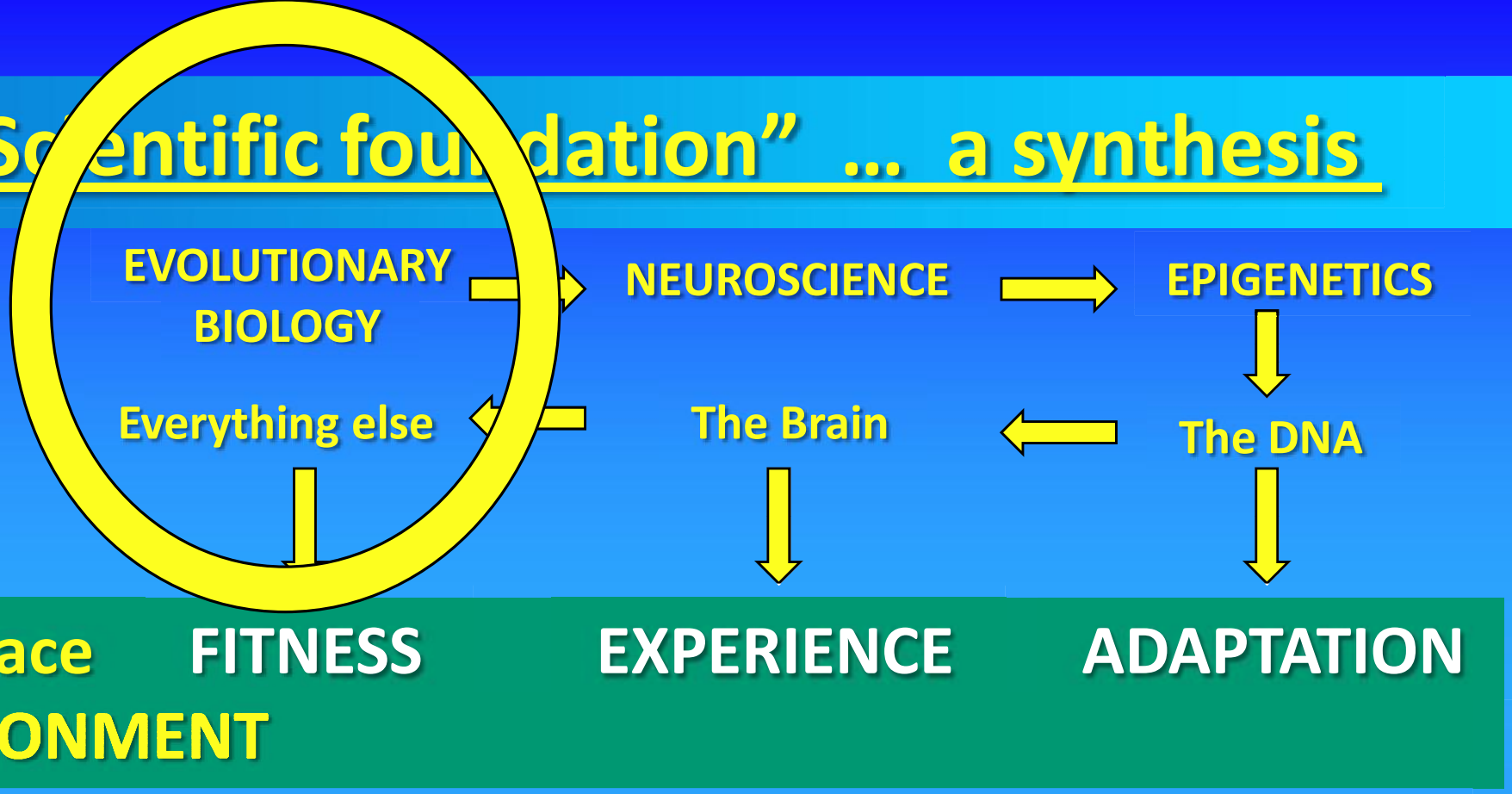
Sarah Blaffer Hrdy, Mother Nature (1999)

Nothing an infant can or cannot do makes sense, except in light of mother's body



"Scientific foundation" … a synthesis

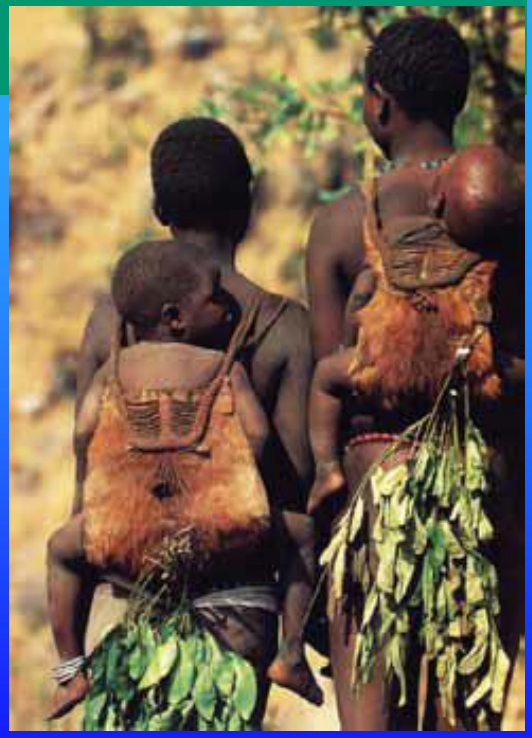


"EXCEPT IN THE LIGHT OF MOTHER'S BODY."

"EEA"

The Place **FITNESS** **EXPERIENCE** **ADAPTATION**
ENVIRONMENT

Environment of Evolutionary Adaptedness



MOTHER

is the key to neurodevelopment …

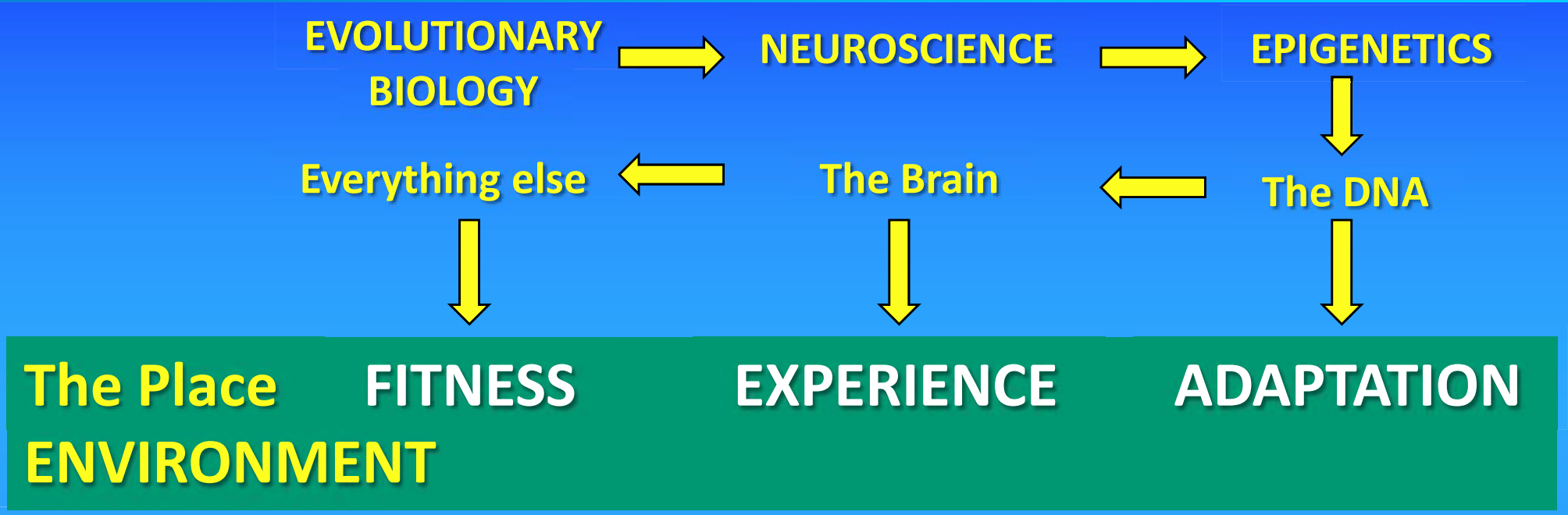
Environment of Evolutionary Adaptedness

MOTHER

is the key to
neurodevelopment …

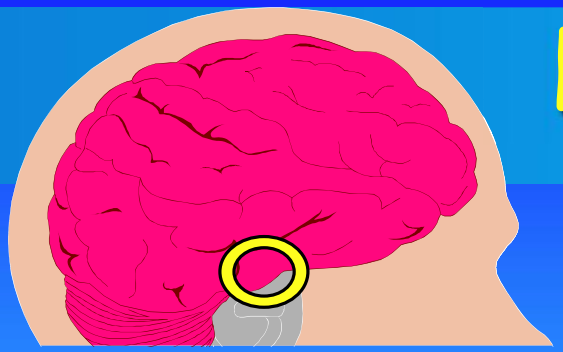
… because she is the
RIGHT PLACE !!

"Scientific foundation" … a synthesis



… because she is the

RIGHT PLACE !!



HIGHLY CONSERVED NEURO-ENDOCRINE BEHAVIOR

DEFENCE **NUTRITION** **REPRODUCTION**

HORMONES NERVES MUSCLES

endocrine autonomic NS somatic

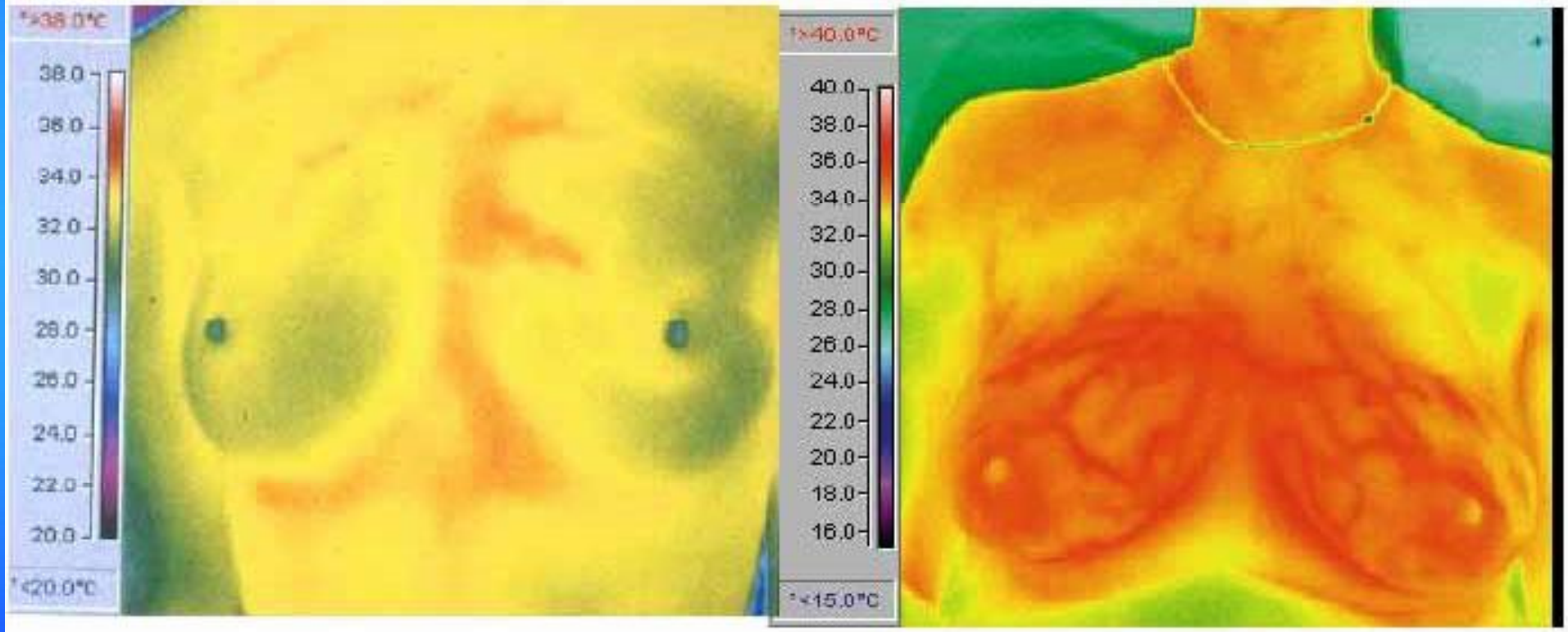

HIGHLY CONSERVED
NEURO-ENDOCRINE
BEHAVIOR


HIGHLY CONSERVED
NEURO-ENDOCRINE
BEHAVIOR

Thermal Images

Non-lactating Breasts

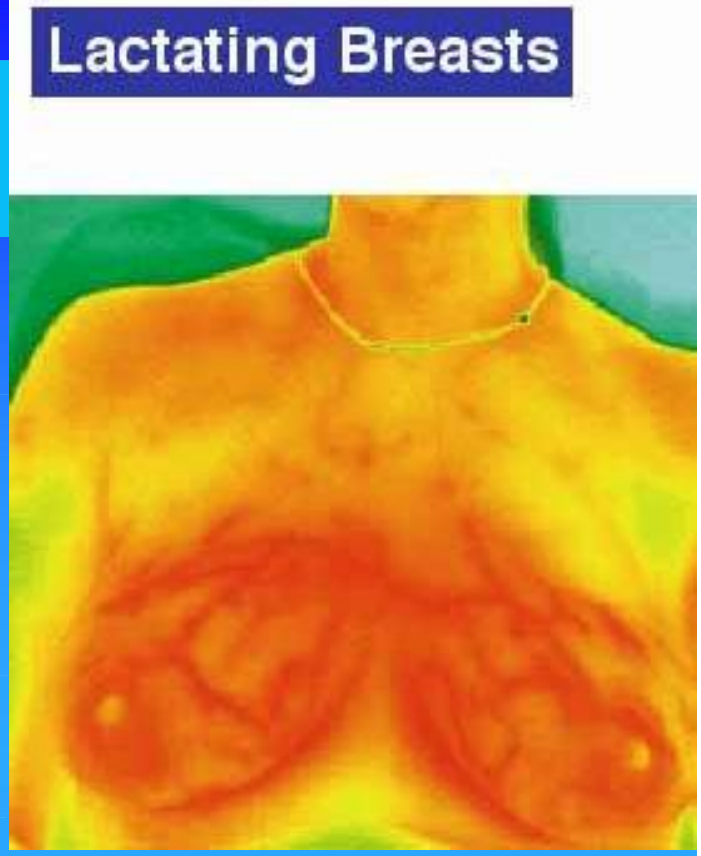
Lactating Breasts



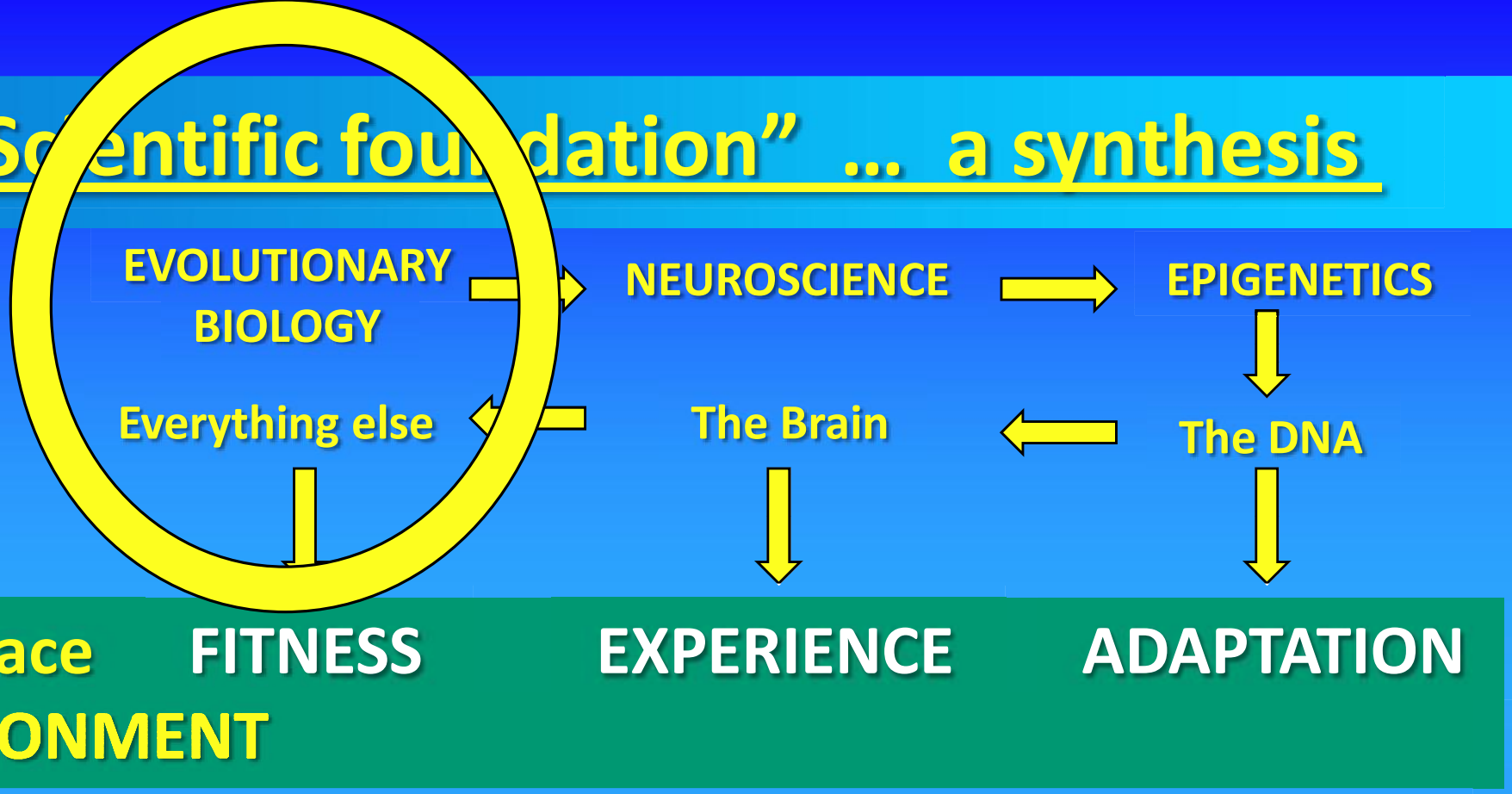
Images courtesy of Prof Peter Hartmann, UWA

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

(Alberts 1994)



"Scientific foundation" … a synthesis



"EXCEPT IN THE LIGHT OF MOTHER'S BODY."

"Scientific foundation" … a synthesis

EVOLUTIONARY BIOLOGY → NEUROSCIENCE → EPIGENETICS

Everything else ← The Brain ← The DNA

The Place ENVIRONMENT | FITNESS | EXPERIENCE | ADAPTATION


Kangaroo Mother Care
and Brain Development
The Place
ENVIRONMENT
FITNESS
EXPERIENCE
ADAPTATION
Kangaroo POSITION
Kangaroo NUTRITION
Kangaroo SUPPORT
DISCHARGE

Kangaroo Mother Care and Brain Development

"Cells which

FIRE TOGETHER,

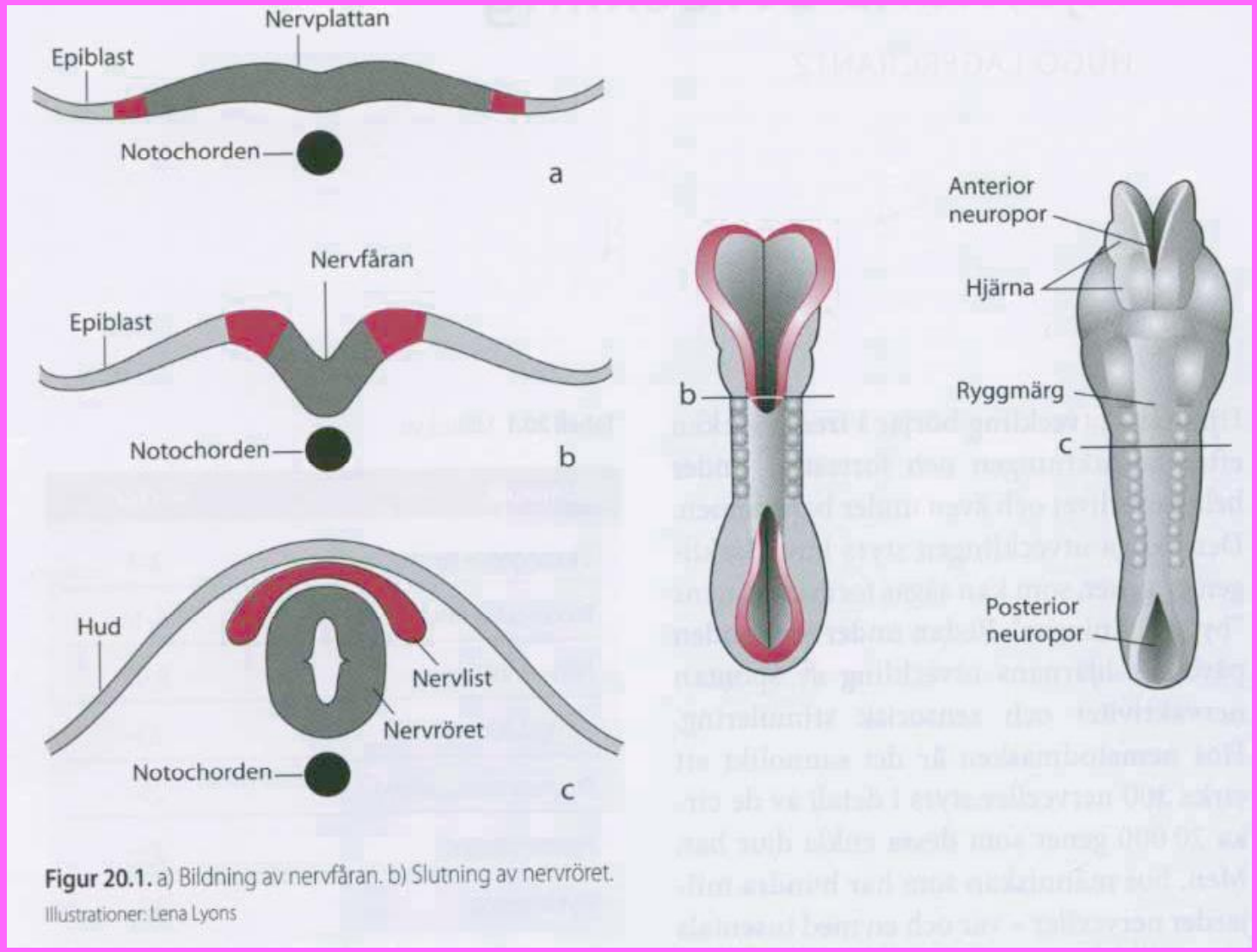
WIRE TOGETHER,

and those which

don't, won't."

Carla Shatz

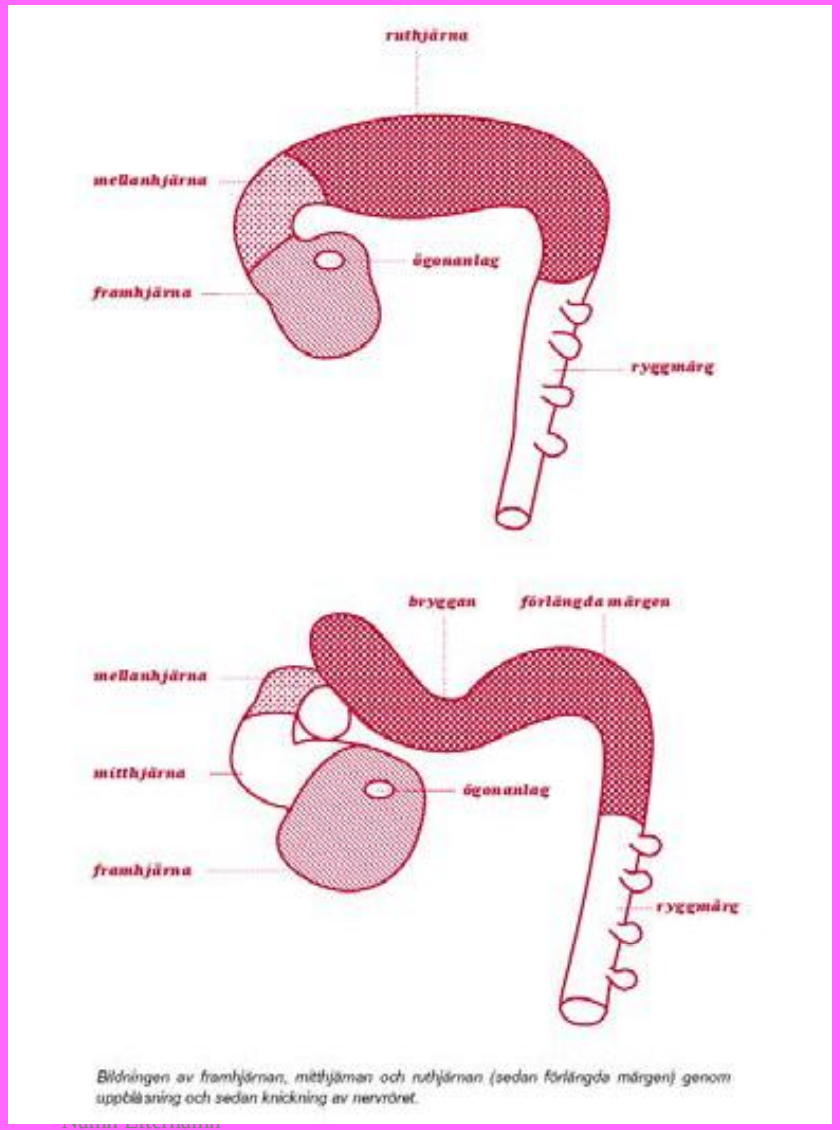
Making of the neural tube



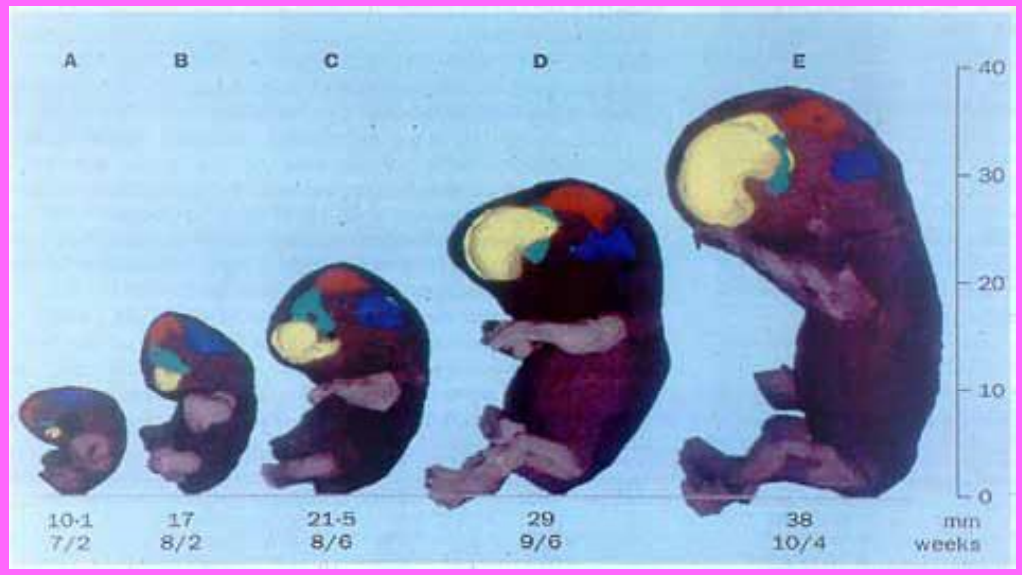
Figur 20.1. a) Bildning av nervfåran. b) Slutning av nervröret.

Illustrationer: Lena Lyons

Sonic goes ballooning

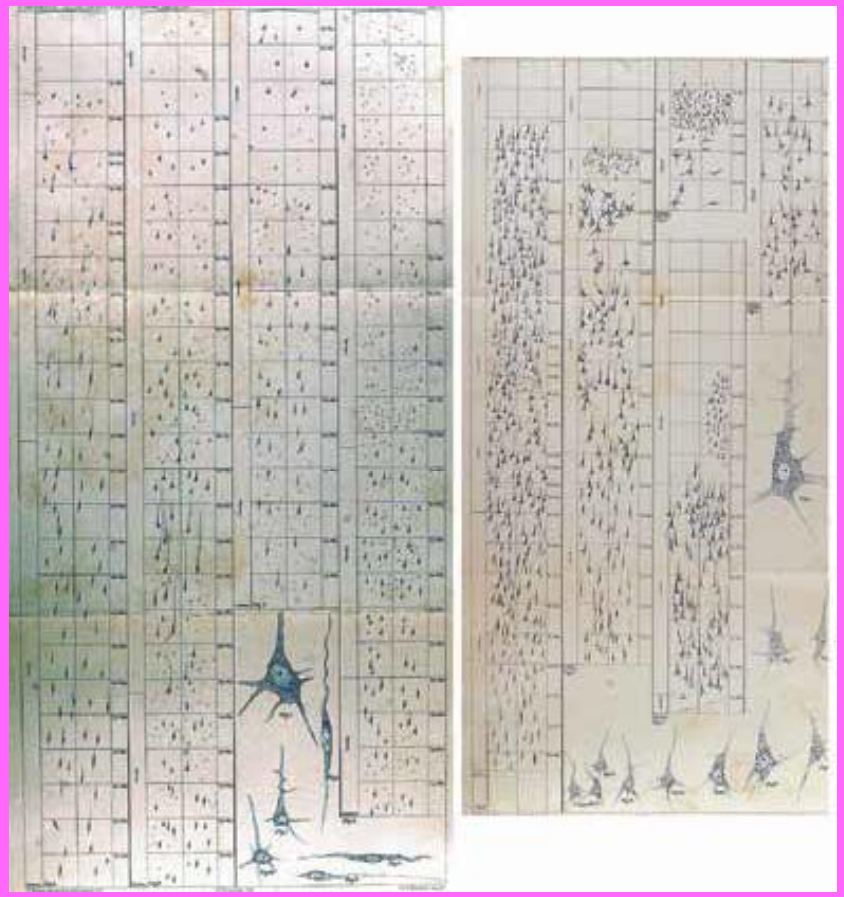


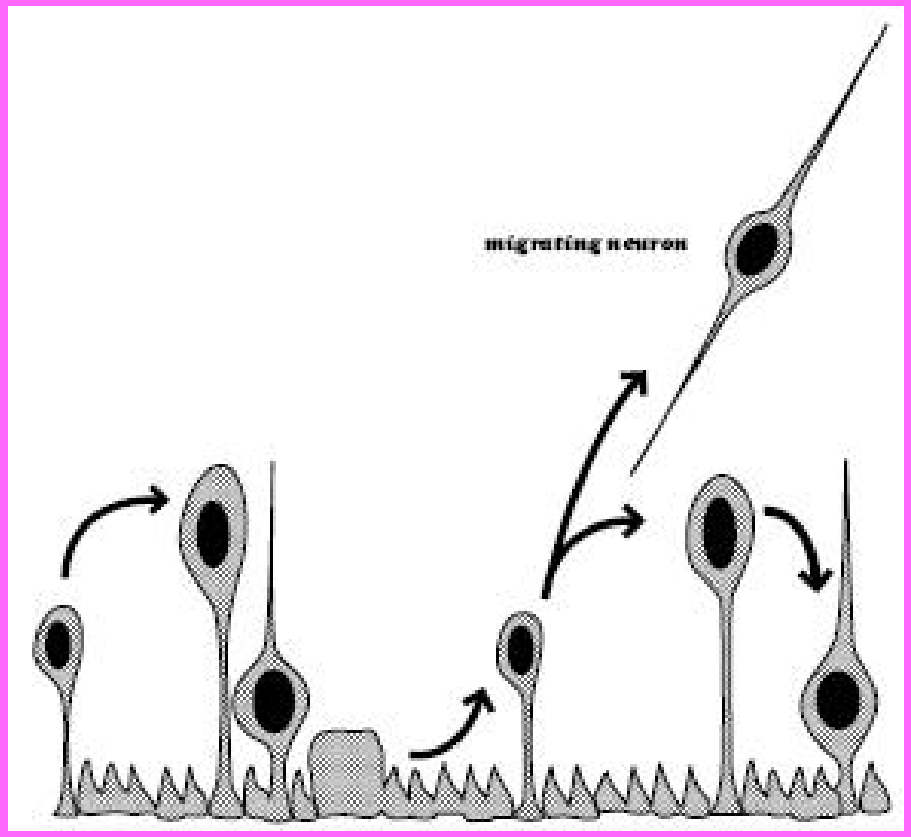
Bildningen av framhjärnan, mitthjärnan och ruthjärnan (sedan förlängda märgen) genom uppblåsning och sedan knickning av nervröret.

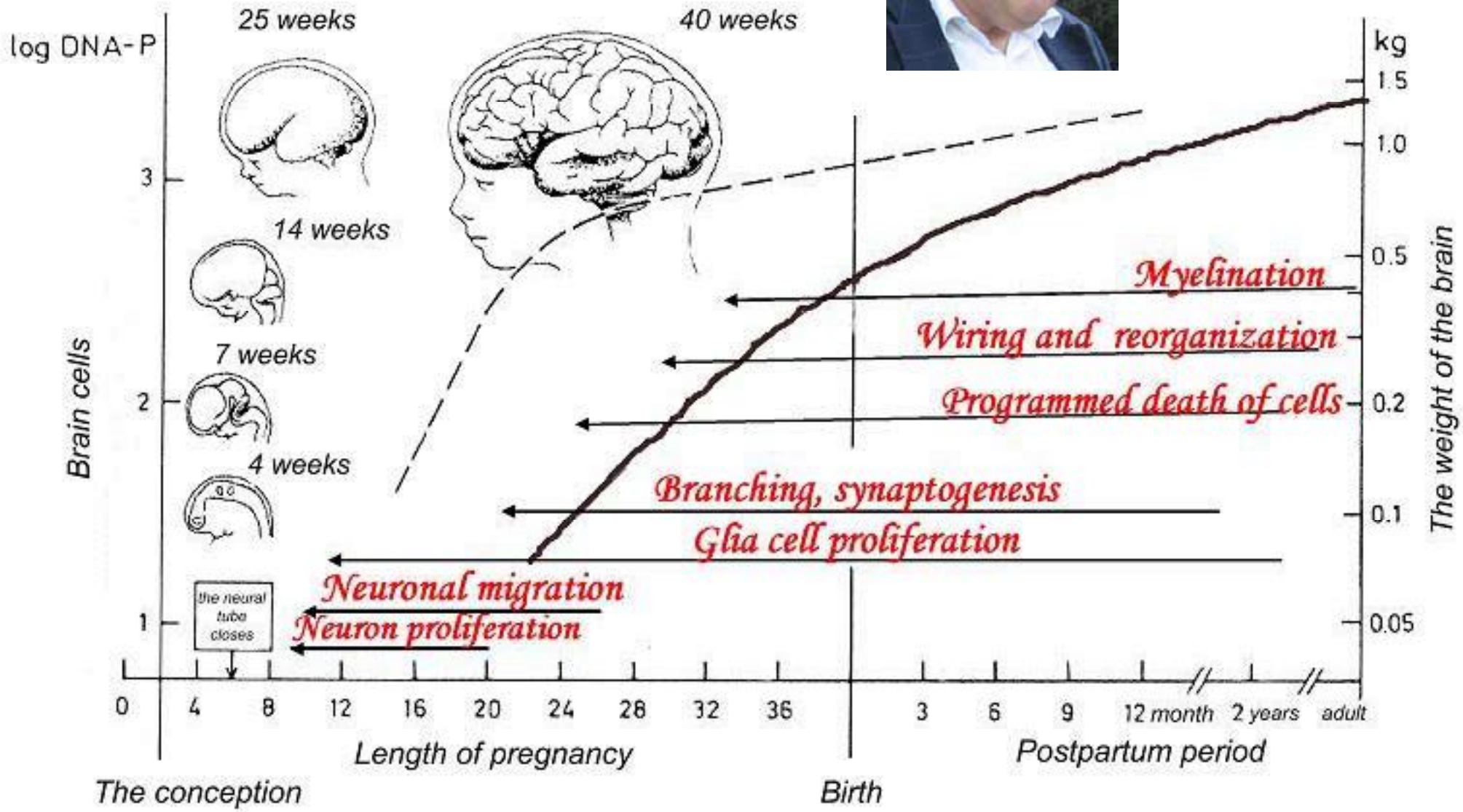


200000 new nerve cells/min

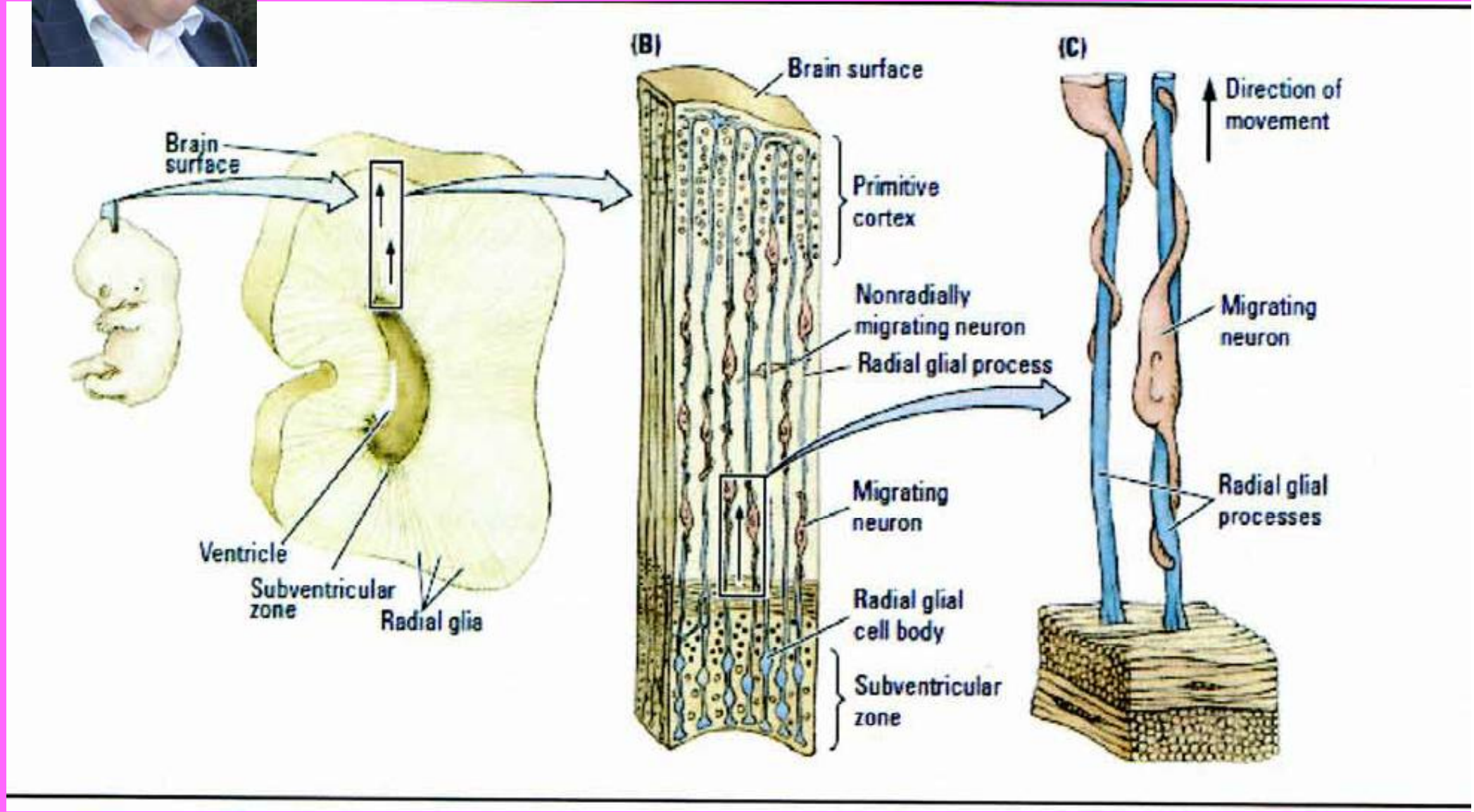
Hammarberg 1896 Caviness 2008





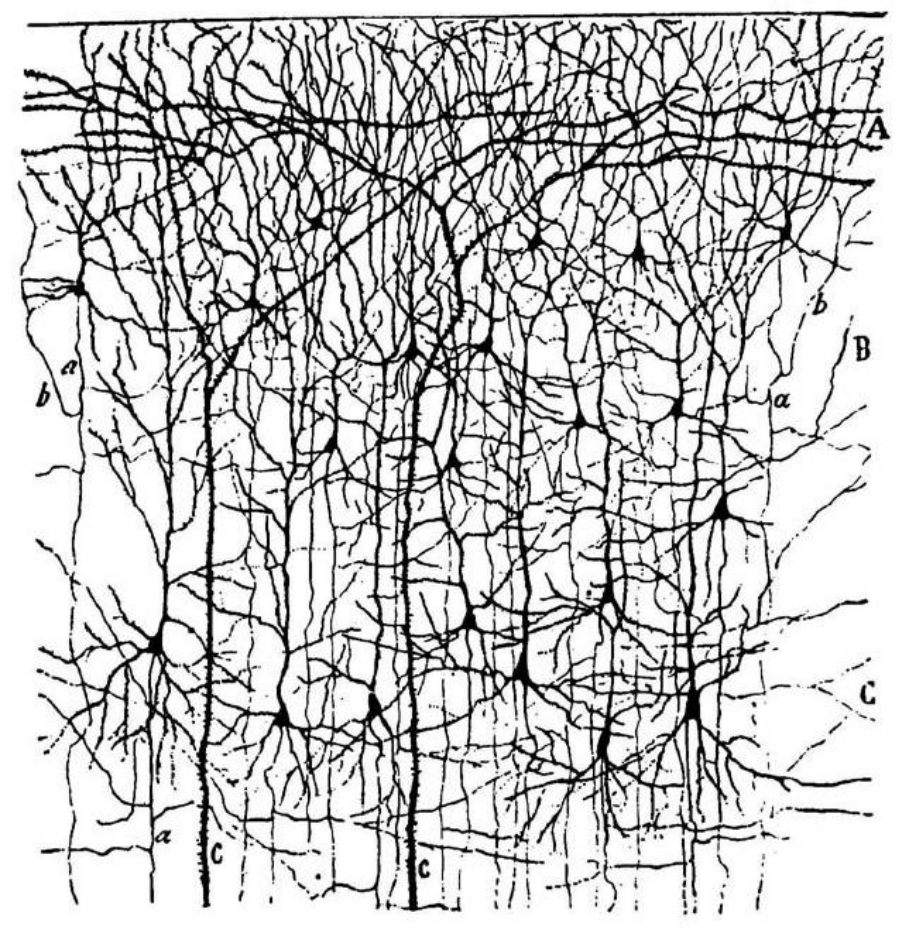

log DNA-P
25 weeks
40 weeks
14 weeks
7 weeks
4 weeks
the neural tube closes
Brain cells
3
2
1
Myelination
Wiring and reorganization
Programmed death of cells
Branching, synaptogenesis
Glia cell proliferation
Neuronal migration
Neuron proliferation
kg
1.5
1.0
0.5
0.2
0.1
0.05
The weight of the brain
0
4
8
12
16
20
24
28
32
36
3
6
9
12 month
2 years
adult
Length of pregnancy
Postpartum period
The conception
Birth

Neuronal migration

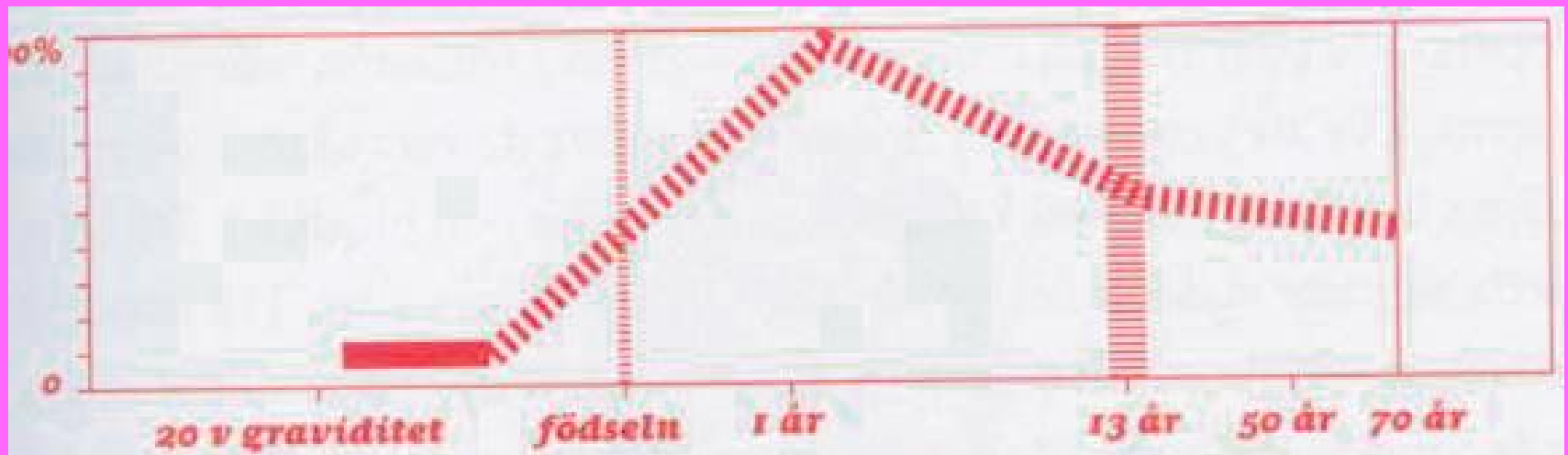


The brain is not a computer, it is a jungle

G Edelman

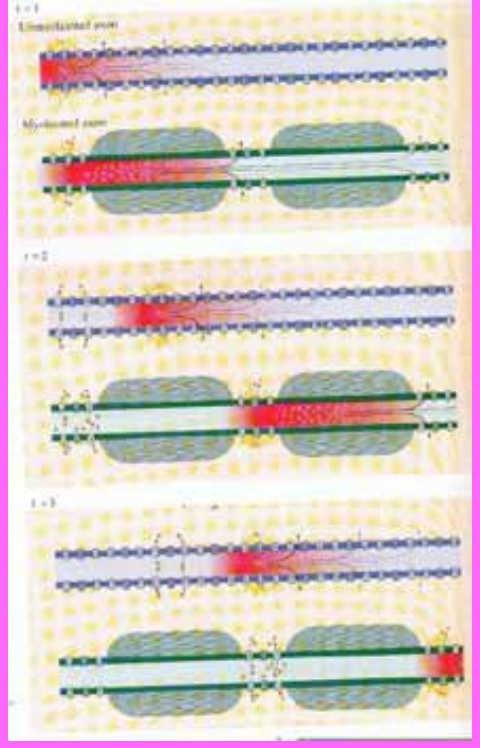


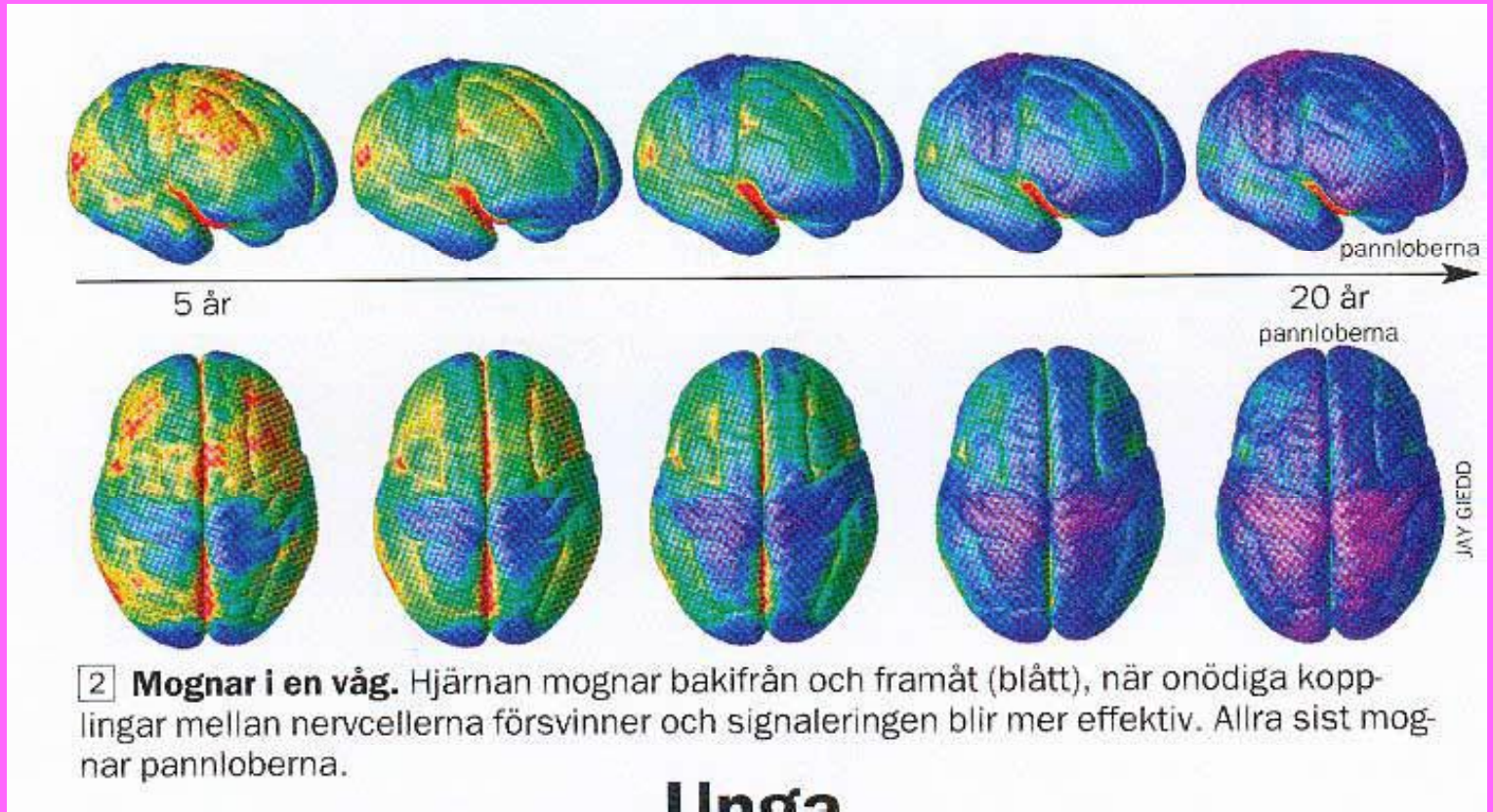
One million new synapses/second at 1 year!



Bildningen av synapser börjar i fosterlivet ungefär i 20:e fosterveckan, ökar kraftigt efter födelsen, för att sedan explodera vid 1–2-årsåldern, då det bildas upp till en miljon synapser per sekund. Synapsbildningen planar sedan ut, men fortgår hela livet. Vid puberteten no… en kraftig minskning. Originalbild: J-P Bourgeois

Myelin important for rapid nerve conduction

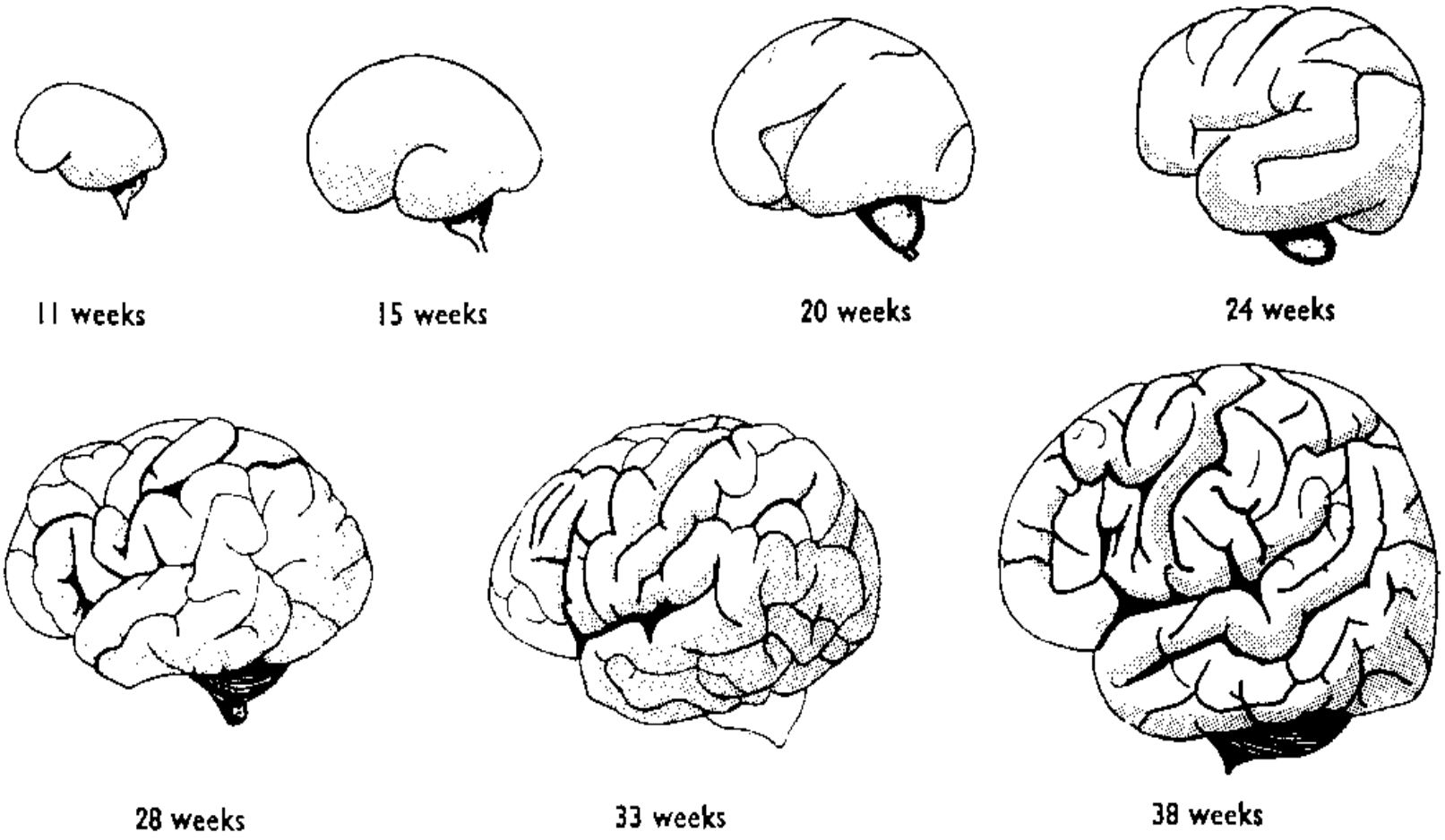




2 **Mognar i en våg.** Hjärnan mognar bakifrån och framåt (blått), när onödiga kopplingar mellan nervcellerna försvinner och signaleringen blir mer effektiv. Allra sist mognar pannloberna.

Unga

Convolutions of the cortex



Robinson RJ & Tizard JPM Br Med Bull 1966 22:49-55

Kangaroo Mother Care and Brain Development

"Cells which

FIRE TOGETHER,

WIRE TOGETHER,

and those which

don't, won't."

Carla Shatz

fetal REM sleep

(or active sleep) seems to be particularly important to the developing organism

… spontaneous synchronous firing

Marks et al 1995

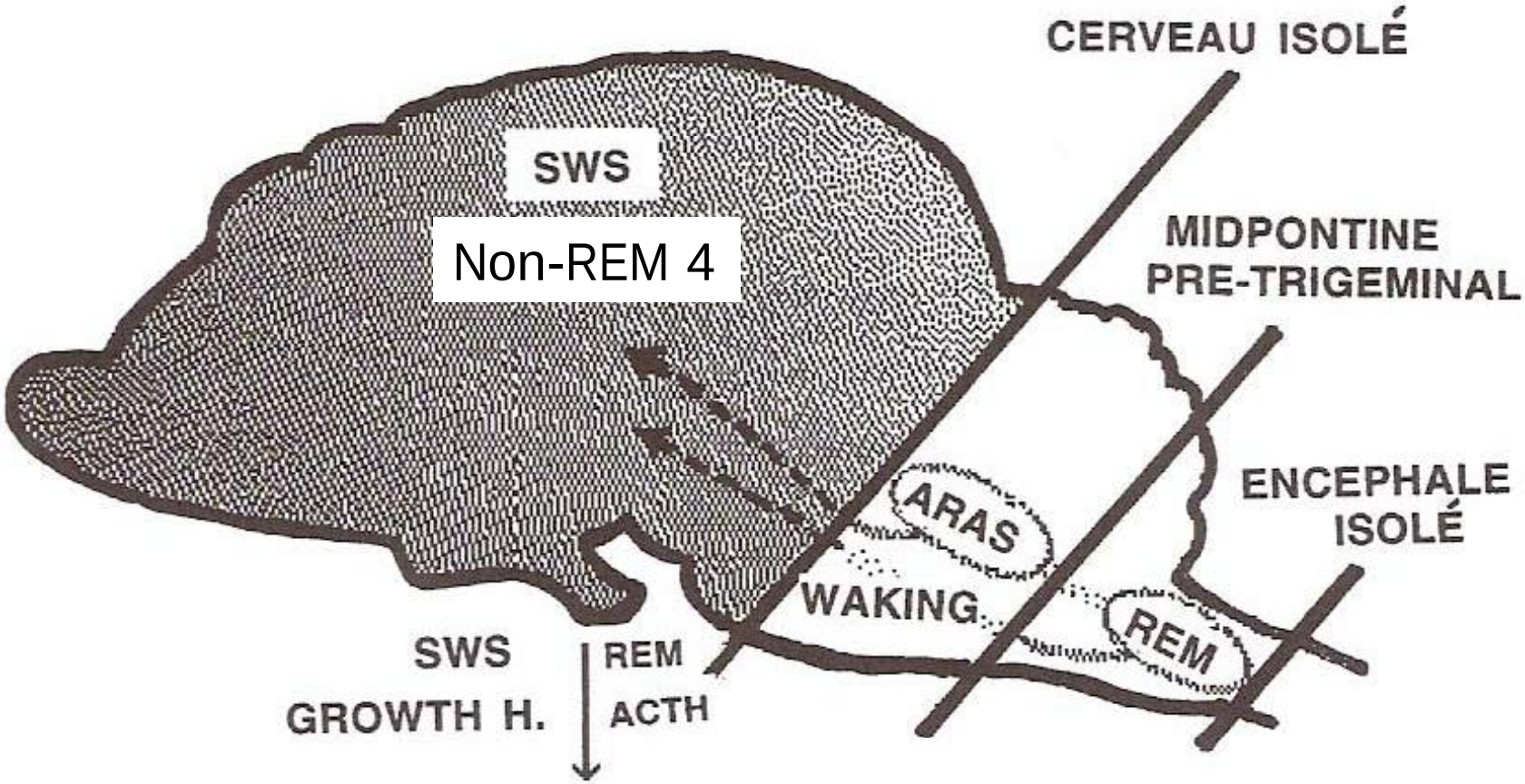


Figure 7.2. Overview of the types of brain transections that led to the general locations of major waking, SWS, and REM systems within the neuro- axis. For instance, with the midpontine pretrigeminal cut, waking and SWS were left in the forebrain, while the potential for REM was only manifested in neural and bodily systems below the cut. When the cut was slightly further rostral, through the midbrain (i.e., the *cereveau isolé* cut), the forebrain remained perpetu-ally in the darkness of SWS, while tissue below the cut cycled between waking type arousal and activated sleep states. Also, note that growth hormone secretion from the pituitary occurs in conjunction to SWS episodes, while ACTH secretion is entrained to REM periods.

Panksepp 1998
Siegel 2005

BRAIN WIRING

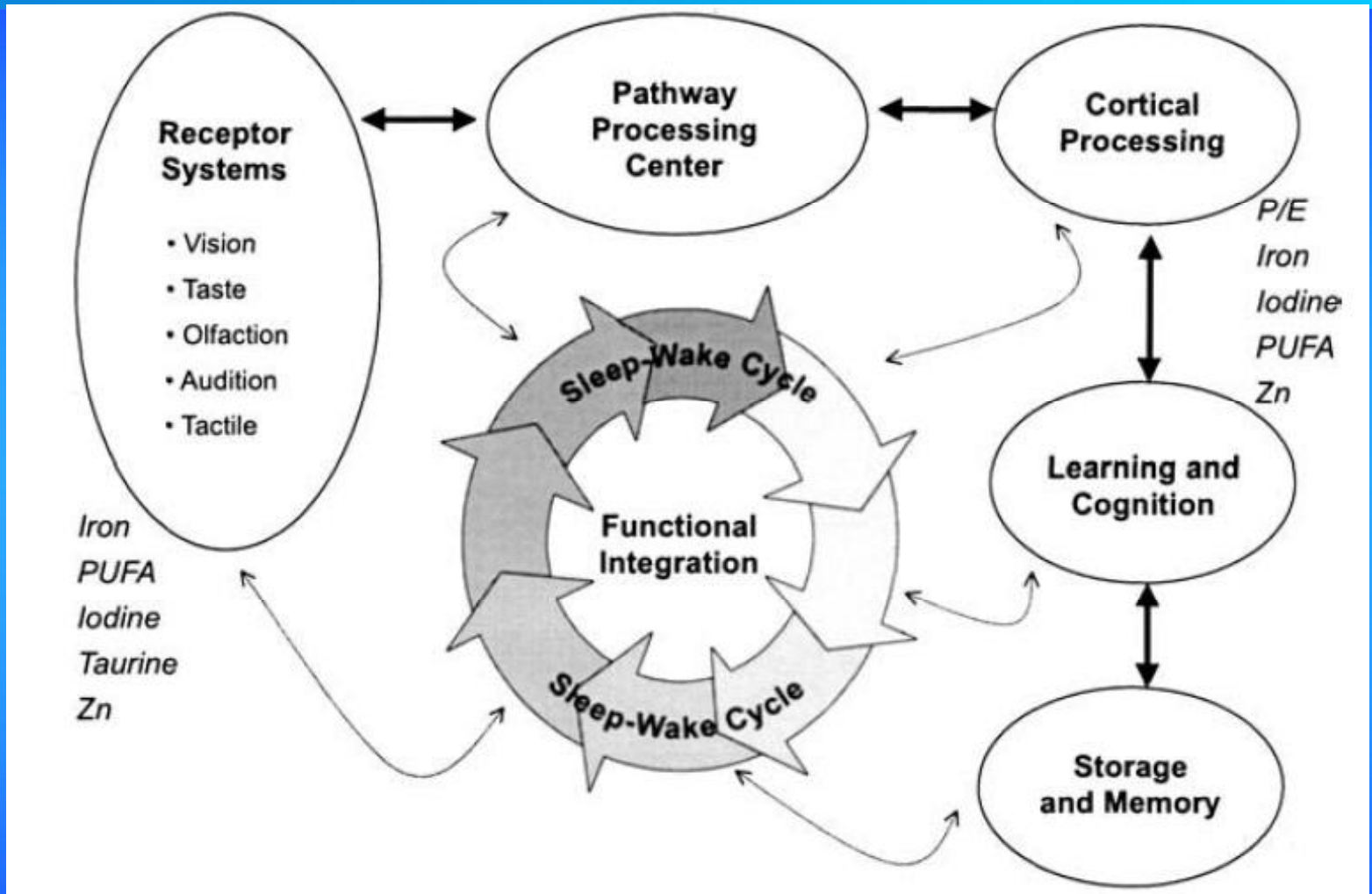
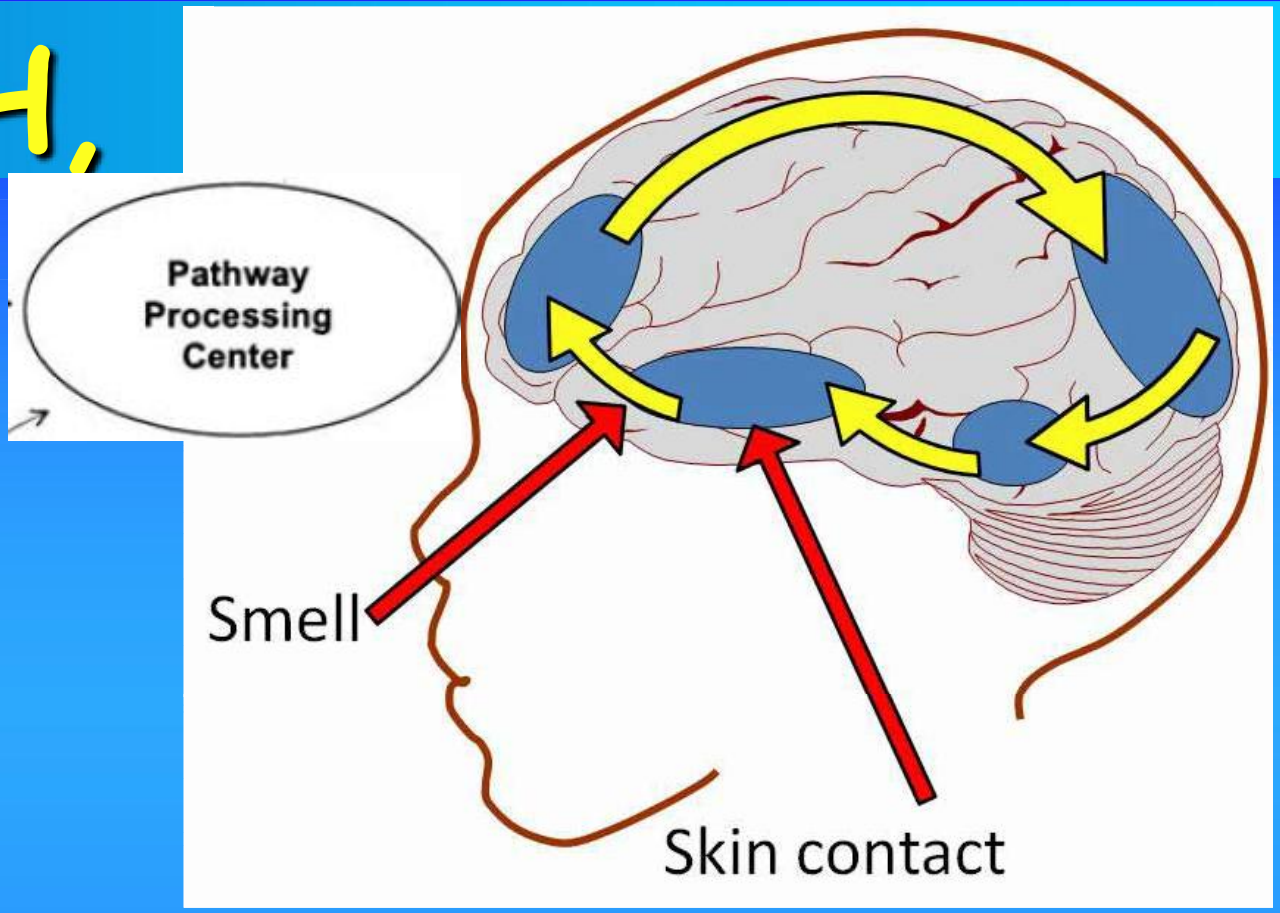


Fig 4. Schematic representation of the interaction between sensory receptors and CNS functions within the framework of the sleep-wake cycle. Nutrients with proven effects on sensory receptors and/or cortical processing are included (*PUFA*, polyunsaturated fatty acids; *Zn*, zinc; *P/E*, protein/energy).

Peirano 2003

AT BIRTH,

the brain has TWO CRITICAL SENSORY NEEDS:



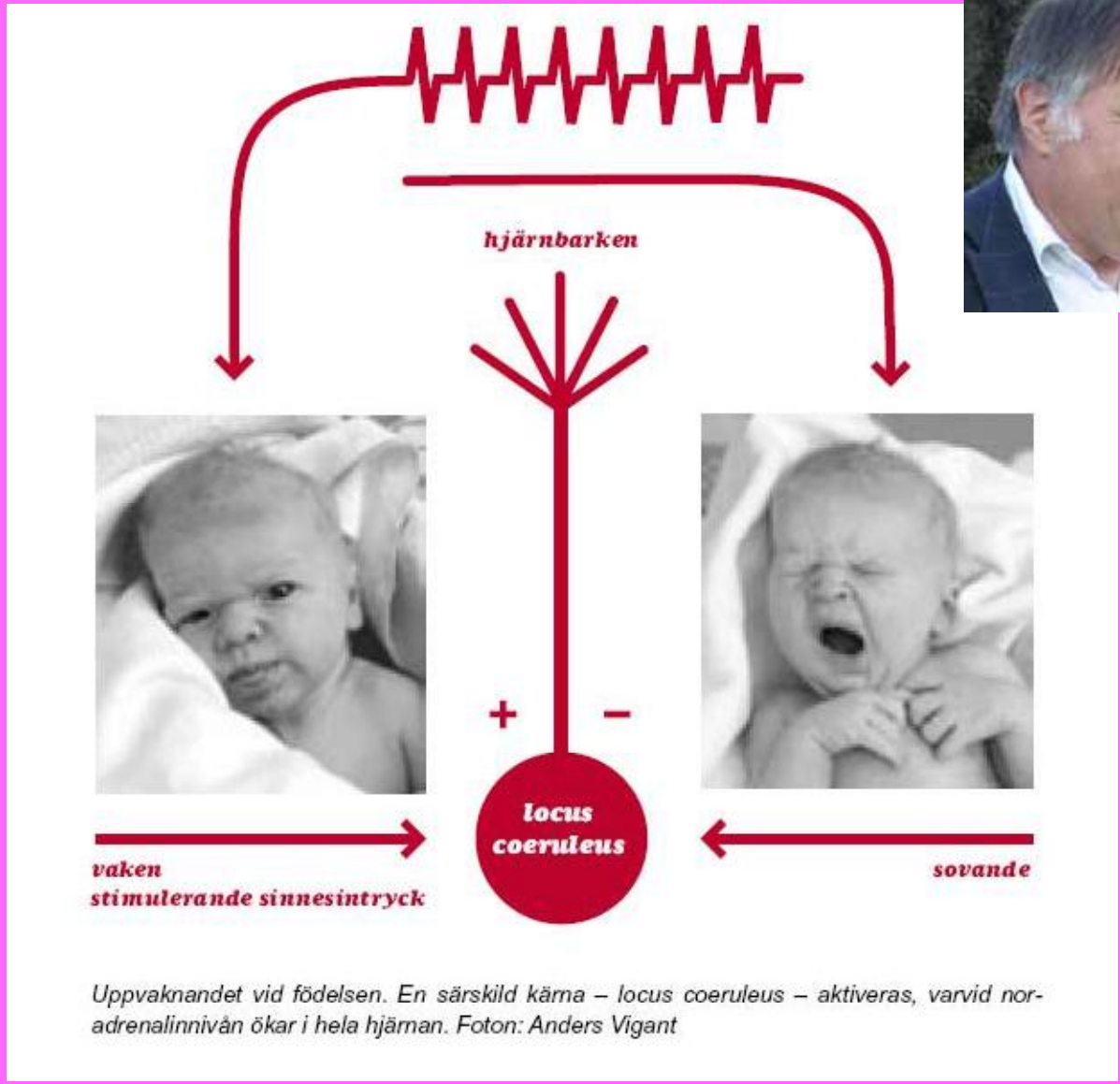
SMELL & CONTACT

connect direct to the amygdala

When does the infant become conscious?

Awake at birth

Noradrener-
gic neurons
from locus
coeruleus may
activate the
whole brain
during
wakefulness



Uppvaknandet vid födelsen. En särskild kärna – locus coeruleus – aktiveras, varvid noradrenalinnivån ökar i hela hjärnan. Foton: Anders Vigant

The "Stress" of Being Born

The stress of journeying through the birth canal is not harmful to most infants. In fact, the surge of "stress" hormones it triggers can be important to the neonate's survival outside the womb

by Hugo Lagercrantz and Theodore A. Slotkin

At first thought, being born would seem to be a terrible and dangerous ordea.. The human fetus is squeezed through the birth canal for several hours, during which the head sustains considerable pressure and the infant is intermittently deprived of

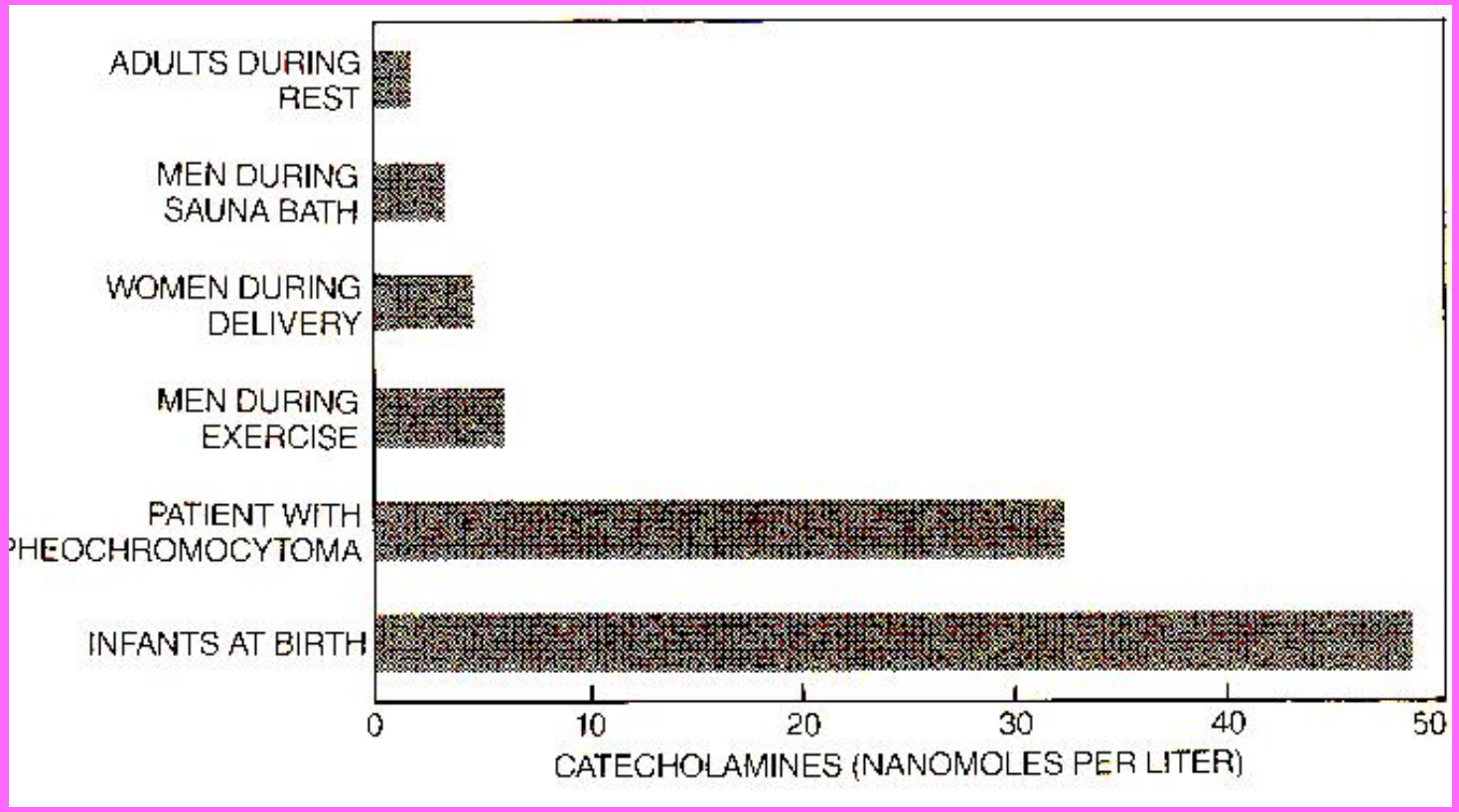
of blood goes to the heart and brain and may even promote attachment between mother and child.

The first major clue that catecholamines are important to fetal survival came from pioneering studies

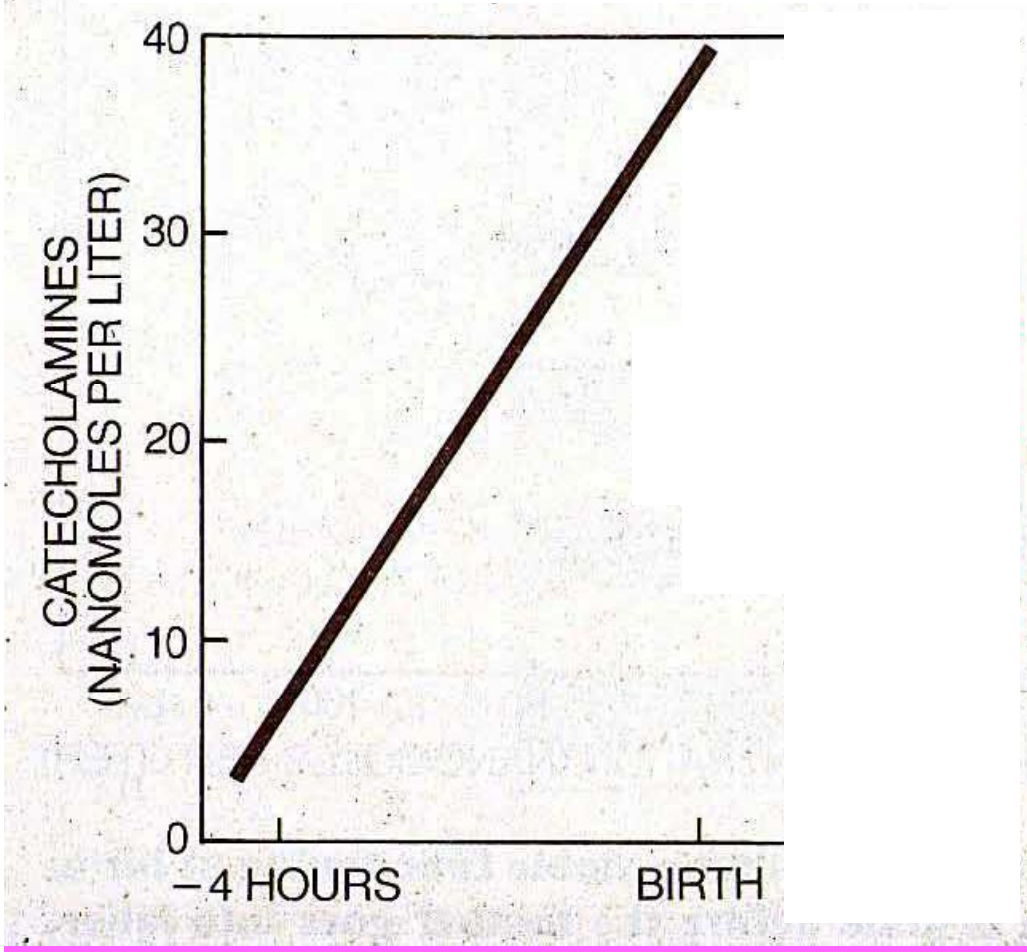
ing the threat (skin, intestines, kidneys) and toward ones that are essential (heart, brain, skeletal muscle). The stress hormones also dilate the bronchioles to aid respiration, cause fat and glycogen to be broken down into readily usable fuels, dilate the pupils and

Scientific American 1986
Scientific American Mind 2009

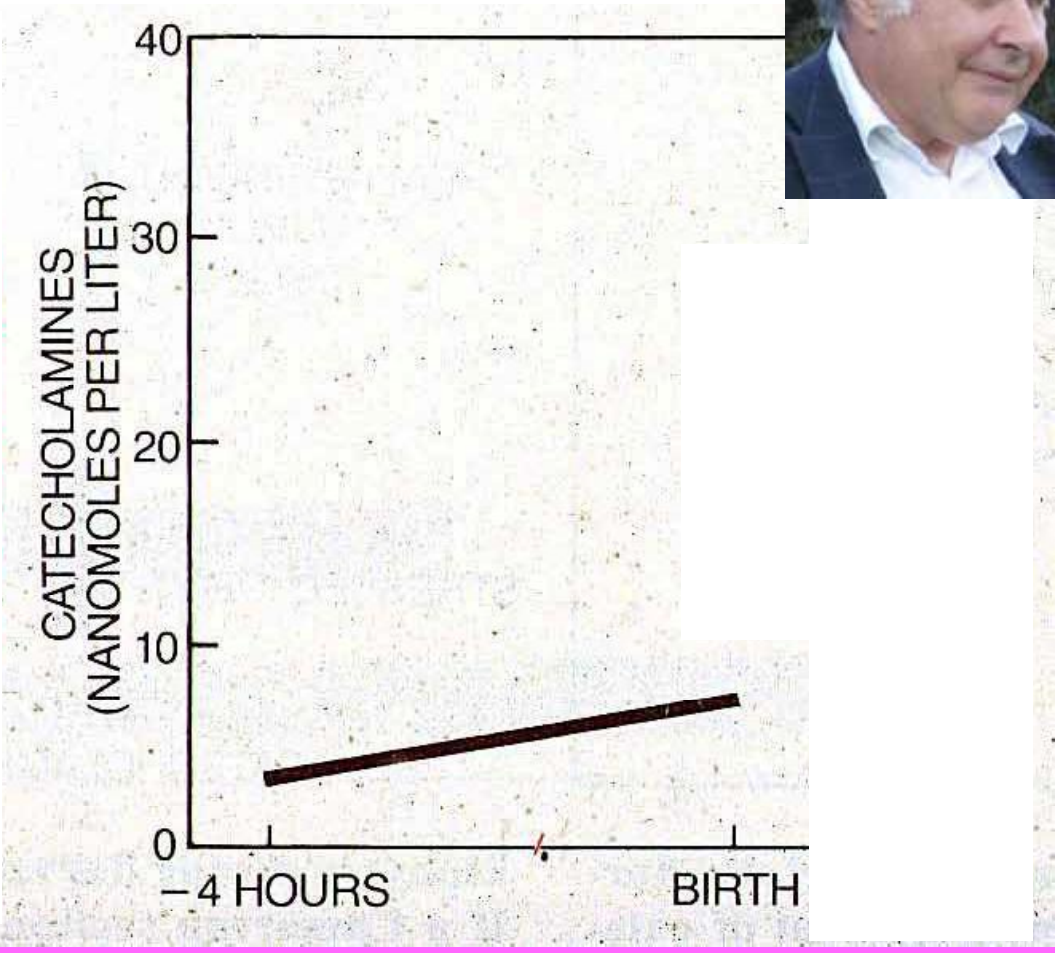
You can never reach the same high levels of catecholamine levels during the whole life as at birth



Reduced catecholamine surge after C-section



Vaginal delivery



Elective C-section

The Brain's (Dark Energy)

Brain regions active when our minds wander may hold a key to understanding neurological disorders and even consciousness itself

By Marcus E. Raichle

The newborn brain consumes 50 % of all the blood glucose

In the adult 20 %

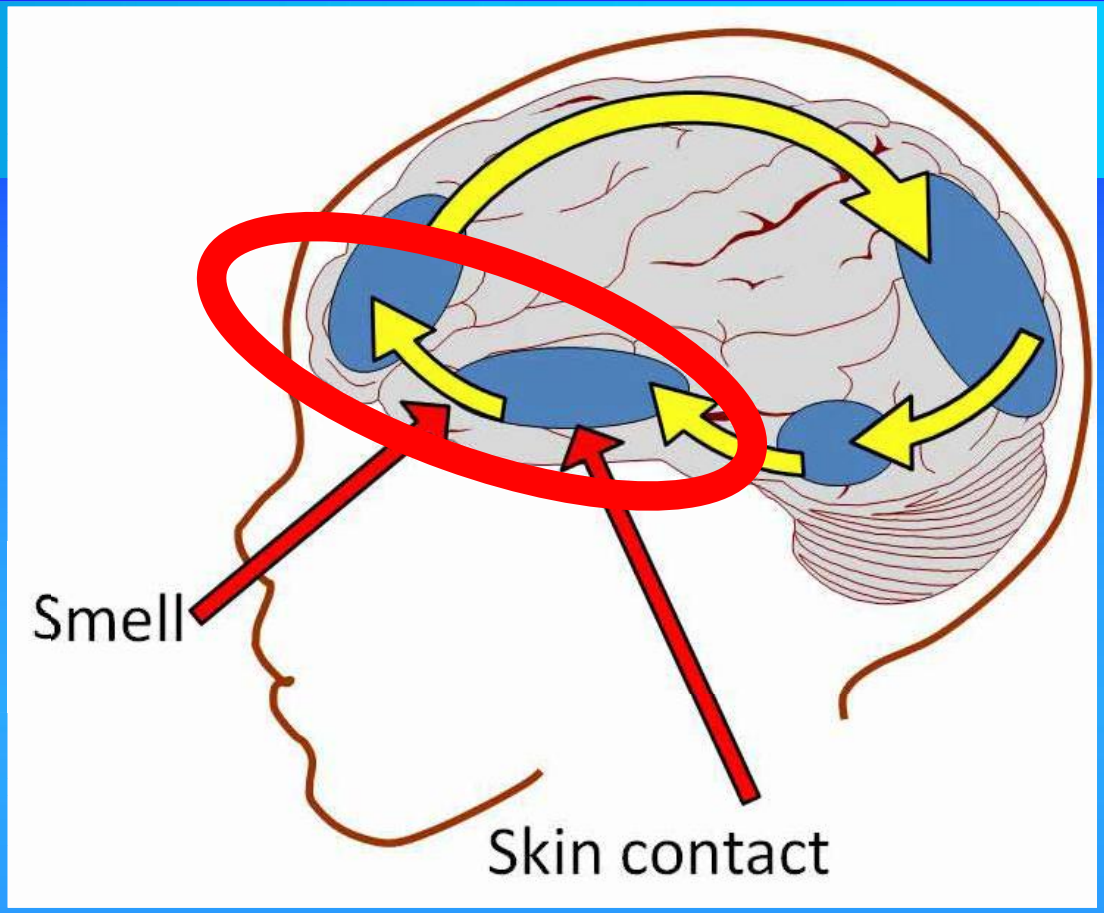
Only a small part is used for real thinking

Most of it goes to daydreaming or resting activity

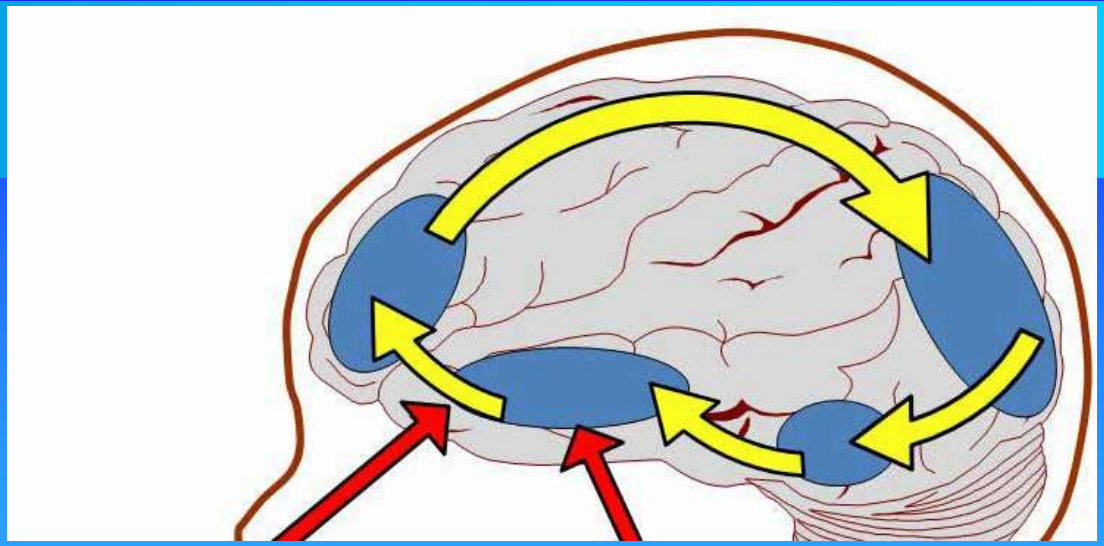
Scientific American 2010

THE NEWBORN BRAIN

SKIN-TO-SKIN CONTACT fires and wires



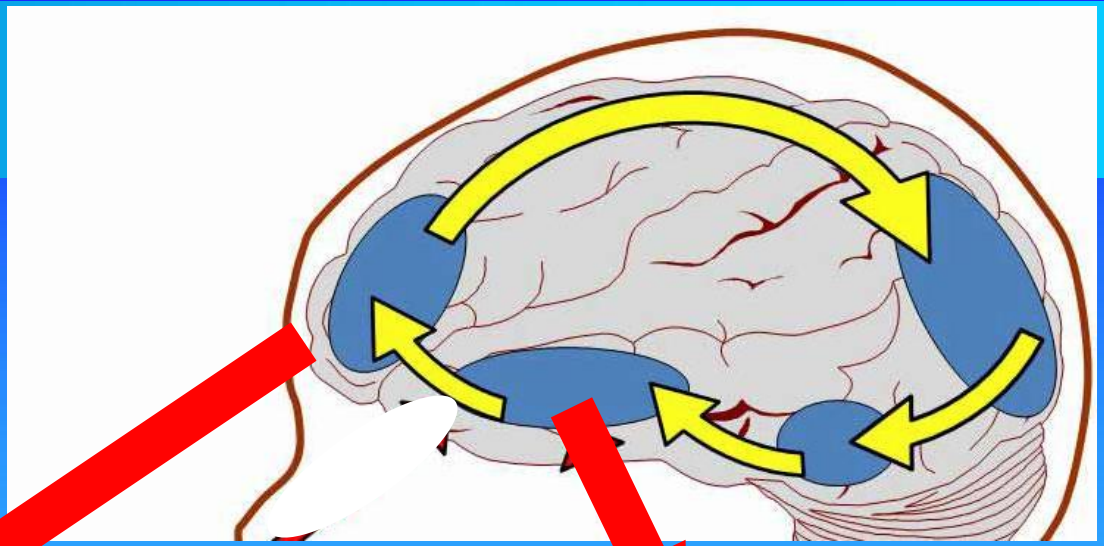
the amygdala-prefronto-orbital cortical pathway **(PFOC)**



Prefrontal cortex
Executive function

approach / avoid

AMYGDALA:
Emotional Processing Unit



Prefrontal cortex
Executive function

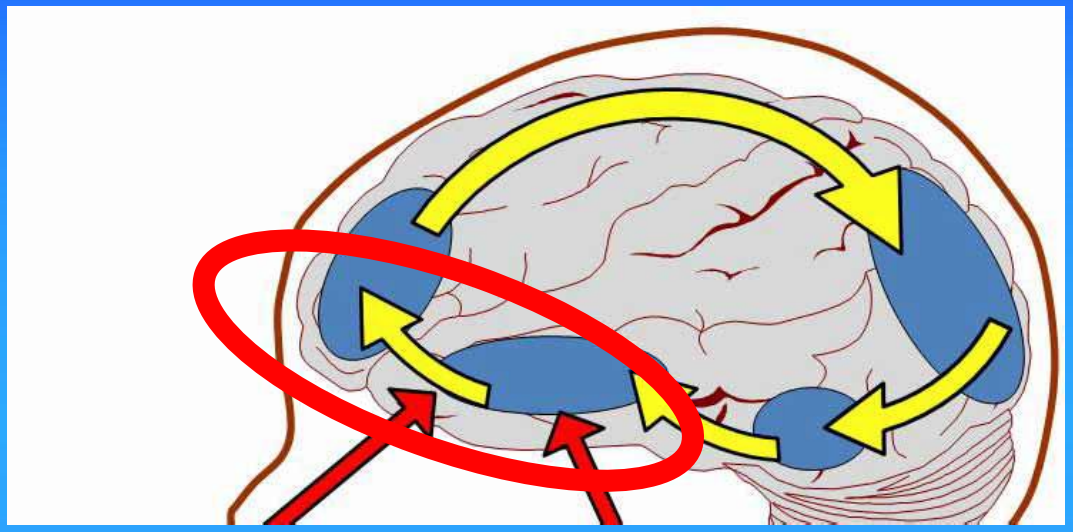
AMYGDALA:
Emotional Processing Unit

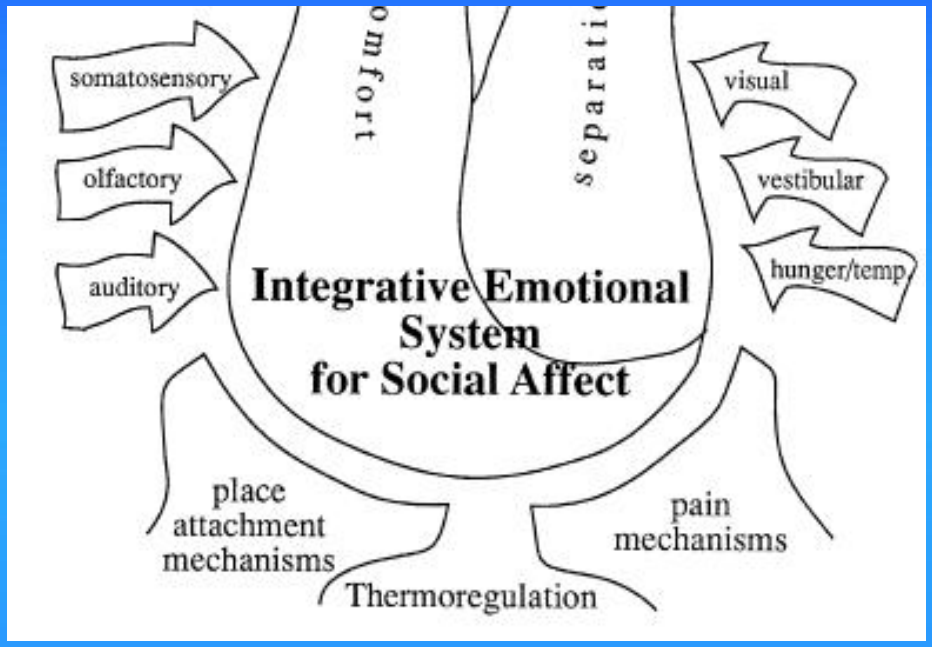
CPU

SOCIAL and EMOTIONAL INTELLIGENCE

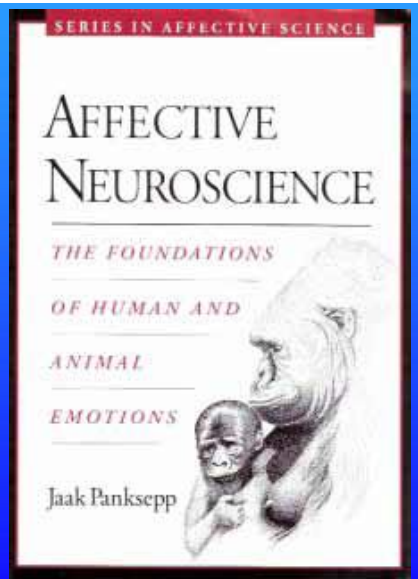
SOCIAL INTELLIGENCE

EMOTIONAL INTELLIGENCE





Behavioural activation system reward-based (dopamine)



Early Experience Alters Brain Function and Structure

Heidelise Als, PhD*; Frank H. Duffy, MD‡; Gloria B. McAnulty, PhD*; Michael J. Rivkin, MD*‡§;

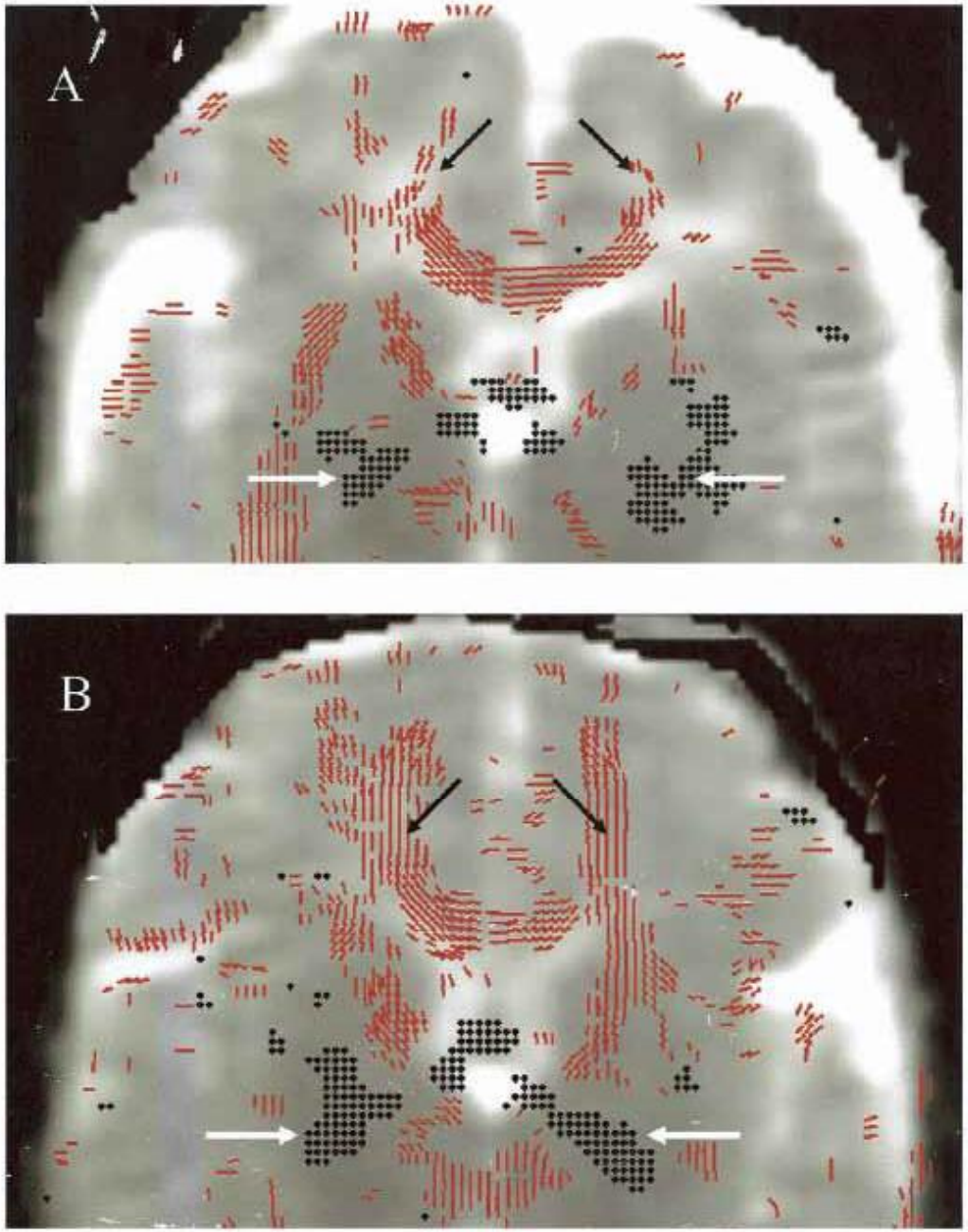
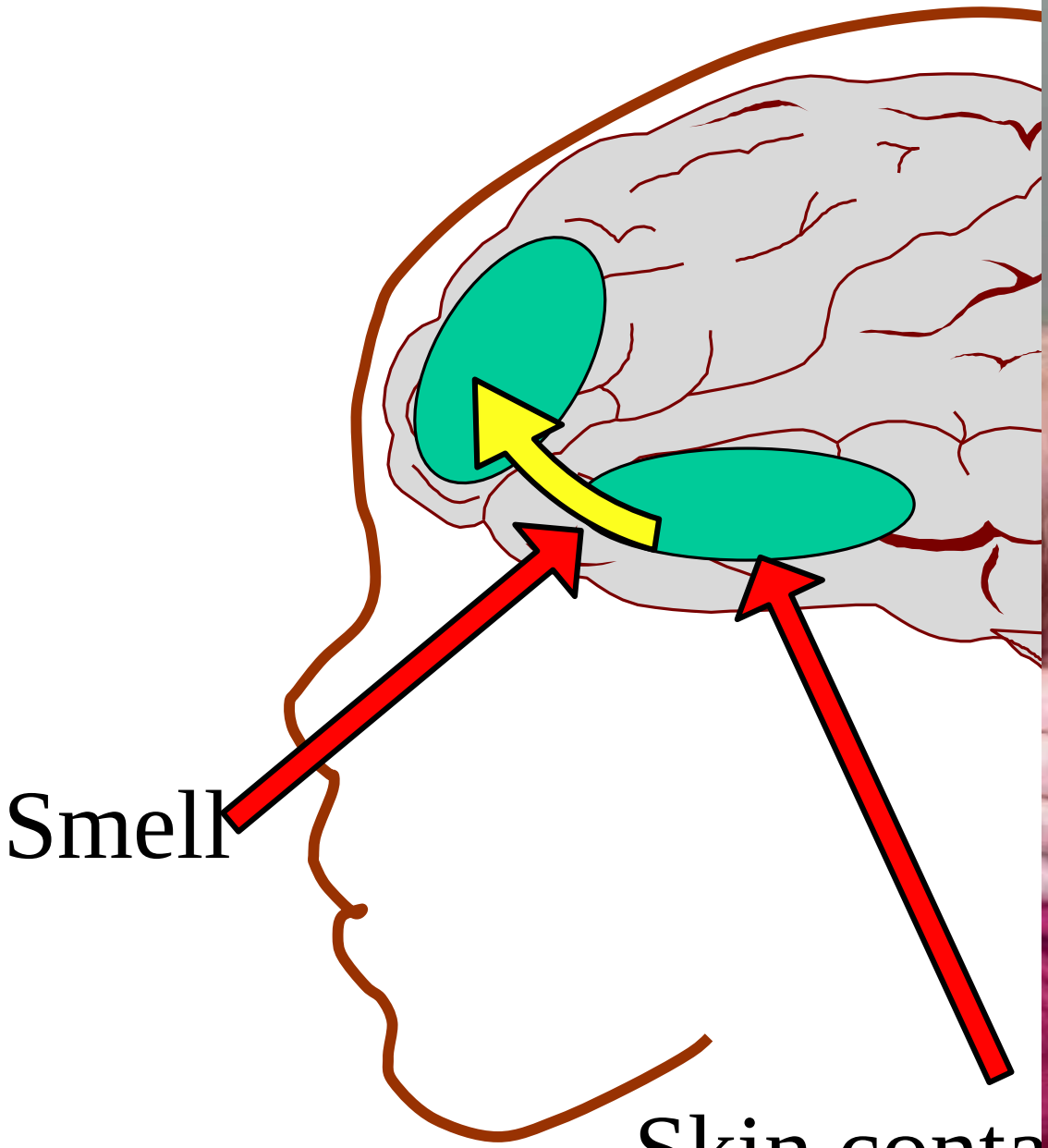
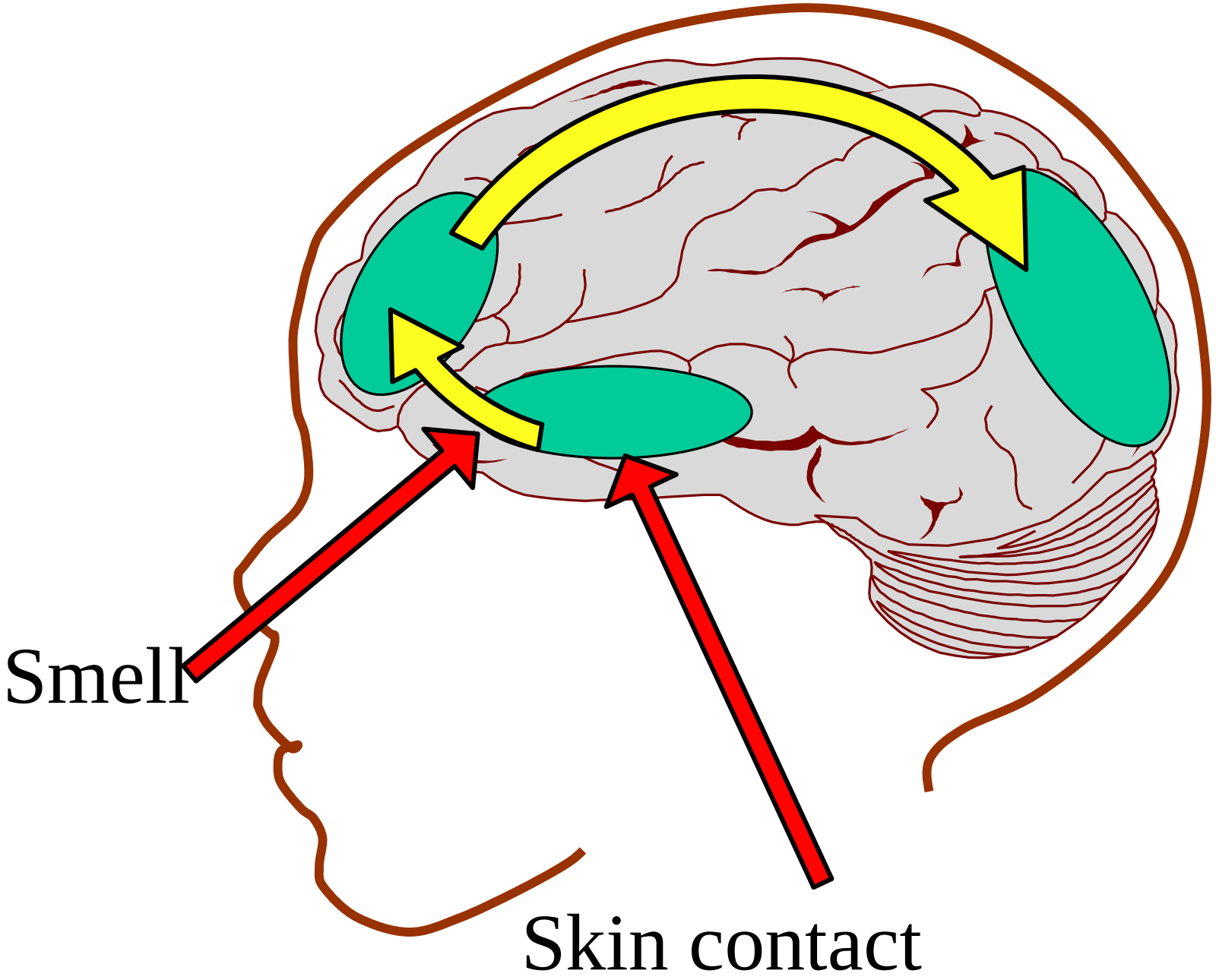


Fig 3. MRI DTI: comparison of control and experimental group infants at 2 weeks' corrected age. Shown are examples of diffusion tensor maps from identical axial slices through the frontal lobes of a representative control group (A) and an experimental group (B) infant obtained at 2 weeks' corrected age. In each example, the principal eigenvectors (shown in red and black) overlie the apparent diffusion coefficient (ADC) map to show anisotropy in white matter. The red lines denote eigenvectors located within the plane of the image, and the black dots indicate eigenvectors oriented mostly perpendicular to the image plane. The ratio of E1/E3 has been used as a threshold to show only eigenvectors at those voxels where E1/E3 exceeds a threshold value of 1.3 in both images. Note the greater anisotropy of white matter found in the experimental infant (B) as compared with the control infant (A) at the posterior limbs of the internal capsule (white arrows) and the frontal white matter adjacent to the corpus callosum (black arrows). The greater anisotropy found in the experimental infant (B) suggests more advanced white matter development in these regions as compared with white matter found in the control infant (A).


Smell
Skin conta


Smell
Skin contact

Kerstin
Uvnas-Moberg

Ross 2009

Interpersonal awareness Emotions

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.

Cerebral Cortex May 2009;19:1124-1133
doi:10.1093/cercor/bhn153
Advance Access publication September 11, 2008

Neural Basis of Maternal Communication and Emotional Expression Processing during Infant Preverbal Stage

infant self. Sixteen mothers underwent functional magnetic resonance imaging while observing and imitating faces of their own child and those of someone else's child. We found that the mirror neuron system, the insula 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 emotions with each

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

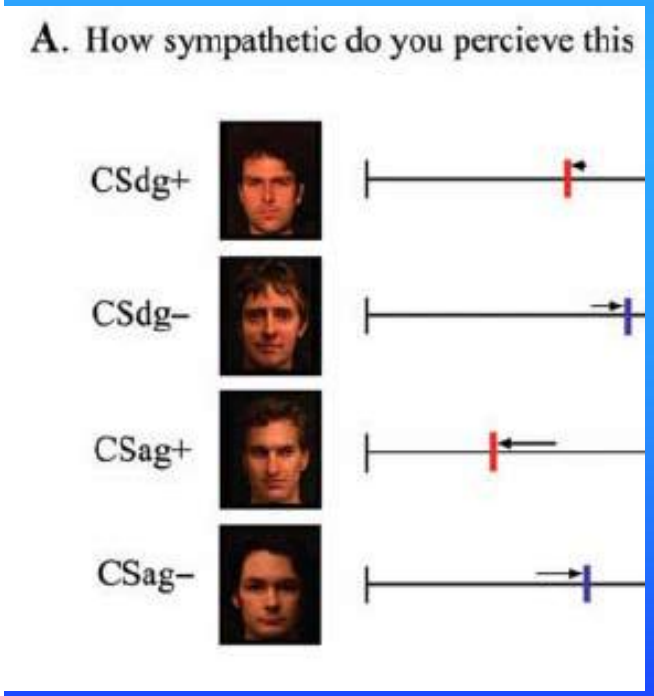
Therefore, our results are in keeping with the *simulation theory* (or motor theory of empathy), according to which empathy is generated by inner imitation of actions of others

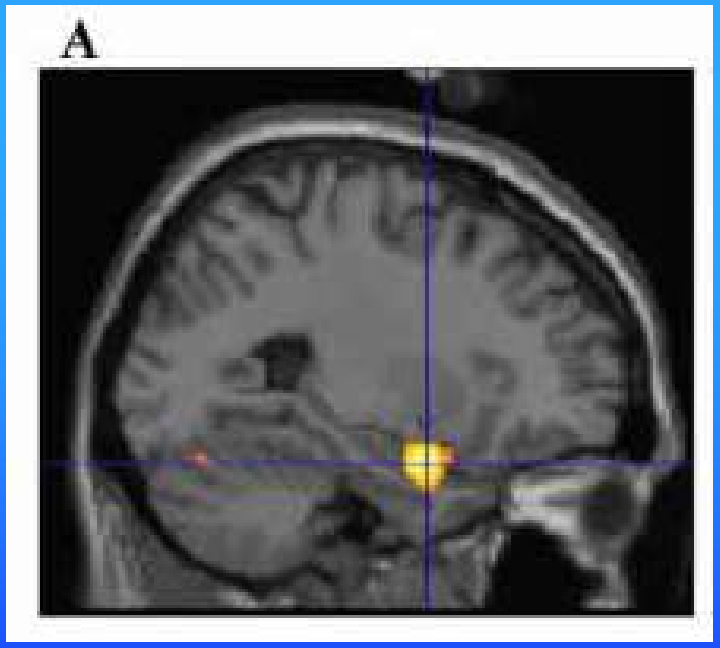
The newborn can imitate - Mirror neurons

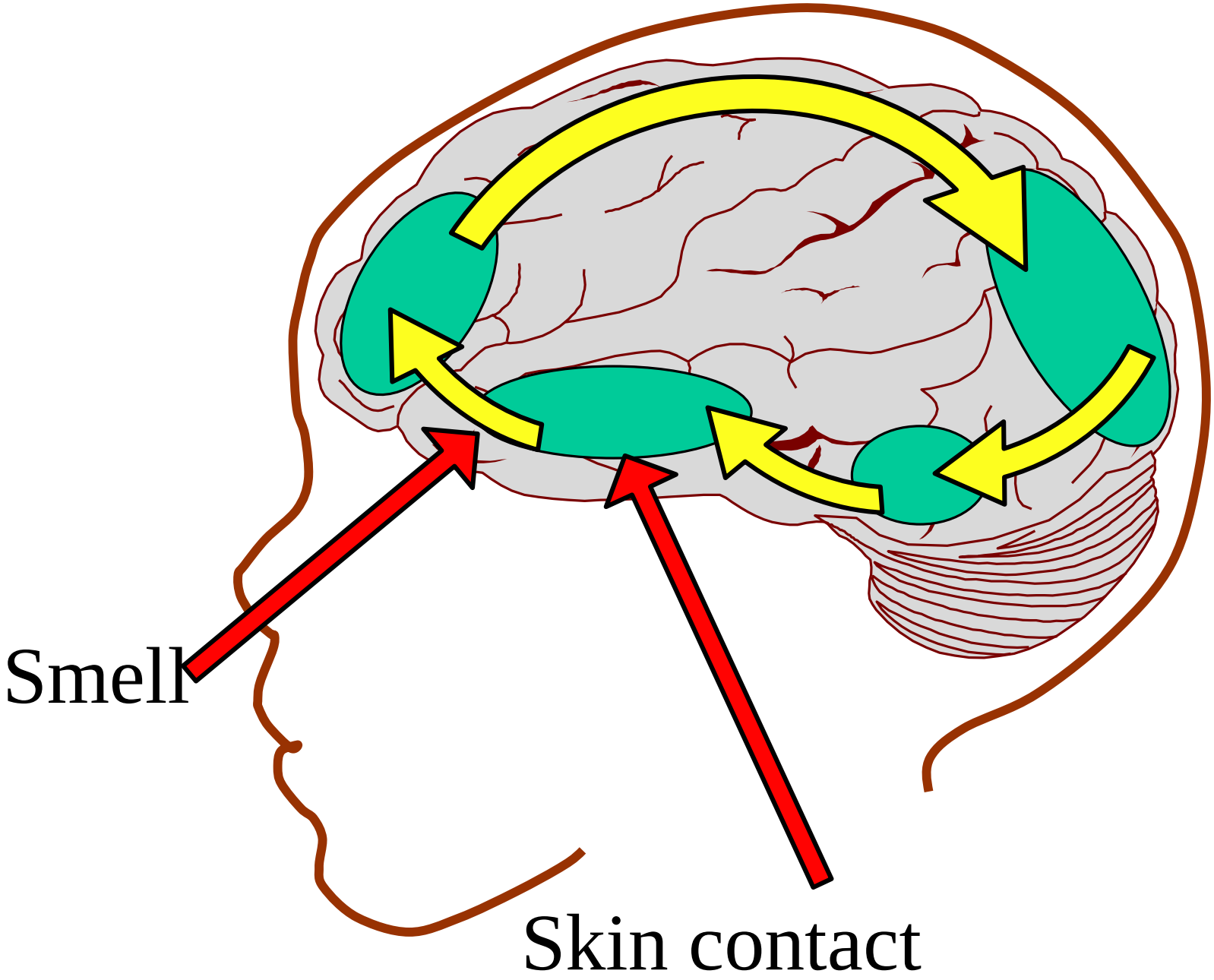
Learning affective values for faces is expressed in amygdala and fusiform gyrus

Predrag Petrovic, Raffael Kalisch, Mathias Pessiglione, Tania Singer, and Raymond J. Dolan
Wellcome Trust Centre for Neuroimaging, University College of London, 12 Queen Square, London, WC1N 3BG, UK

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



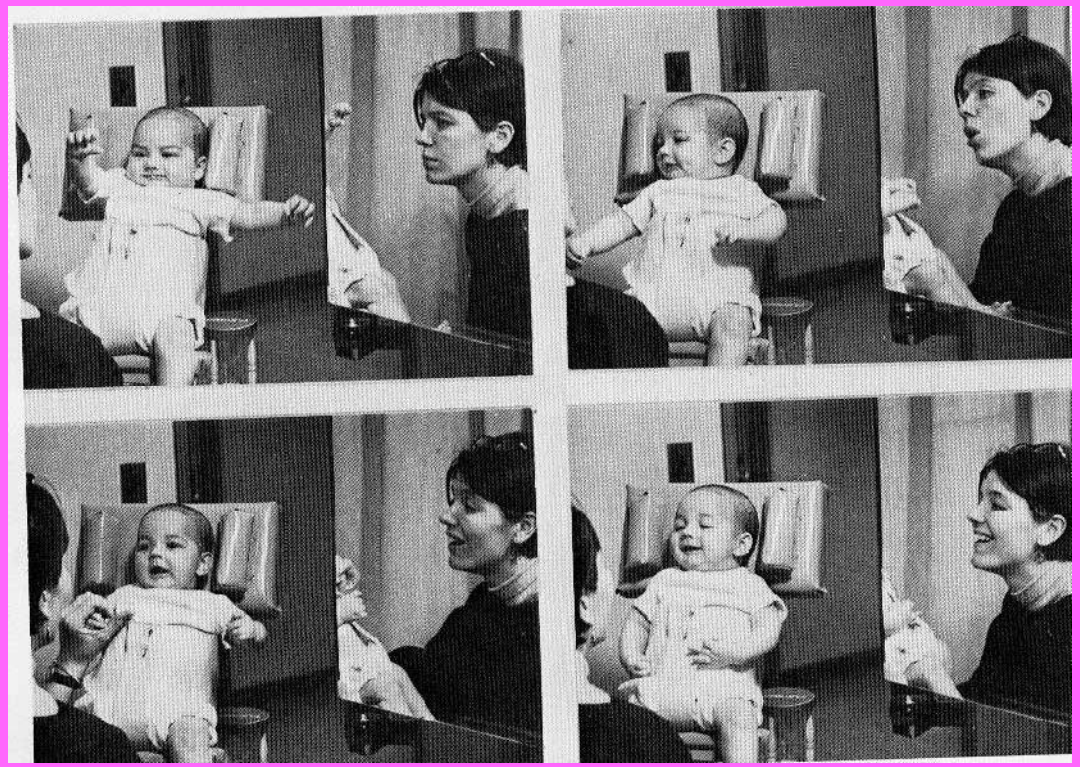



Smell
Skin contact

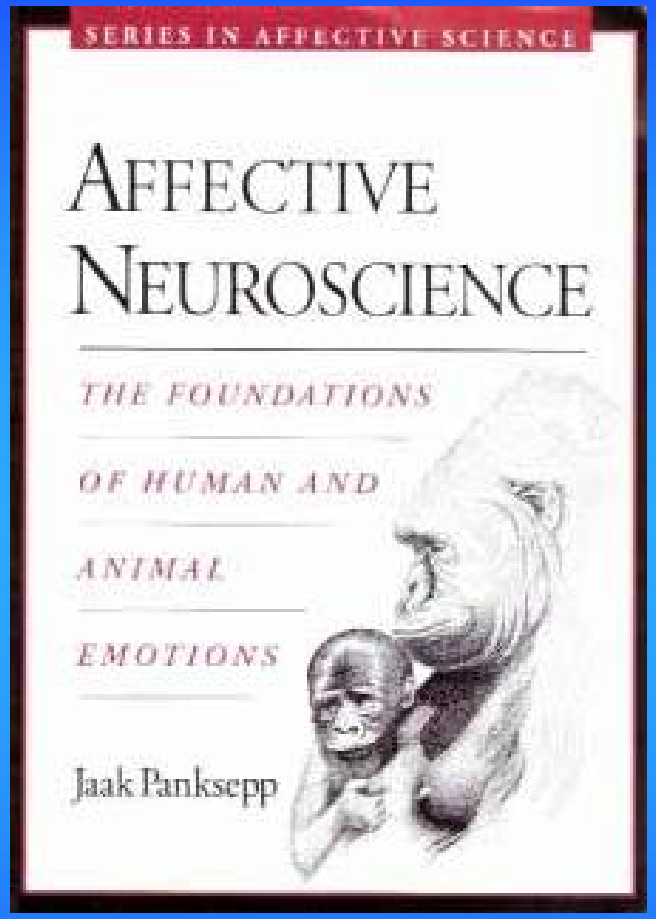
Social interaction

Tizian

From Trevarten



NELSON, E. E., PANKSEPP, J. *Brain substrates of infant–mother attachment: contributions of opioids, oxytocin, and norepinephrine.* NEUROSCI BIOBEHAV REV **22**(3) 437–452, 1998.—The aim of this paper is to review recent work concerning the psychobiological



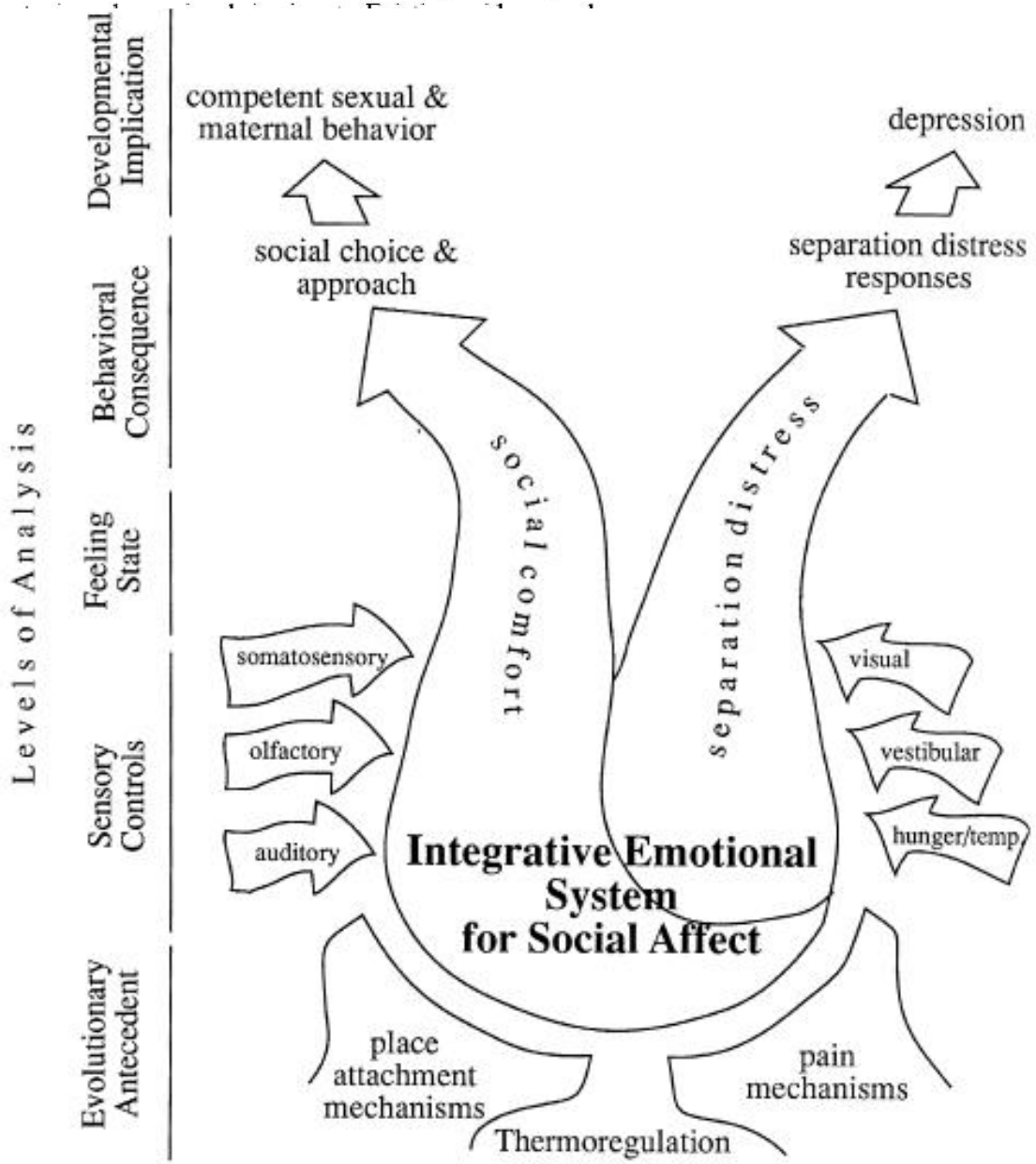
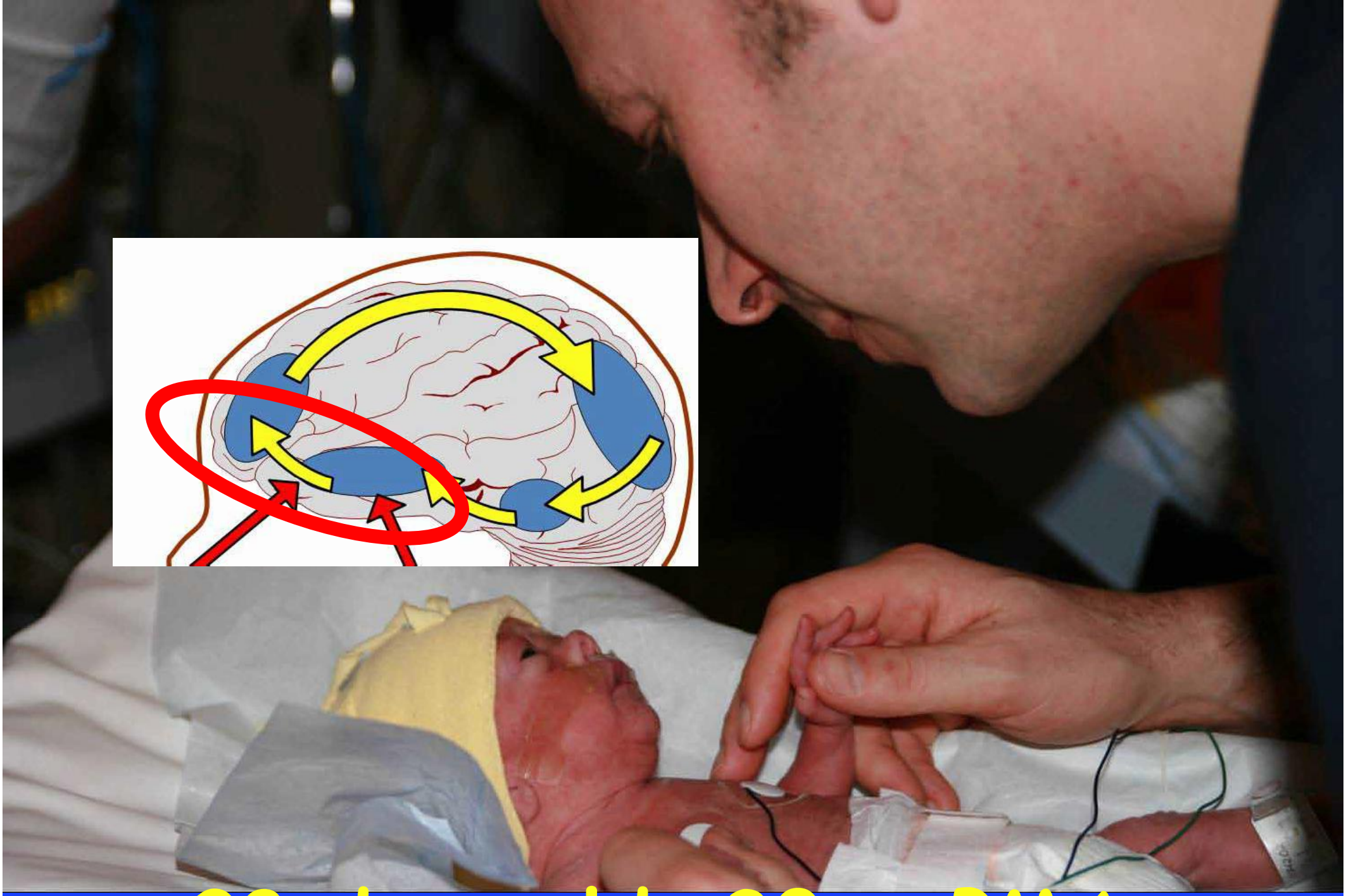


FIG. 1. Schematic depiction of the neurobiological foundations, inputs, and consequences of attachment and affiliative behavior in mammals. Figure reprinted with permission of the New York Academy of Sciences.

28 days old, 30 w PMA

Photo: Karolinska Institute, Stockholm

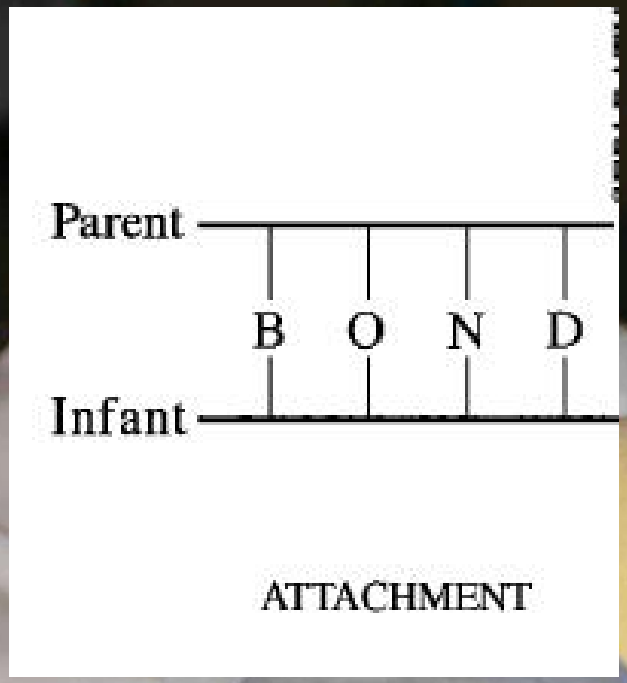


28 days old, 30 w PMA

Photo: Karolinska Institute, Stockholm

Psychobiological Roots of Early Attachment

Myron A. Hofer



28 days old, 30 w PMA

Psychobiological Roots of Early Attachment

Myron A. Hofer

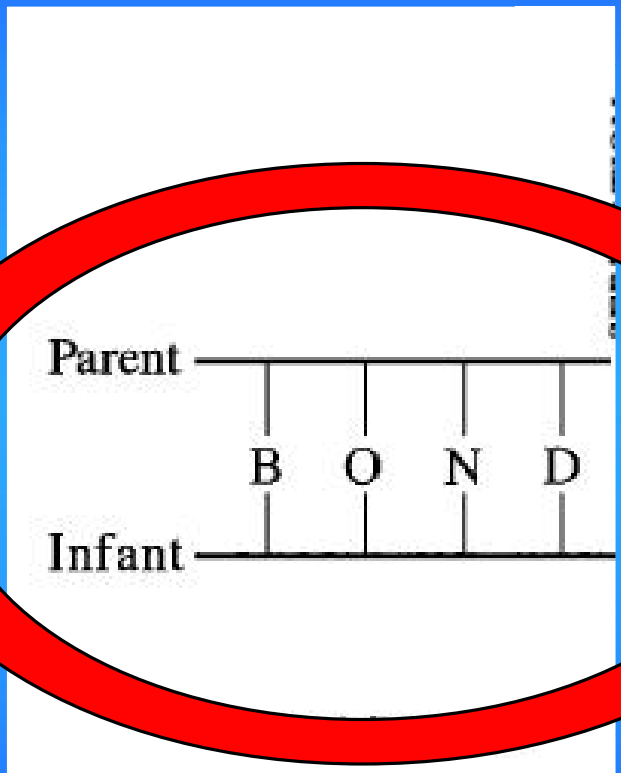


Fig. 1. Schematic repres
responses based on the c
John Bowlby (Bowlby, 19

REGULATION

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

Bowlby 1969, 1973, 1980

Through "hidden maternal regulators" ...

We concluded from these surprising results that warmth provided by the mother normally maintained the pup's activity level and that her milk maintained her pup's heart rate. Maternal

warmth → activity level
milk → heart rate

" physiological set points "

internal working models
scripts - templates

Through "hidden maternal regulators" ...

a mother precisely controls every element of her infant's physiology,

from its heart rate to its release of hormones

from its appetite to the intensity of its activity

(Gallagher 1992)

Psychobiological Roots of Early Attachment

Myron A. Hofer

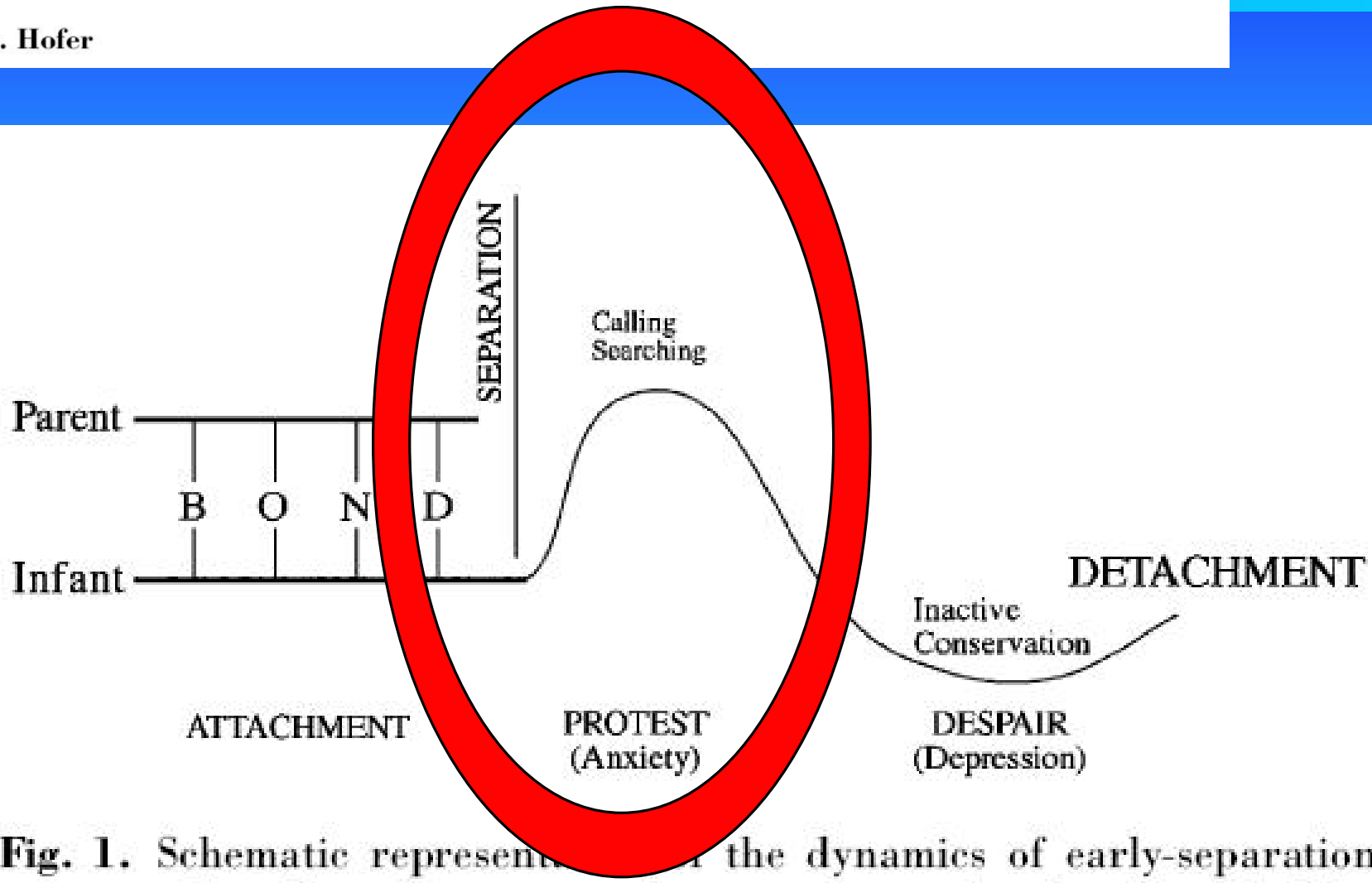


Fig. 1. Schematic represent[illegible] the dynamics of early-separation responses based on the concept of an attachment bond as described by John Bowlby (Bowlby, 1982).

WHY IS EARLY MATERNAL SEPARATION STRESSFUL?

SEPARATION DYSREGULATES

CORTISOL

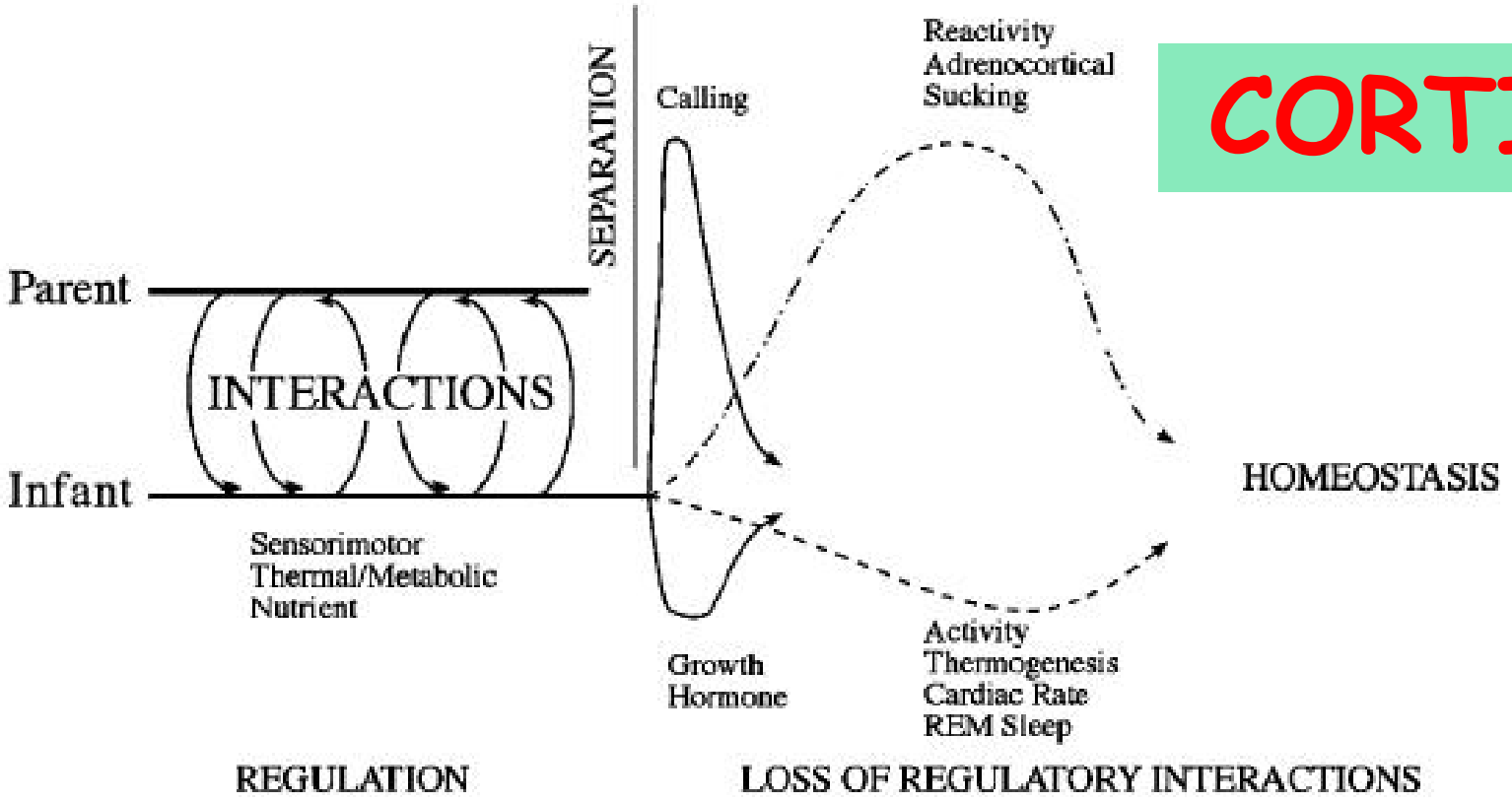
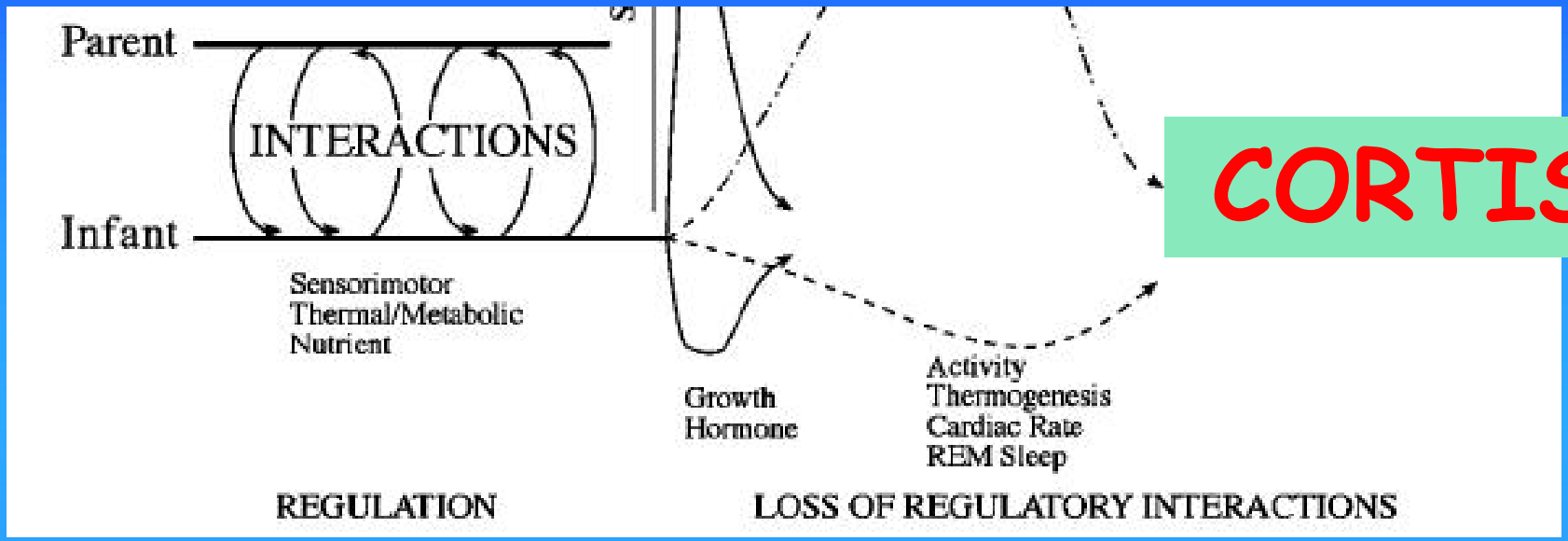


Fig. 2. Schematic representation of the dynamics of early-separation responses resulting from the loss of regulatory interactions within the mother–infant relationship.

WHY IS EARLY MATERNAL SEPARATION STRESSFUL?



CORTISOL

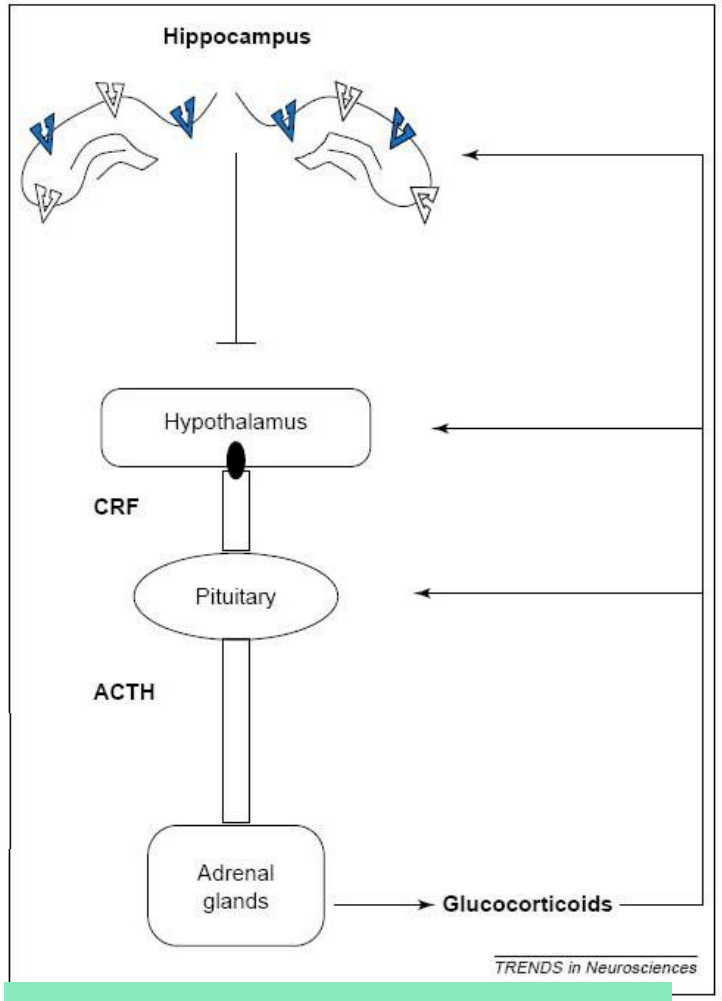
components (e.g., nutrient, thermal/metabolic, or sensorimotor) of the infant's previous interaction with its mother and that the complex response to separation was due to the withdrawal of all these components at once.

MICHAEL MEANEY

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

Michael J. Meaney[1] and Moshe Szyf[2]

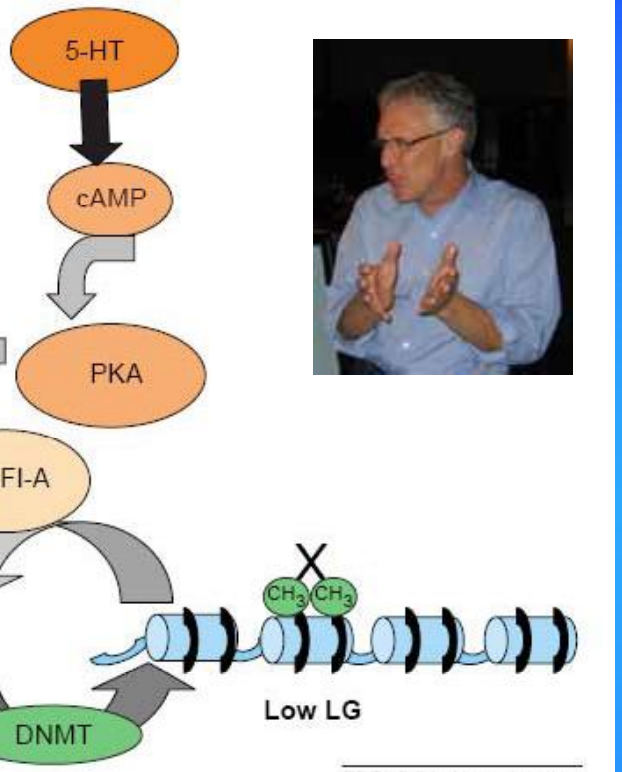
"In response to stress, CRF … and vasopressin are released … anterior pituitary … synthesis release ACTH …glucocorticoids → "



CORTISOL

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

MICHAEL MEANEY epigenetics



Tactile stimulation
(maternal LG)

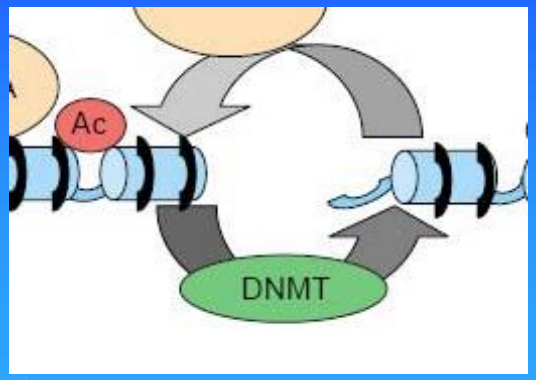
Early stress alters gene expression, with health impact across lifespan.

Tactile stimulation
(maternal LG)

MOTHER
LG Low Grooming

MOTHER
High Grooming HG

LG BABY



HG BABY

Unhealthy
adult

Makes MOTHER
LG Low Grooming

Makes MOTHER
High Grooming HG

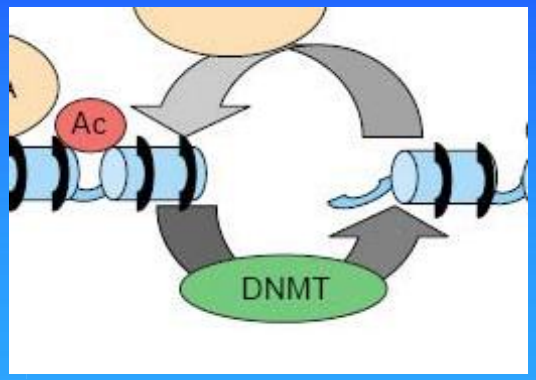
HEALTHY
adult

Tactile stimulation
(maternal LG)

MOTHER
LG Low Grooming

MOTHER
High Grooming HG

LG BABY



HG BABY

Unhealthy
adult

HEALTHY
adult

Makes MOTHER
LG Low Grooming

Makes MOTHER
High Grooming HG

LG BABY

LG BABY
High grooming care

HEALTHY
adult

Makes MOTHER
LG Low Grooming

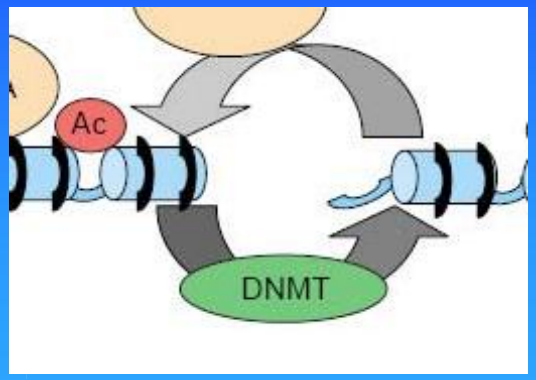
Makes MOTHER
High Grooming HG

Tactile stimulation
(maternal LG)

MOTHER
LG Low Grooming

MOTHER
High Grooming HG

LG BABY



HG BABY

Unhealthy
adult

Makes MOTHER
LG Low Grooming

Makes MOTHER
High Grooming HG

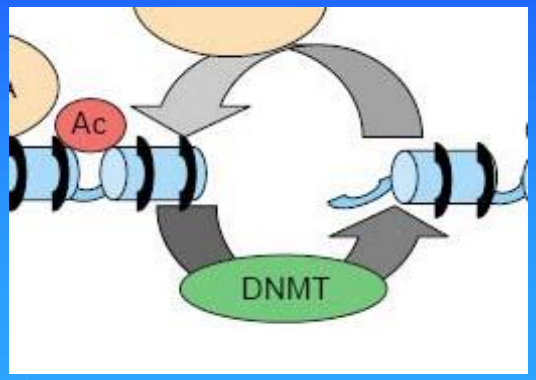
HEALTHY
adult

Tactile stimulation
(maternal LG)

MOTHER
LG Low Grooming

MOTHER
High Grooming HG

LG BABY



HG BABY

Unhealthy
adult

HEALTHY
adult

Makes MOTHER
LG Low Grooming

Makes MOTHER
High Grooming HG

HG BABY
LOW grooming care

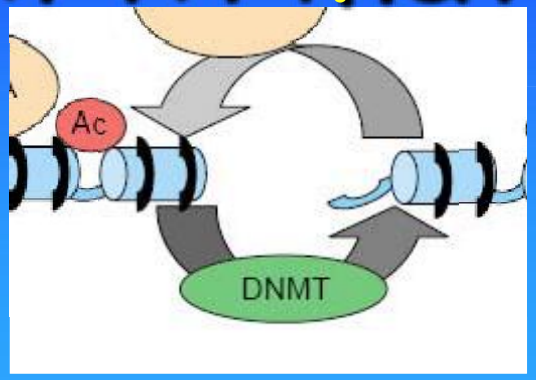
HG BABY

UN - HEALTHY
adult

Makes MOTHER
LG Low Grooming

Earliest care at birth matters

Same gene



→ switched

Makes MOTHER
LG Low Grooming

Makes MOTHER
High Grooming HG

HG BABY
LOW grooming care

HG BABY

CORTISOL

UN - HEALTHY
adult

Makes MOTHER
LG Low Grooming

Primate separation studies

Primate Early Life Stress Leads to Long-Term Mild Hippocampal Decreases in Corticosteroid Receptor Expression

Dimitrula Arabadzisz, Rochellys Diaz-Heijtz, Irene Knuesel, Elisabeth Weber, Sonia Pilloud, Andrea C. Dettling, Joram Feldon, Amanda J. Law, Paul J. Harrison, and Christopher R. Pryce

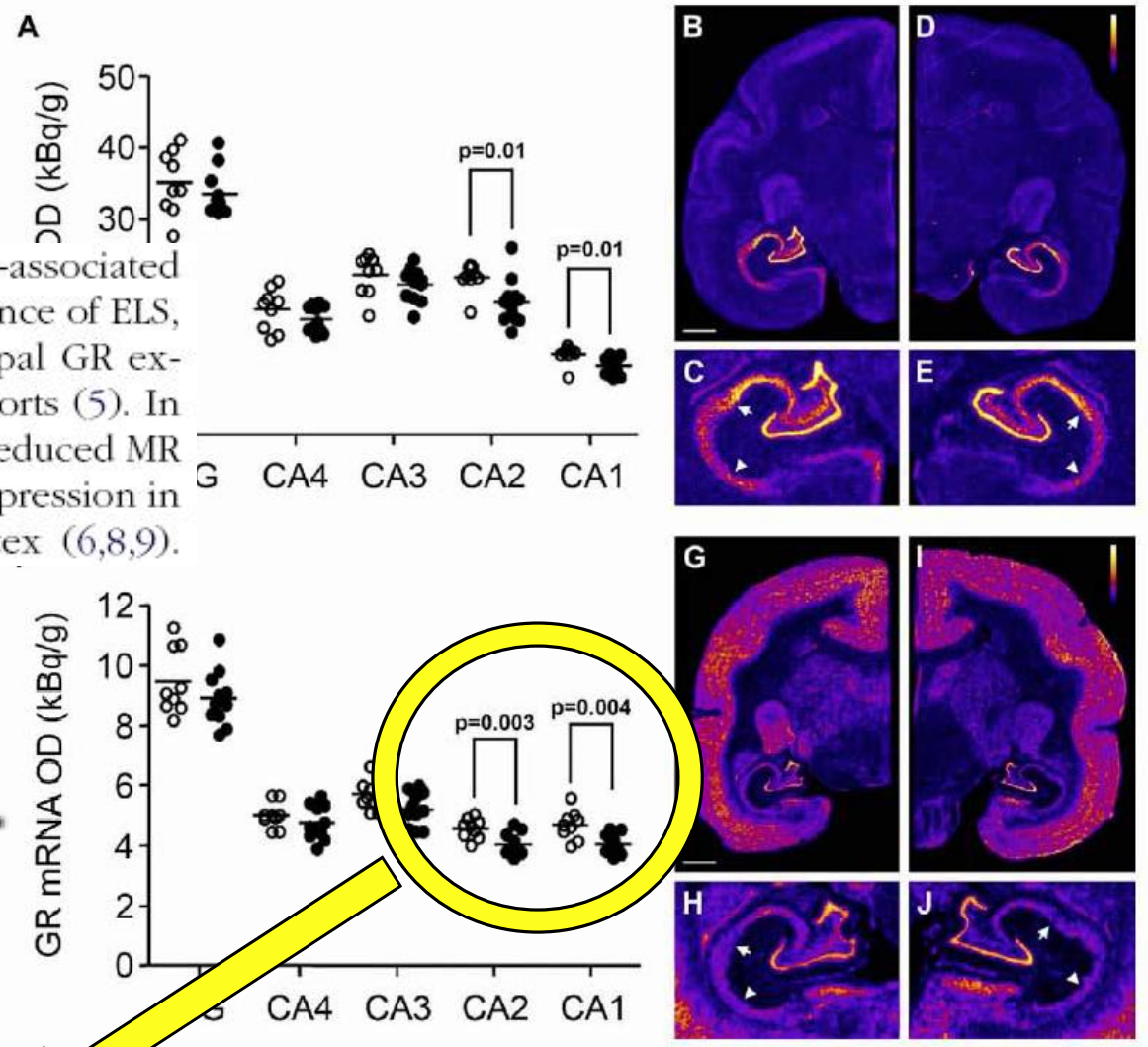
Depression is predicted by prior early life stress (ELS), such as parent–infant/child neglect or abuse (1,2), but mediating mechanisms and processes are not well-

Maternal Separation Paradigm

Early Deprivation (ED) vs control (CON)

	0d	2d	→	→28d	→	→	48w
ED n 11	Mat	30 -120 min daily			→		
CON n 4	Mat →	→	→	→	→	→	48w

adult human probands who committed depression-associated suicide were separated according to presence or absence of ELS, the ELS/suicide cohort exhibited reduced hippocampal GR expression relative to non-ELS/suicide and control cohorts (5). In depression with unknown early life history, there is reduced MR expression in hippocampus (6,7) and reduced GR expression in hippocampus, prefrontal cortex, and temporal cortex (6,8,9).



Repeated short separations:

LOW gene expression

CORTISOL

Correlate to human adult depression

Maternal support in early childhood predicts larger hippocampal volumes at school age

Joan L. Luby[a,1], Deanna M. Barch[a,b,c], Andy Belden[a], Michael S. Gaffrey[a], Rebecca Tillman[a], Casey Babb[a], Tomoyuki Nishino[a], Hideo Suzuki[a], and Kelly N. Botteron[a,c]

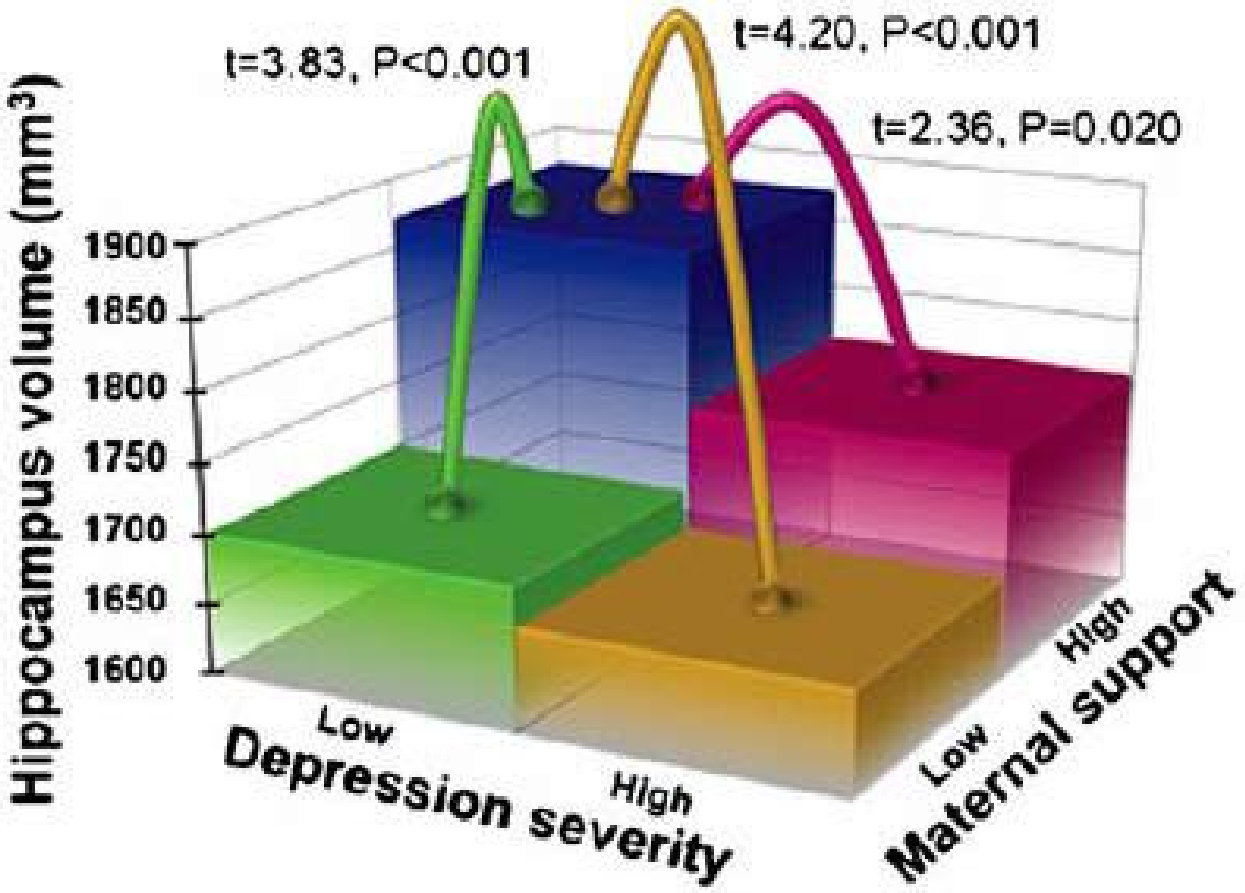
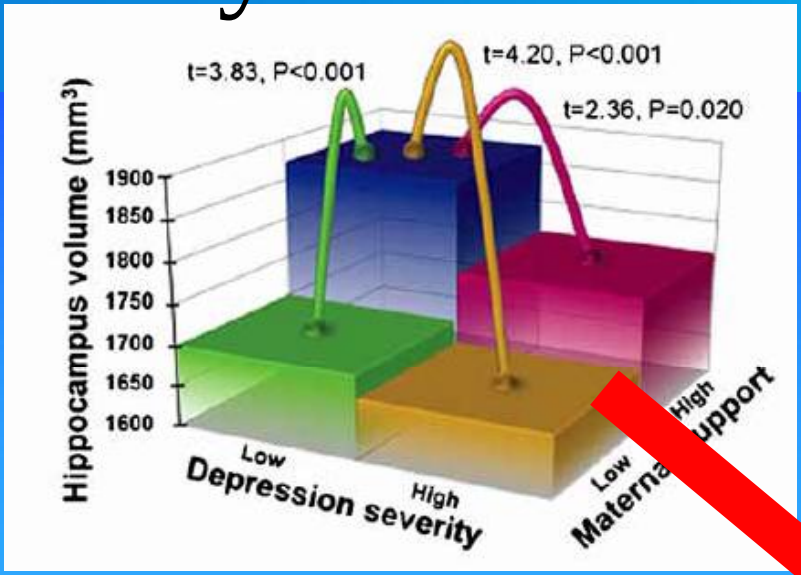
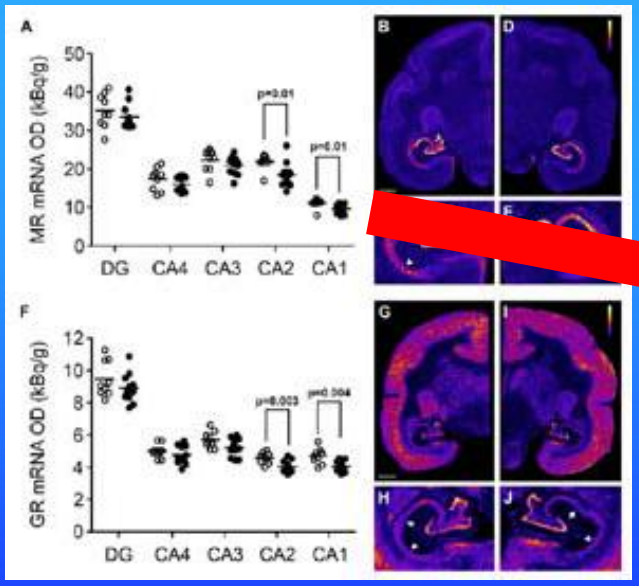


Fig. 2. Hippocampus volume by preschool depression severity and maternal support.

Luby





Arabadzisz

438

CORTISOL

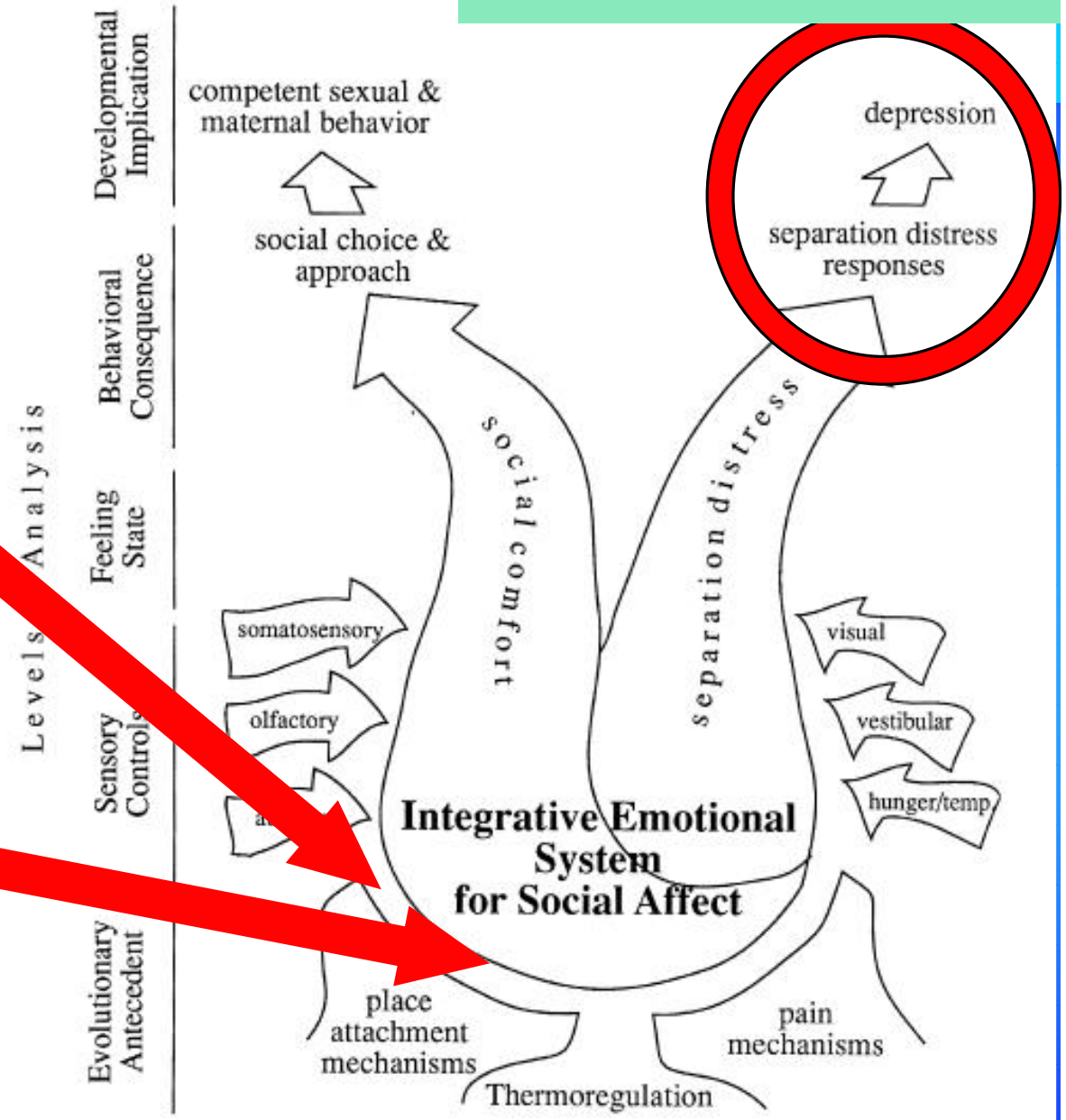


FIG. 1. Schematic depiction of the neurobiological foundations, inputs, and consequences of attachment and affiliative behavior in mammals. Figure reprinted with permission of the New York Academy of Sciences.

CORTISOL

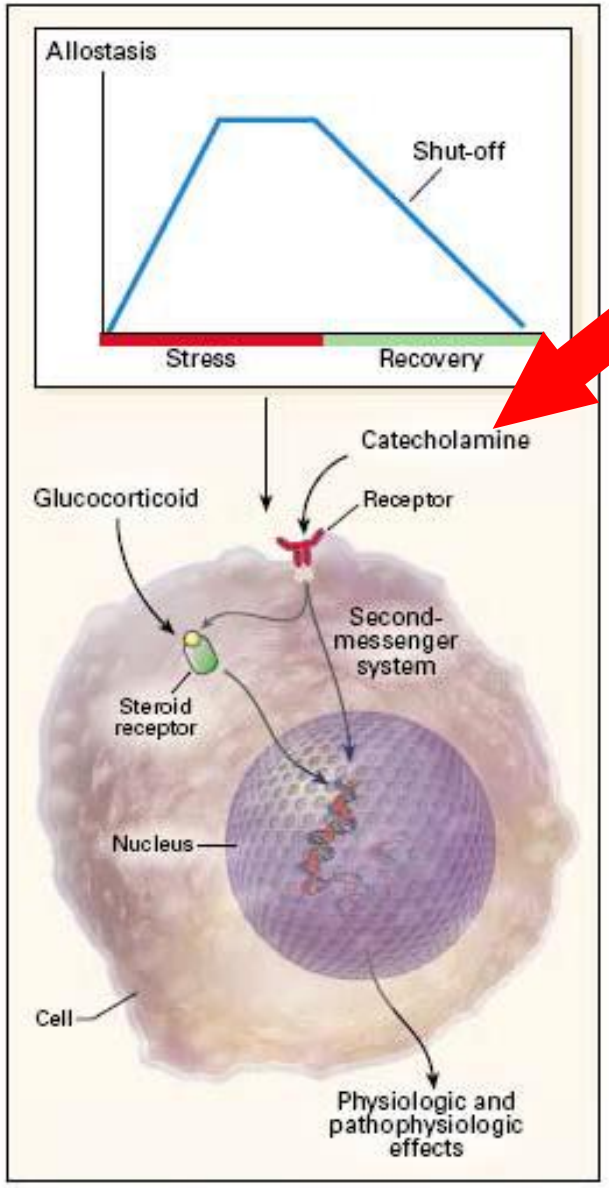
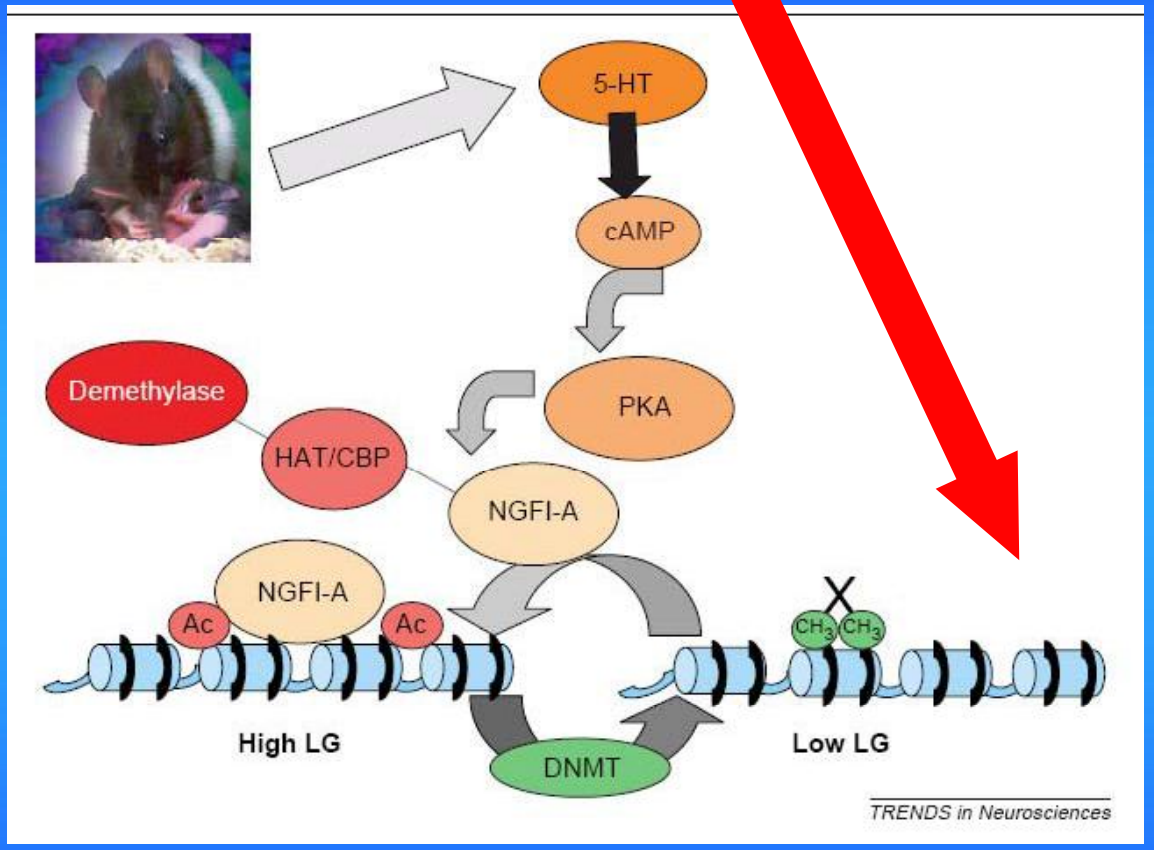
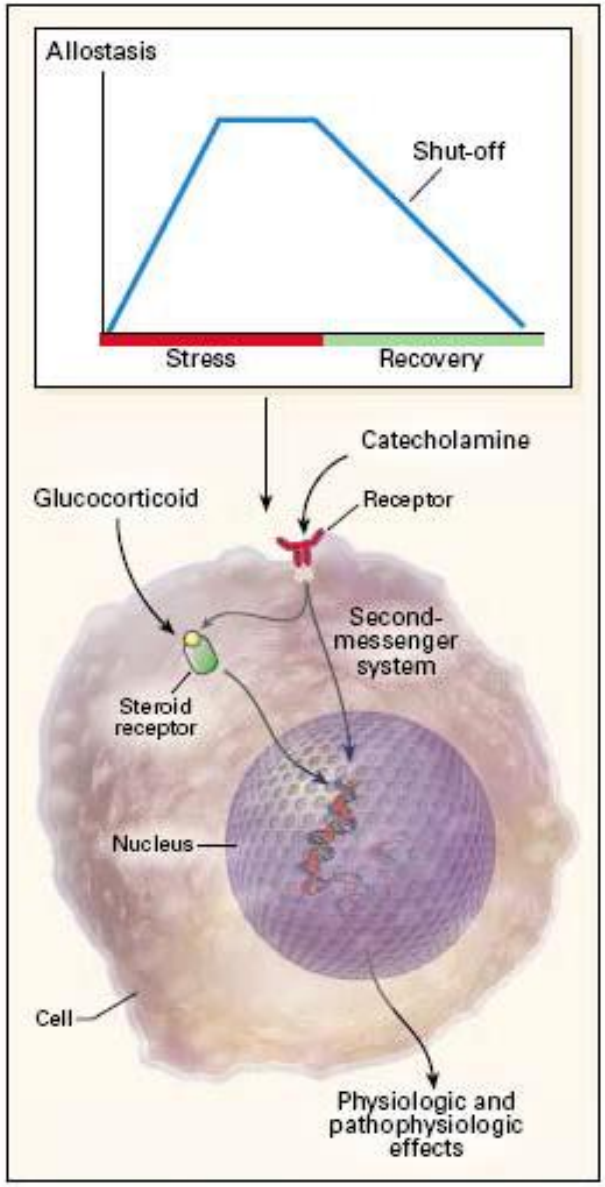


Figure 2. Allostasis in the Autonomic Nervous System and the HPA Axis.

Allostatic systems respond to stress (upper panel) by initiating the adaptive response, sustaining it until the stress ceases, and then shutting it off (recovery). Allostatic responses are initiated (lower panel) by an increase in circulating catecholamines from the autonomic nervous system and glucocorticoids from the adrenal cortex. This sets into motion adaptive processes that alter the structure and function of a variety of cells and tissues. These processes are initiated through intracellular receptors for steroid hormones, plasma-membrane receptors, and second-messenger systems for catecholamines. Cross-talk between catecholamines and glucocorticoid-receptor signaling systems can occur.





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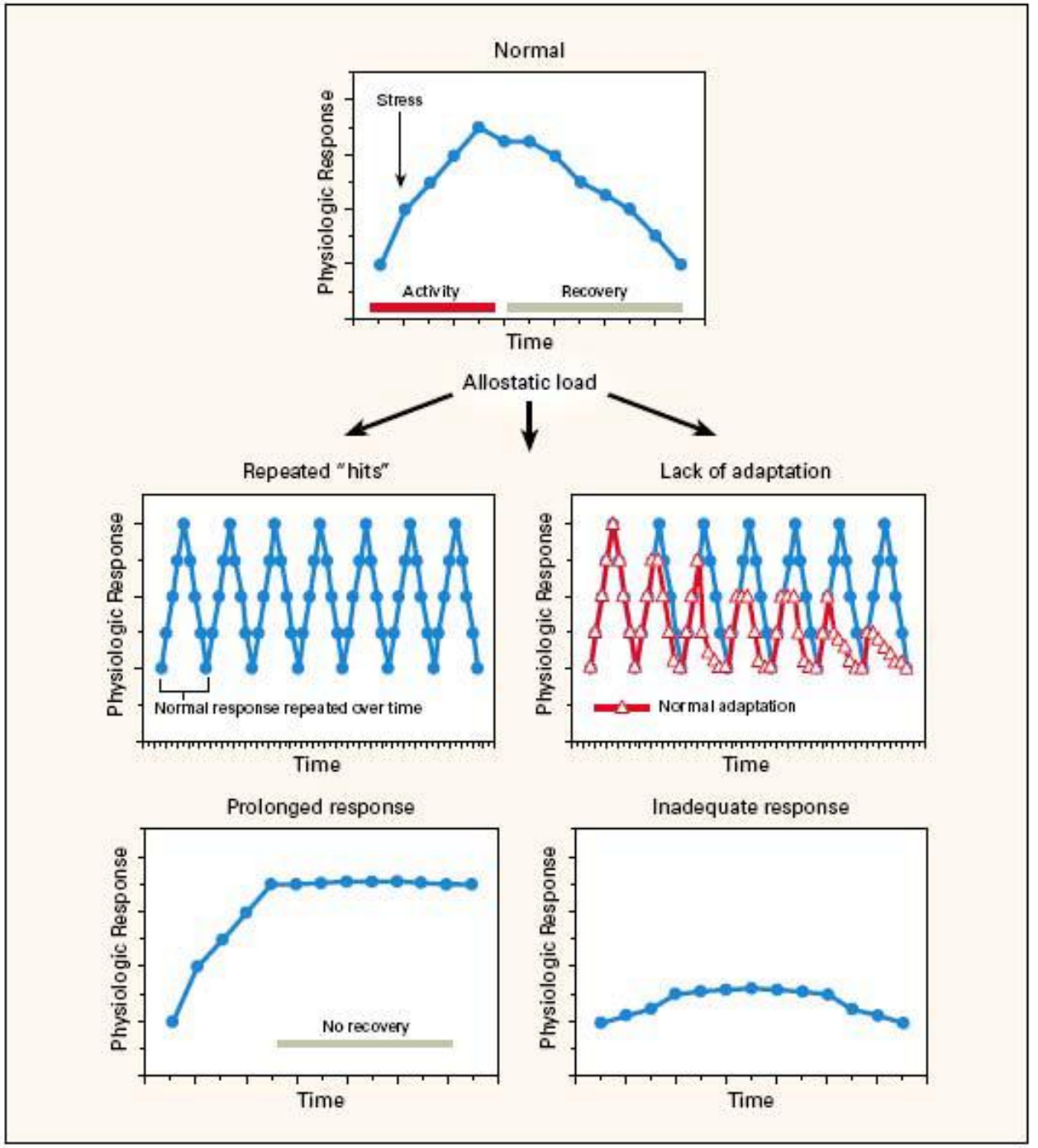


Figure 3. Three Types of Allostatic Load.

The top panel illustrates the normal allostatic response, in which a response is initiated by a stressor, sustained for an appropriate interval, and then turned off. The remaining panels illustrate four conditions that lead to allostatic load: repeated "hits" from multiple stressors; lack of adaptation; prolonged response due to delayed shutdown; and inadequate response that leads to compensatory hyperactivity of other mediators (e.g., inadequate secretion of glucocorticoids, resulting in increased concentrations of cytokines that are normally counterregulated by glucocorticoids).

Allostasis the mechanism by which homeostatic systems are maintained in balance …

Allostatic state elevated activity of mediators, with return to baseline and no impact on health.

Allostatic load elevated activity – sustained over time, or severe …

→ changes target cells of mediators,
and so changes the "set points" for homeostasis
(e.g. increasing blood pressure,
change in cholesterol level)

BRUCE McEWEN allostasis

PROTECTIVE AND DAMAGING EFFECTS OF STRESS MEDIATORS

BRUCE S. MCEWEN, PH.D.

This article reviews the long-term effect of the physiologic response to stress, which I refer to as allostatic load.[2] Allostasis — the ability to achieve stability through change[3] — is critical to survival. Through allostasis, the autonomic nervous system, the hypothalamic–pituitary–adrenal (HPA) axis, and the cardiovascular, metabolic, and immune systems protect the body by responding to internal and external stress. The price of this accommodation to stress can be allostatic load,[2] which is the wear and tear that results from chronic overactivity or underactivity of allostatic systems.

ALLOSTASIS

Allostasis is the relationship between psychoneurohormonal responses to stress and physical and psychological manifestations of health and illness.

PERCEPTIONS
"NEUROCEPTION"

Psychological
Neurological
Endocrine
Immune

STRESS → RESPONSE

← RESILIENCE / SENSITIVITY →

ALLOSTATIC STATE

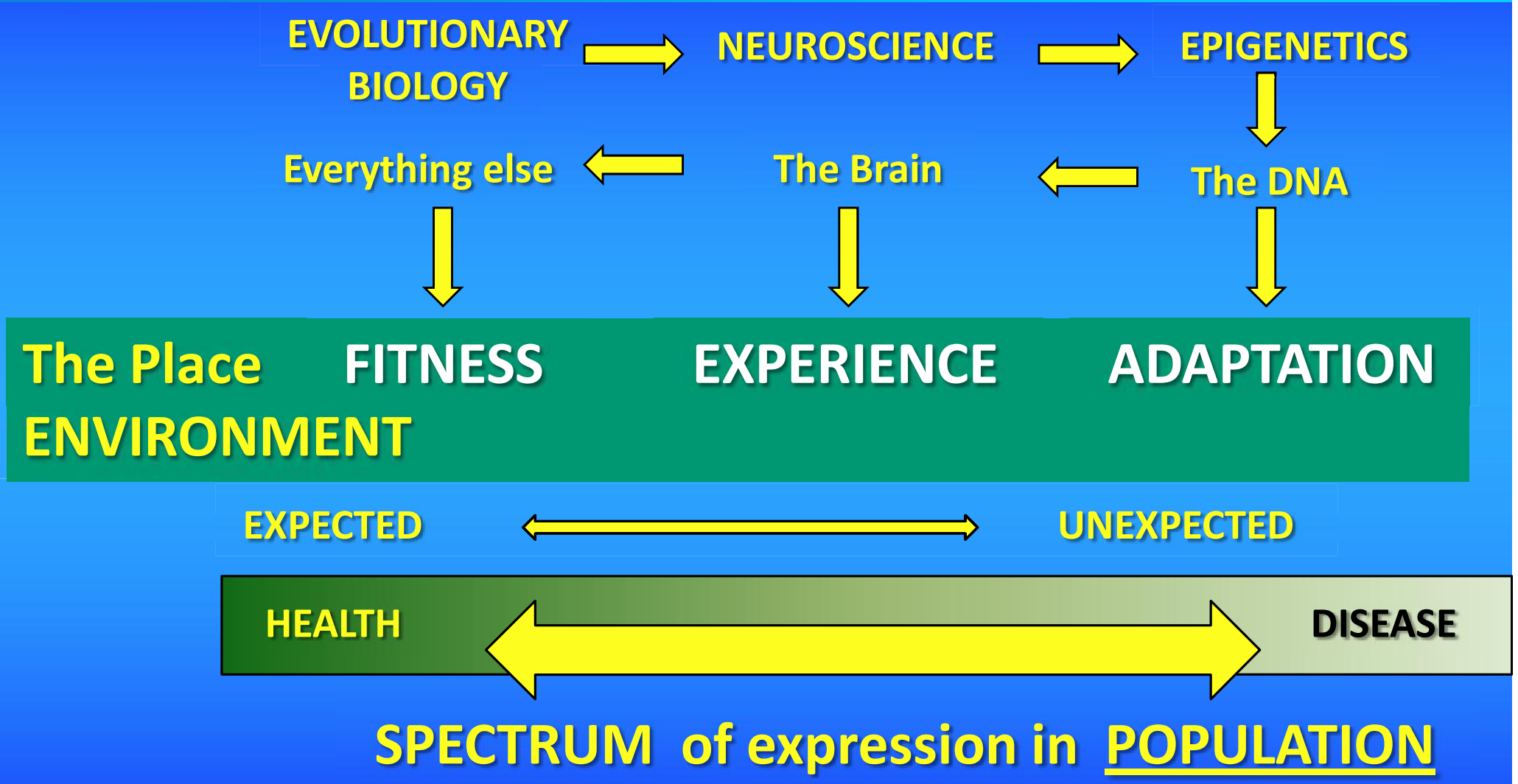
ALLOSTATIC LOAD

ALLOSTATIC OVERLOAD

HEALTH ↔ DISEASE

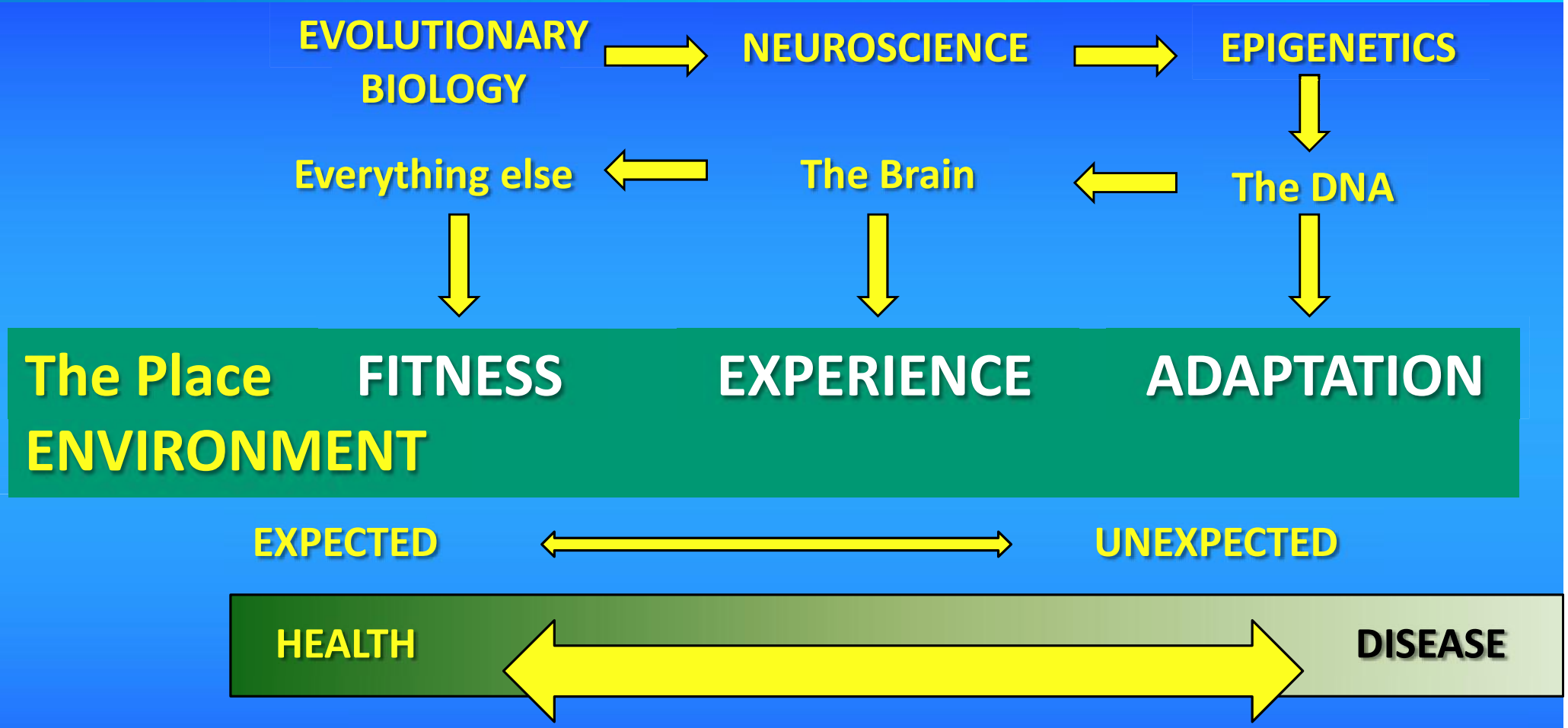
WELL-BEING → SUSCEPTIBILITY → MORBIDITY → MORTALITY

"Scientific foundation" … a synthesis



SPECTRUM of expression in POPULATION

"Scientific foundation" … a synthesis



SPECTRUM of expression in POPULATION

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… policy and practice that impacts the care of mothers and babies.

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

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

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TECHNICAL REPORT

The Lifelong Effects of Early Childhood Adversity and Toxic Stress

Jack P. Shonkoff, Andrew S. Garner, THE COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH, COMMITTEE ON EARLY CHILDHOOD, ADOPTION, AND DEPENDENT CARE, AND SECTION ON DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS, Benjamin S. Siegel, Mary I. Dobbins, Marian F. Earls, Andrew S. Garner, Laura McGuinn, John Pascoe and David L. Wood

Pediatrics 2012;129;e232; originally published online December 26, 2011;
DOI: 10.1542/peds.2011-2663

INTRODUCTION

Of a good beginning cometh a good end.

John Heywood, *Proverbs* (1546)

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

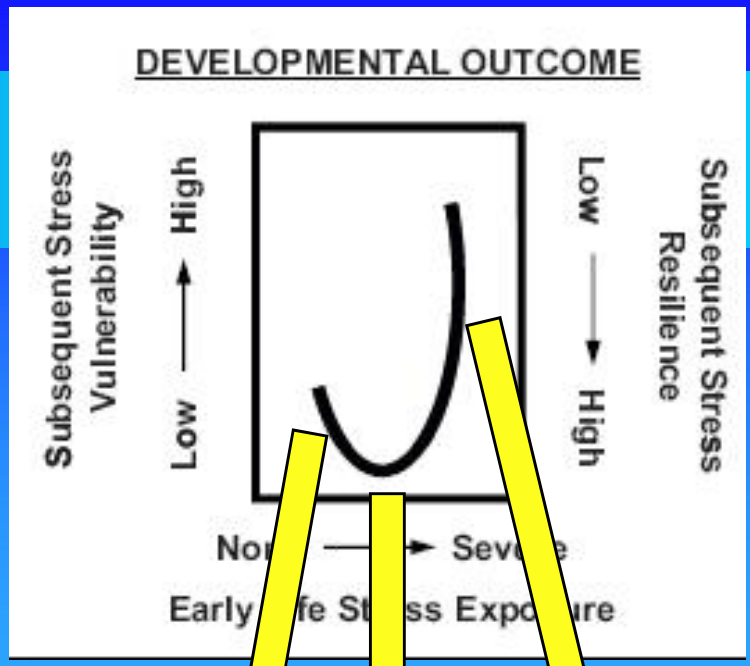
Positive Stress

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

- **An important and necessary aspect of healthy development that occurs in the context of stable and supportive relationships.**

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

Positive Stress = Eustress



Under-activity

EUSTRESS

Over-activity

- **An important and necessary aspect of healthy development that occurs in the context of stable and supportive relationships.**

Tolerable Stress

- **Stress responses that could disrupt brain architecture, but are buffered by supportive relationships that facilitate adaptive coping.**

- **Generally occurs within a time-limited period, which gives the brain an opportunity to recover from potentially damaging effects.**

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

Toxic Stress

- **Strong and prolonged activation of the body's stress management systems in the absence of the buffering protection of adult support.**

JACK SHONKOFF

"BUFFERING PROTECTION OF ADULT SUPPORT"

Toxic Stress

- **Strong and prolonged activation of the body's stress management systems in the absence of the buffering protection of adult support.**
- **Disrupts brain architecture and leads to stress management systems that respond at relatively lower thresholds, thereby increasing the risk of stress-related physical and mental illness.**

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

CORTISOL

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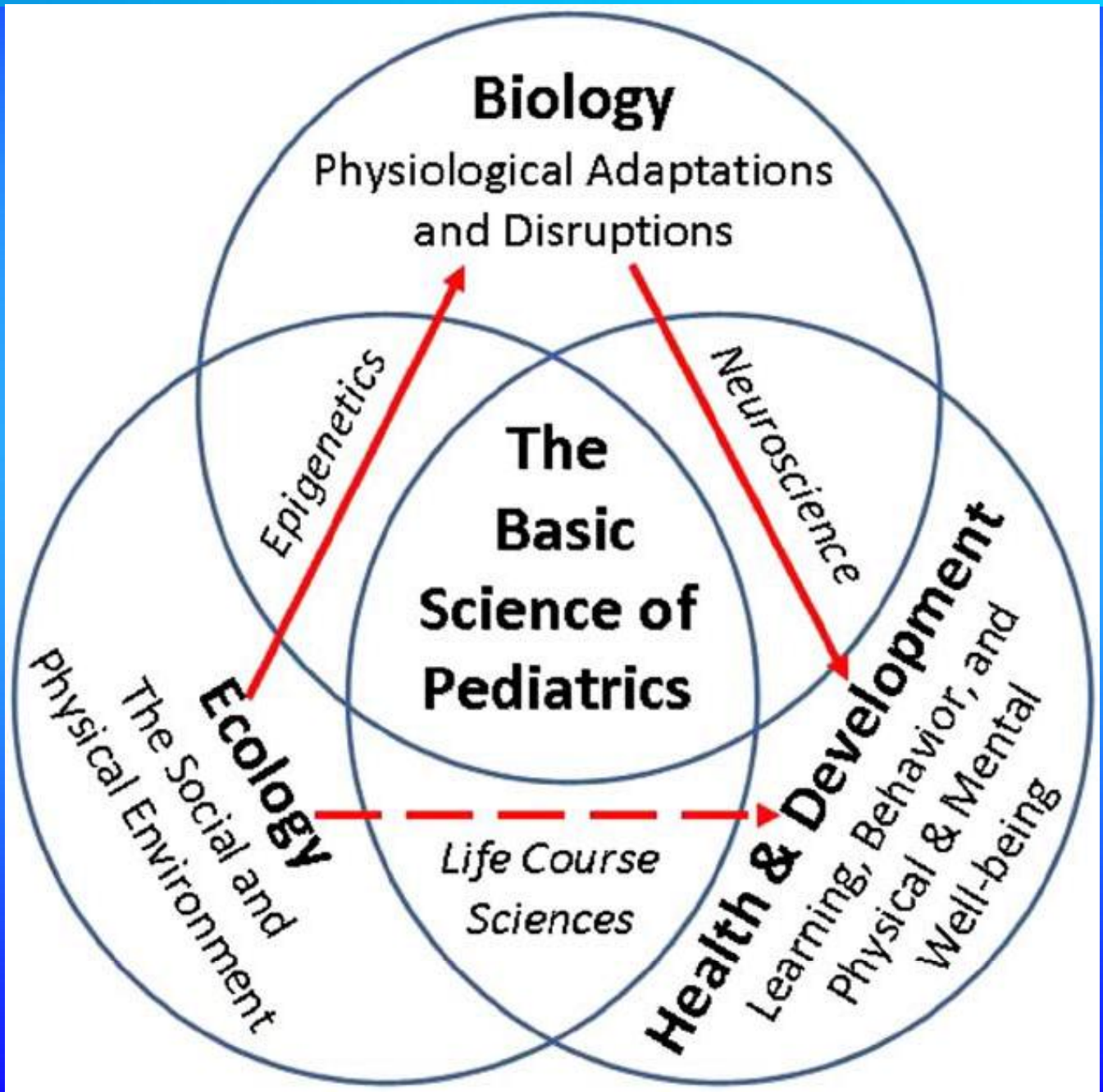
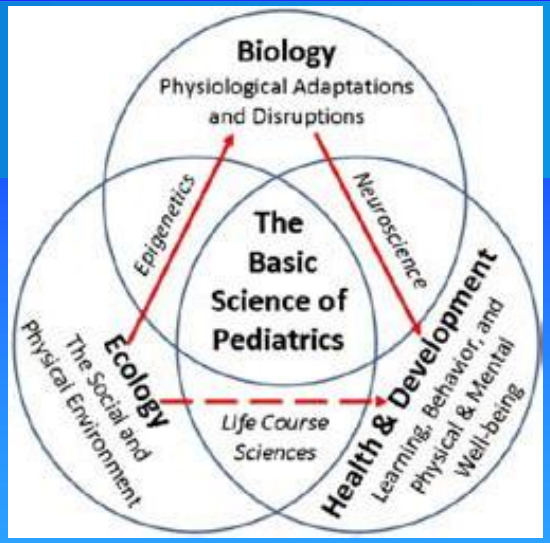
The basic science of pediatrics.

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

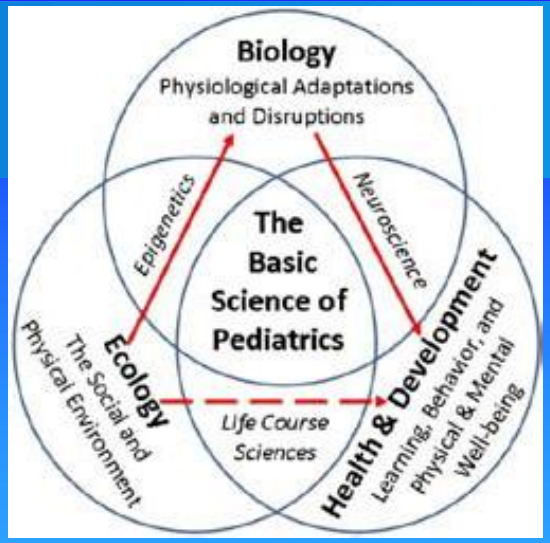




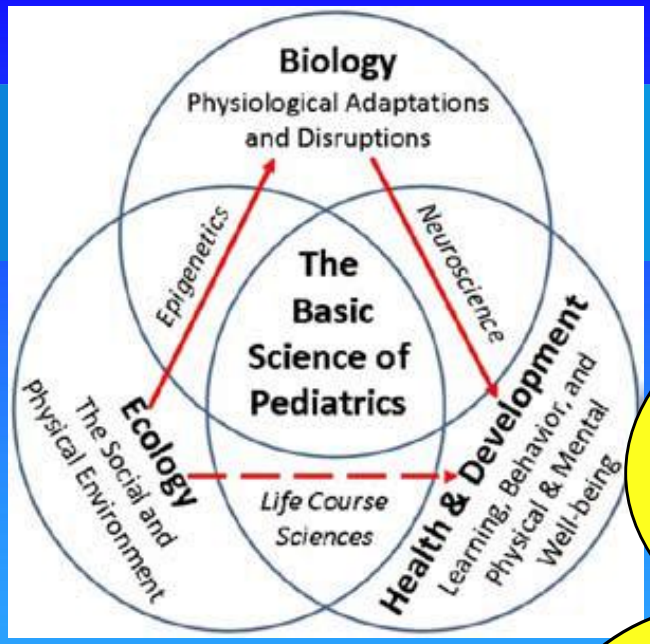
Learning
Behavior
Physical well being
Mental well being

EARLY YEARS → LIFE SPAN

2 … advances in the biological sciences underscore the foundational importance of the early years and support an EBD framework for understanding the evolution of human health and disease across the life span.



3. The biology of early childhood adversity reveals the important role of toxic stress in disrupting developing brain architecture and adversely affecting the concurrent development of other organ systems and regulatory functions.



EARLY LIFE ADVERSITY

Learning
Behavior
Physical well being
Mental well being

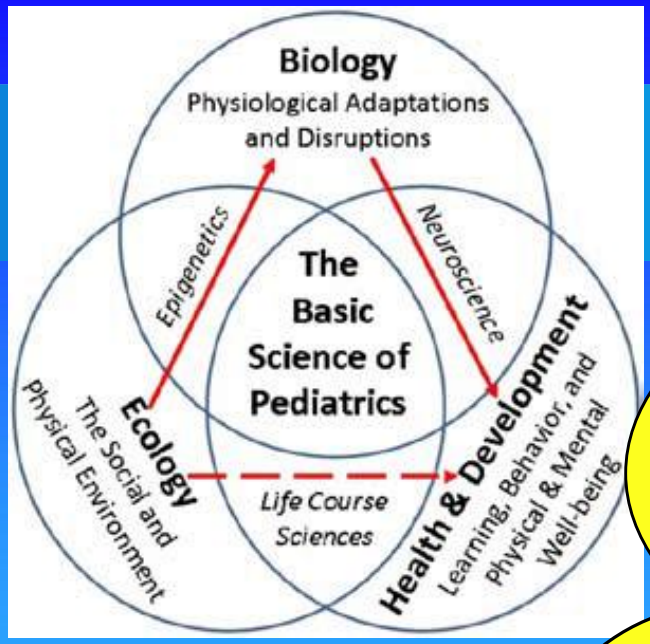
MAKES POORER
Linguistic
Cognitive
Emotional
Adaption
responsivity

TOXIC STRESS

→ unhealthy lifestyle
→Chronic disease
→health disparity

EARLY YEARS → LIFE SPAN

4 Toxic stress can lead to potentially permanent changes in learning (…), behavior (…), and physiology (…) and can cause … higher levels of stress related chronic diseases, …increase the prevalence of unhealthy lifestyles that lead to widening health disparities.



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TOXIC STRESS

→ unhealthy lifestyle
→Chronic disease
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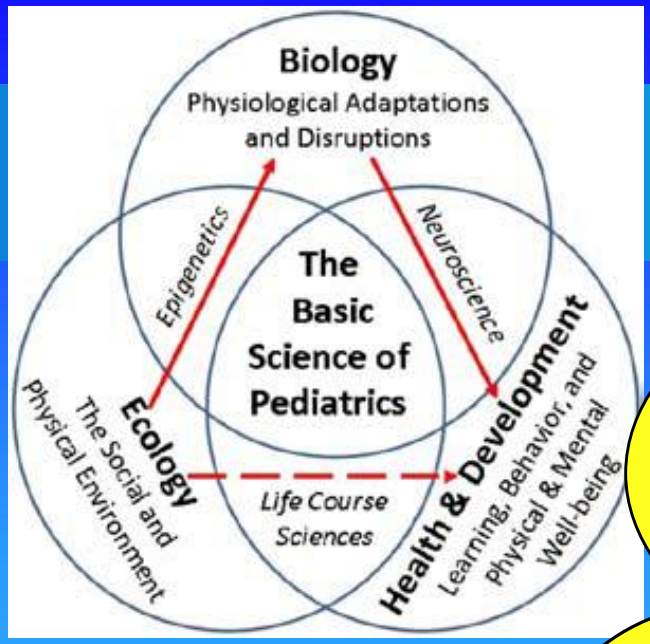
EARLY YEARS → LIFE SPAN

MASSIVE COST $$$$

5. The lifelong costs of childhood toxic stress are enormous, … and effective early childhood interventions provide critical opportunities to prevent these undesirable outcomes and generate large economic returns for all of society.



EARLY LIFE ADVERSITY

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Physical well being
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Linguistic
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Emotional
Adaption
responsivity

TOXIC STRESS

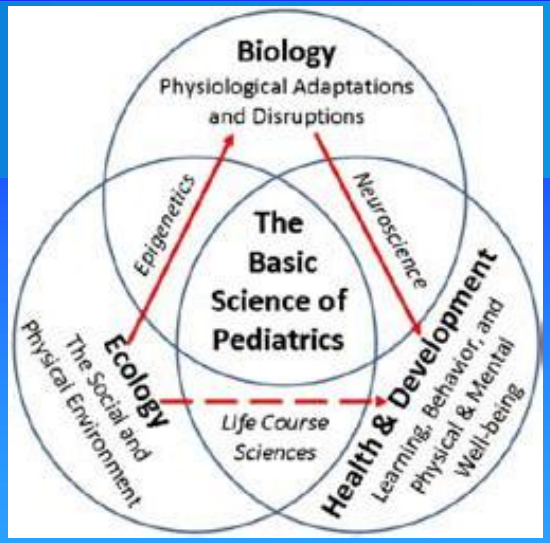
→ unhealthy lifestyle
→Chronic disease
→health disparity

EARLY YEARS → LIFE SPAN

MASSIVE COST $$$$

REDUCE TOXIC STRESS

6. The consequences of significant adversity early in life prompt an urgent call for innovative strategies to reduce toxic stress within the context of a coordinated system of policies and services guided by an integrated science of early childhood and early brain development.

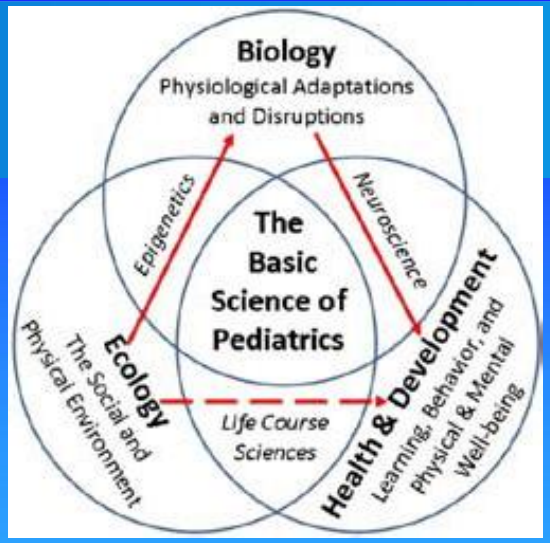


Learning
Behavior
Physical well being
Mental well being

EARLY YEARS → LIFE SPAN

BERGMAN COMMENTARY - NEWBORN

Early years = early hours & days



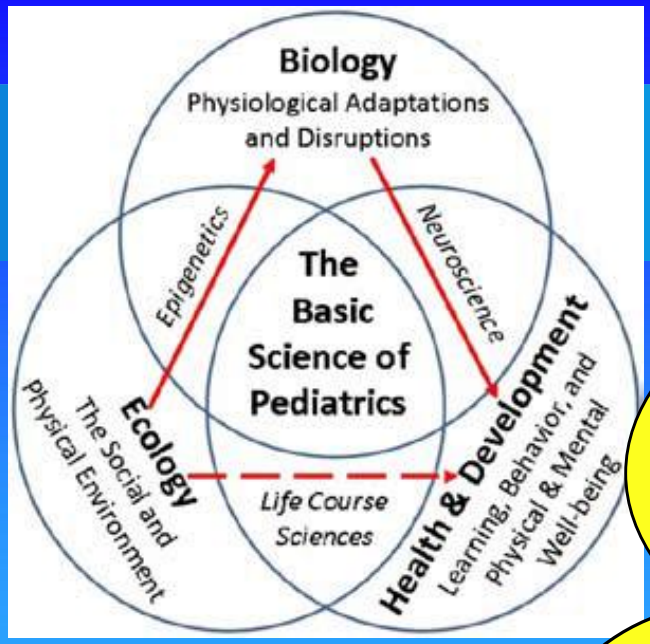
EARLY LIFE ADVERSITY

Learning
Behavior
Physical well being
Mental well being

TOXIC STRESS

EARLY YEARS → LIFE SPAN

BERGMAN COMMENTARY - NEWBORN Maternal absence is TOXIC STRESS



EARLY LIFE ADVERSITY

Learning
Behavior
Physical well being
Mental well being

MAKES POORER
Linguistic
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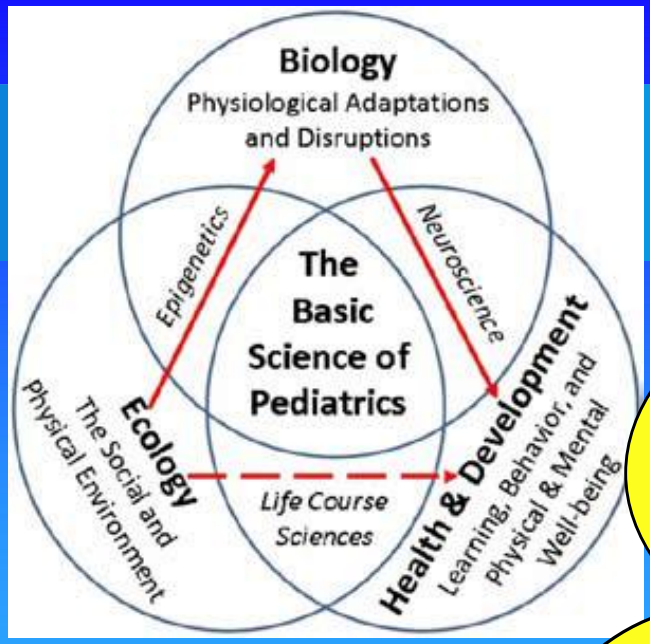
Emotional
Adaption
responsivity
→ unhealthy lifestyle
→Chronic disease
→health disparity

TOXIC STRESS

EARLY YEARS → LIFE SPAN

BERGMAN COMMENTARY - NEWBORN

For separated preterm newborns, we have decades of evidence for this.



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TOXIC STRESS

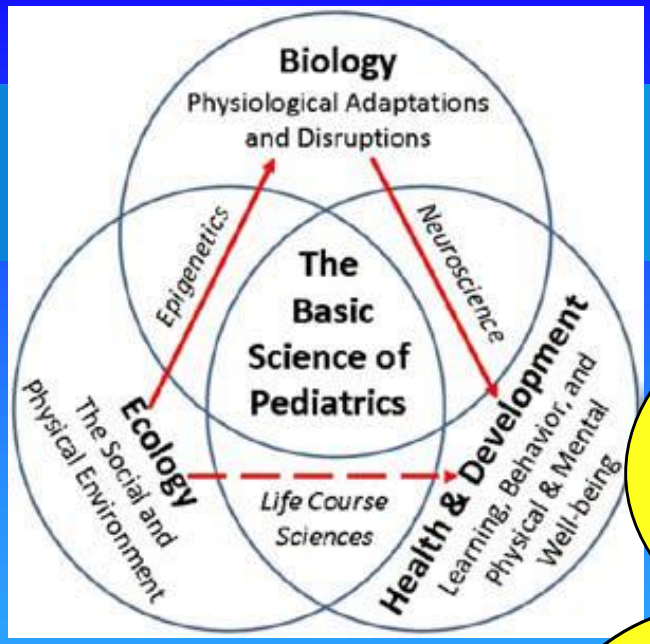
→ unhealthy lifestyle
→Chronic disease
→health disparity

EARLY YEARS → LIFE SPAN

MASSIVE COST $$$$

BERGMAN COMMENTARY - NEWBORN

even more massive ??



EARLY LIFE ADVERSITY

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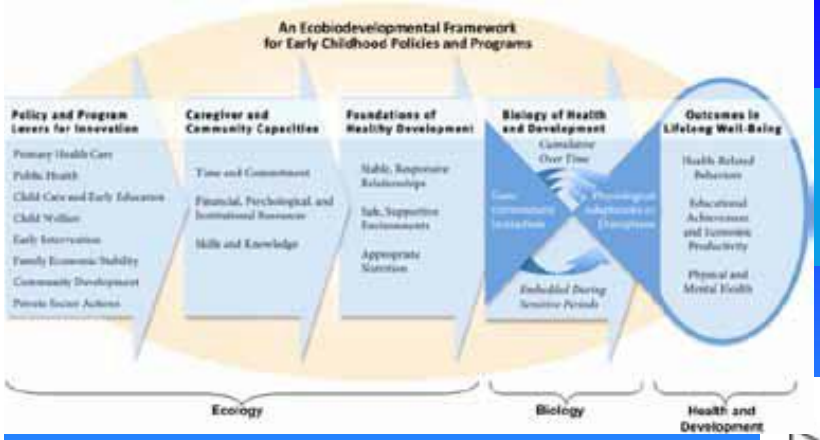
EARLY YEARS → LIFE SPAN

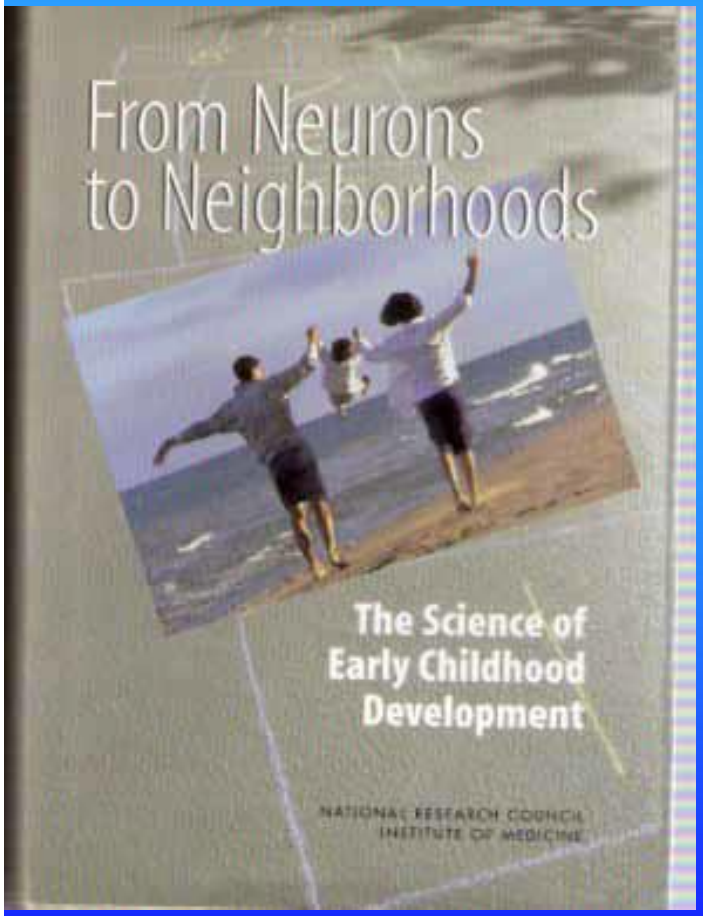
MASSIVE COST $$$$

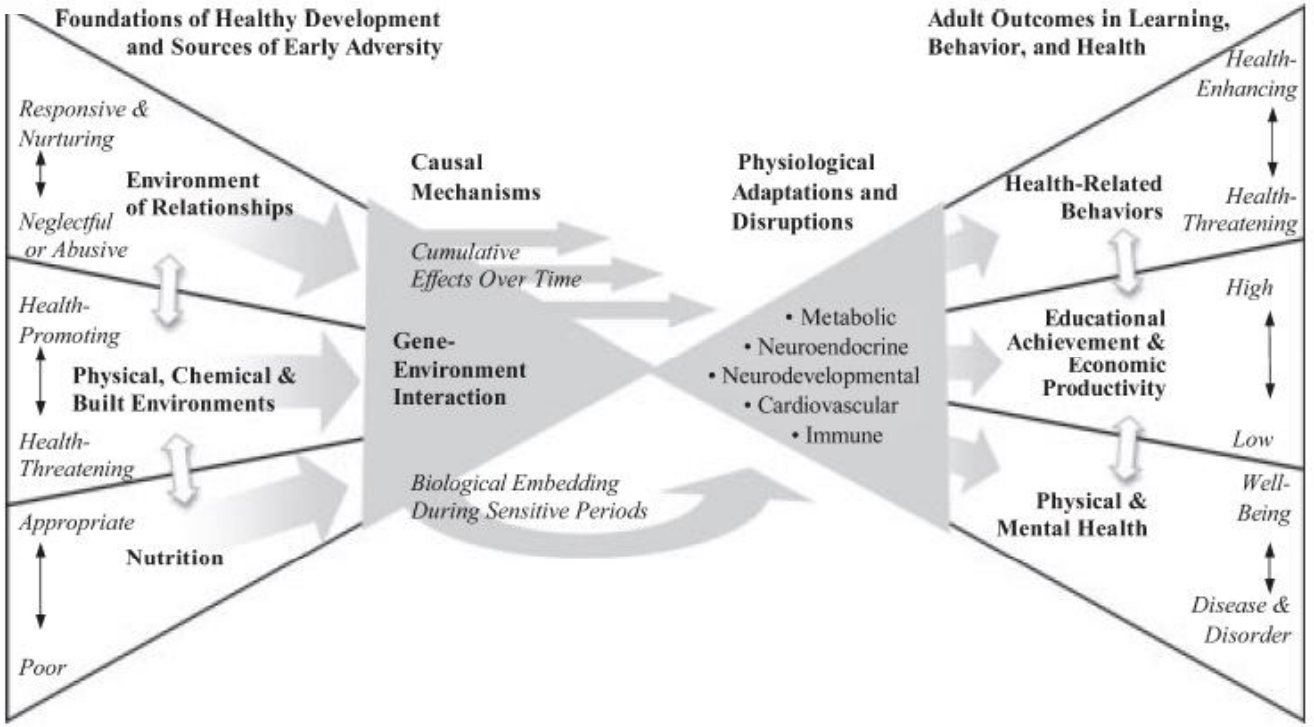
REDUCE TOXIC STRESS

BERGMAN COMMENTARY - NEWBORN

Reducing toxic stress IS VERY EASY !!


An Ecobiodevelopmental Framework
for Early Childhood Policies and Programs
Policy and Program Levers for Innovation
Caregiver and Community Capacities
Foundations of Healthy Development
Biology of Health and Development
Outcomes in Lifelong Well-Being
Ecology
Biology
Health and Development


From Neurons to Neighborhoods
The Science of Early Childhood Development
NATIONAL RESEARCH COUNCIL
INSTITUTE OF MEDICINE


Foundations of Healthy Development and Sources of Early Adversity
Responsive & Nurturing
Environment of Relationships
Neglectful or Abusive
Health-Promoting
Physical, Chemical & Built Environments
Health-Threatening
Appropriate
Nutrition
Poor
Causal Mechanisms
Cumulative Effects Over Time
Gene-Environment Interaction
Biological Embedding During Sensitive Periods
Physiological Adaptations and Disruptions
• Metabolic
• Neuroendocrine
• Neurodevelopmental
• Cardiovascular
• Immune
Adult Outcomes in Learning, Behavior, and Health
Health-Related Behaviors
Health-Enhancing
Health-Threatening
Educational Achievement & Economic Productivity
High
Low
Physical & Mental Health
Well-Being
Disease & Disorder

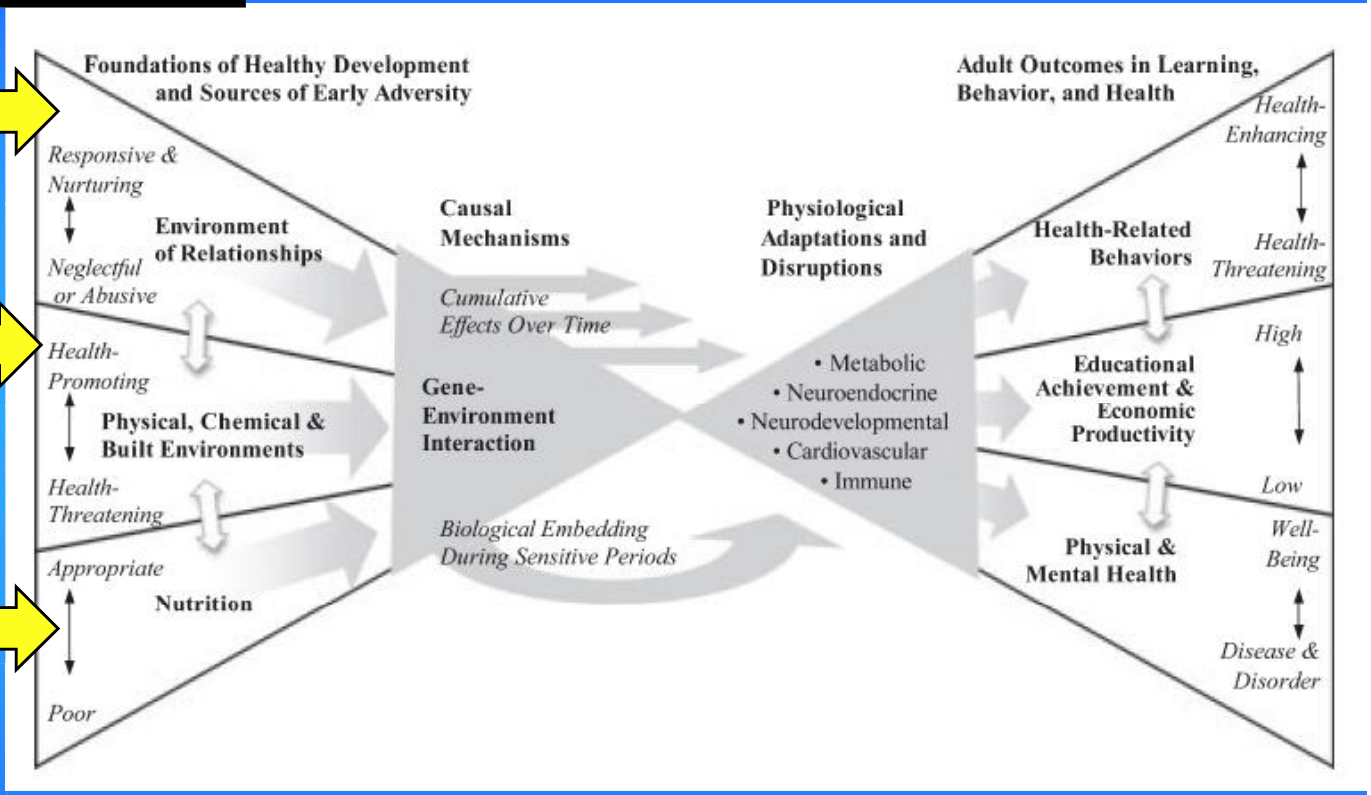
Attachment

Bonding

Skin-to-Skin Contact

Breast-feeding

Regulation



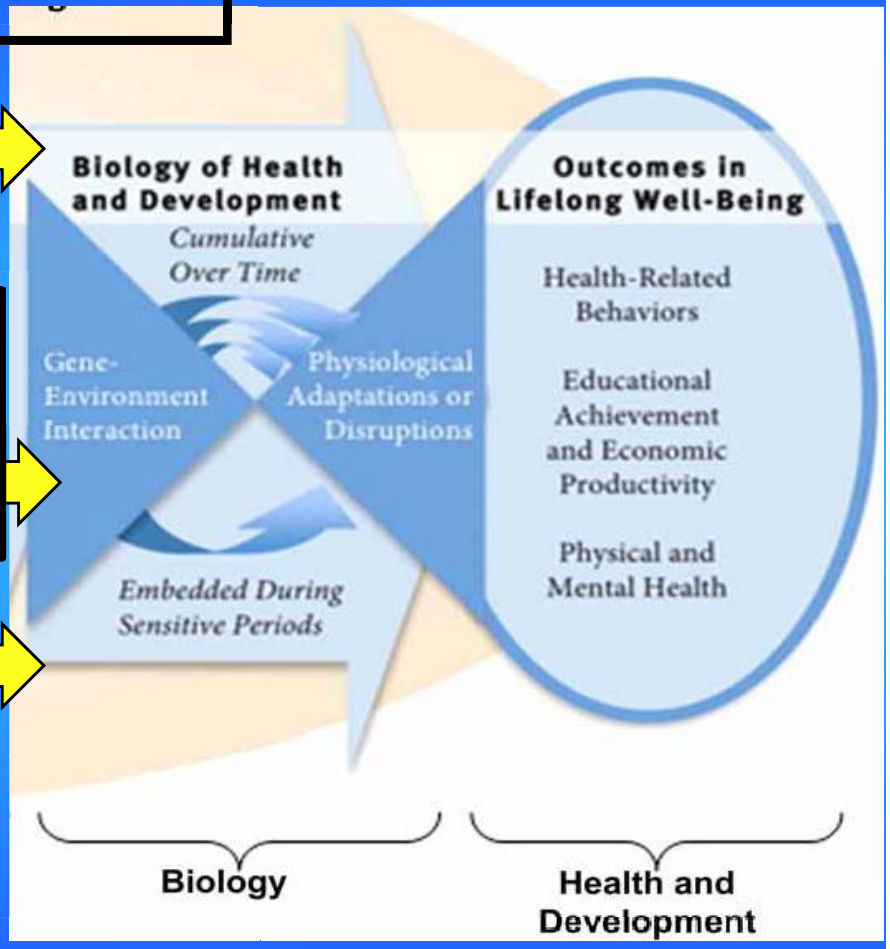
An ecobiodevelopmental framework for early childhood policies and programs.

Attachment

Bonding

Skin-to-Skin Contact

Breast-feeding



BERGMAN COMMENTARY - NEWBORN

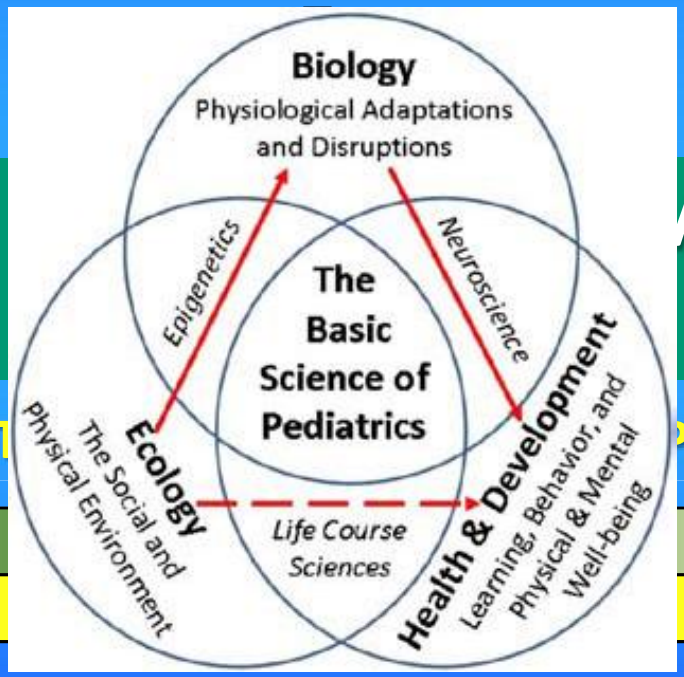
Reducing toxic stress IS VERY EASY !!

"Scientific foundation" … a synthesis

EVOLUTIONARY BIOLOGY → NEUROSCIENCE → EPIGENETICS

Everything else ← The Brain ← The DNA

The Place ENVIRONMENT — FITNESS — ADAPTATION



EXPECT … PECTED

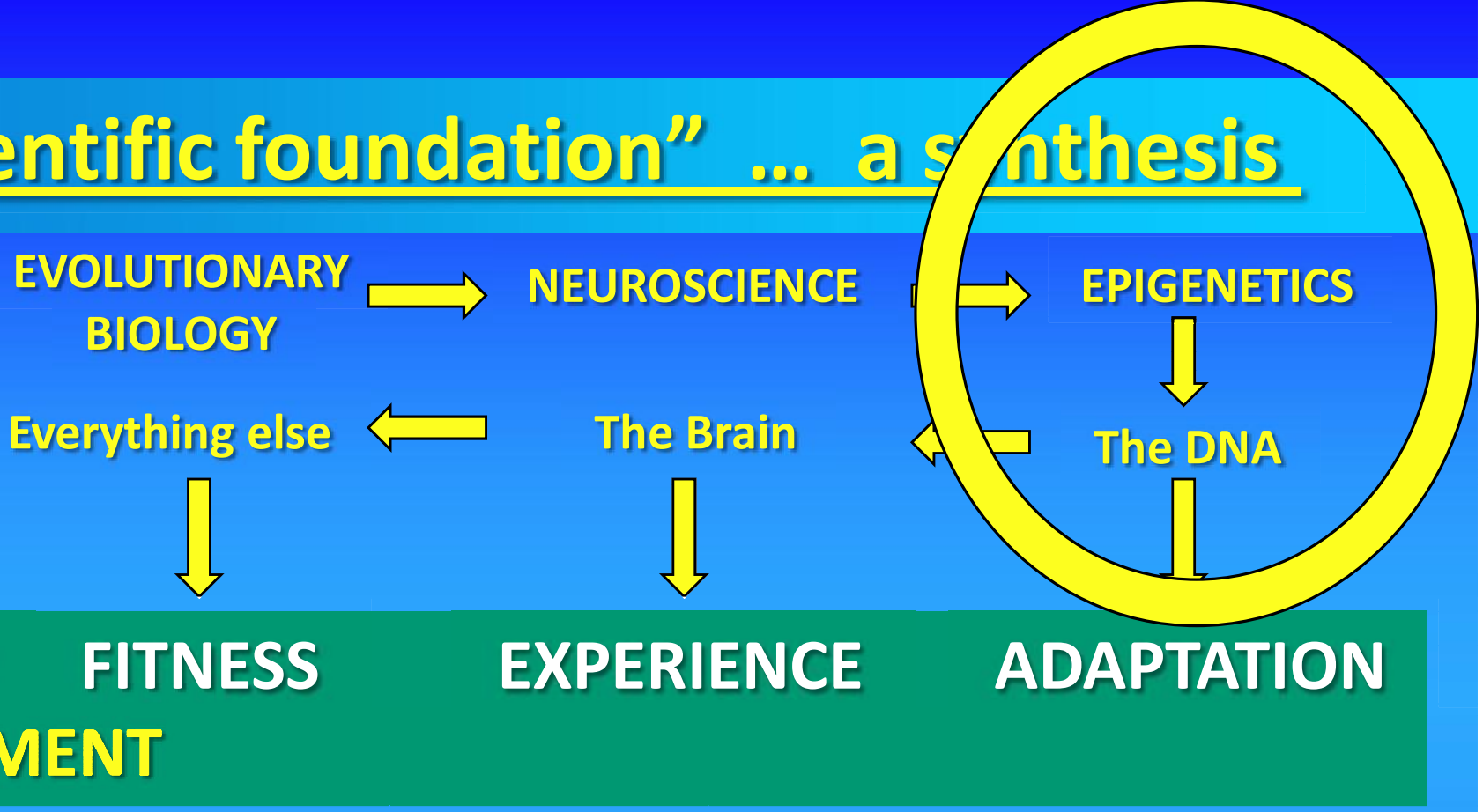
HEALTH ← → DISEASE

SPECTRUM of expression in POPULATION

Platform for better understanding of PUBLIC HEALTH.

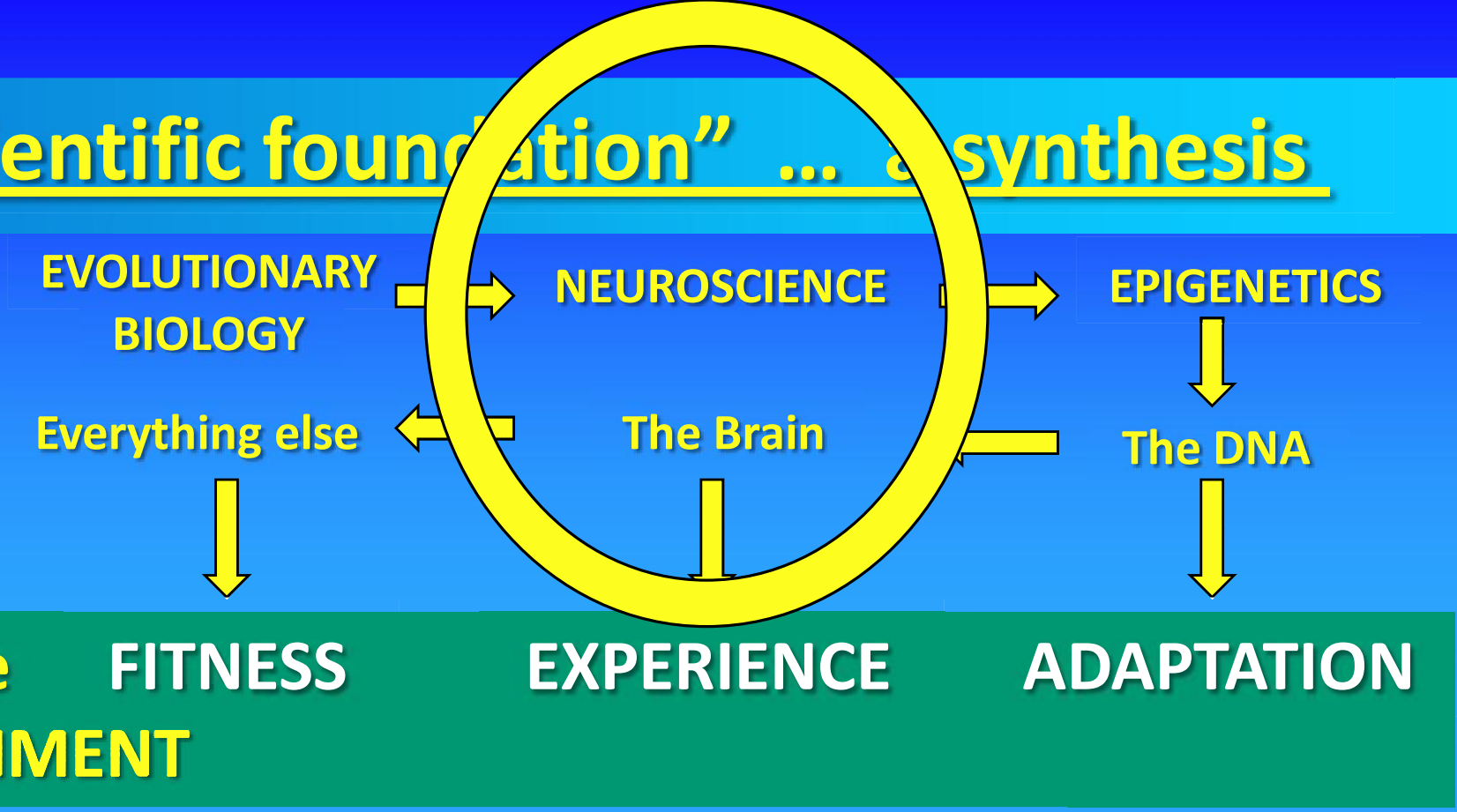
… policy and practice that impacts the care of mothers and babies.

"Scientific foundation" … a synthesis



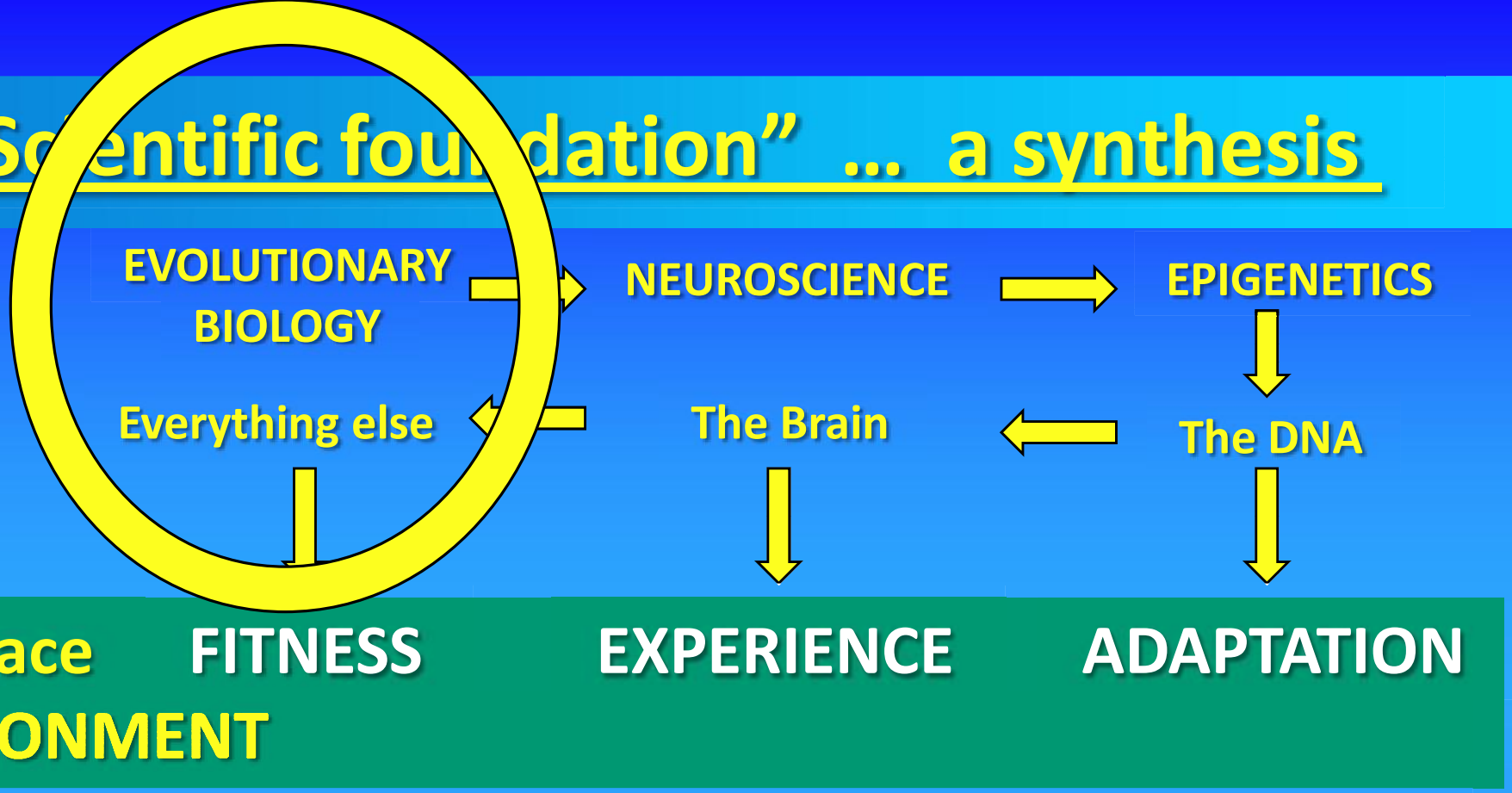
"BUFFERING PROTECTION OF ADULT SUPPORT"

"Scientific foundation" ... a synthesis



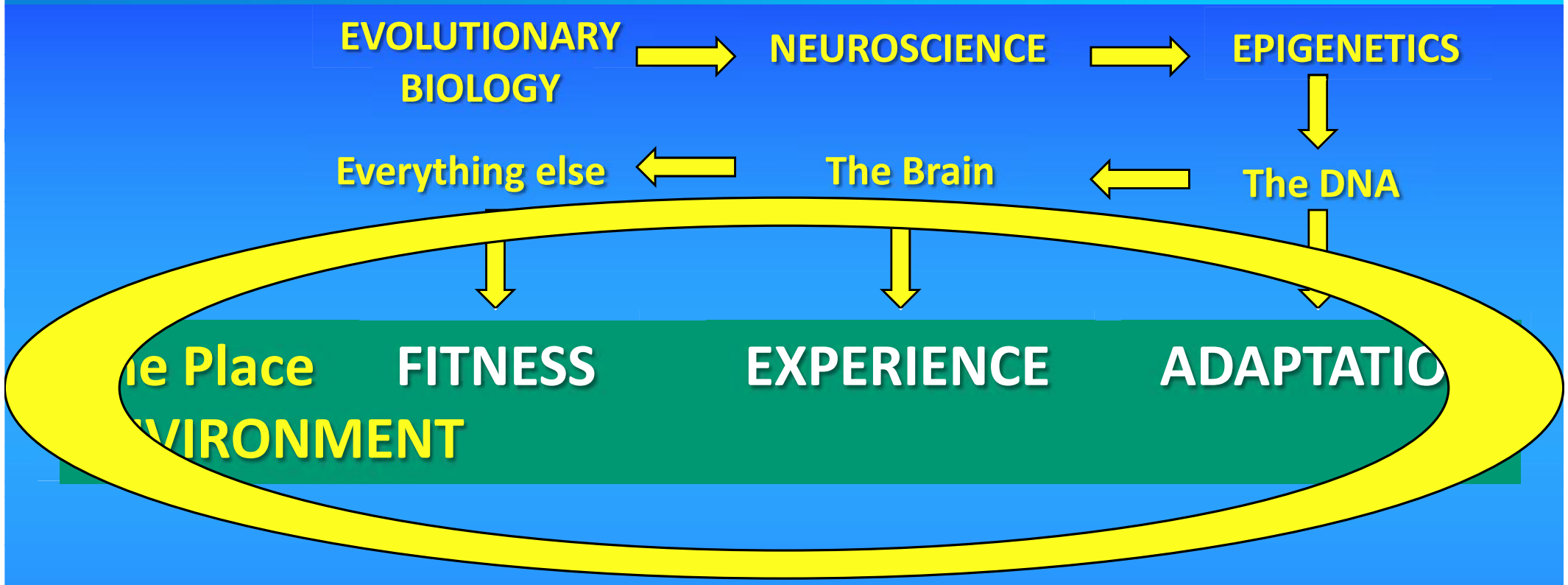
"NEEDED NEURAL PROCESSES"

"Scientific foundation" … a synthesis



"EXCEPT IN THE LIGHT OF MOTHER'S BODY."

"Scientific foundation" … a synthesis



ZERO SEPARATION

ZERO SEPARATION

EXPECTED ⟷ UNEXPECTED

HEALTH ⟵ ⟶ DISEASE

?

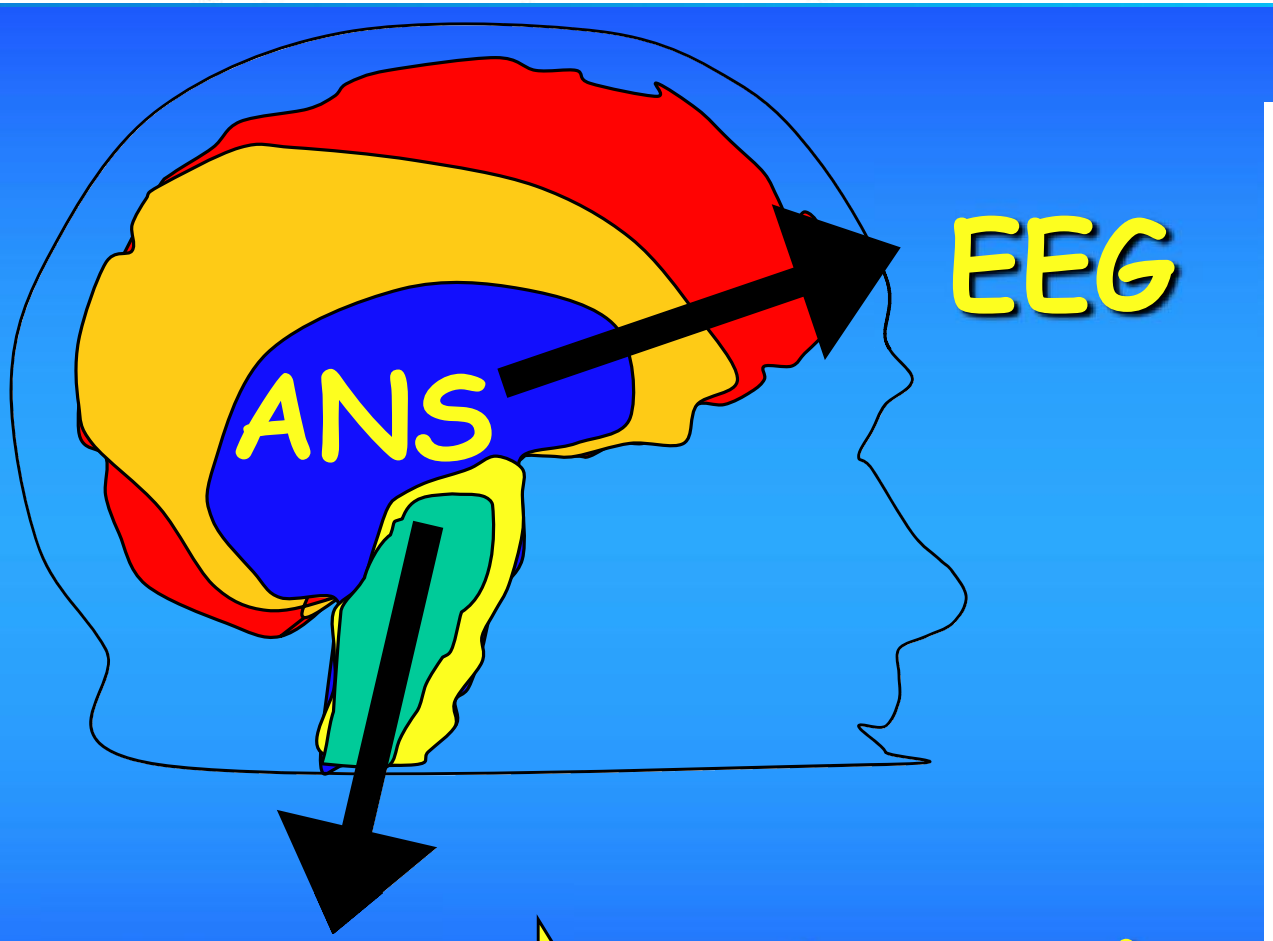
SKIN-TO-SKIN ←→ INCUBATOR ARE <u>OPPOSITES</u>

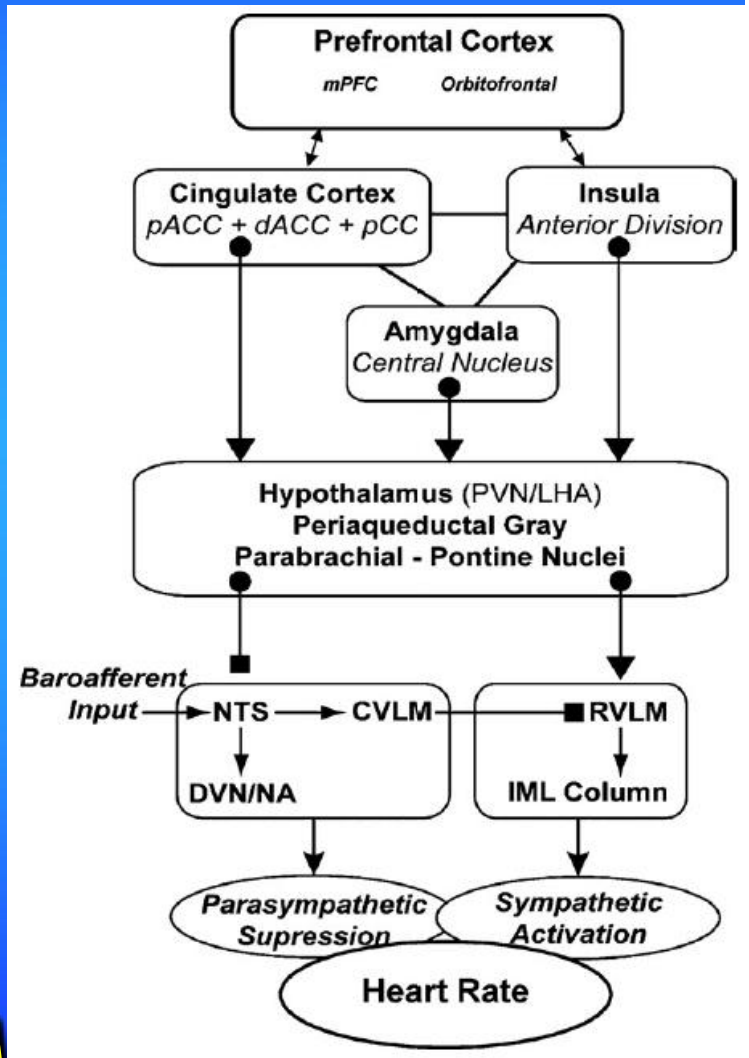

PRIMUM NON NOCERE
HARM ?


PRIMUM NON NOCERE
TOXIC STRESS ??
HARM ?

Should Neonates Sleep Alone?

Barak E. Morgan, Alan R. Horn, and Nils J. Bergman





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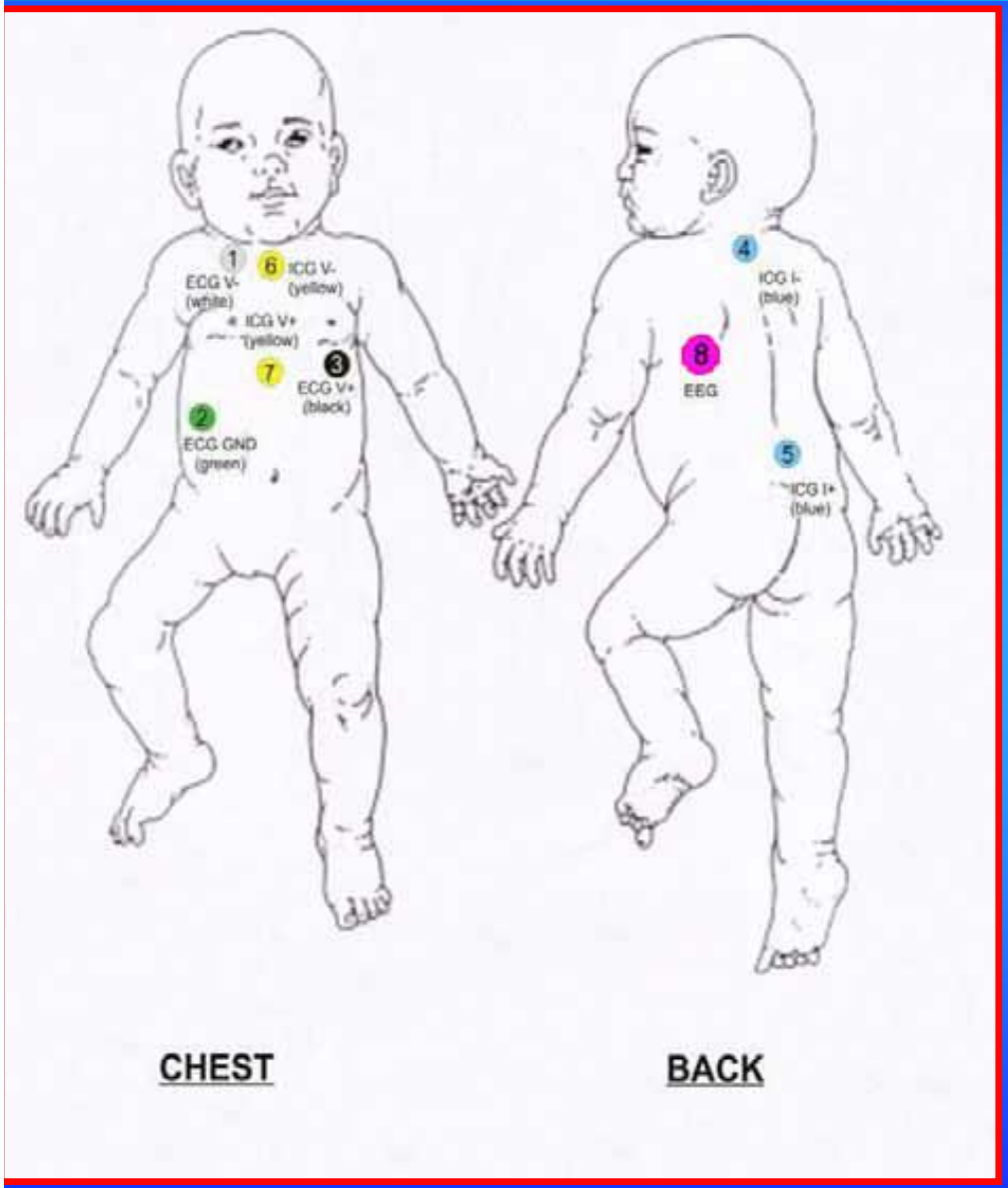
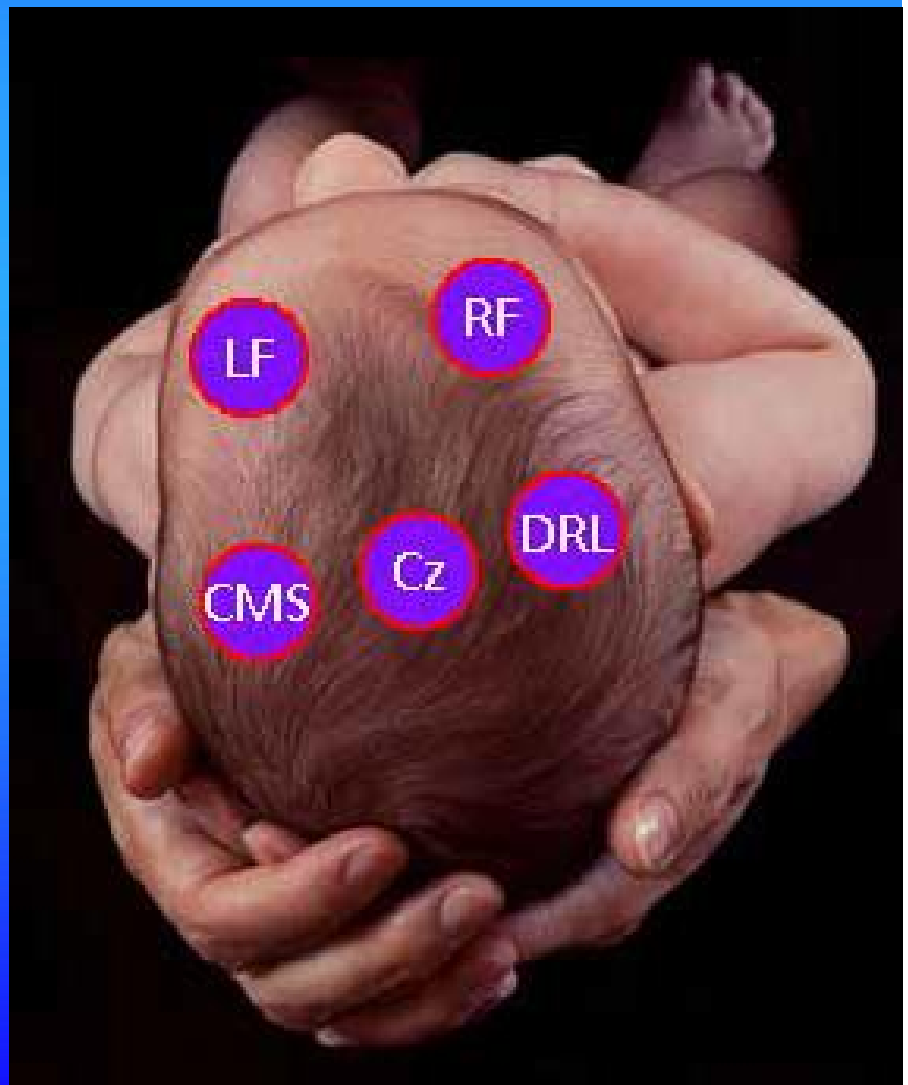

1
ECG V-
(white)
6
ICG V-
(yellow)
ICG V+
(yellow)
7
3
ECG V+
(black)
2
ECG GND
(green)
4
ICG I-
(blue)
8
EEG
5
ICG I+
(blue)
CHEST
BACK


LF
RF
CMS
Cz
DRL

PLACE convention

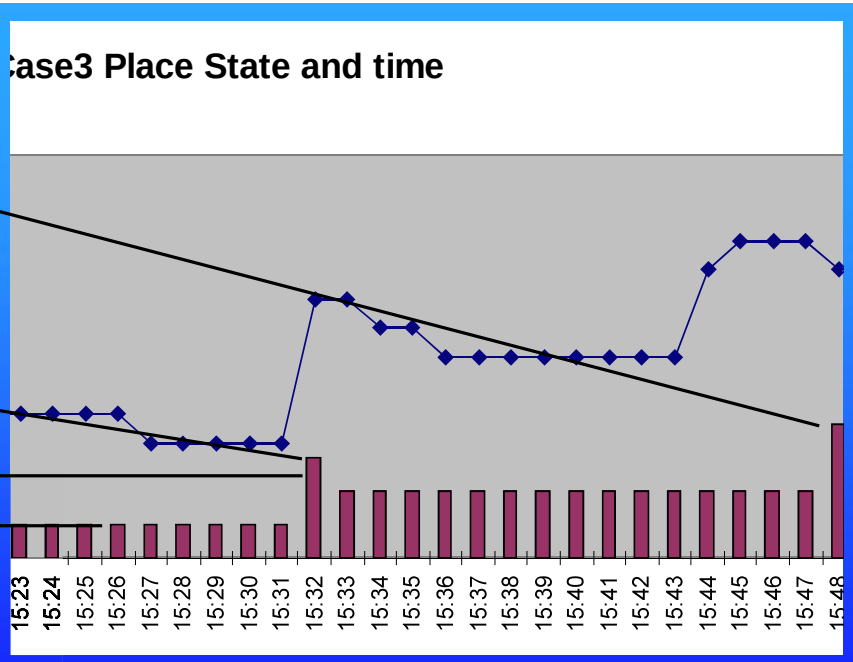
Place 1. skin-to-skin contact

Place 2. maternal-neonate separation

Place 3. holding

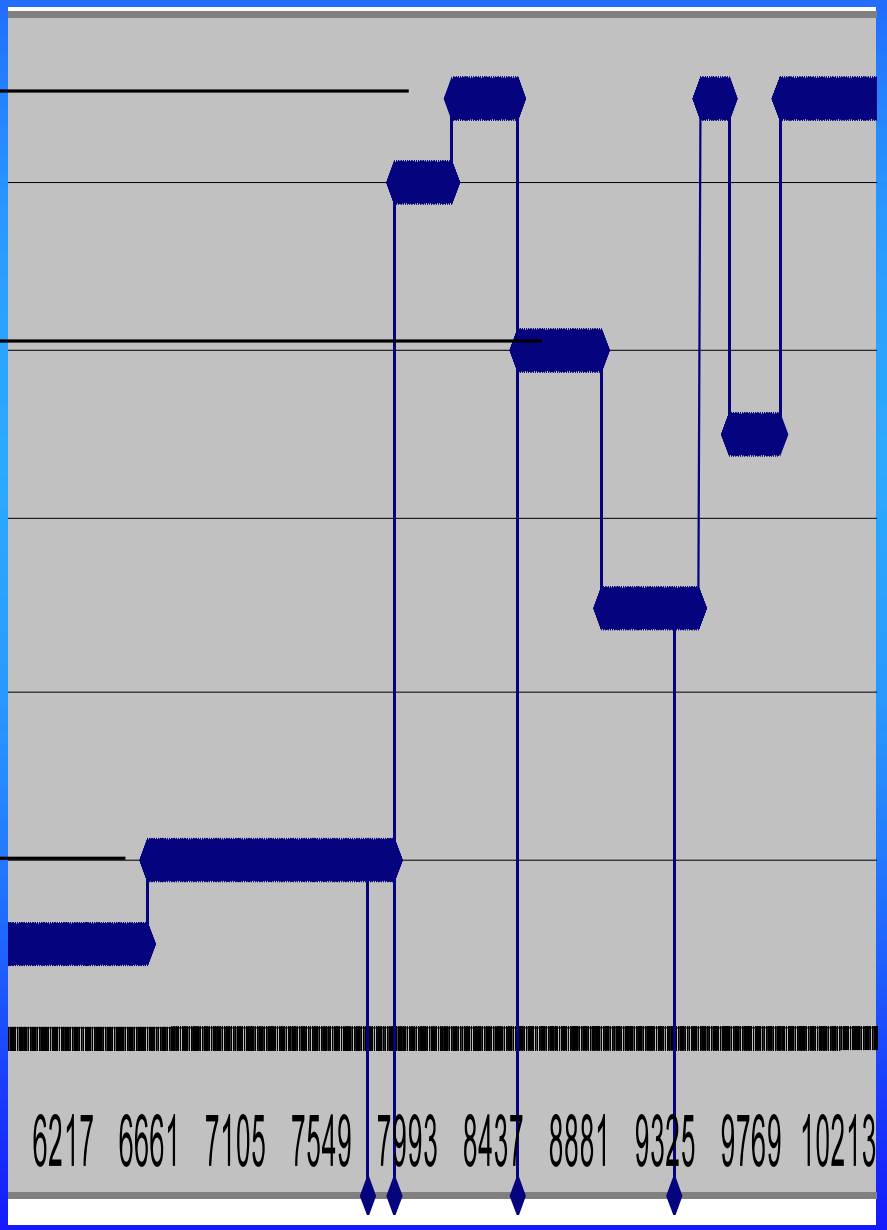
Place 4. breastfeeding

4 Breastfeeding
3 Holding
2 MIS (Cot)
1 SSC (Skin-to-skin)



ANDERSON BEHAVIOURAL STATE SCALE

12
11 Crying
10 Fussing
9 Active
8 Breastfeeding
7 Alert Awake
6 Quiet Awake
5 Drowsy
4
3 Active Sleep
2 Irregular Sleep
1 Regular / Quiet Sleep

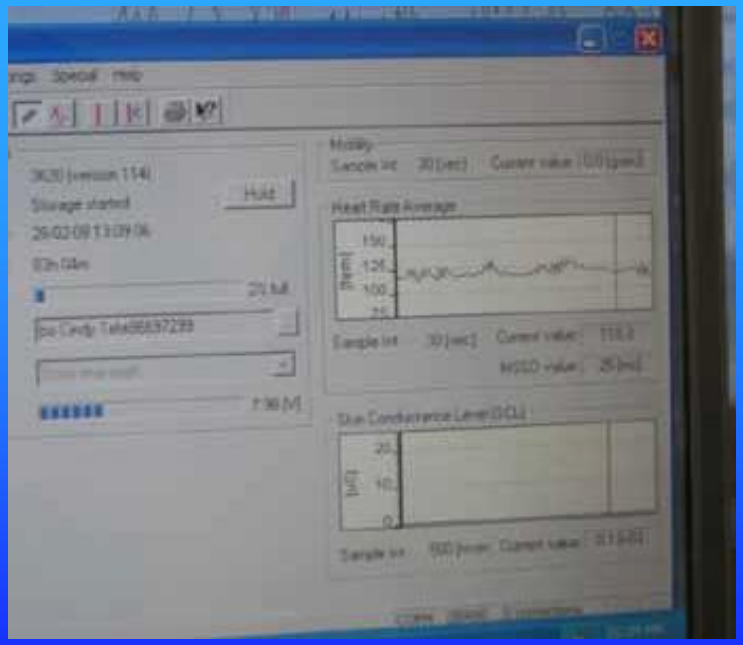




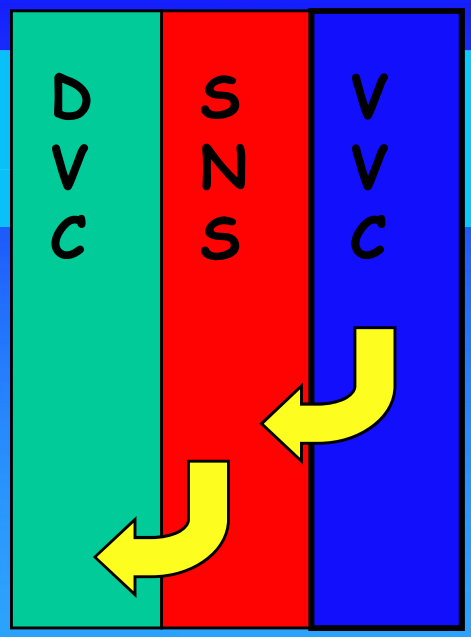



Babies 2 days old SSC vs MIS, 1hr


umama
baphumle


Hold
Heart Rate Average
Skin Conductance Level (SCL)

HRV produces IBI
(Inter Beat Interval)



FFT / AR / wavelet

- social vagus (validated)
- sympathetic (accepted)
- "old vagus" (our hypothesis)

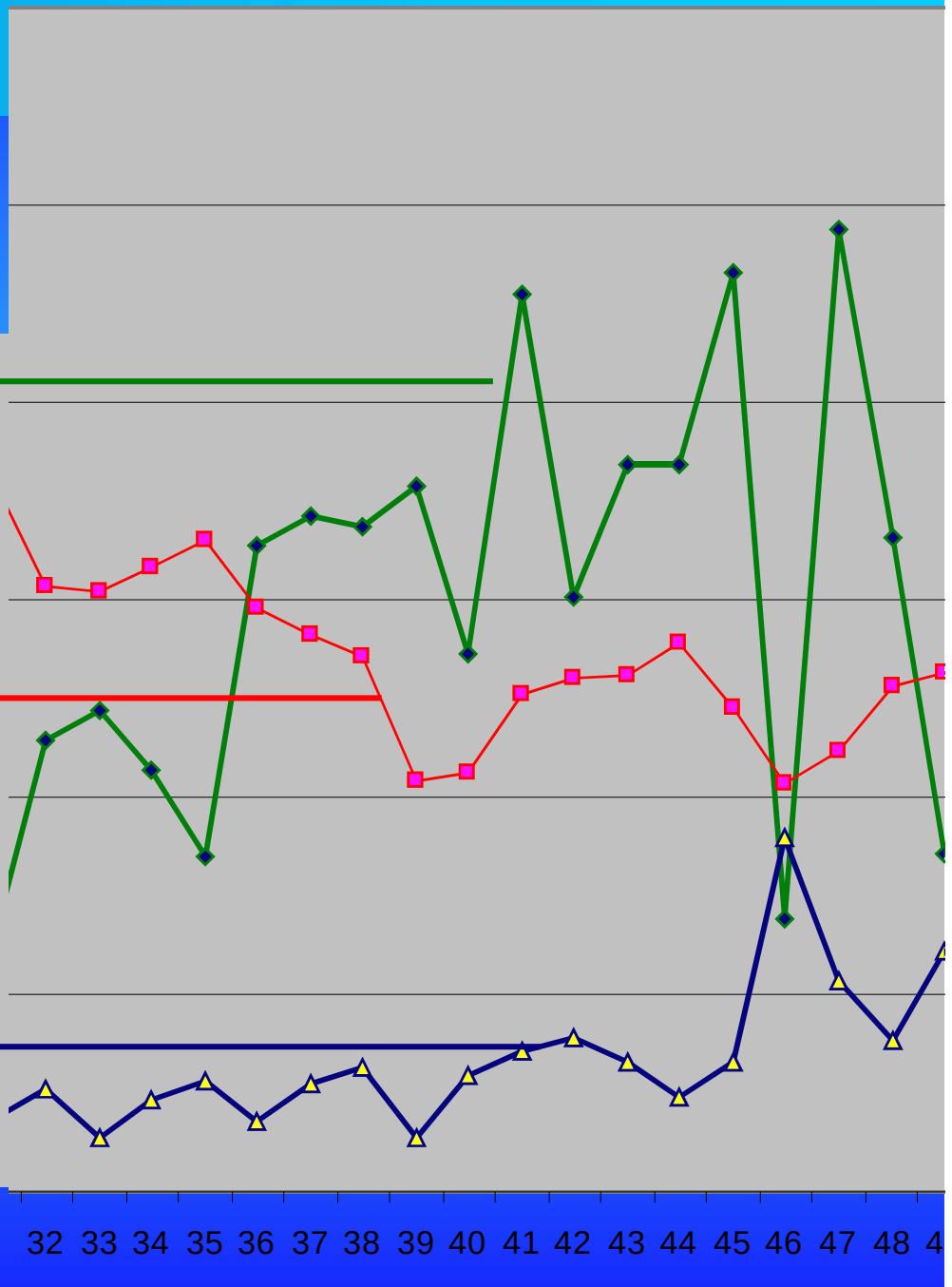
1. The ventral vagal complex (VVC): a mammalian signaling system for motion, emotion, and communication.
2. The sympathetic nervous system (SNS): an adaptive mobilization system supporting fight or flight behaviors.
3. The dorsal vagal complex (DVC): a vestigial immobilization system.

AUTONOMIC STATE COMPONENTS:

GREEN = OLD
VEGETATIVE VAGUS

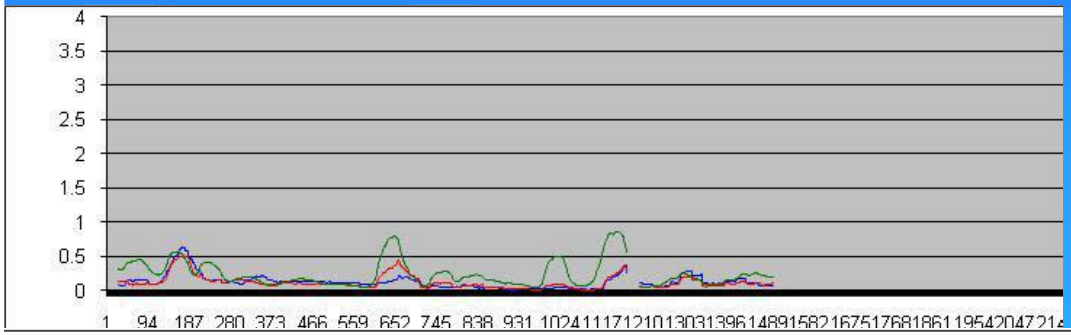
RED = SNS
SYMPATHETIC

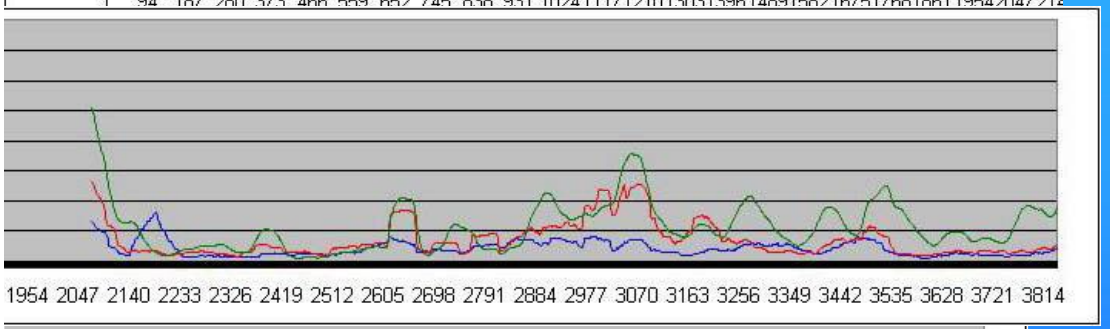
BLUE = NEW
SOCIAL VAGUS

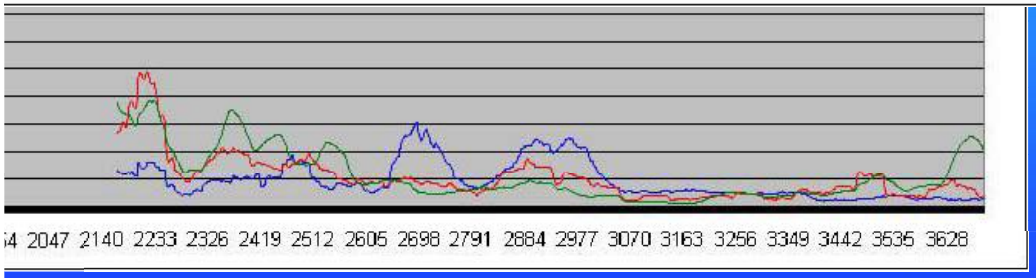


SLEEPING AUTONOMIC TONE:

SSC .....| MIS .....



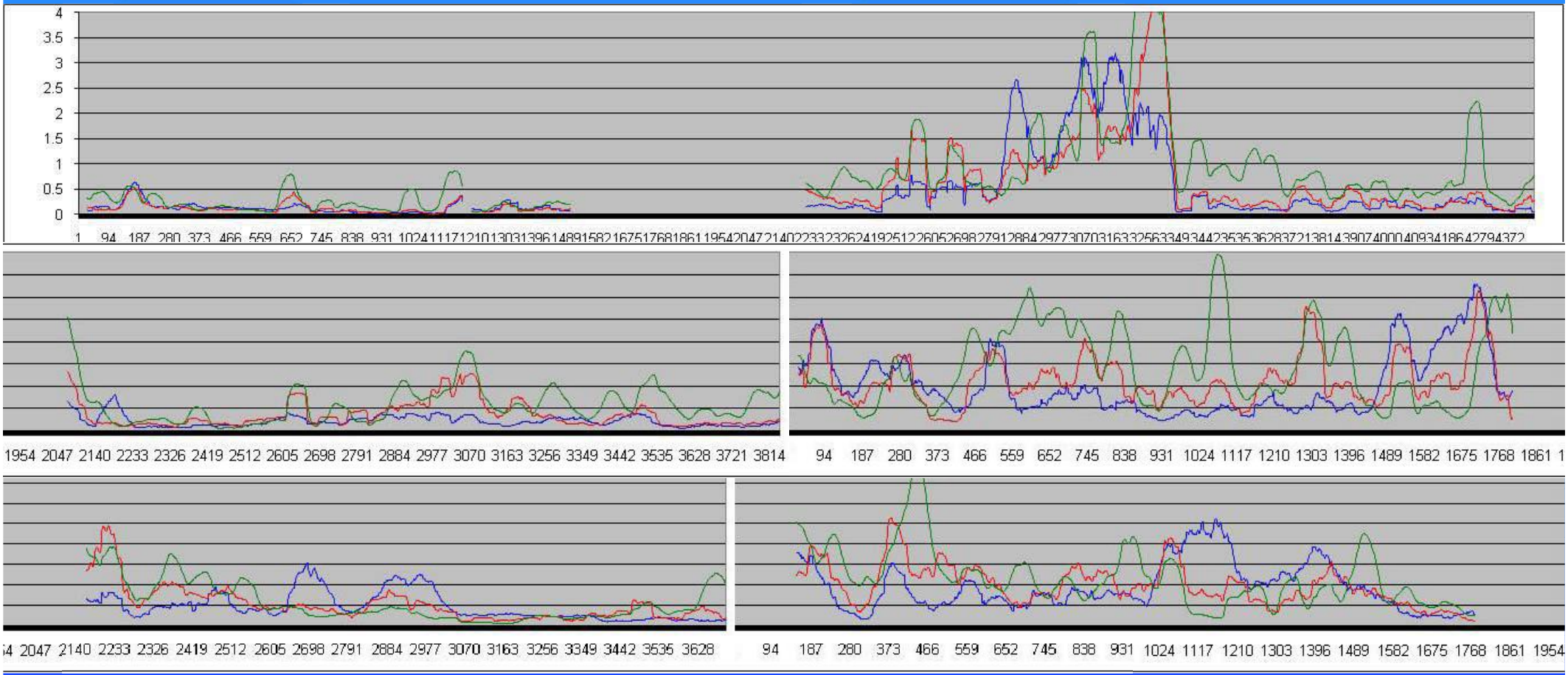




(Spectral analysis HRV)

SLEEPING AUTONOMIC TONE:

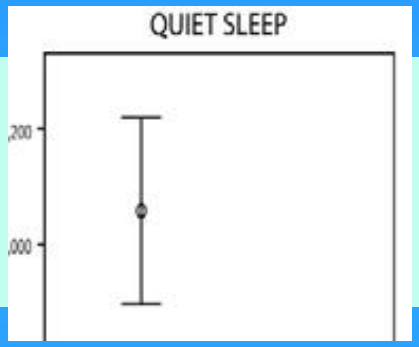
SSC .....| MIS .....

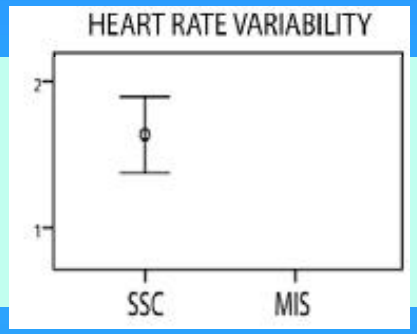


(Spectral analysis HRV)

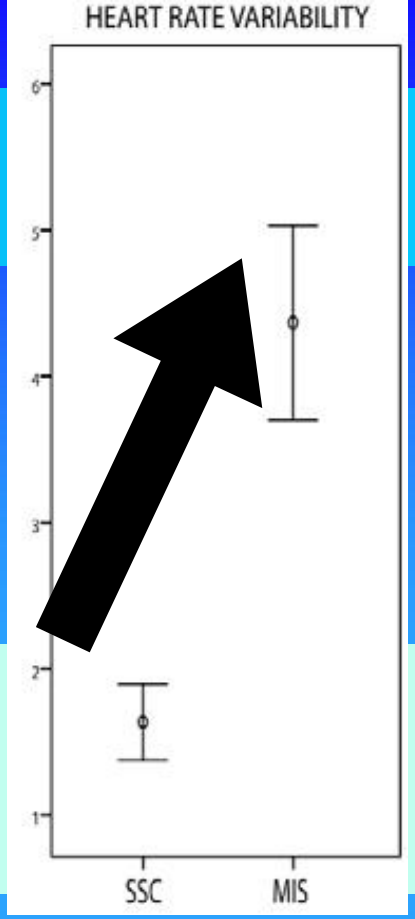
Skin-to-skin contact
= *NORMAL* PLACE

Skin-to-skin contact
= *NORMAL* PLACE

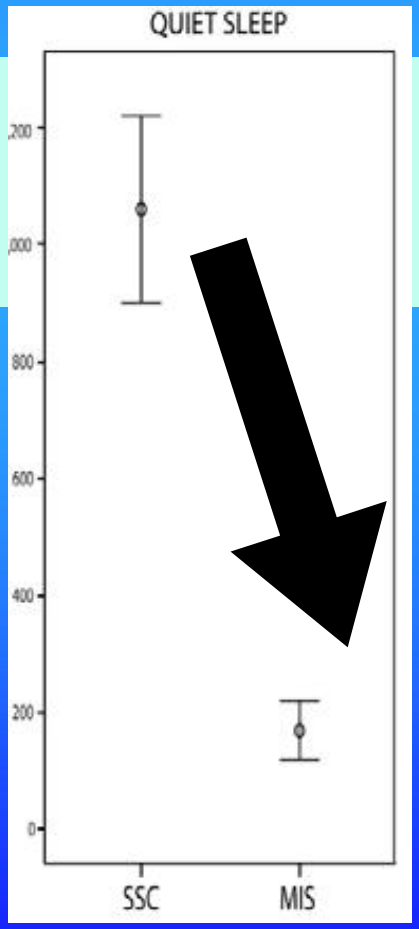




SEPARATE
176%
Increase
Autonomic
activity



Skin-to-skin contact
= *NORMAL* PLACE



SEPARATE
86%
Decrease
Quiet Sleep

SLEEP CYCLE - Neurodevelopment

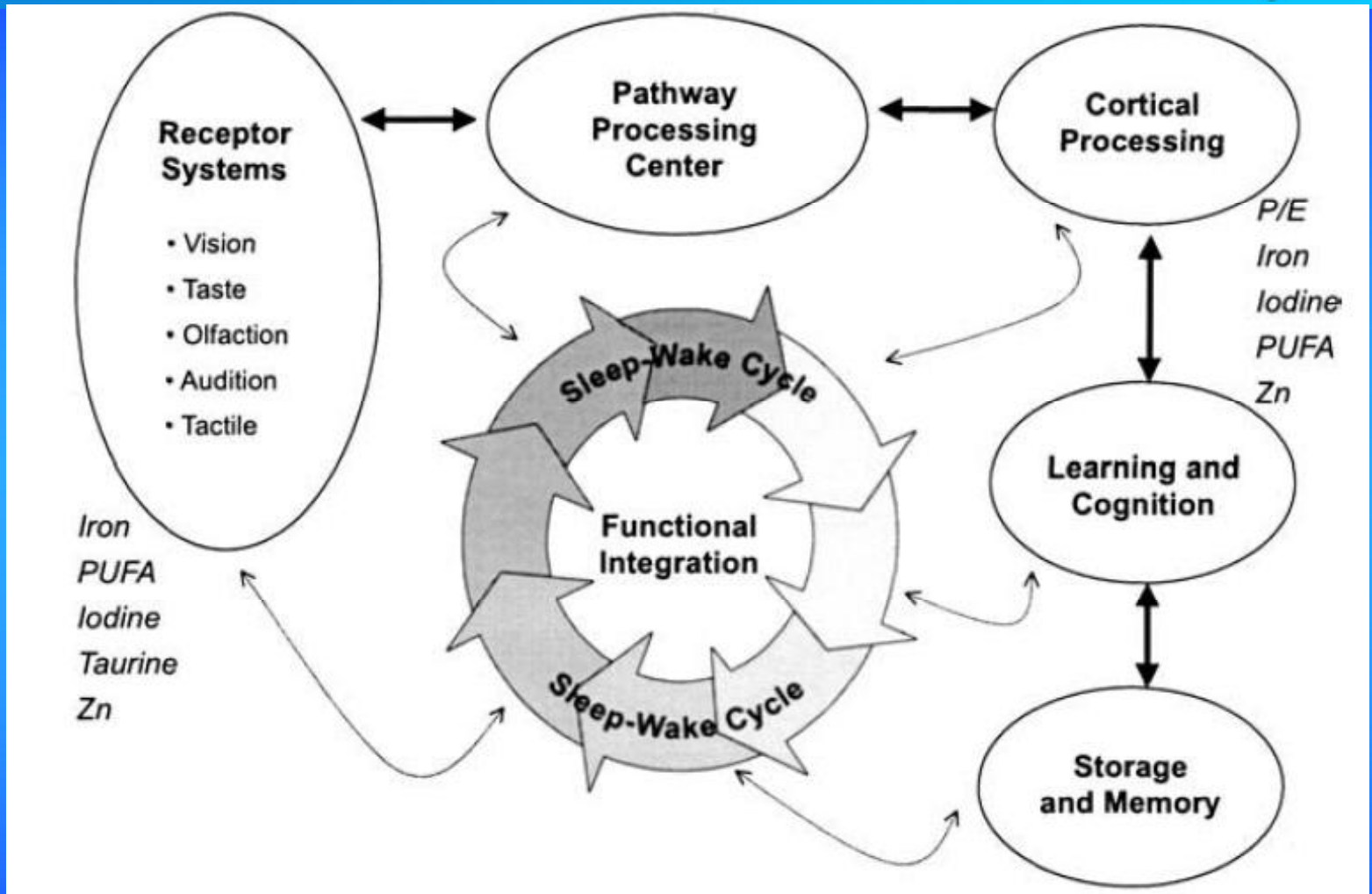
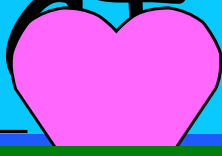


Fig 4. Schematic representation of the interaction between sensory receptors and CNS functions within the framework of the sleep-wake cycle. Nutrients with proven effects on sensory receptors and/or cortical processing are included (*PUFA*, polyunsaturated fatty acids; *Zn*, zinc; *P/E*, protein/energy).

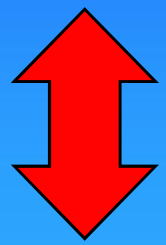
Peirano 2003

SKIN-TO-SKIN CONTACT



MOTHER

Normal sleep cycling



OTHER

Higher state arousal

SEPARATION

Separated neonates experience disturbed sleep cycling: instead **FREEZE & DISSOCIATION.**

Kangaroo Mother Care and Brain Development

ARTICLE IN PRESS

ARCHIVAL REPORT

Should Neonates Sleep Alone?

Barak E. Morgan, Alan R. Horn, and Nils J. Bergman

Maternal separation may be a stressor the human neonate is not well-evolved to cope with, and may not be benign.

NILS' TRANSLATION:

MATERNAL SEPARATION IS TOXIC STRESS !!

Maternal separation may be a stressor the human neonate is not well-evolved to cope with, and may not be benign.

ARCHIVAL REPORT

Should Neonates Sleep Alone?

...k E. Morgan, Alan R. Horn, and Nils J. Bergman

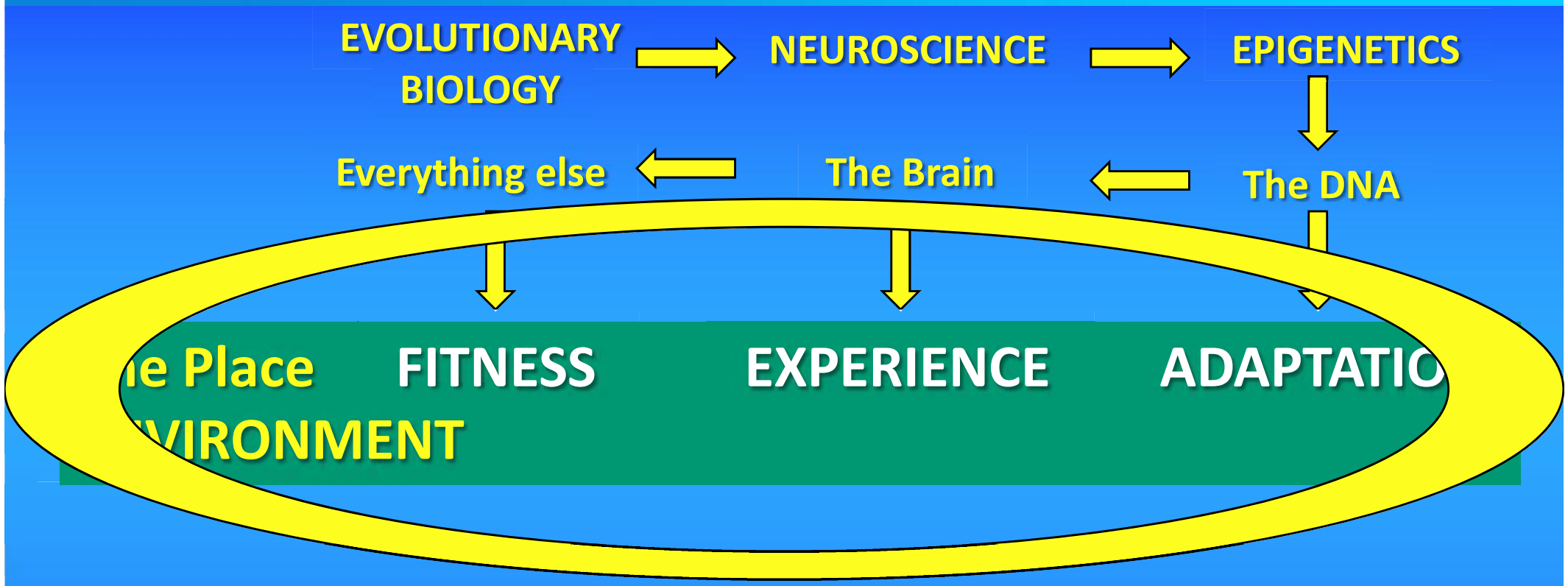
Backgrou... ...nal-neonate separation (MNS) in mam... model for studying the effects of stress on the development and function of physiological sy... ...mans, MNS is a Western norm and standard medical practice. However, the physiological impact of this is unknown. The physiological stress-response is orchestrated by the autonomic nervous system and heart rate variability (HRV) is a means of quantifying autonomic nervous system activity. He...t rate variability is influenc...d by level of arou... ...ch can b... accurately quantified during sleep. Sleep is also essential for optimal ear... ...ain development.

Methods: To investigate the impact of MNS in humans, we measured HRV ... 16 2-day-old full-ter... neonates s...ping in skin-to-skin contact with their mothers and sleeping alone, for 1 hour in each pla..., befor... ischarge from ho...pital. Infant ...havior was observed continuously and manually recorded according to a validated scale. C...diac interbe...t intervals and continuous ...ectrocardiogram were recorded using two independent devices. Heart rate variability (taken o...y from sleep sta... to contr... for level o... ...rousal) was analyzed in the frequency domain using a wavelet method.

Results: Results show a 176% increase in autonomic activity and an 8...% decrease in quiet sleep duration duri... MNS compa... with skin-to-skin contact.

Conclusions: Maternal-neonate separation is associated with a dramatic increase in HRV power, possibly indicative of central anxious autonomic arousal. Maternal-neonate separation also had a profoundly negative impact on quiet sleep duration. Maternal separation may be a stressor the human neonate is not well-evolved to cope with and may not be benign.

"Scientific foundation" … a synthesis



ZERO SEPARATION

Kangaroo Mother Care

The prime philosophy of care of low birth weight infants

Skin-to-skin contact is the right PLACE

Separation → maladaptation

Kangaroo Mother Care

The prime philosophy of care of low birth weight infants

KMC is NORMAL

Separation → causes TOXIC STRESS