THE HEALING POWER OF LOVE:
AN OXYTOCIN HYPOTHESIS

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A few of the questions that we are examining:

What is love and what are social bonds? (A biological point of view)

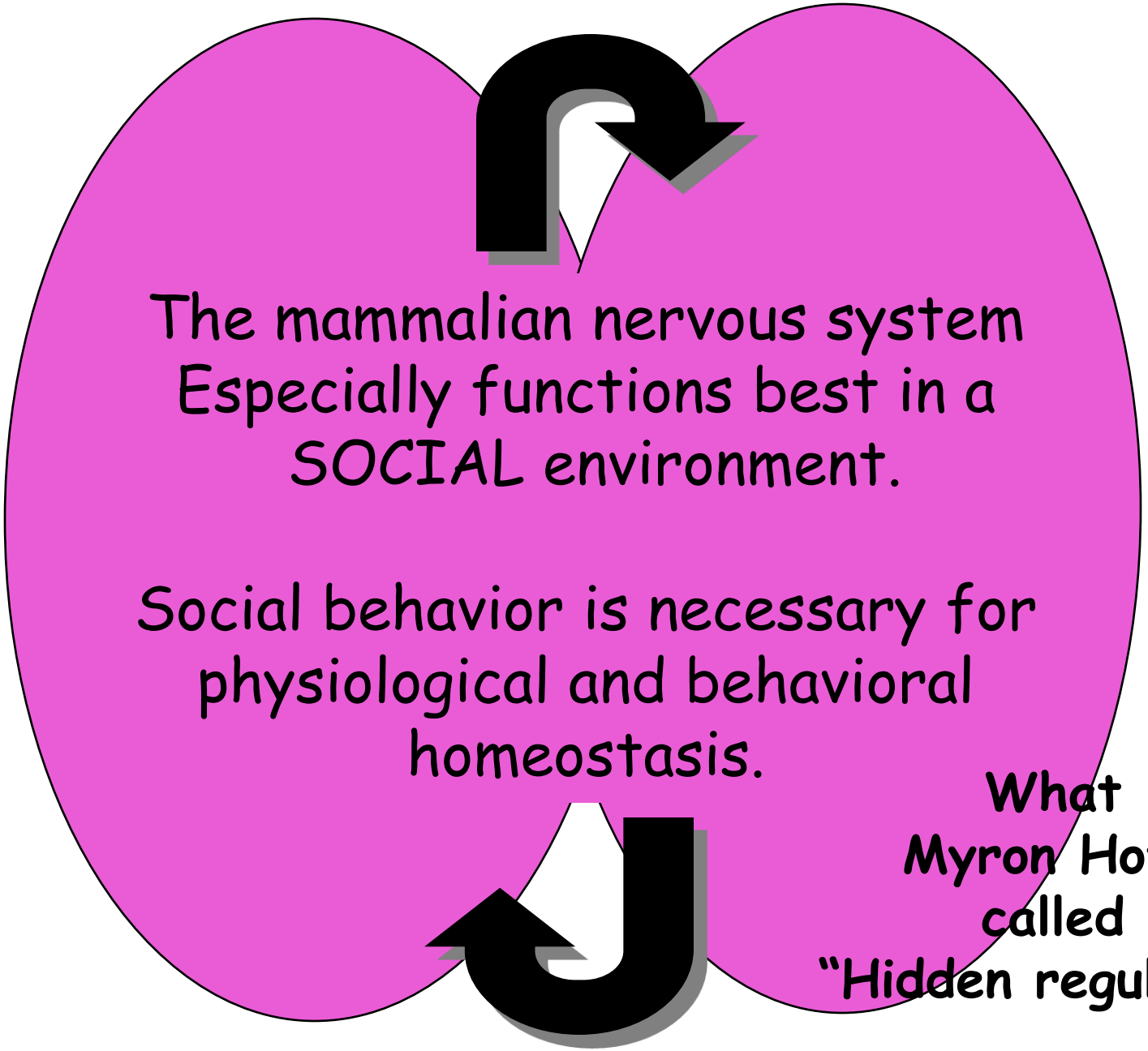
What are the causes and consequences of social bonds and social support? …Essential components of what humans call "LOVE.

How does the study of social mammals help us understand the mechanisms underlying the health benefits of love and social support?

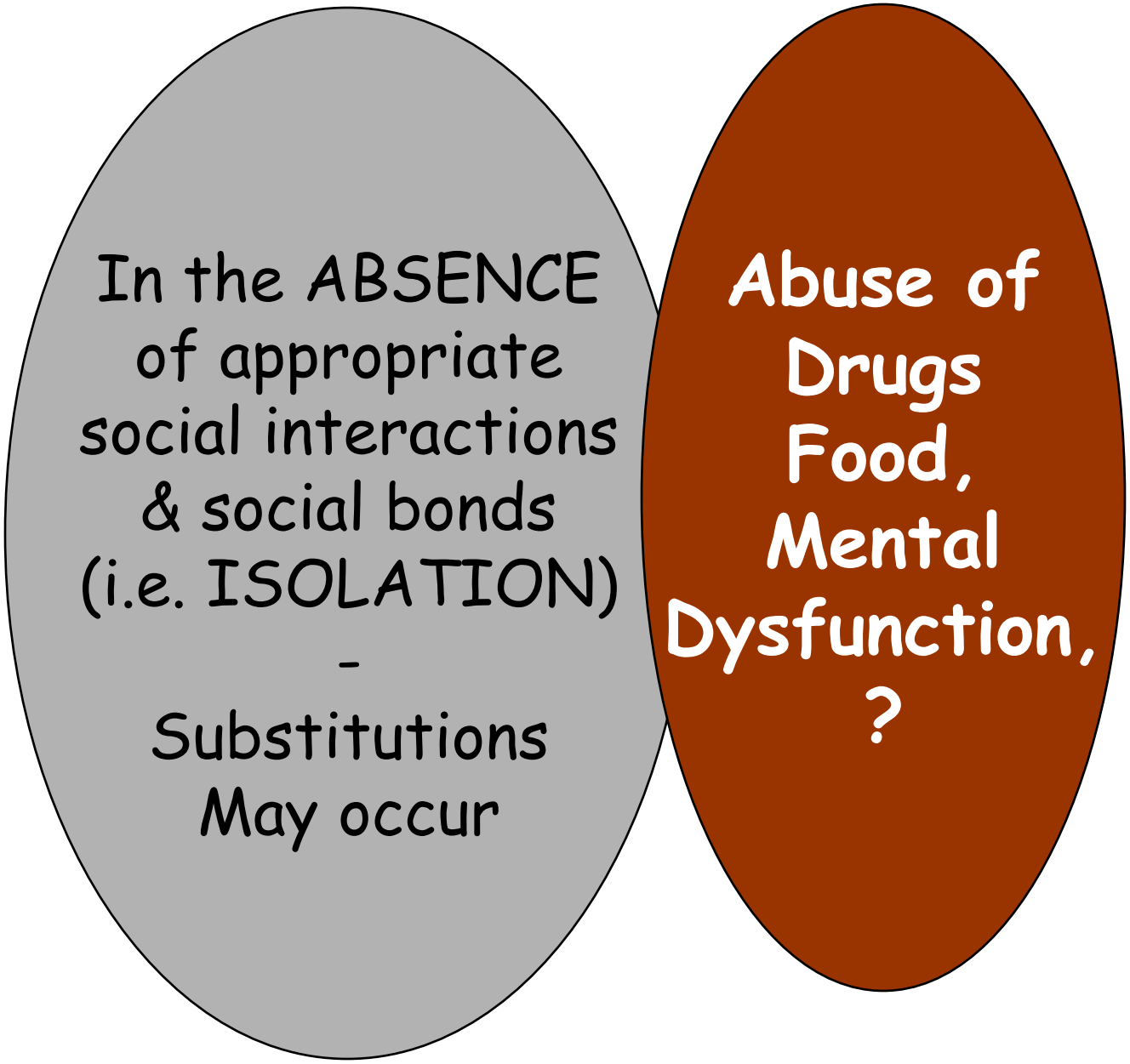
How can neuroendocrine systems that uses an ancient hormone, known as OXYTOCIN, help us understand the role of love, social bonds or social support in healing and restoration? And

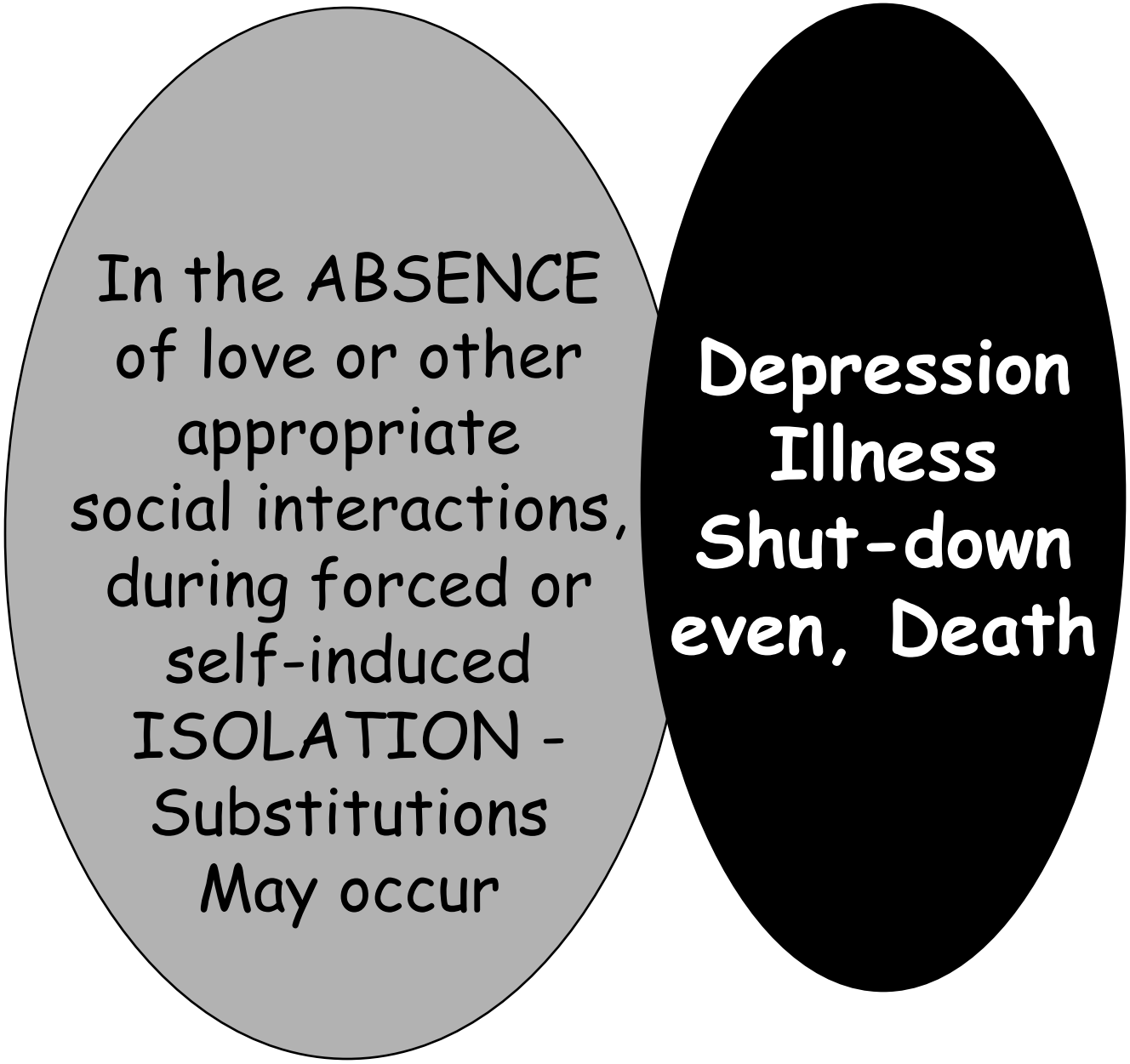
The EVOLUTION OF THE HUMAN NERVOUS SYSTEM AND HUMAN SOCIALITY

Most living organisms can
NOT SURVIVE
OR REPRODUCE ALONE.



What Myron Hofer called "Hidden regulators"


In the ABSENCE of appropriate social interactions & social bonds (i.e. ISOLATION)
-
Substitutions May occur
Abuse of Drugs Food, Mental Dysfunction, ?


In the ABSENCE of love or other appropriate social interactions, during forced or self-induced ISOLATION - Substitutions May occur
Depression Illness Shut-down even, Death

Abstract concepts like

LOVE & SOCIAL BONDS, are most easily understood in the context of their functions which are

SURVIVAL

- social support & safety

REPRODUCTION

- access to mates
- care of offspring
- genetic survival

How can a knowledge of the nervous system, and in particular the neurochemistry of OXYTOCIN give us a deeper understanding of –

THE EVOLUTION OF HUMAN BEHAVIOR

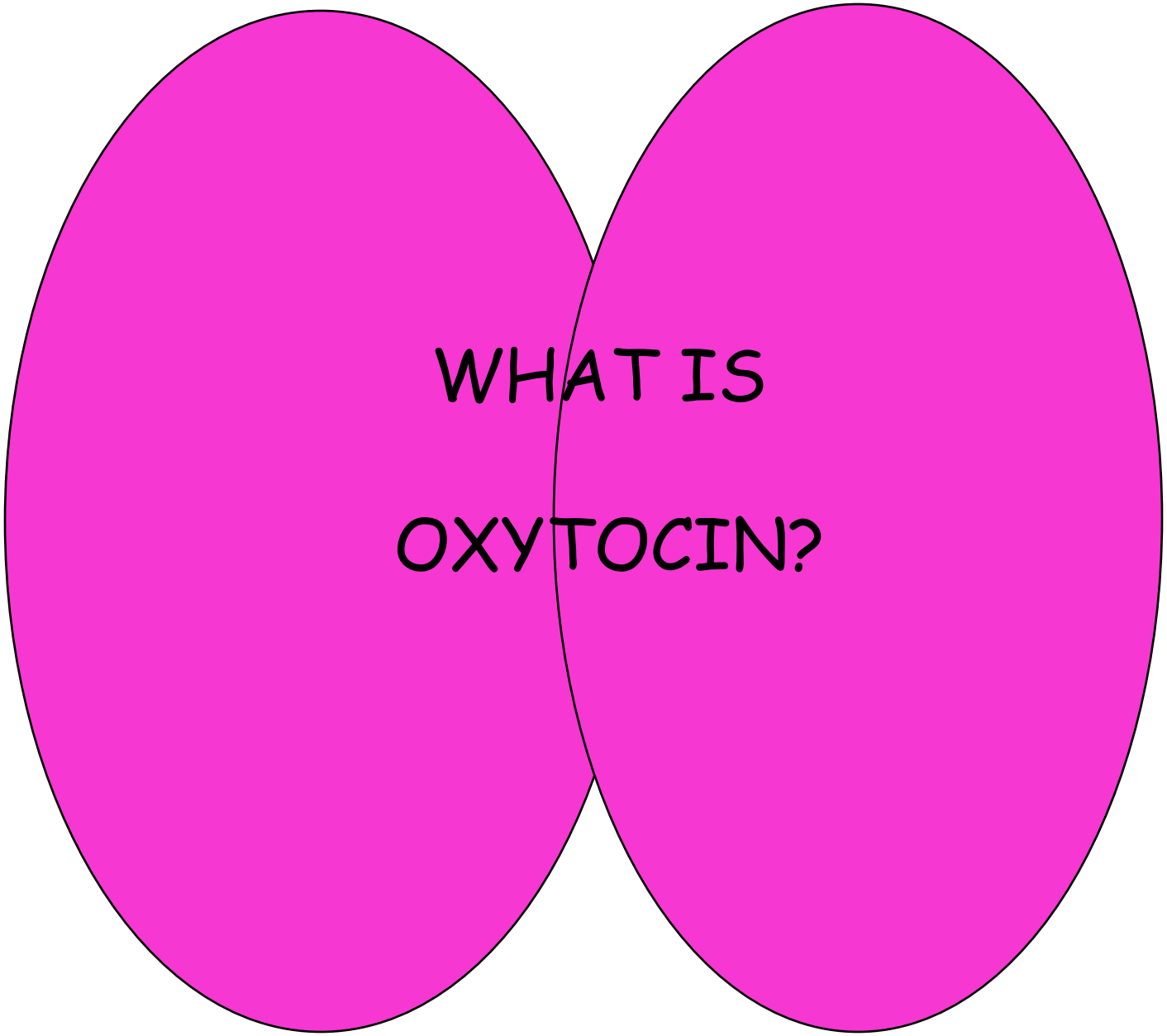
THE POWER OF LOVE AND SOCIAL SUPPORT?

WHY HUMANS ARE SO DEPENDENT ON SOCIALITY

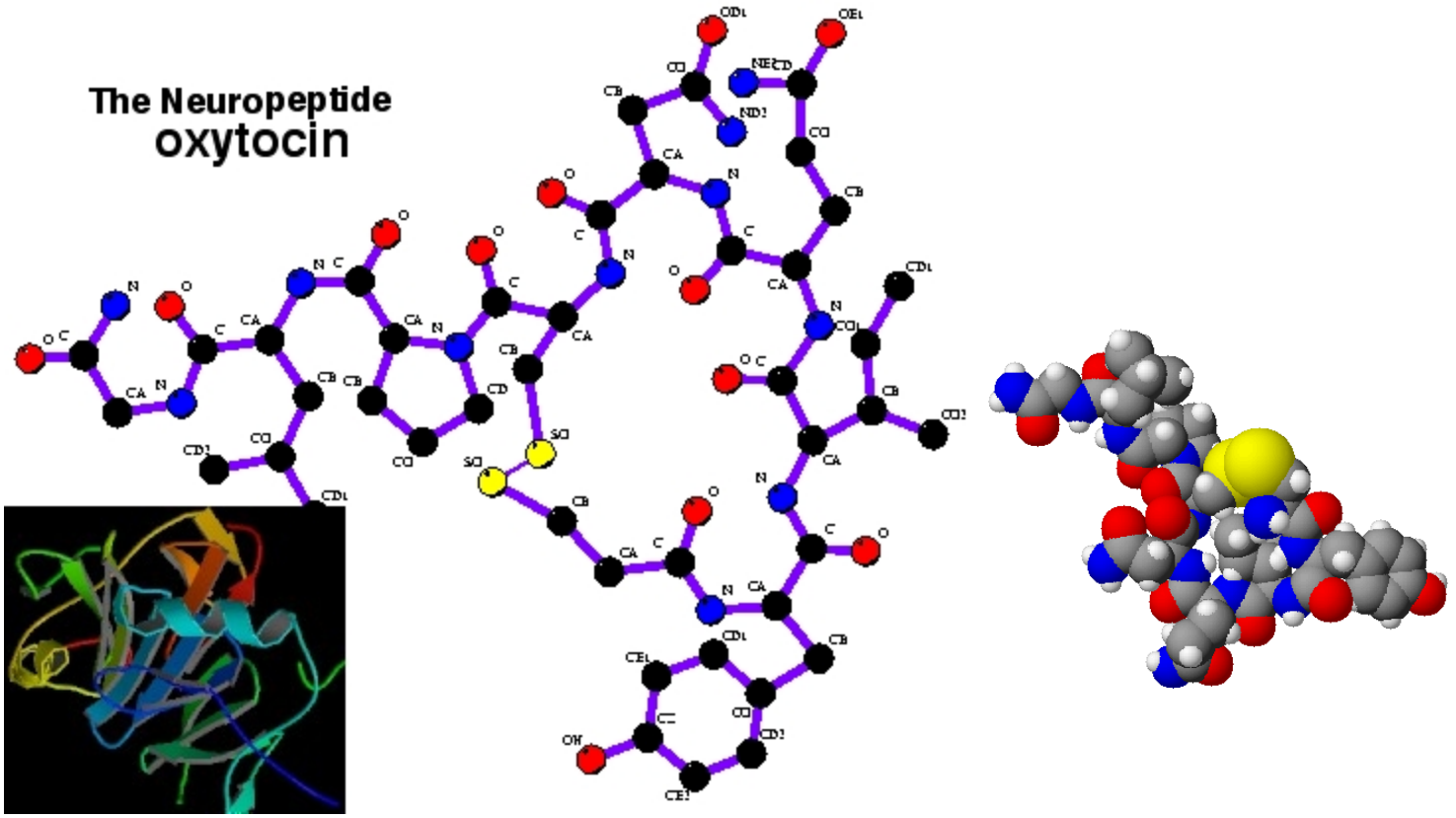
THE MECHANISMS THROUGH WHICH BOTH GIVING AND RECEIVING LOVE CAN HEAL?

The EVOLUTIONARY prototype for LOVE, SOCIAL BONDS and SOCIAL SUPPORT in mammals is the parent-child interaction

Studies in rodents leave no doubt that the mechanisms underlying social bonds share neuroendocrine substrates with those for sex, birth, maternal behavior, and lactation, including reliance on uniquely mammalian hormones including OXYTOCIN

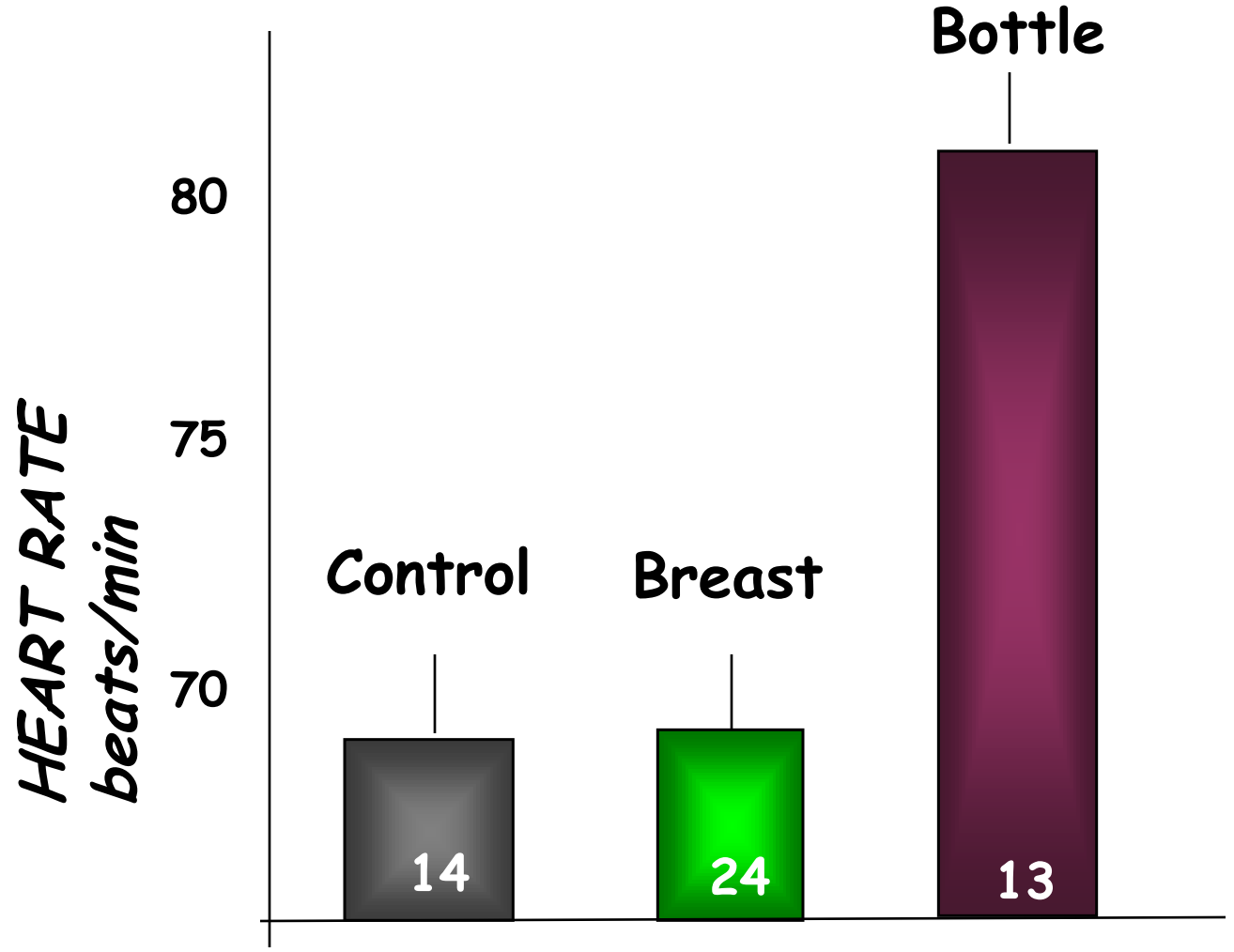

WHAT IS
OXYTOCIN?

Oxytocin is central to the biology of social behavior, social bonds and social support, and sexual behavior.



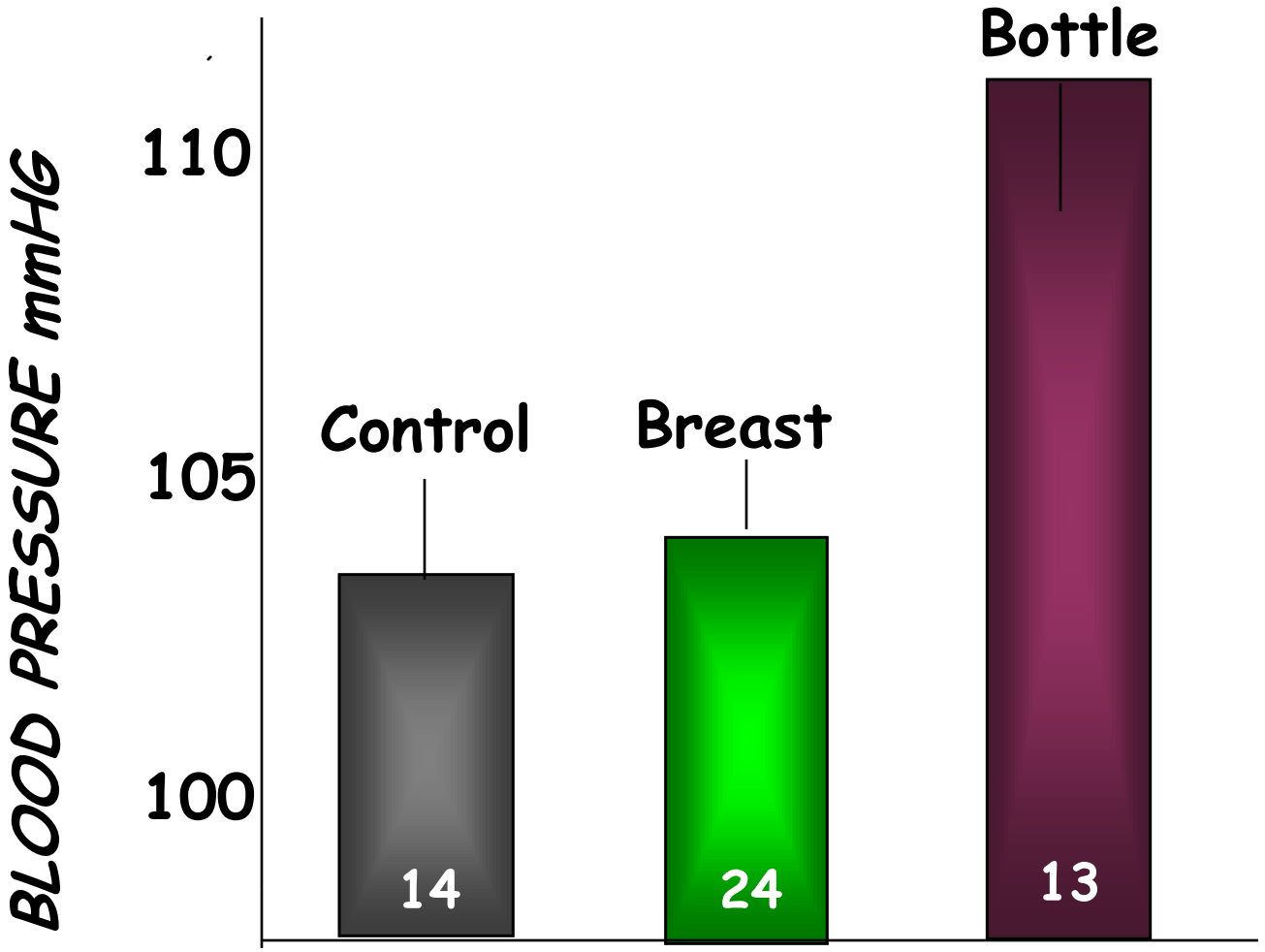
The dependence of humans on oxytocin is best understood in the context of mammalian evolution.
Historically breast-feeding was the only viable method for nourishing newborn humans – and other mammals. Oxytocin is essential for lactation and also important to birth, especially in humans with our large cranium and extended period of dependency on "mothers or others".

Bottle-feeding women have higher basal heart rate



Altemus, et al., Psychosom. Med. 2001

Bottle-feeding women have higher systolic blood pressure

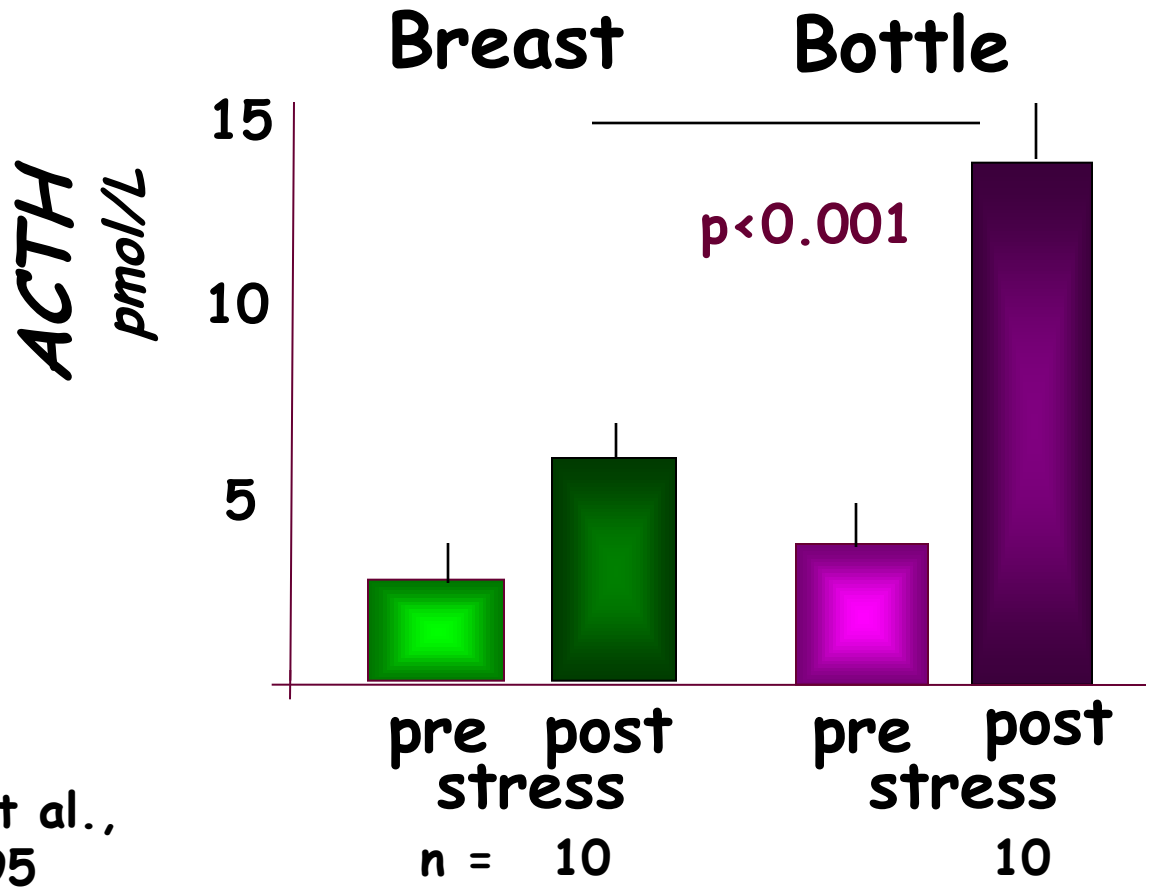


Altemus, et al., Psychosom. Med. 2001

Breast feeding women are less reactive to physical stressors

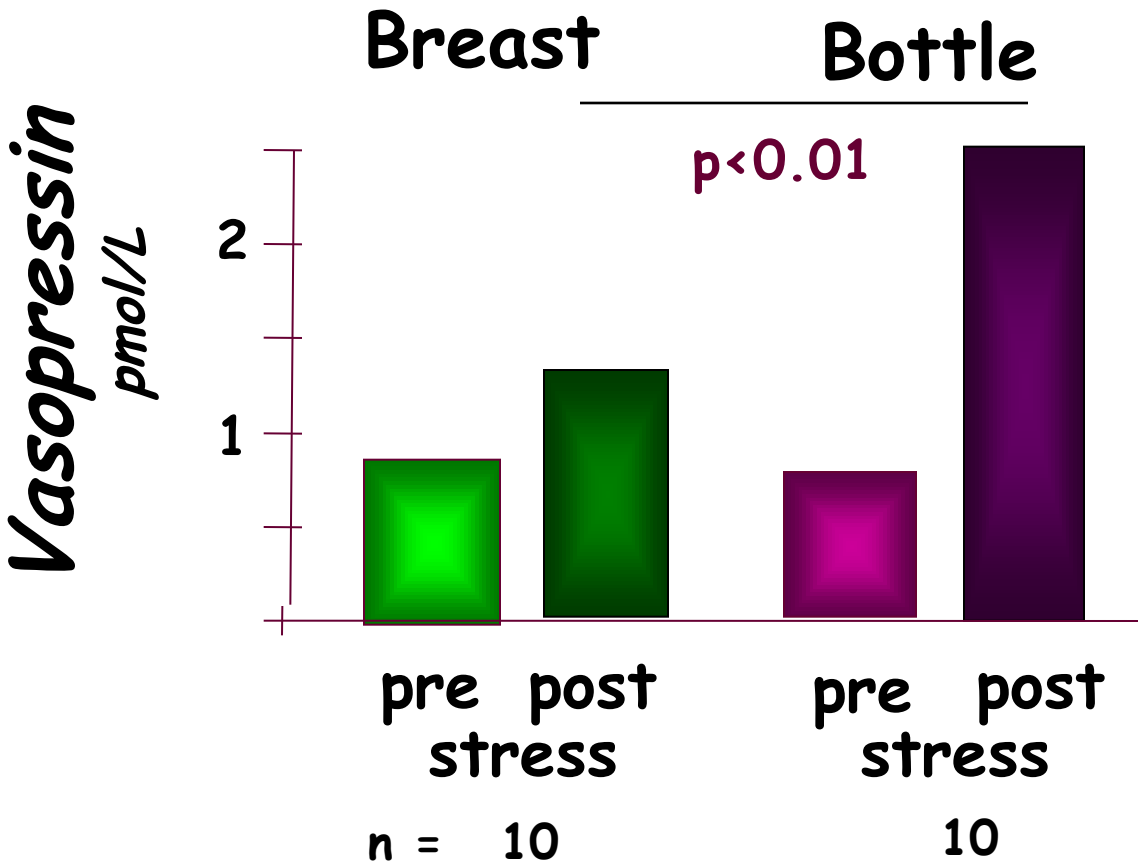
ACTH

(before & 30 min after the onset of exercise)



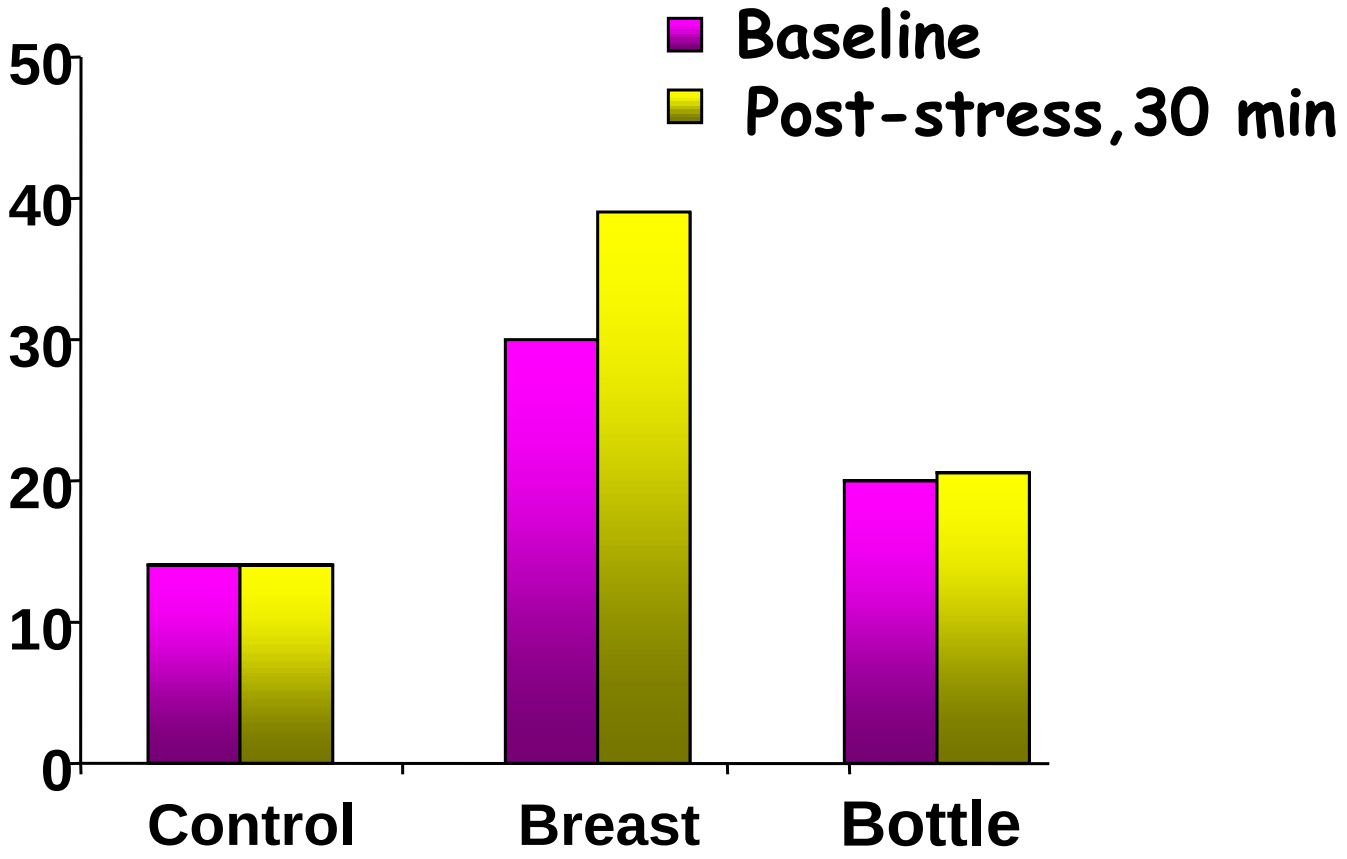
Altemus, et al.,
JCEM, 1995

Breast feeding women are less reactive to physical stressors including LOWER VASOPRESSIN (before & 25 min after the onset of exercise)



Altemus, et al., JCEM, 1995

White blood cell (lymphocyte) proliferation in response to a mitogen was higher in breastfeeding women, even in comparison to control women - not postpartum



Enhanced immune responses were seen in lactating women

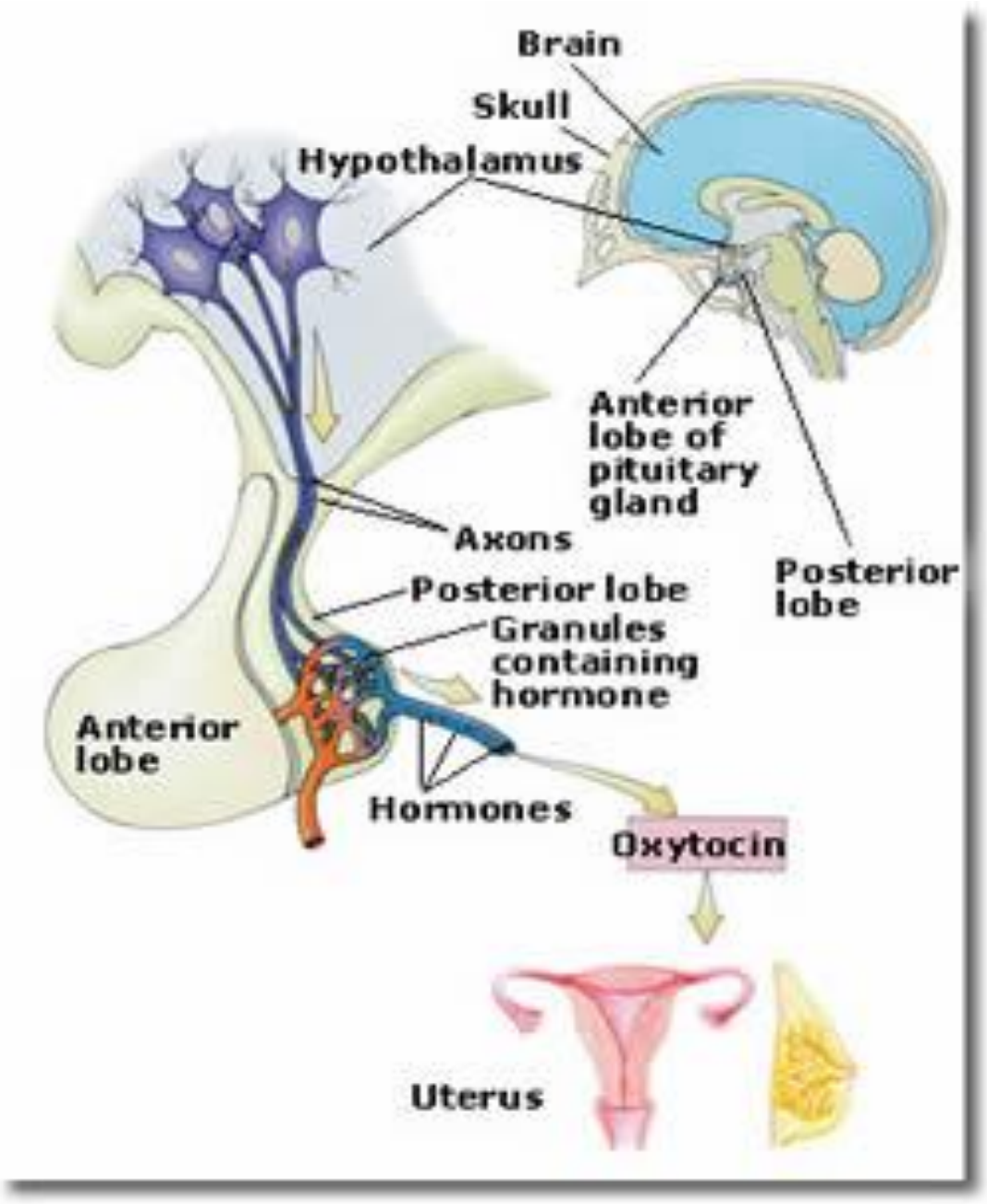
Lactation may allow a new mother to manage stress more effectively.

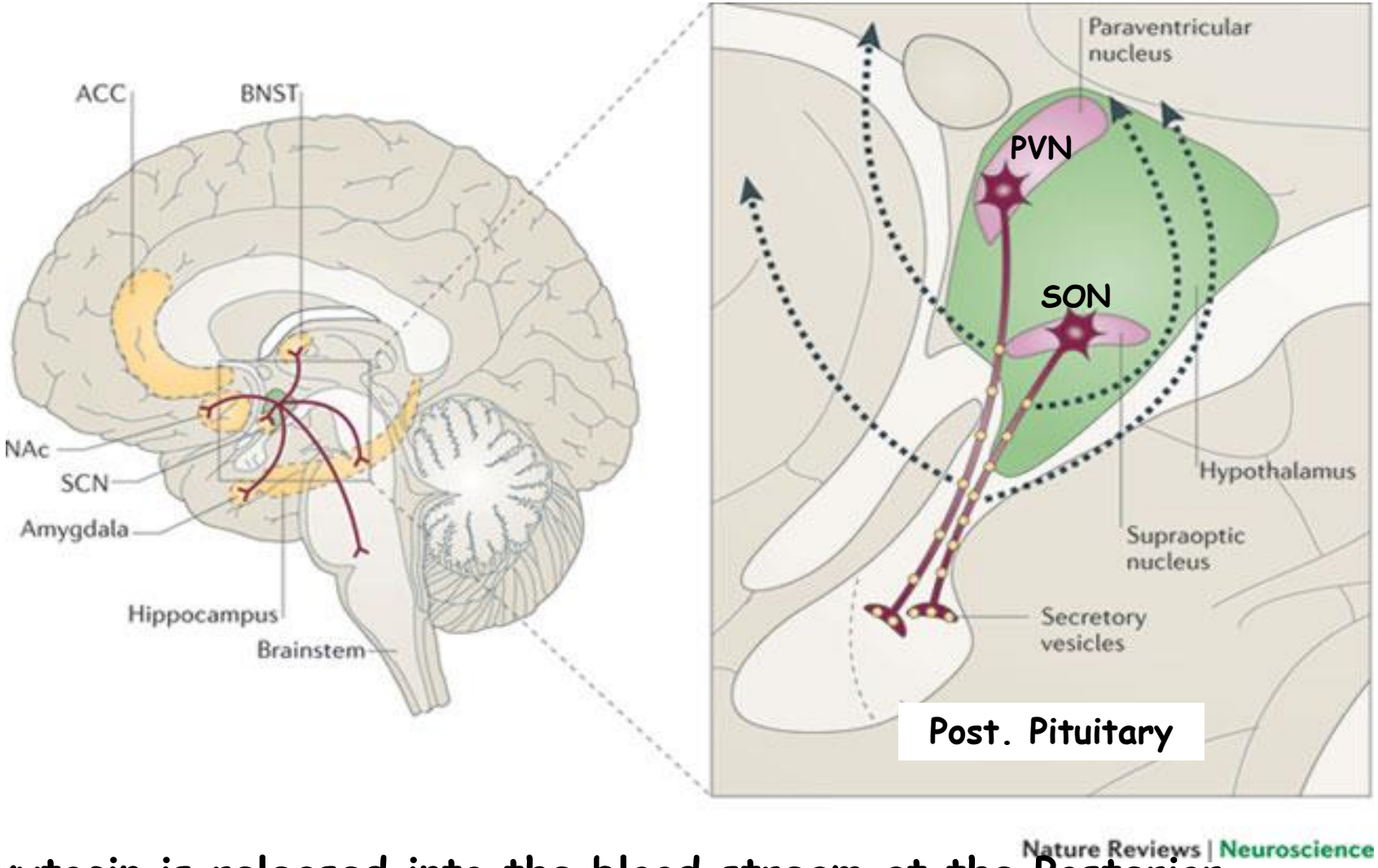
Less reactivity or more appropriate reactions to stressors, including stressful stimuli associated with child rearing.

Buffer between the physiological state of pregnancy & the postpartum period - in part through effects of OXYTOCIN.

Oxytocin was classically viewed as a "FEMALE REPRODUCTIVE" Hormone, Acting primarily On the UTERUS And MAMMARY GLAND.

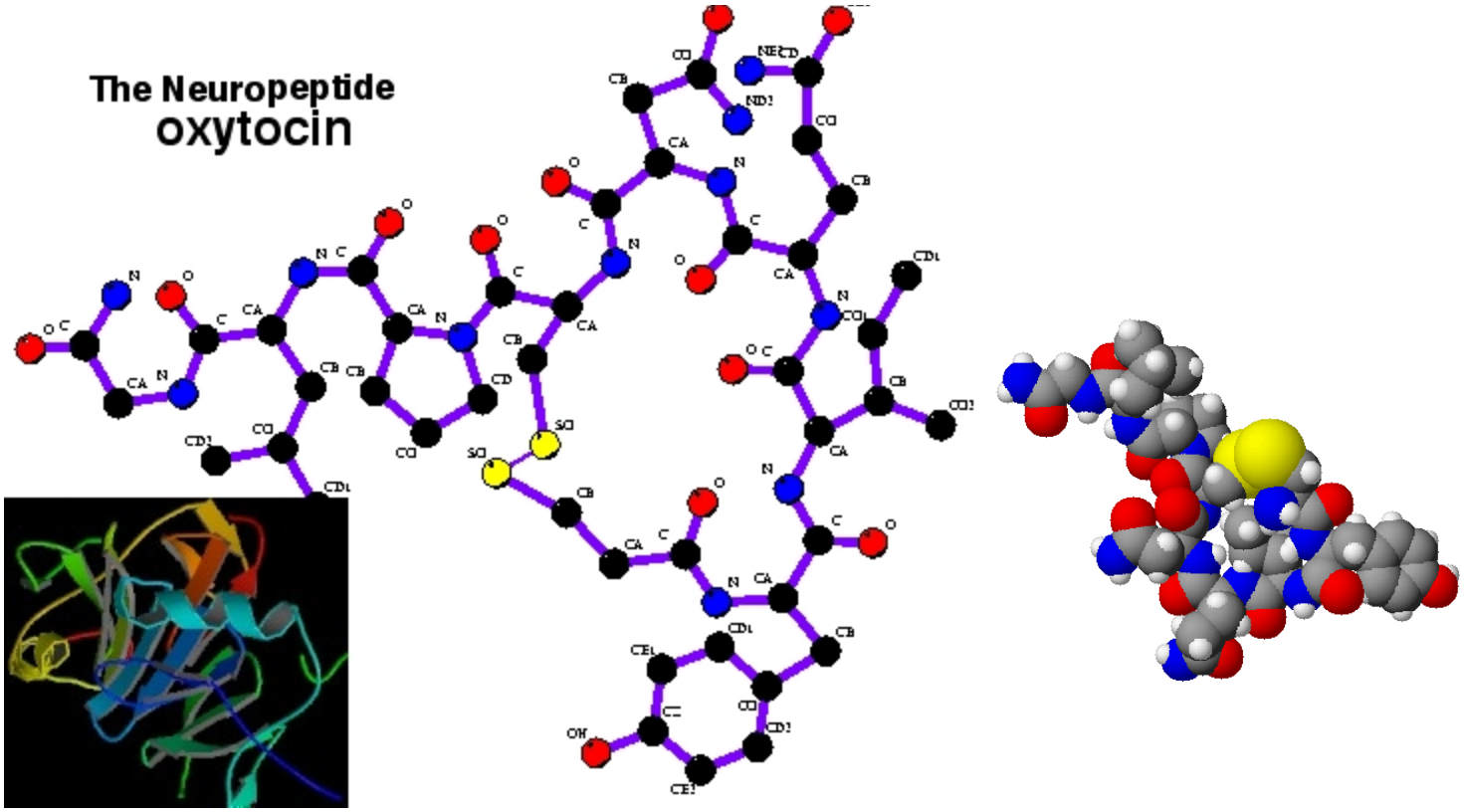
This is only part of the story!

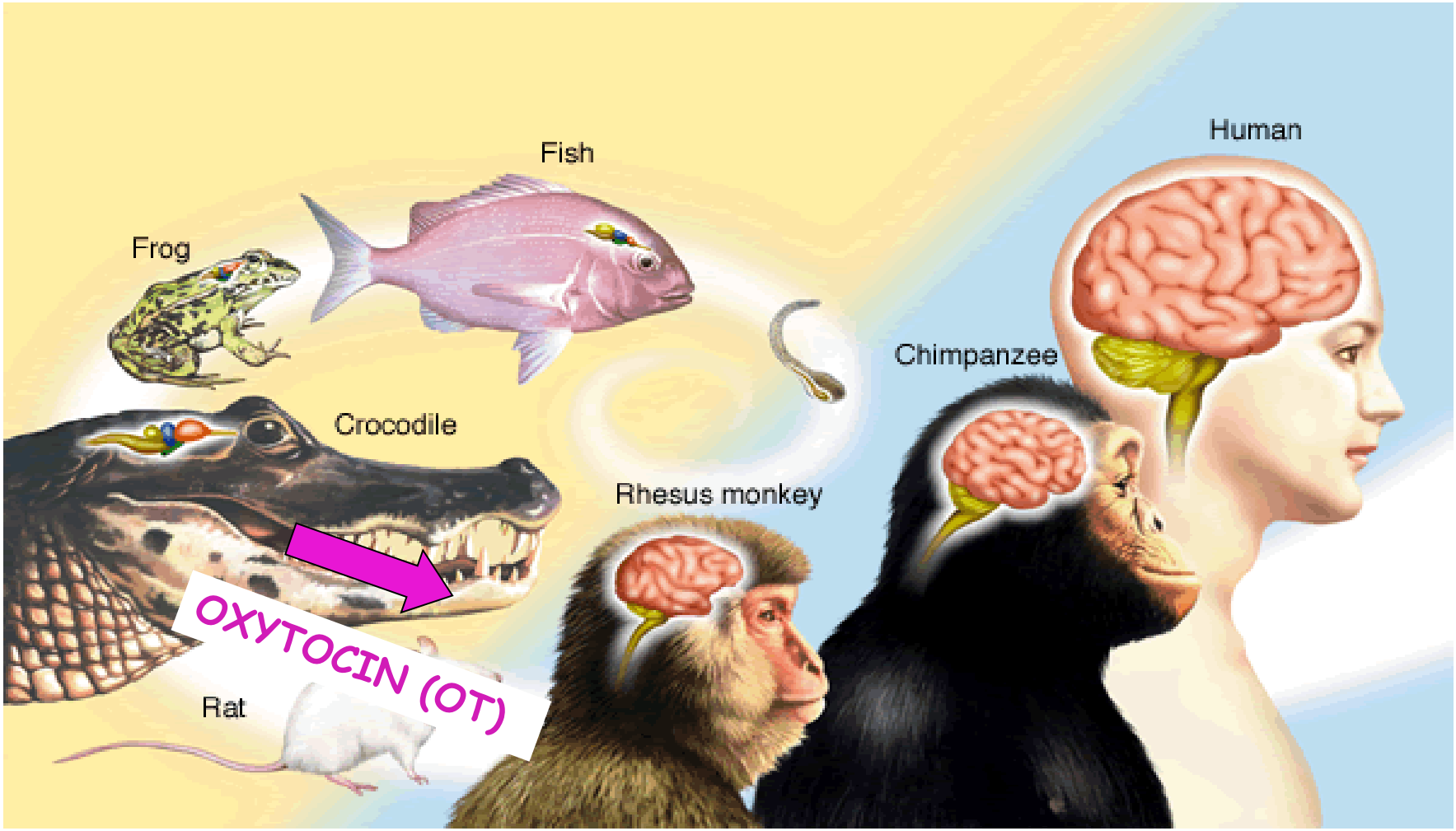




Oxytocin is released into the blood stream at the Posterior Pituitary, but is also released within the nervous system. Oxytocin can affect social behavior, the autonomic nervous system and the immune system,allowing the body to ADAPT, protect and heal itself in the face of challenge.

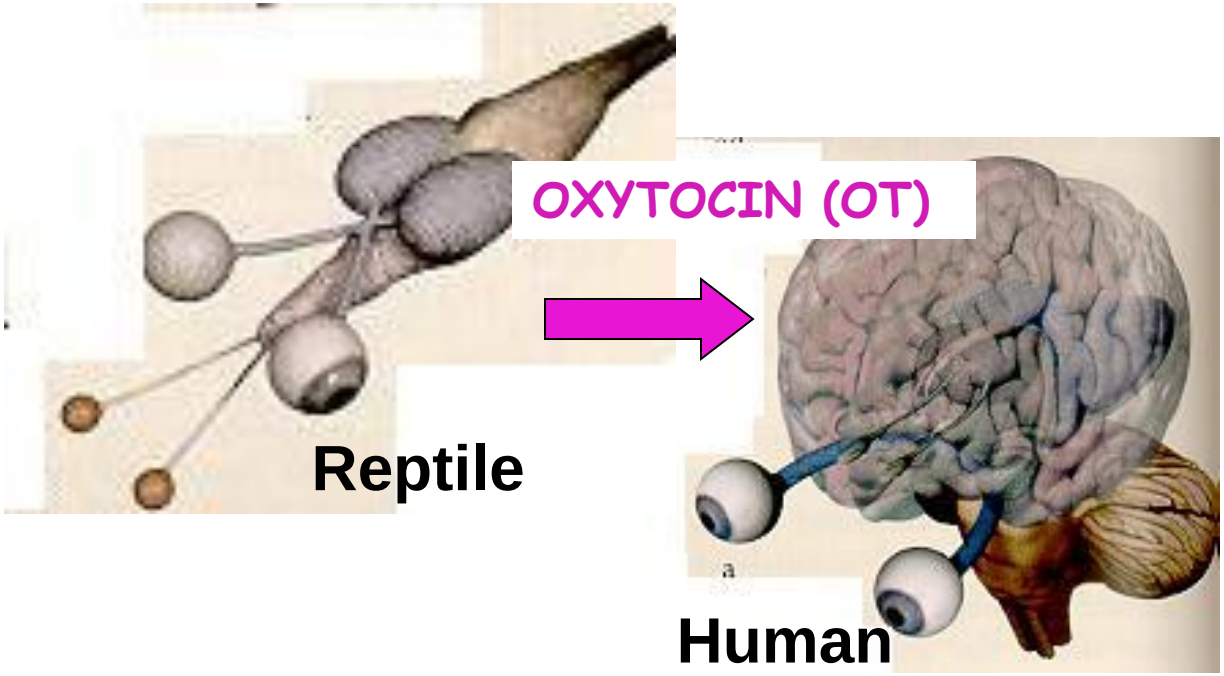
Oxytocin is not only central to the biology of social behavior, social bonds, social support, sexual behavior but also may have permitted the EVOLUTION OF THE HUMAN NERVOUS SYSTEM.





OXYTOCIN permitted the EVOLUTION of the MAMMALIAN NERVOUS SYSTEM and eventually the EVOLUTION of the HUMAN NERVOUS SYSTEM

The human nervous system is a consequence of evolution, with a massive increase in the cerebral cortex



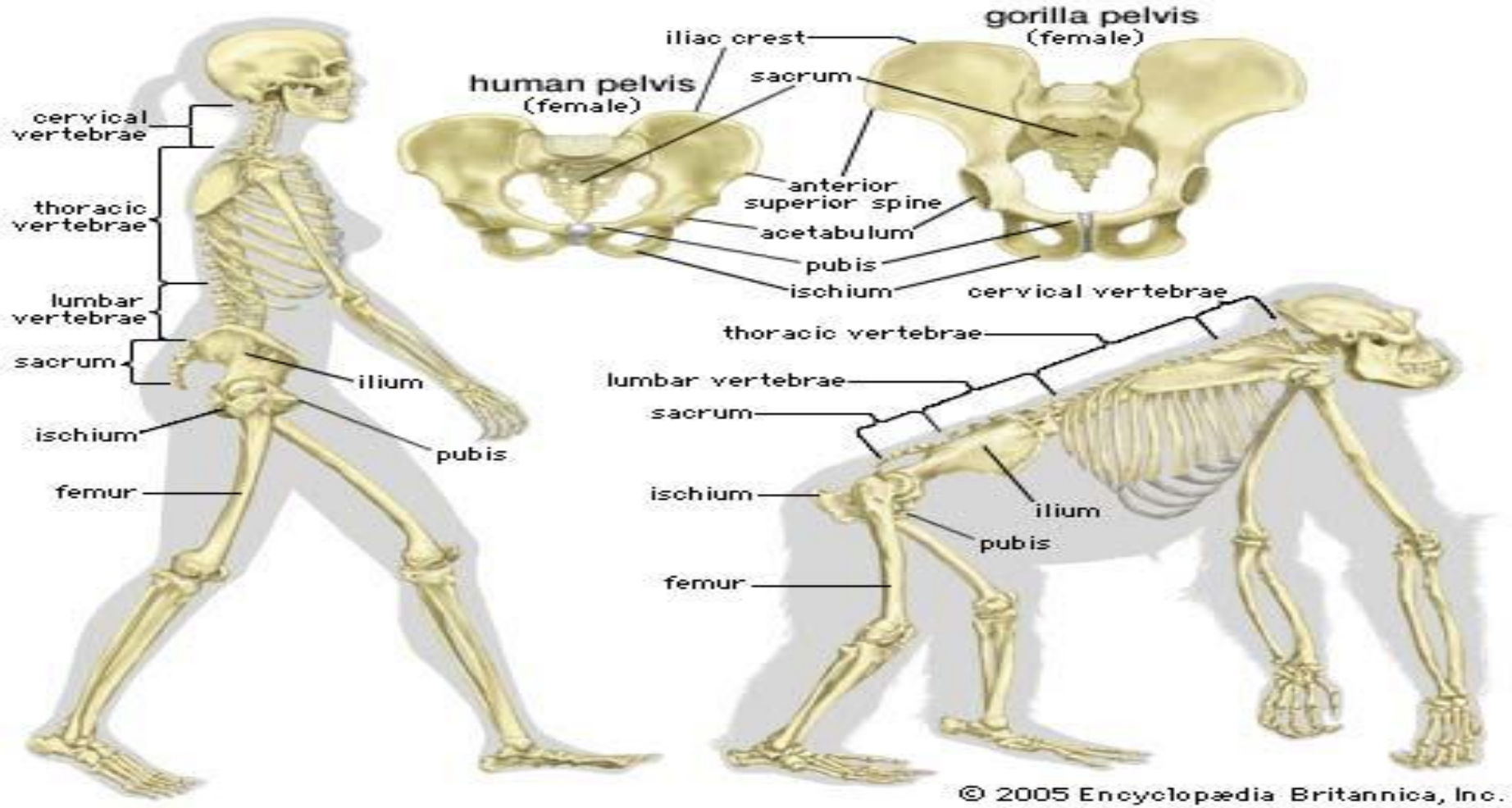
OXYTOCIN allows the transition from reptile to mammal.

OT permits birth (expelling the large-brained baby from the uterus)

OT permits post-birth nutrition & supports the baby (lactation/maternal behavior)

OT facilitates oxygenation of the brain (myelinated vagus).

PERMITS HUMAN COGNITION AND SOCIAL BEHAVIOR!



HUMAN BIRTH presents special problems because of our

- **BIG CORTEX and SKULL,**
- **BIPEDAL LOCOMOTION and**
- **SMALL, RIGID PELVIC GIRDLE**

OXYTOCIN FACITATES BIRTH by STRONG UTERINE CONTRACTIONS

Oxytocin does not act alone – for example, OXYTOCIN has a sibling hormone - VASOPRESSIN - from which it differs by 2 (of 9) amino acids

OXYTOCIN (OT)

Arginine VASOPRESSIN (AVP)

Oxytocin and Vasopressin evolved from an ancestral molecule, that preceded the evolution of Vertebrates

VASOPRESSIN	OXYTOCIN
DEFENSE	PROSOCIALITY
Territoriality	Sharing
Vigilance	Relaxation/Recovery
Mobilization	"Immobilization without fear"
ACTIVE	PASSIVE
ACUTELY PROTECTIVE	CHRONIC HEALING
SYMPATHETIC Nervous system	PARASYMPATHETIC Nervous system
	Oxygen to the cortex

WHAT IS LOVE?

METAPHORS for SAFETY, WORKING THROUGH THE AUTONOMIC NERVOUS SYSTEM.

OXYTOCIN LEVELS CAN BE REGULATED BY SOCIAL STIMULI AND EXPERIENCE WITH POTENTIALLY LONG LASTING CONSEQUENCES?

AND THESE EFFECTS OFTEN DIFFER IN MALES AND FEMALES

WHAT IS OXYTOCIN?

OXYTOCIN and SOCIAL EXPERIENCES, INCLUDING "LOVE"
ARE UNDER THE INFLUENCE OF EPIGENETICALLY-REGULATED SYSTEMS

By understanding the causes and consequences of mammalian sociality and the "social nervous system," we are gaining a deeper understanding of the biology of human emotion, and natural factors, such as "social support" or "love" that contribute to human health and well being.

Because of the fundamental role of sociality in human behavior, concepts like "social support" or "social bonds" translate not just into "love," but also to a sense of SAFETY. A concept that is at the heart of enduring loving relationship and also most successful therapies - of all kinds. A perceived sense of safety is necessary to allow the body to grow, heal and restore itself in the face of the "stress of life".

OXYTOCIN may play a critical, central role in allowing the human nervous system to feel safe.

Oxytocin also helps to explain much of Human Behavior.

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Oxytocin explains much of Human Behavior including our capacity to LOVE and

to use LOVE to HEAL.

LOVE is specific to mammals.
Reptiles do not have the capacity for love.

The EVOLUTION OF LOVE involves:

A dynamic dance between
Oxytocin and Vasopressin
(both of which are critical to mental health)

Oxytocin facilitates SOCIAL ENGAGEMENT
And a Sense of Safety
(love, empathy, compassion, relaxation)

Vasopressin may allow DEFENSE
OF SELF AND OTHERS
(vigilance, hypermobilization, territoriality, arousal)

Oxytocin is

1. made primarily in the brain (hypothalamus) & released into the blood supply at the posterior pituitary from which is acts on the uterus (birth) and Mammary tissue (milk ejection)

2.also released into the brain & spinal cord where it binds to OXYTOCIN receptors OTRs) to influence behavior & physiology

3. possibly a major factor in the body's capacity to PROTECT or HEAL in the face of either emotional or physical challenge/stress.

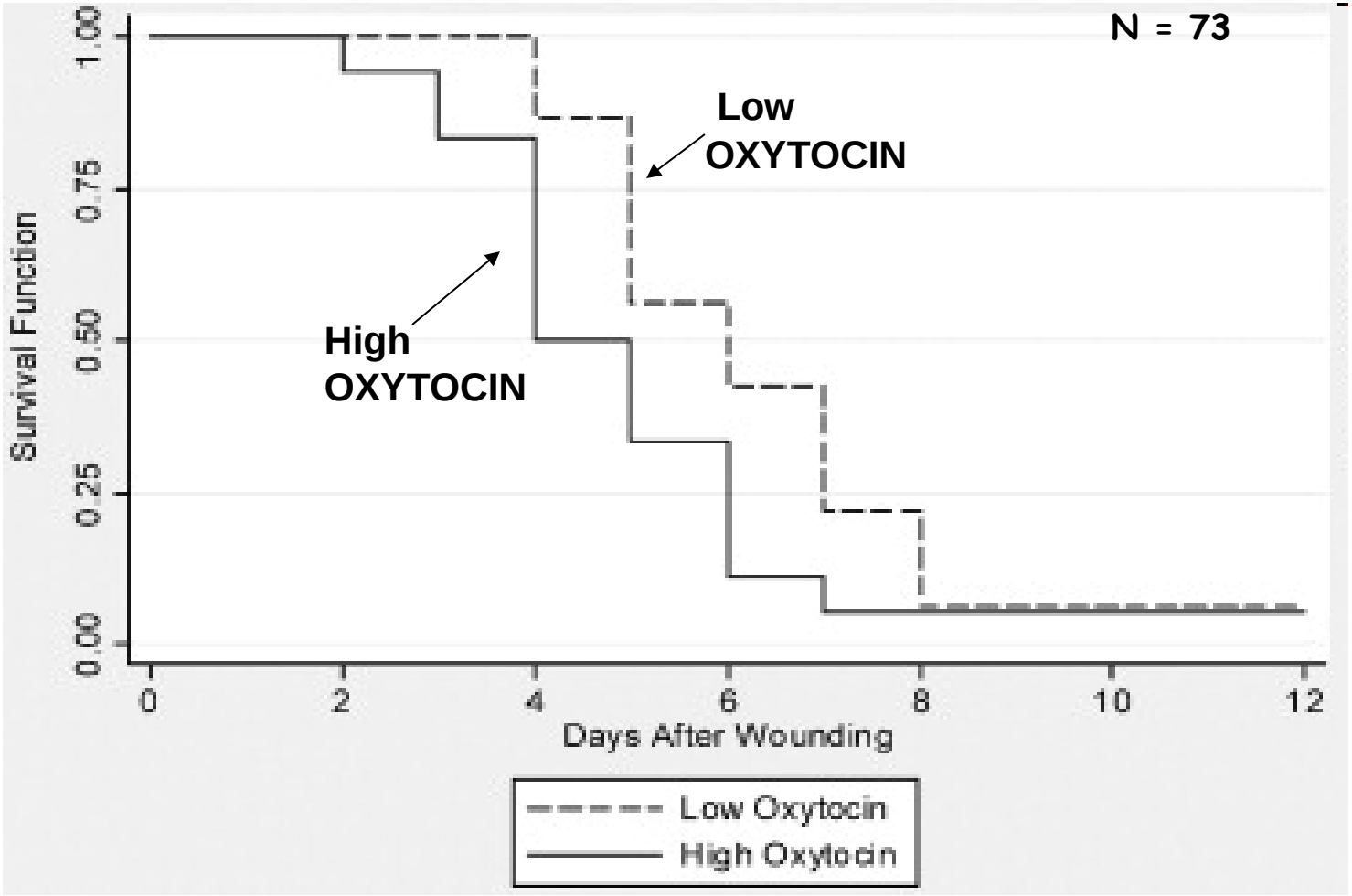
4. capable of healing – partial list

injured skin (burns),
heart (cardiac infarct)
bone (osteoporosis)
intestines (intestinal bowel disease)
brain (stroke)
mental disorders (anxiety, depression
autism, schizophrenia)

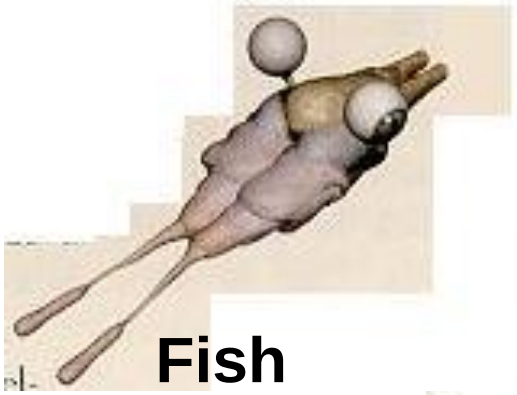
5. Oxytocin is an anti-inflammatory and anti-oxidant

WOUND HEALING of small blisters was faster in individuals with HIGH levels of ENDOGENOUS OXYTOCIN.

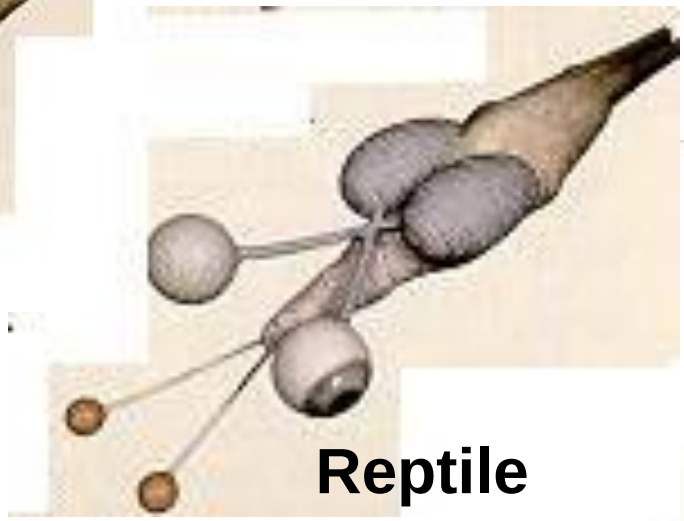
(Gouin, Carter, Kiecolt-Glaser, et al., 2010, PNEC)



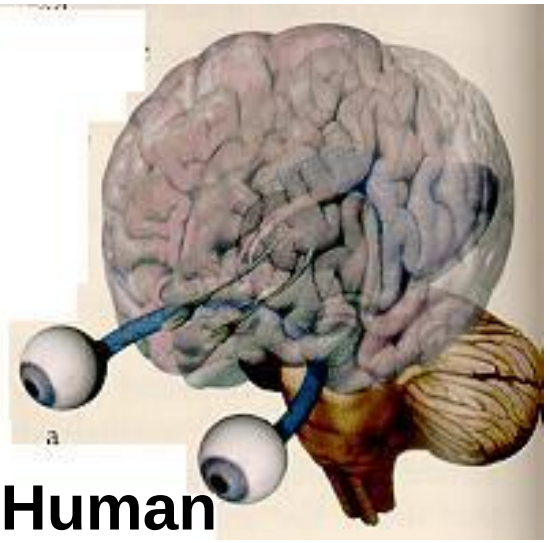
The human nervous system is a consequence of evolution, with a massive increase in the cerebral cortex



Fish



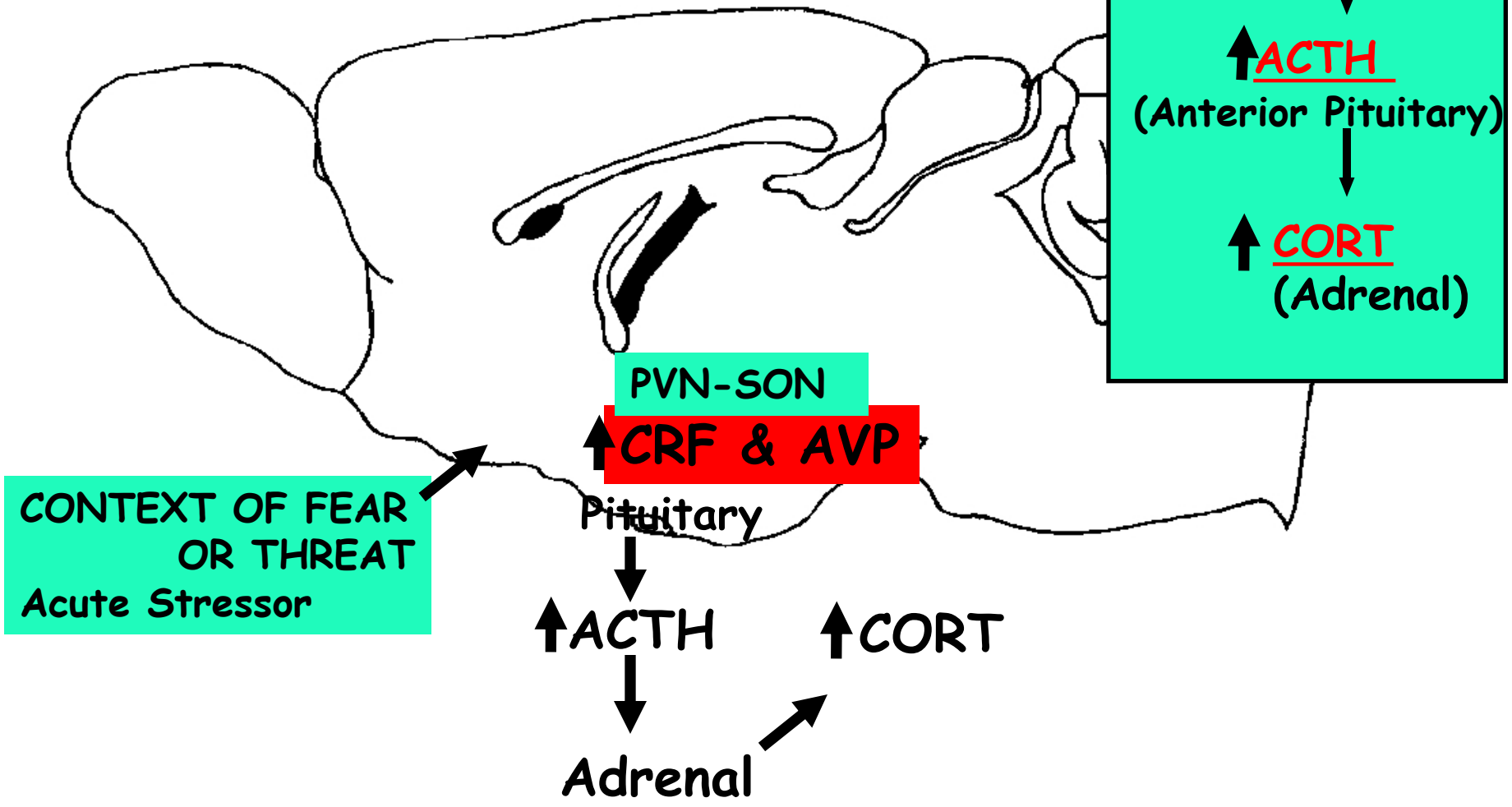
Reptile



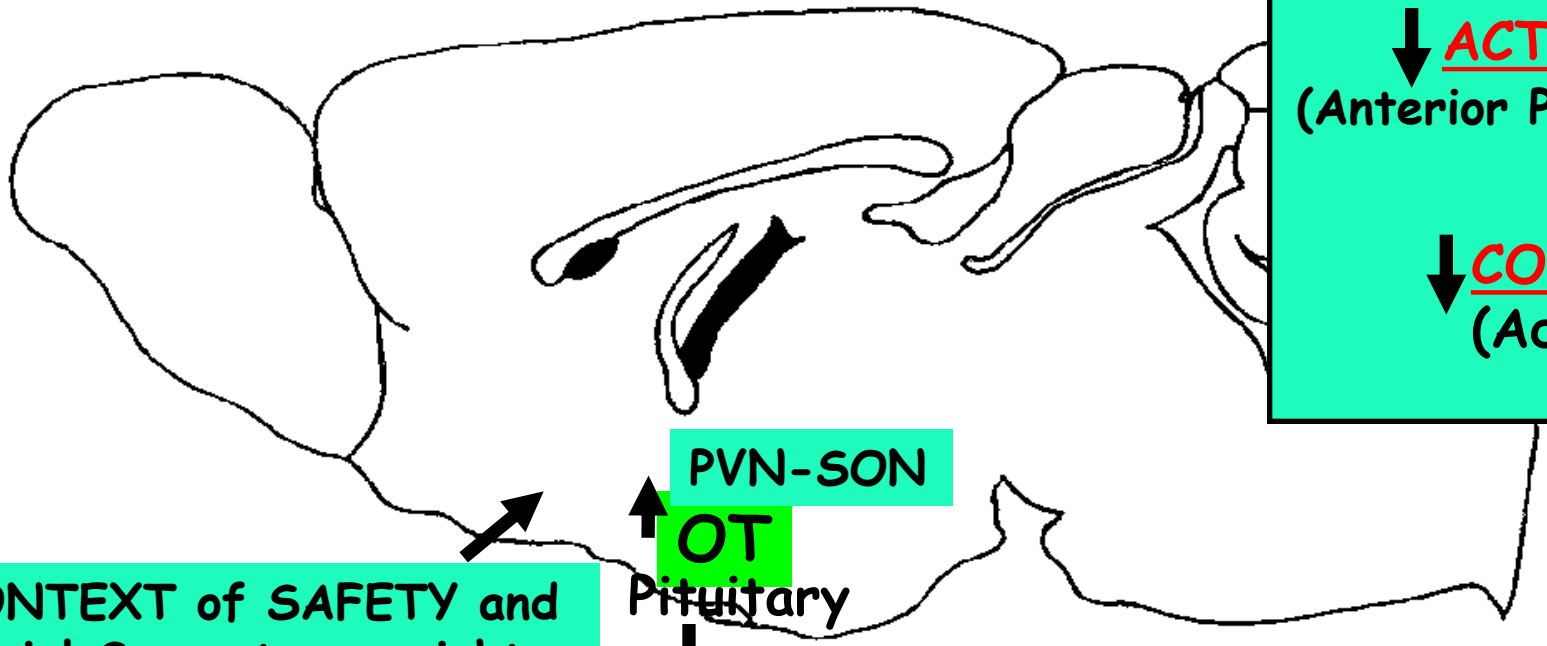
Human

But, the old parts of the nervous system are still present, and can influence the actions of more modern components. Much of the wiring comes UP from these more primitive brain regions, with fewer pathways that come down. This is why it is hard to use cognition to control emotion.

Hypothalamic – Pituitary – Adrenal Axis
CLASSIC MODEL



Hypothalamic – Pituitary – Adrenal Axis
Role of OXYTOCIN (OT) in CONTEXT OF SAFETY OR SOCIAL SUPPORT



↑ OT (PVN) ↓ AVP, CRF (PVN)

↓ ACTH (Anterior Pituitary)

↓ CORT (Adrenal)

PVN-SON

↑ OT

Pituitary

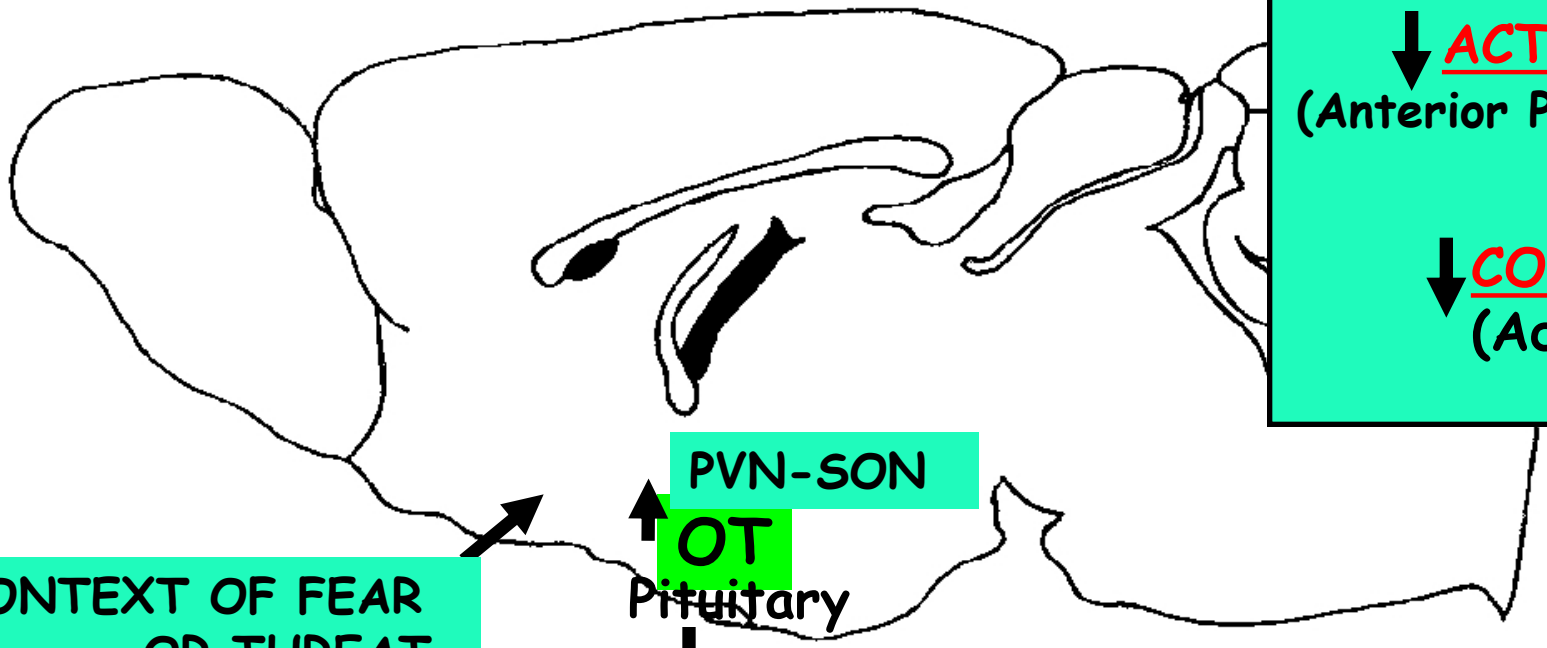
↓ ACTH

↓ CORT

Adrenal

CONTEXT of SAFETY and Social Support, we might expect the emergence of positive social behaviors, growth, healing and restoration.

Hypothalamic – Pituitary – Adrenal Axis
Role of OXYTOCIN (OT) in CONTEXT OF EXTREME FEAR OR LIFE THREAT



OT (PVN)

AVP, CRF (PVN)

ACTH (Anterior Pituitary)

CORT (Adrenal)

PVN-SON

OT Pituitary

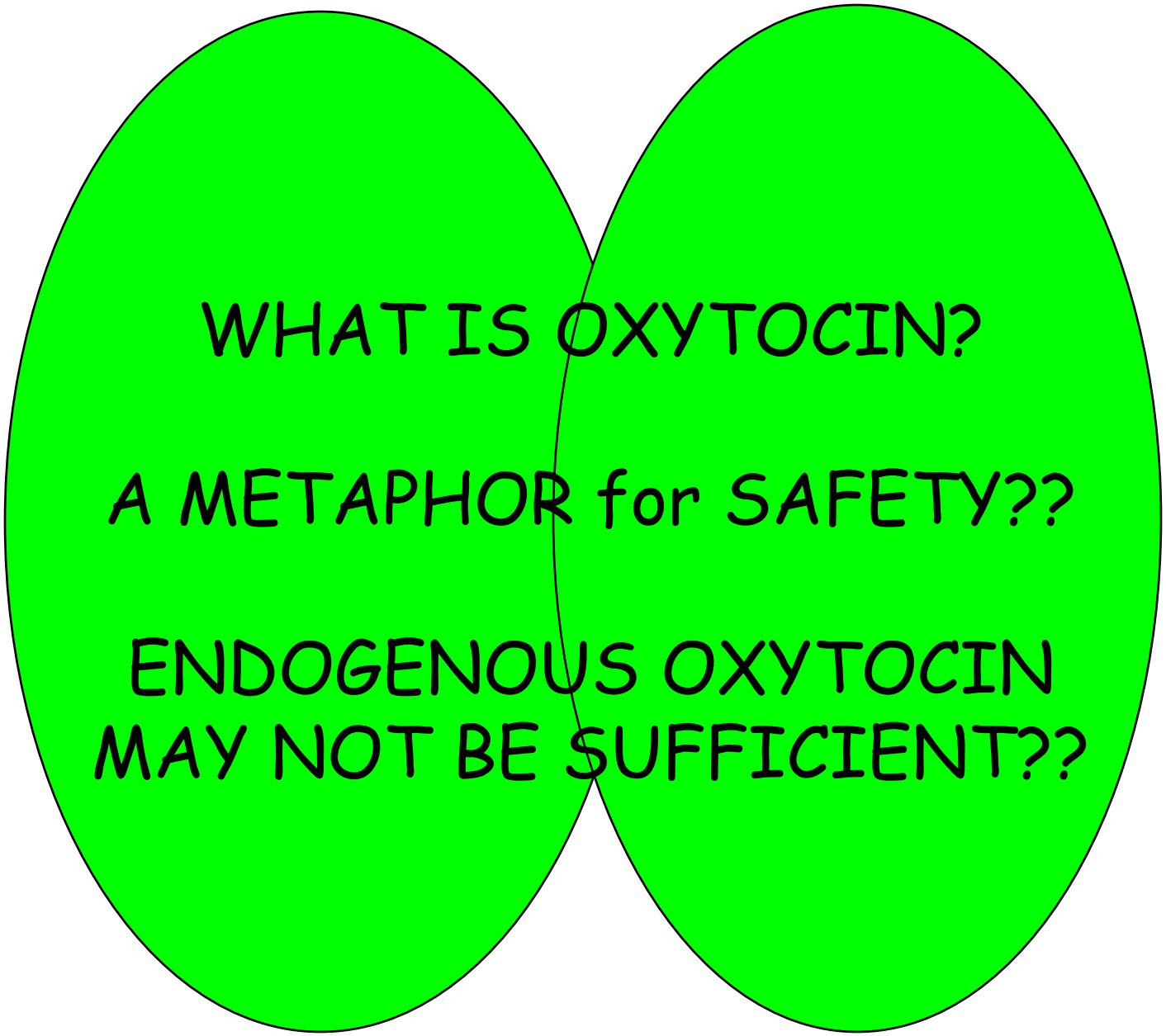
CONTEXT OF FEAR OR THREAT

Acute Stressor → OT

ACTH

CORT

Adrenal


WHAT IS OXYTOCIN?
A METAPHOR for SAFETY??
ENDOGENOUS OXYTOCIN
MAY NOT BE SUFFICIENT??

SO…. WHAT does recent research tell us about OXYTOCIN?

OXYTOCIN is more than just a "FEMALE" HORMONE.

IN BOTH SEXES ENDGENOUS OXYTOCIN CAN REGULATE:

* the HPA axis – downregulating "stress"
* the parasympathetic nervous system/cardiovascular function
* anti-inflammatory and wound healing processes
* processes protecting against ANXIETY and DEPRESSION
* vulnerability to MENTAL ILLNESSES including SCHIZOPRENIA (AND perhaps also AUTISM)
* the capacity to form SOCIAL BONDS that are essential to MONOGAMY

Physiological, especially neurobiological studies are most easily conducted in animals.

What kinds of animals form true social bonds - that is have SELECTIVE social preferences or selective social behavior?

Social bonds are most easily identified and studied in *SOCIALLY MONOGAMOUS SPECIES.*

But such species are rare in mammals; only 3-5% of mammalian species are described as "monogamous."

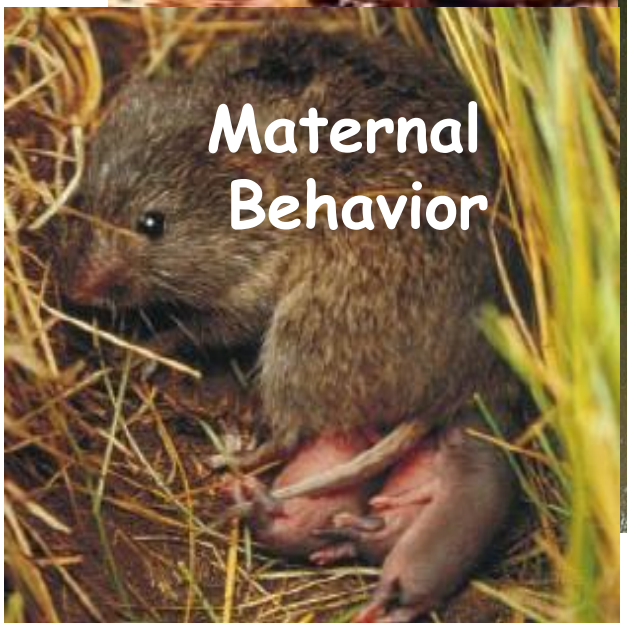
Particularly helpful to our understanding of social behavior, especially SELECTIVE social behaviors, social bonds and even "love", as well as the neurobiology of OXYTOCIN have been SOCIALLY MONOGAMOUS RODENTS including -

PRAIRIE VOLES,
Microtus ochrogaster

Prairie voles can be studied in nature

And in the Laboratory

Oxytocin may be released under conditions that involve positive social interactions, including:



Inherent in the concept of MONOGAMY or at least SOCIAL MONOGAMY is

Selective and Long-lasting Social Behavior usually between one male and one female - or in other words SOCIAL BONDS

FEATURES OF PRAIRIE VOLE BEHAVIORAL BIOLOGY (SOCIAL MONOGAMY)

HIGH LEVELS OF SOCIAL CONTACT and
DEPENDENCE ON SOCIAL INTERACTION

PAIR BONDING (male-female)

BIPARENTAL CARE OF YOUNG and
ALLOPARENTING (baby sitting)

HIGH LEVELS OF OXYTOCIN

HUMAN-LIKE AUTONOMIC NERVOUS SYSTEM,
WITH HIGH LEVELS OF VAGAL TONE
(Parasympathetic activity- helping to explain in part why social interactions and social bonds play a critical role in emotional regulation)

Oxytocin also may be released under conditions that are negative or acutely "stressful,"

Including in response to:

1. Social challenges
   (esp. same-sex intruders)
2. Forced restraint/immobility
3. Immune challenge (LPS)
4. Chronic social isolation (females)

Oxytocin serves as a component of an adaptive, coping strategy, buffering against stressors, with effects that in some cases differ in males and females.

WHAT IS OXYTOCIN?

A PHYSIOLOGICAL METAPHOR for SAFETY?

POSSIBLY WORKING IN PART THROUGH EFFECTS ON THE AUTONOMIC NERVOUS SYSTEM.

OXYTOCIN HAS ACTIONS ON THE MYELINATED VAGAL PATHWAYS (PARASYMPATHETIC), WITH POTENTIAL FOR AFFECTING SOCIAL ENGAGEMENT AND EMOTION REGULATION, AS WELL AS PROVIDING NEUROPROTECTION, HEALING AND RESTORATION IN THE FACE OF THE "STRESS OF LIFE"

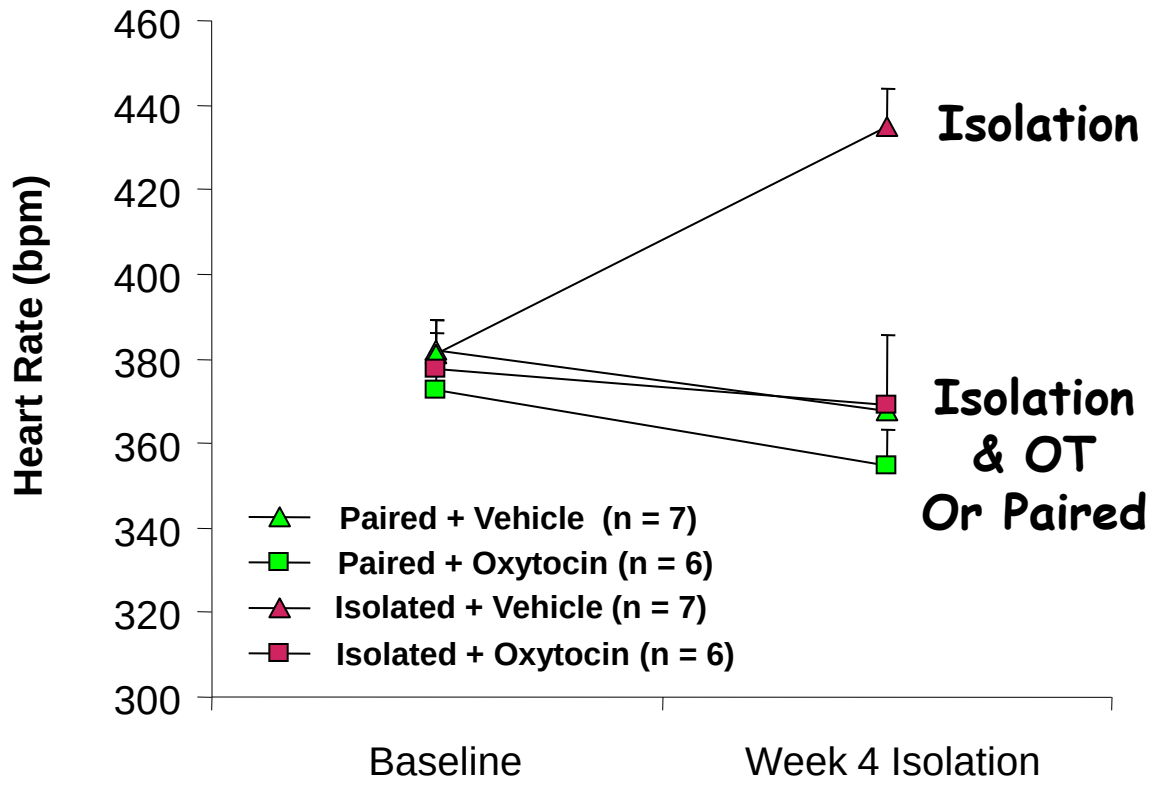
The opposite of social stimulation is - SOCIAL ISOLATION*

WHICH MAY HAVE PARTICULARLY POWERFUL EFFECTS IN PRAIRIE VOLES INCLUDING:

Variable	Direction of changes
CRF-ir (cns)	INCREASED*
CORTICOSTERONE (blood)	INCREASED*
VASOPRESSIN-ir (cns)	Inc or Dec (area specific, in females)
OXYTOCIN-ir (cns)	NO CHANGE (juveniles)
	INCREASED (adults)
NEUROGENESIS	DECREASED
SUCROSE PREF (hedonic?)	DECREASED**
VAGAL CONTROL OF THE HEART***	DECREASED**

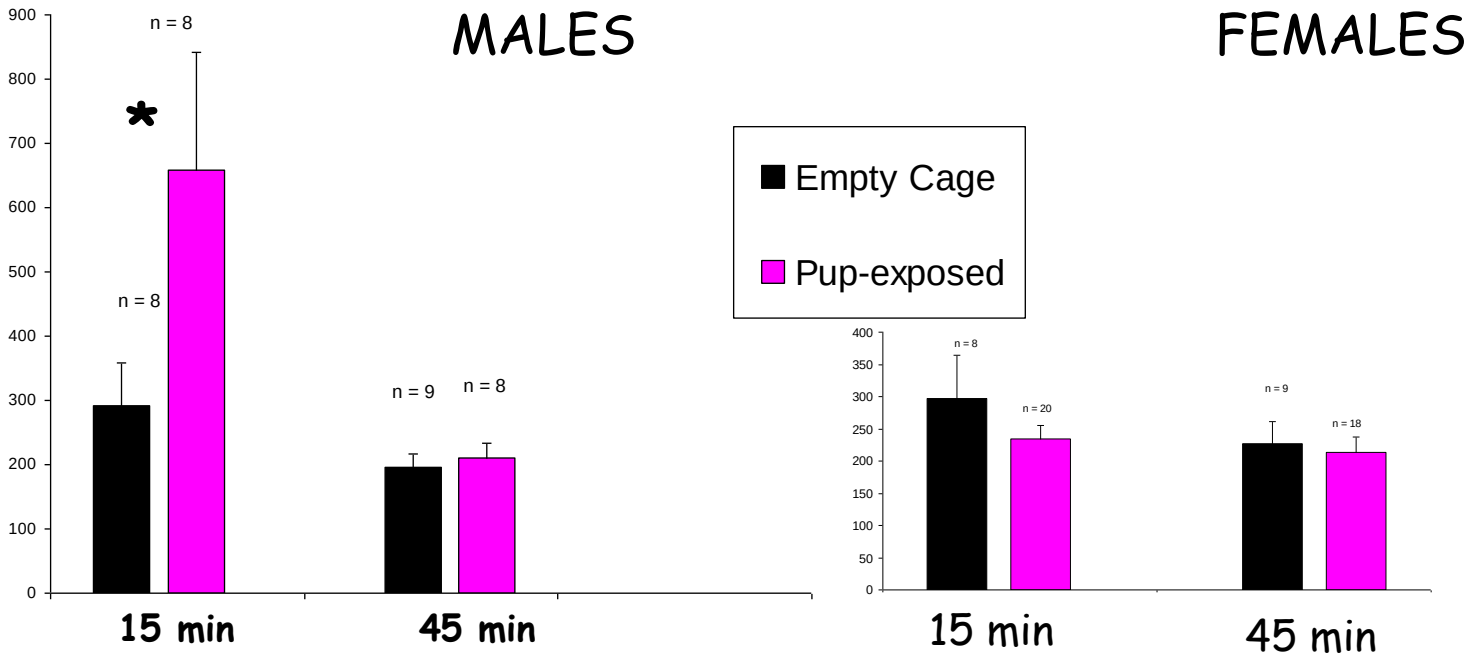
(*for periods ranging from 4 days to 4 weeks, Ruscio, et al.)
(** Grippo, et al.)
*** Prairie voles have vagal tone in the range of humans

Oxytocin treatment (14 days,sc) reversed or prevented the adverse effects of isolation on heart rate (also on measures of anxiety and "depression")



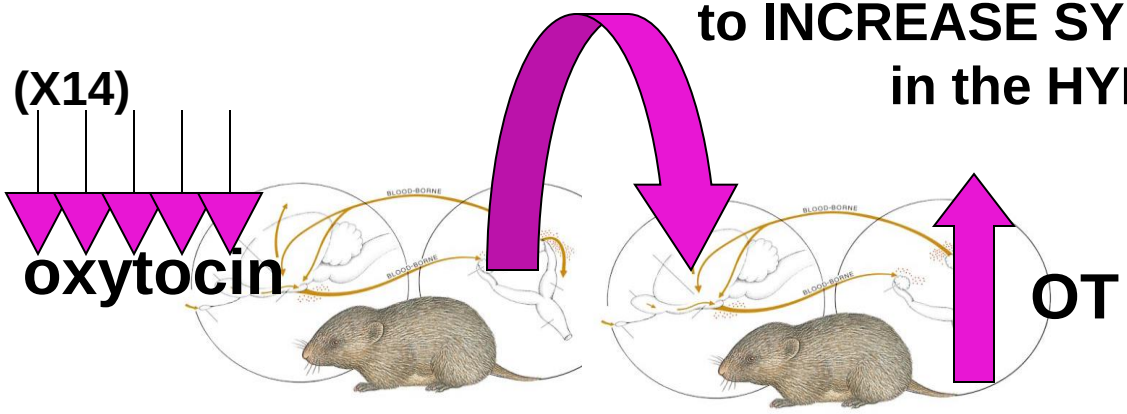
Grippo, et al. Psychoneuroendocrinology, 2009

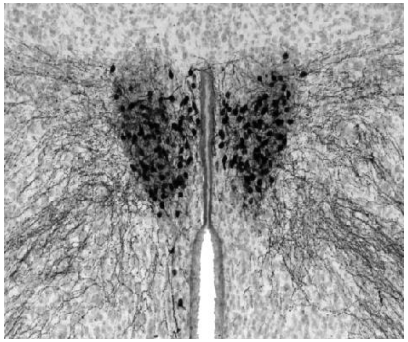
Blood levels of OXYTOCIN increased in reproductively naïve MALES, (but NOT females) immediately following 10-15 min PUP EXPOSURE



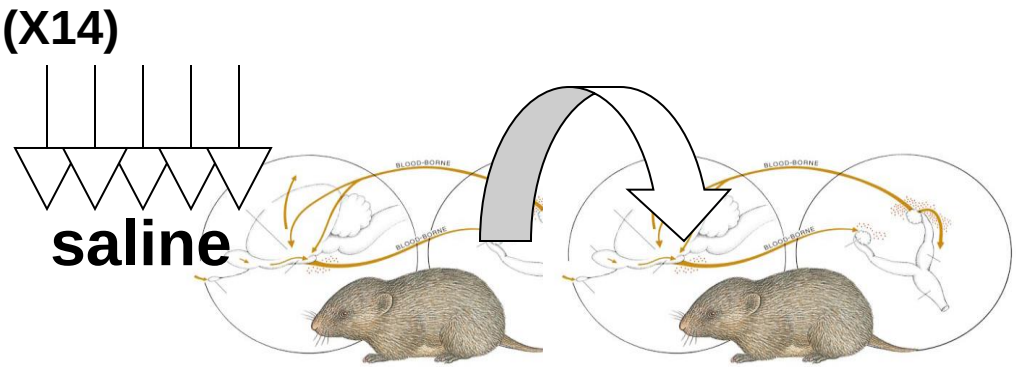
Kenkel, Paredes, Yee, Pournajafi-Nazarloo, Bales, & Carter, Journal of Neuroendocrinology 2012

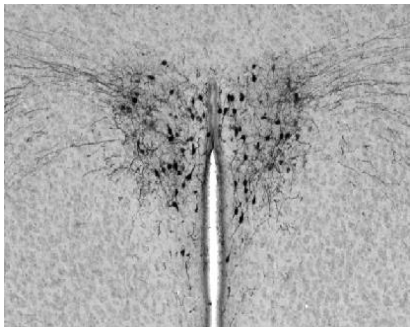
Repeated injection or release of Oxytocin can "feed forward" to INCREASE SYNTHESIS OF OT in the HYPOTHALAMUS





Oxytocin-stained cells





Oxytocin-stained cells

FROM GRIPPO,, ET AL, STRESS 2012

SHOULD OXYTOCIN BE A MEDICINE??

Oxytocin is already available on the internet as an intranasal spray. It is NOT a controlled substance. It has NOT been evaluated by the FDA. We have little information about the CHRONIC effects of exogenous oxytocin. (Chronic elevations in OT were associated with a down-regulation of OT receptors… Will this happen if OT is chronically used as a "medicine?" Probably!!)

However, used wisely it may have a role in medicine. Several drug companies are testing OT-based compounds for the treatment of autism, schizophrenia and other disorders.

Oxytocin (Pitocin) is routinely used during birth and in the postpartum period. We know essentially NOTHING about the consequences for the child or mother of these treatments.

OXYTOCIN IS ONE COMPONENT OF A COMPLEX NEUROENDOCRINE-AUTONOMIC SYSTEM. We must have a deeper knowledge of the natural regulation of this system, especially in early life.

Knowledge of ENDOGENOUS oxytocin may serve as a metaphorical Rosetta Stone for understanding natural healing.

I suggest we start there.

WHAT IS OXYTOCIN?

An important neuropeptide with broad effects on physiology and behavior, in BOTH SEXES and during DEVELOPMENT.

WHAT OXYTOCIN IS NOT?

NOT a substitute for "love."
NOT well understood or studied, esp in humans.
NOT something to be treated casually.

For example: even in animal models we do NOT KNOW the effects of CHRONIC oxytocin on
BRAIN?
BEHAVIOR?
IMMUNOLOGY? etc

By understanding the causes and consequences of mammalian sociality and the "social nervous system," we are gaining a deeper understanding of the biology of human emotion, and natural factors, such as "social support" or "love" that contribute to human health and well being.

Because of the fundamental role of sociality in human behavior, concepts like "social support" or "social bonds" translate not just into "love," but also to a sense of SAFETY. A concept that is at the heart of enduring loving relationship and also most successful therapies - of all kinds. A perceived sense of safety is necessary to allow the body to grow, heal and restore itself in the face of the "stress of life".

OXYTOCIN may play a critical, central role in allowing the human nervous system to feel safe

WHAT IS THE MESSAGE OF OXYTOCIN?
Especially Chronic Oxytocin

IS IT A BIOLOGICAL METAPHOR for SAFETY??

Are there cases when ENDOGENOUS OXYTOCIN is NOT SUFFICIENT to deal with INTENSE OR CHRONIC STRESSORS

THESE STUDIES ARE JUST BEGINNING AND MORE KNOWLEDGE IS NEEDED, especially BEFORE OXYTOCIN IS USED AS A "MEDICINE"