PSYCH 260/BBH 203

Hormones

Rick O. Gilmore

2022-02-24 10:46:13

Prelude (5:24)

(orchdorkNo, 2013)

Prelude

Even when practiced discreetly, raised eyebrows and disapproving glances still meet with those who dare to udder-feed in public.

Announcements

- Quiz 2 today (after class)
- Blog post 1 (of 3) due today by 5:00 PM
- Exam 2 *next* Tuesday, March 1 (no in-class meeting)

Today's Topics

- Hormonal communication

Warm-up

Black widow spider venom causes paralysis by impeding the normal function of which neurotransmitter system?

- Glutamate (Glu)
- GABA (GABA)
- Dopamine (DA)
- Acetylcholine (ACh)

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- ~~GABA (GABA)~~
- ~~Dopamine (DA)~~
- Acetylcholine (ACh)

With one exception, the monoamine neurotransmitters bind to what type of receptors?

- ionotropic
- voltage-gated
- nicotinic
- metabotropic

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With one exception, the monoamine neurotransmitters bind to what type of receptor?

- ~~ionotropic~~
- ~~voltage-gated~~
- ~~nicotinic~~ ACh binds to nAChR; ACh not a monoamine
- metabotropic

The *outward* flow of this ion across the neural membrane creates what kind of PSP?

- Cl-; IPSP
- K+; IPSP
- Glutamate; EPSP
- GABA; EPSP

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The *outward* flow of this ion across the neural membrane creates what kind of PSP?

- ~~Cl-; IPSP~~ Outward Cl- -> inside less negative == EPSP
- K+; IPSP Make inside less positive
- ~~Glutamate; EPSP~~ Glu not an ion; transported across
- ~~GABA; EPSP~~ GABA not an ion; transported across

Hormones

Hormones

- Chemicals secreted into blood
- Act on specific target tissues via receptors
- Produce specific effects

Can a substance be a hormone AND a neurotransmitter?

- Yes, why not?
- No, absolutely not.

Can a substance be a hormone AND a neurotransmitter?

- Yes, why not?
- No, absolutely not.
- Do the substances bind to neurons AND to other cells in the body?

Examples of substances that are both hormones and neurotransmitters

- Melatonin
- Epinephrine/adrenaline
- Oxytocin
- Vasopressin

Physiological responses and behaviors under hormonal influence

Physiological responses and behaviors under hormonal influence

- Ingestive (eating/ drinking)
  - Fluid levels
  - Na, K, Ca levels
  - Digestion
  - Blood glucose levels

Physiological responses and behaviors under hormonal influence

Physiological responses and behaviors under hormonal influence

- Reproduction
  - Sexual Maturation
  - Mating
  - Birth
  - Care giving

Physiological responses and behaviors under hormonal influence

Physiological responses and behaviors under hormonal influence

- Responses to threat/challenge
  - Metabolism
  - Heart rate, blood pressure
  - Digestion
  - Arousal

What do these physiological responses and behaviors have in common?

- Biological imperatives
- Events restricted in space and time
- Often involve other animals

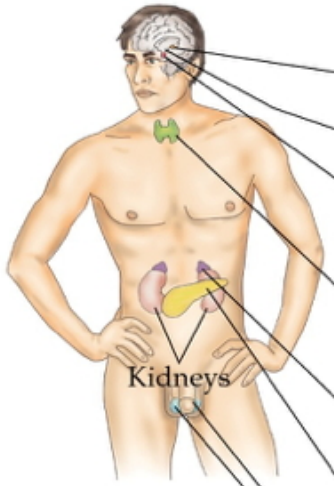
Differences between neural and hormonal communication

- Point to point vs.“broadcast”
  - Wider broadcast than neuromodulators
  - Everywhere in body via bloodstream
- Fast vs. slow-acting
- Short-acting vs. long-acting
- Digital (yes-no) vs. analog (graded)
- Voluntary control vs. involuntary

Similarities between neural and hormonal communication

- Chemical messengers stored for later release
- Release follows stimulation
- Action depends on specific receptors
- 2nd messenger systems common

Where are hormones released

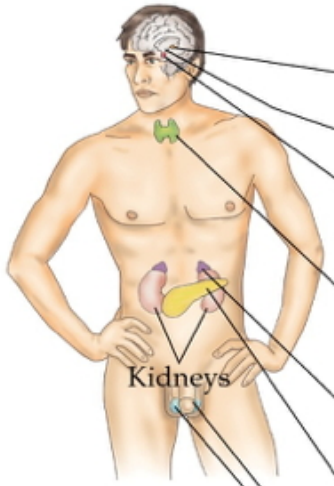


Main endocrine glands	Some main functions regulated by secretion
Pineal gland	Reproductive maturation; bodily rhythms
Hypothalamus	
Pituitary gland:	
Anterior pituitary	Hormone secretion by thyroid, adrenal cortex, and gonads; growth
Posterior pituitary	Water balance; salt balance
Thyroid	Growth and development; metabolic rate
Adrenal glands:	
Adrenal cortex	Salt and carbohydrate metabolism; inflammatory reactions
Adrenal medulla	Emotional arousal
Pancreas	Sugar metabolism
Gonads	Body development; maintenance of reproductive organs in adults

Where are hormones released?

- CNS
  - Hypothalamus
  - *Pituitary*
    - *Anterior*
    - *Posterior*
  - Pineal gland

Where are hormones released



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Where are hormones released?

- Rest of body
  - *Thyroid*
  - *Adrenal (ad=adjacent, renal=kidney) gland*
    - *Adrenal cortex*
    - *Adrenal medulla*
  - *Gonads* (testes/ovaries)

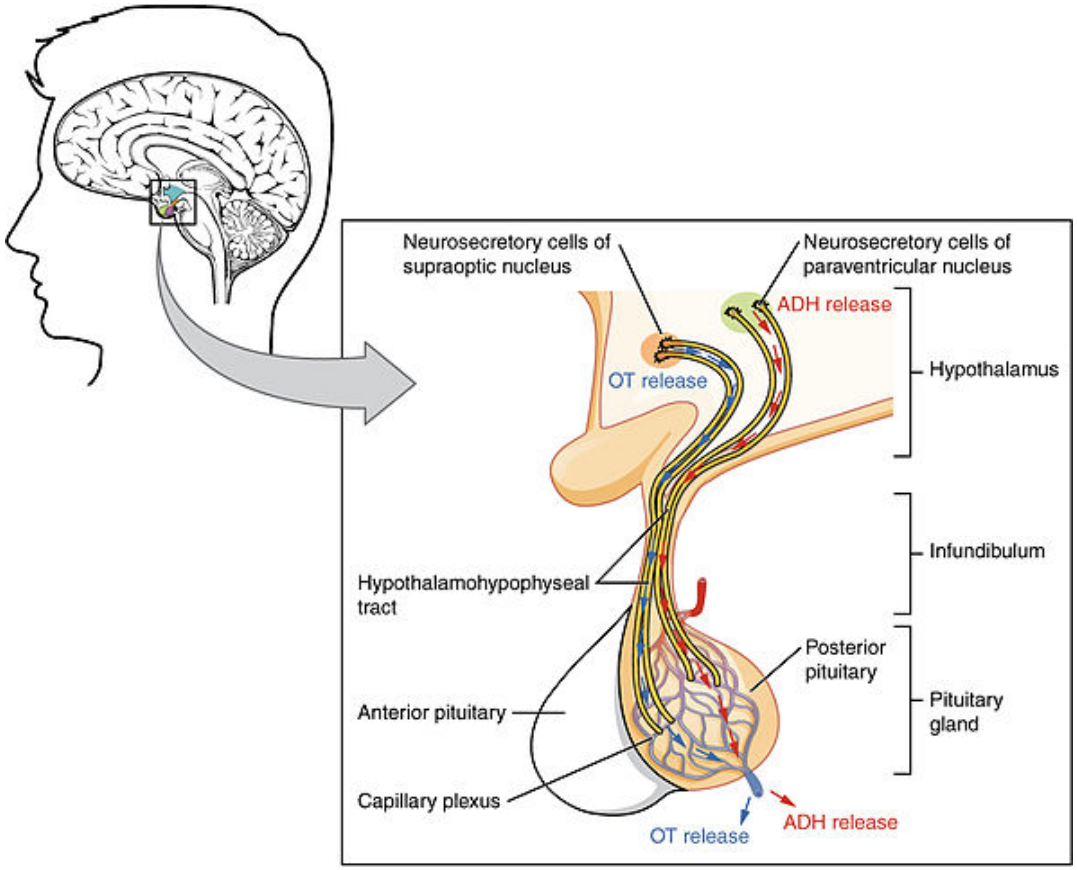
Two hypothalamus/pituitary release systems

- Direct
- Indirect

Direct hormone release into bloodstream

- Hypothalamus (paraventricular nucleus, supraoptic nucleus) to
- Posterior pituitary
  - *Oxytocin*
  - *Arginine Vasopressin (AVP, vasopressin)*

Direct release

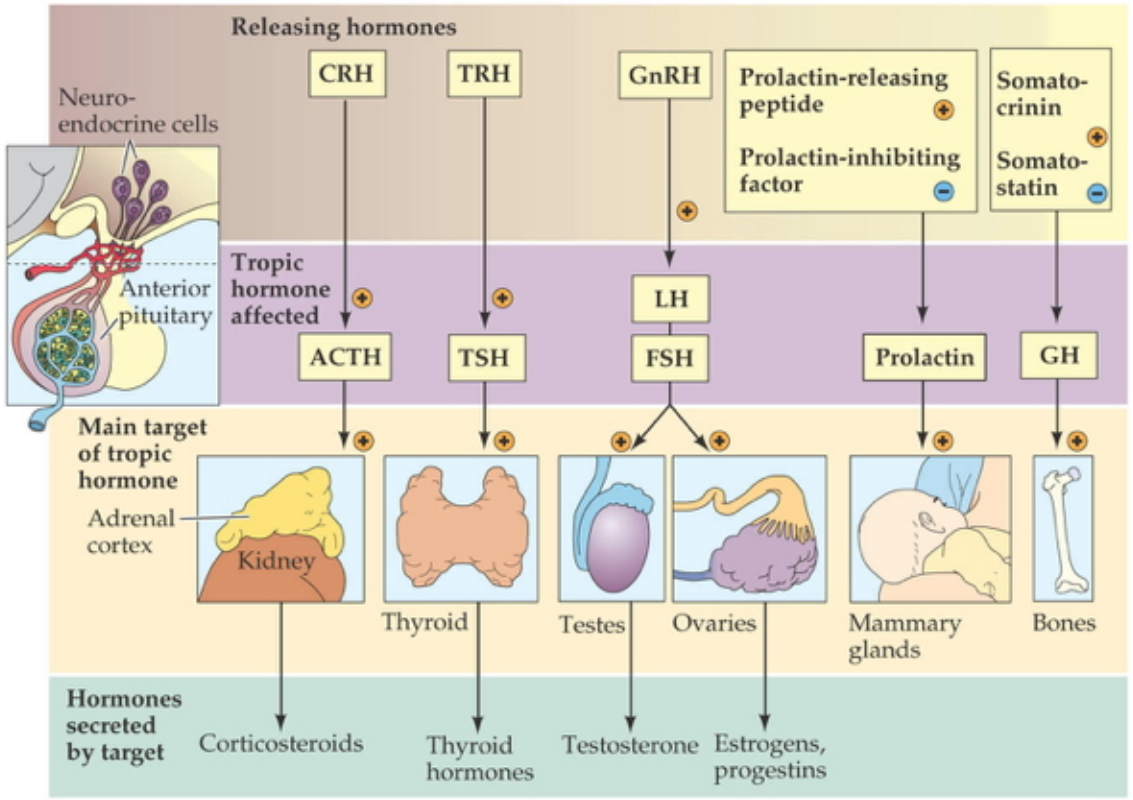


https://upload.wikimedia.org/wikipedia/commons/thumb/7/70/1807_The_Posterior_Pituitary_Complex.jpg/594p
1807_The_Posterior_Pituitary_Complex.jpg

Indirect release

- Hypothalamus -> *releasing hormones*
- Anterior pituitary -> *tropic hormones*
- End organs

Indirect release



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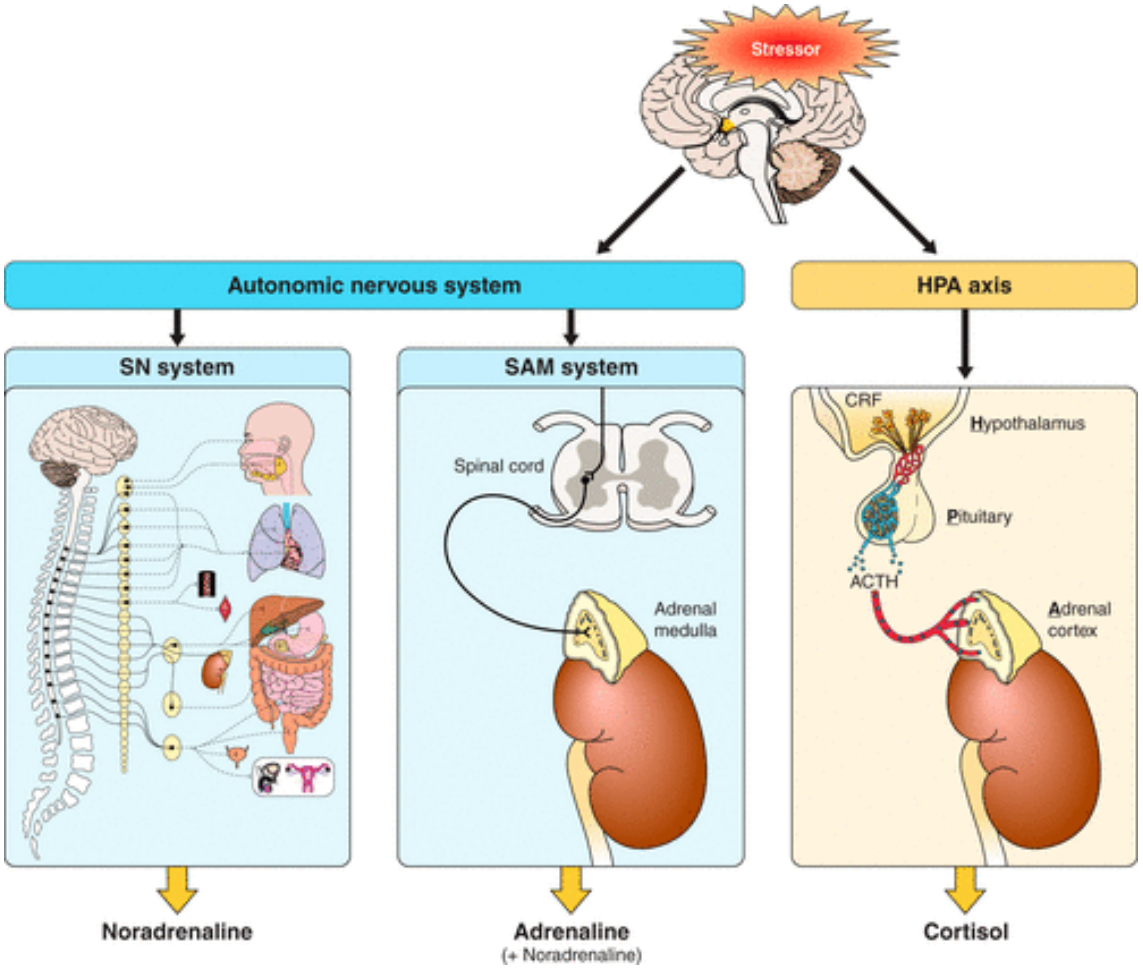
Case studies

Case 1: Responses to threat or challenge

- Neural response
  - *Sympathetic Adrenal Medulla (SAM) response*
  - Sympathetic NS activation of adrenal medulla, other organs
  - Releases NE and Epi



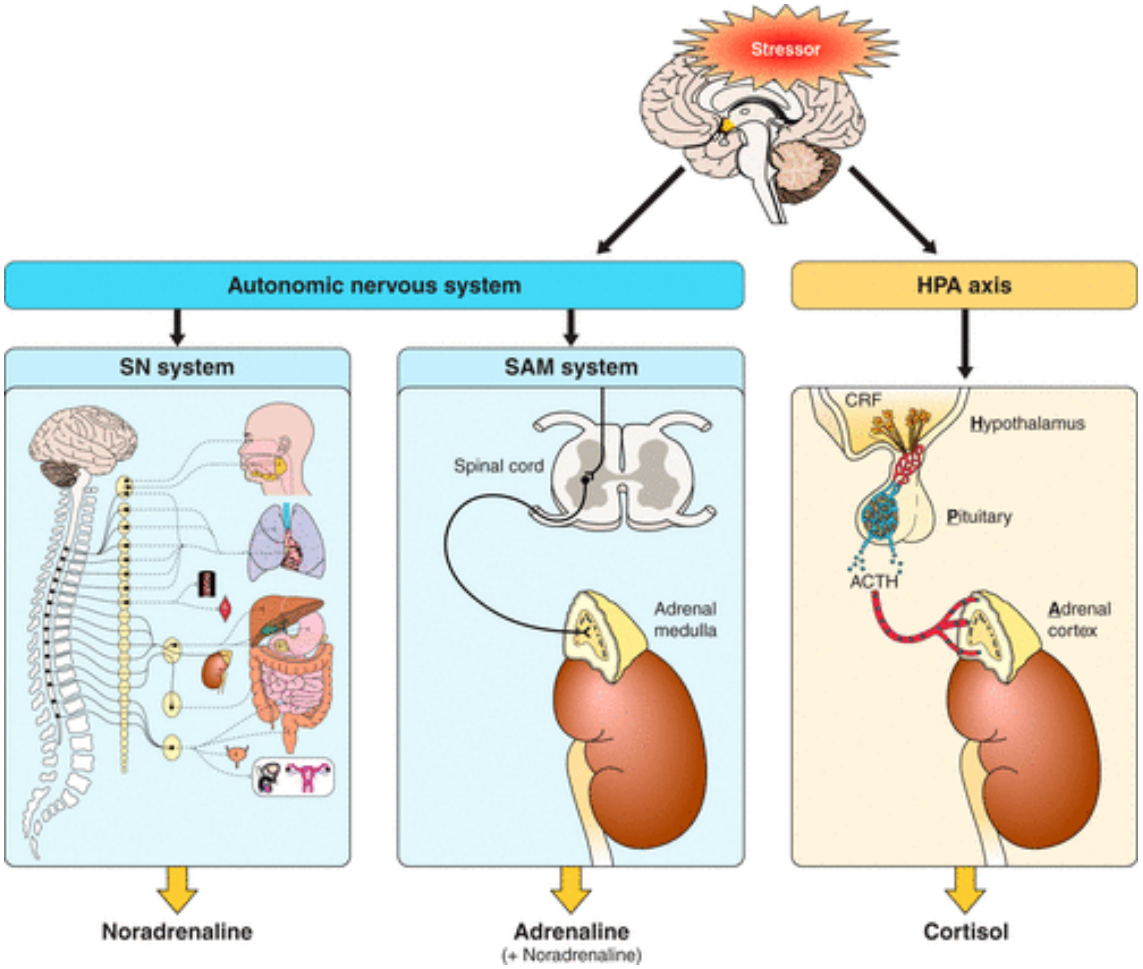
(Deussing & Chen, 2018)

Case 1: Responses to threat or challenge

- Endocrine response
  - *Hypothalamic Pituitary Adrenal (HPA) axis*
  - Adrenal hormones released
- Hypothalamus
  - *Corticotropin Releasing Hormone (CRH)*
- Anterior pituitary
  - *Adrenocorticotropic hormone (ACTH)*

Case 1: Responses to threat or challenge

- Adrenal cortex
  - *Glucocorticoids (e.g., cortisol)*
  - *Mineralocorticoids (e.g. aldosterone)*

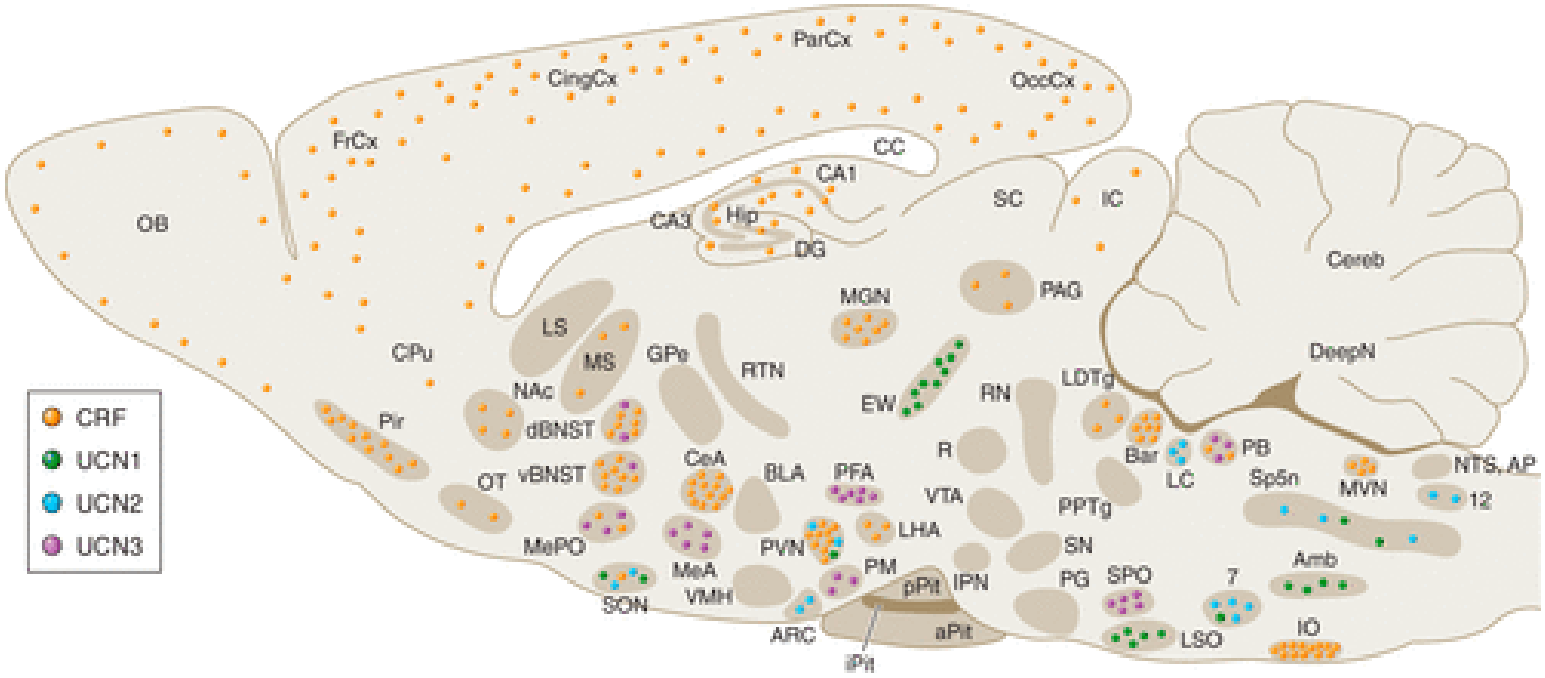


(Deussing & Chen, 2018)

Adrenal hormones

- *Steroids*
  - Derived from cholesterol
- *Cortisol*
  - increases blood glucose, anti-inflammatory
  - negative consequences of prolonged exposure
- *Aldosterone*
  - Regulates Na (and water) retention in kidneys

CRH/CRF receptors widespread in brain

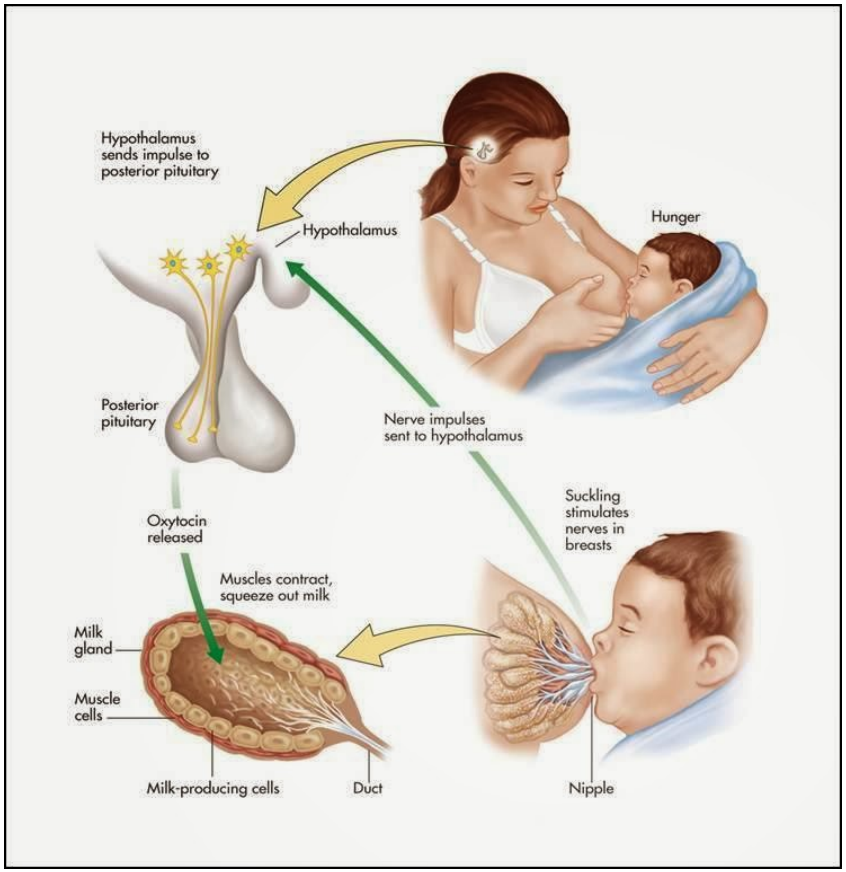


(Deussing & Chen, 2018)

Case 2: Reproductive behavior – the milk letdown reflex

- Hypothalamus releases oxytocin into posterior pituitary
- Targets milk ducts in breast tissue

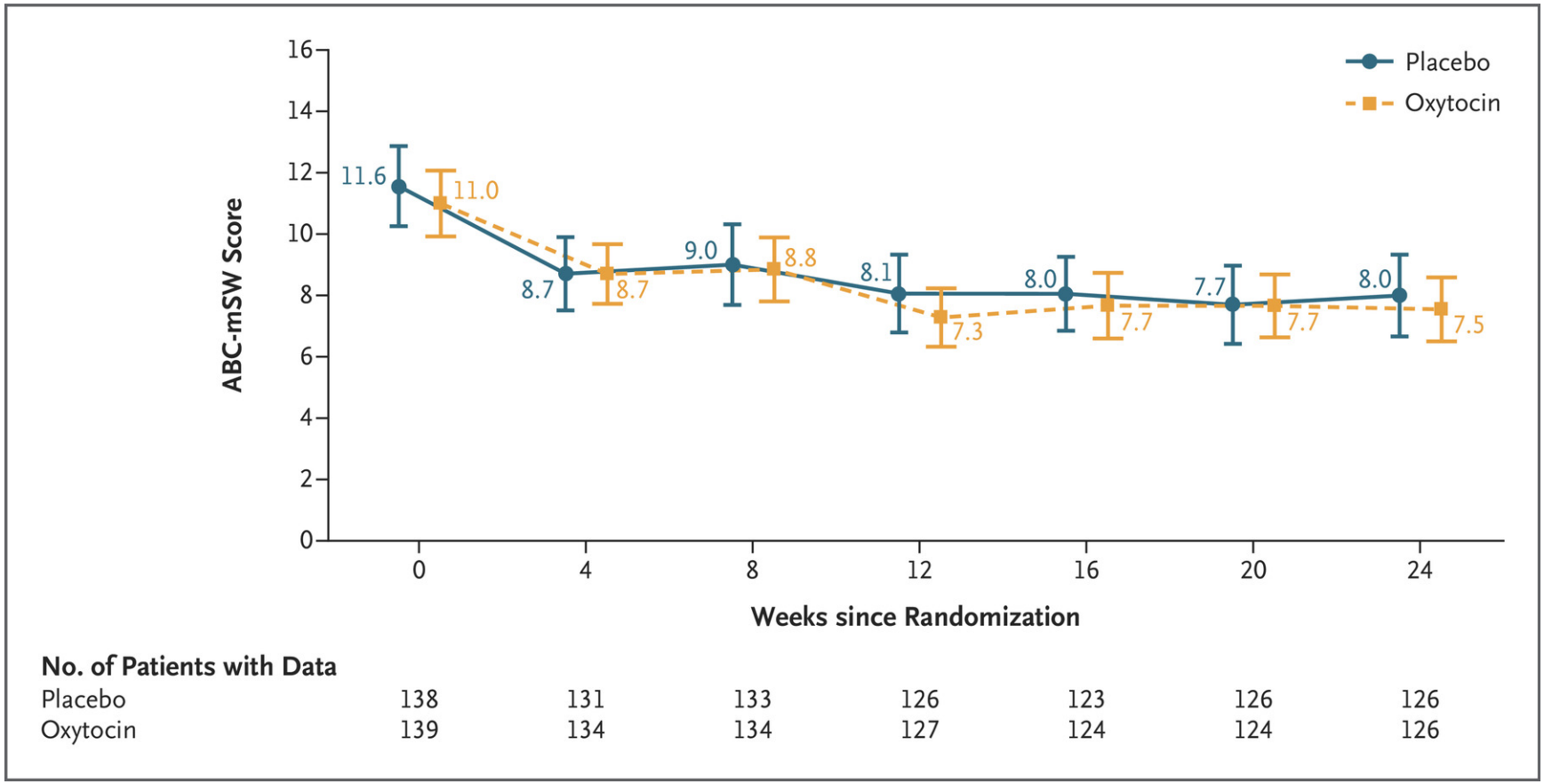
Milk letdown reflex



Oxytocin's role

- Sexual arousal
- Released in bursts during orgasm
- Stimulates uterine, vaginal contraction
- Links to social interaction, bonding (Weisman & Feldman, 2013)
- Alters face processing in autism (Domes et al., 2013)

Can oxytocin treat social impairments in autism?



No. of Patients with Data							
Placebo	138	131	133	126	123	126	126
Oxytocin	139	134	134	127	124	124	126

(Sikich et al., 2021)

Oxytocin

References

Deussing, J. M., & Chen, A. (2018). The Corticotropin-Releasing factor family: Physiology of the stress response. *Physiological Reviews*, *98*(4), 2225–2286. https://doi.org/10.1152/physrev.00042.2017

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