PSYCH 260

Hormones

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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
- Blog post 1 (of 3) due today by 5:00 PM
- Exam 2 *next* Thursday

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

- ionotropic
- voltage-gated
- nicotinic
- metabotropic

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- ~~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

- Chemical secreted into blood
- Act on specific target tissues
- 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

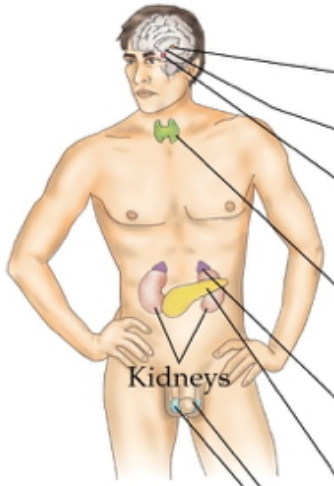
Differences between neural and hormonal communication

- 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

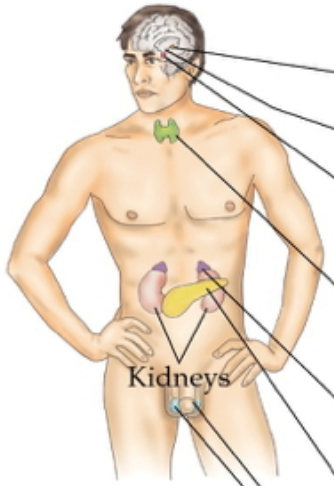


Main endocrine glands	Some main functions regulated by secretion
Pineal gland	Reproductive maturation; bodily rhythms
Hypothalamus	
Pituitary gland:	
Anterior pituitary	Hormone secretion by thyroid, adrenal cortex, and gonads; growth
Posterior pituitary	Water balance; salt balance
Thyroid	Growth and 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)

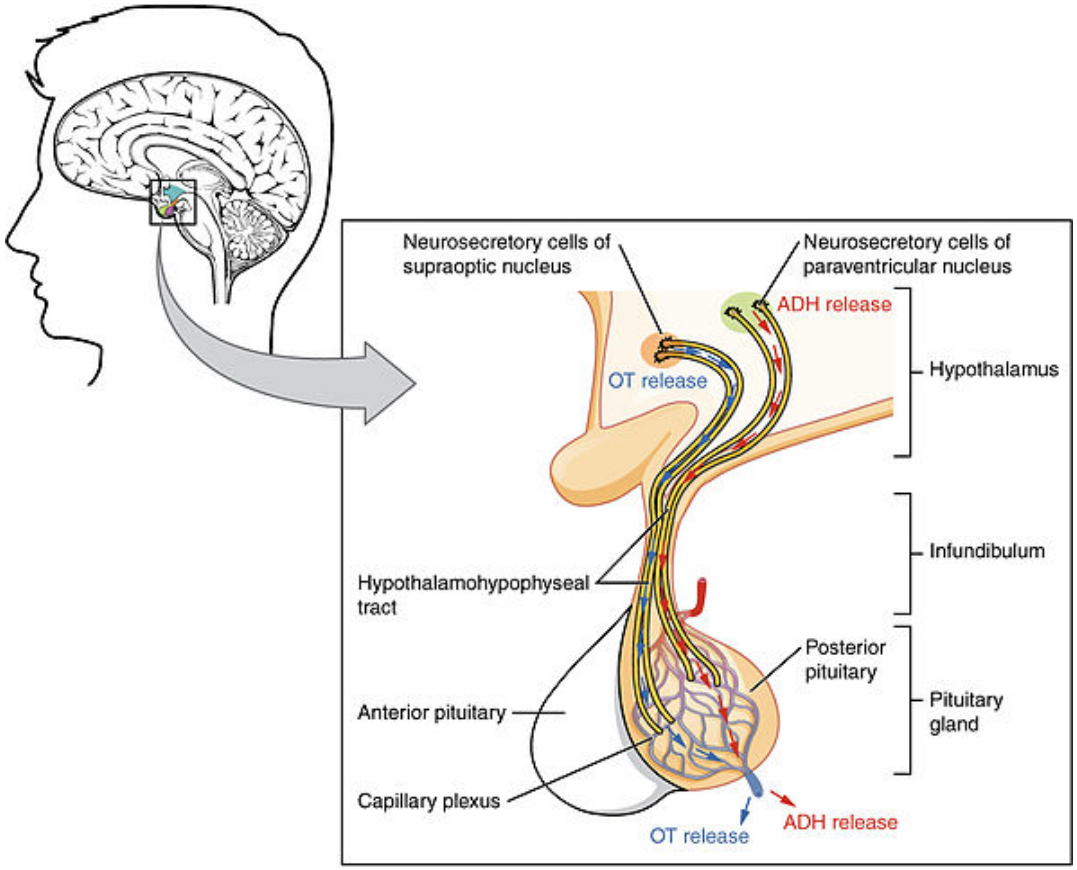
Two hypothalamus/pituitary release systems

- Direct
- Indirect

Direct hormone release into bloodstream

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

Direct release

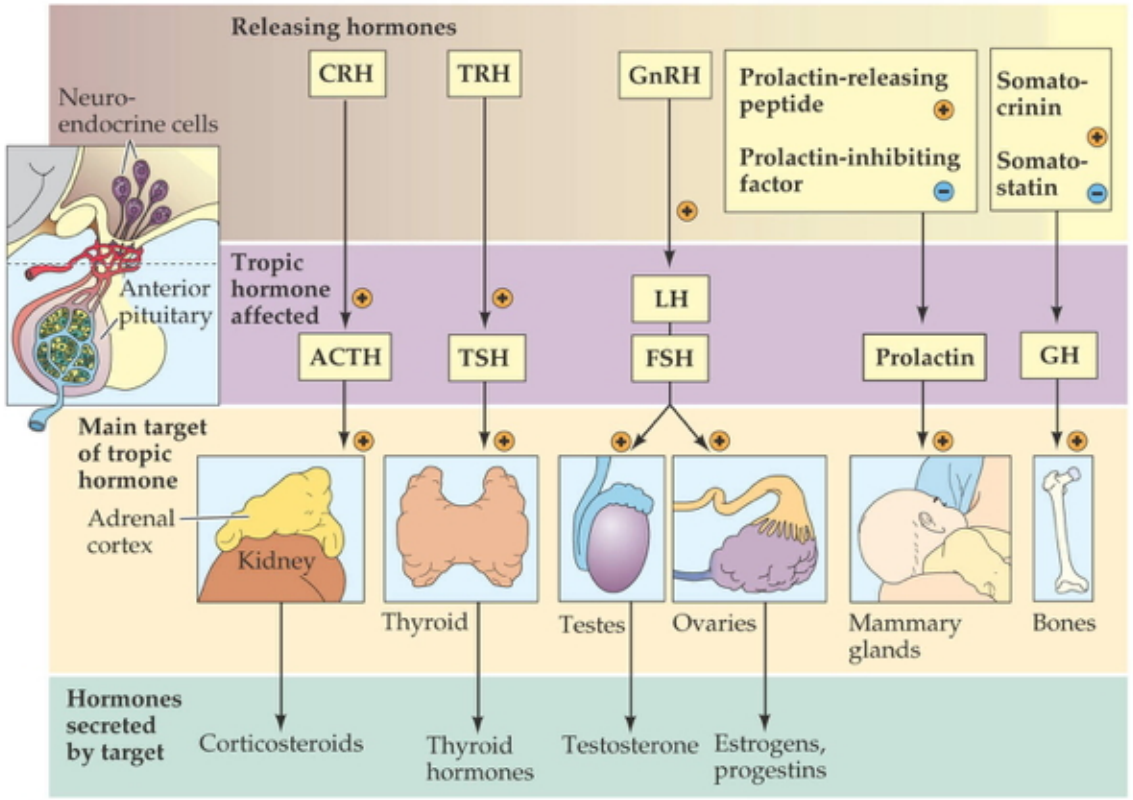


https://upload.wikimedia.org/wikipedia/commons/thumb/7/70/1807_The_Posterior_Pituitary_Complex.jpg/594p1807_The_Posterior_Pituitary_Complex.jpg

Indirect release

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

Indirect release



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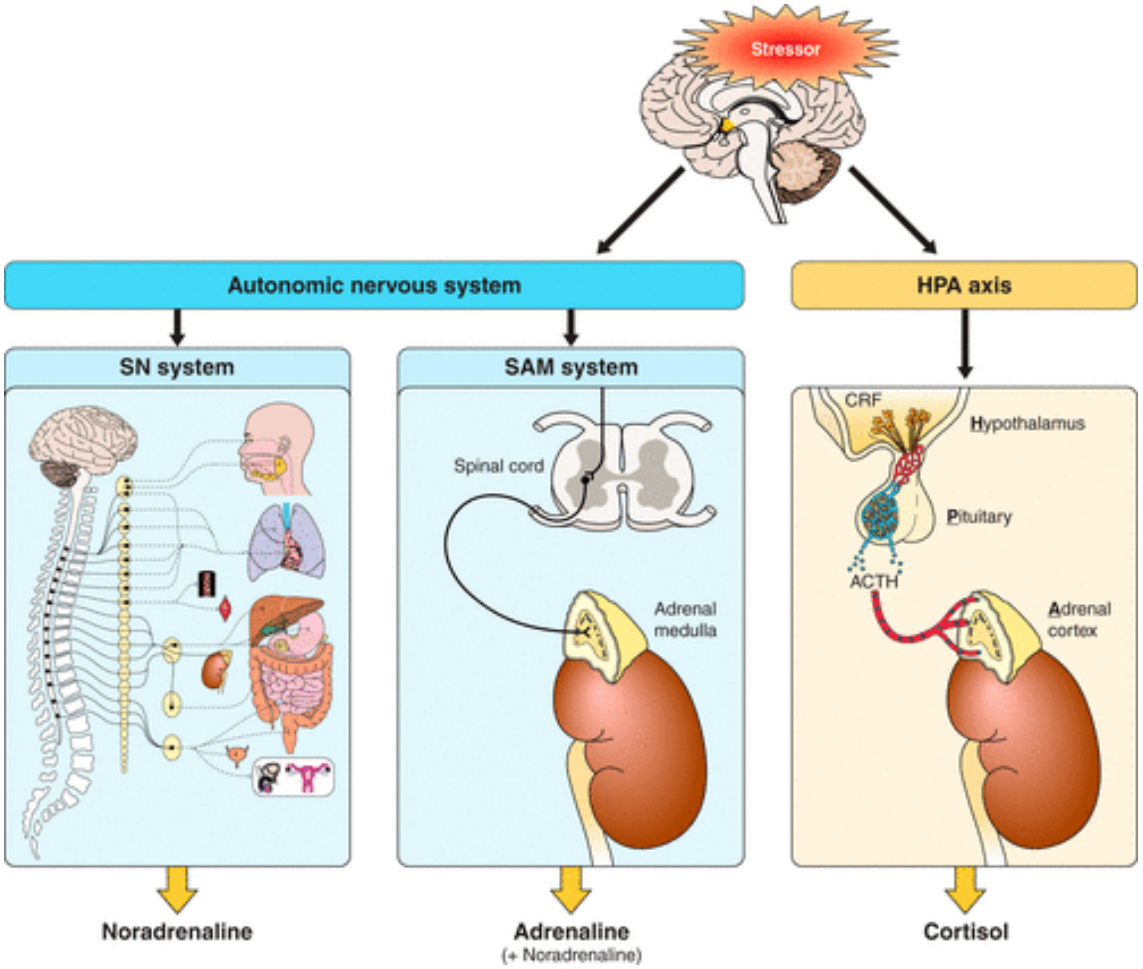
Case studies

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



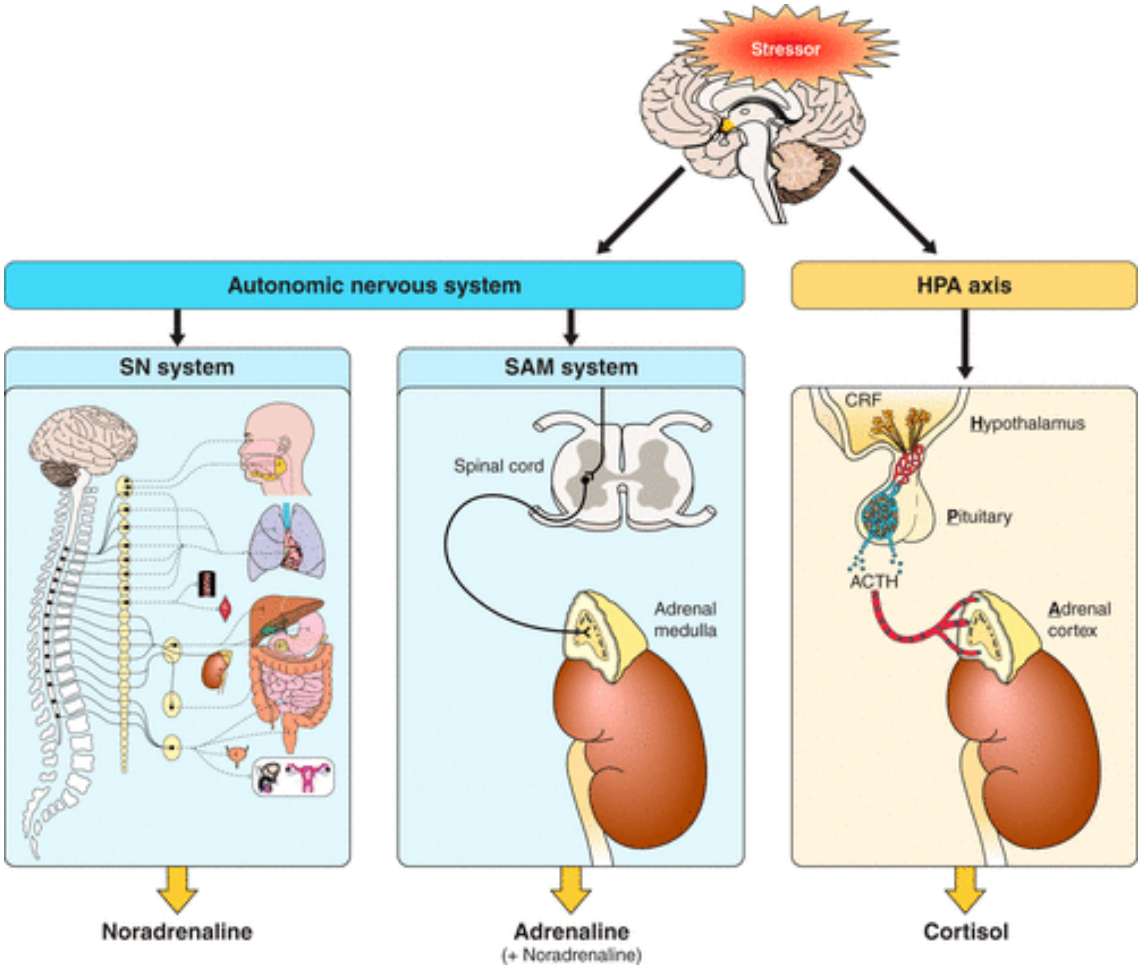
(Deussing & Chen, 2018)

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)

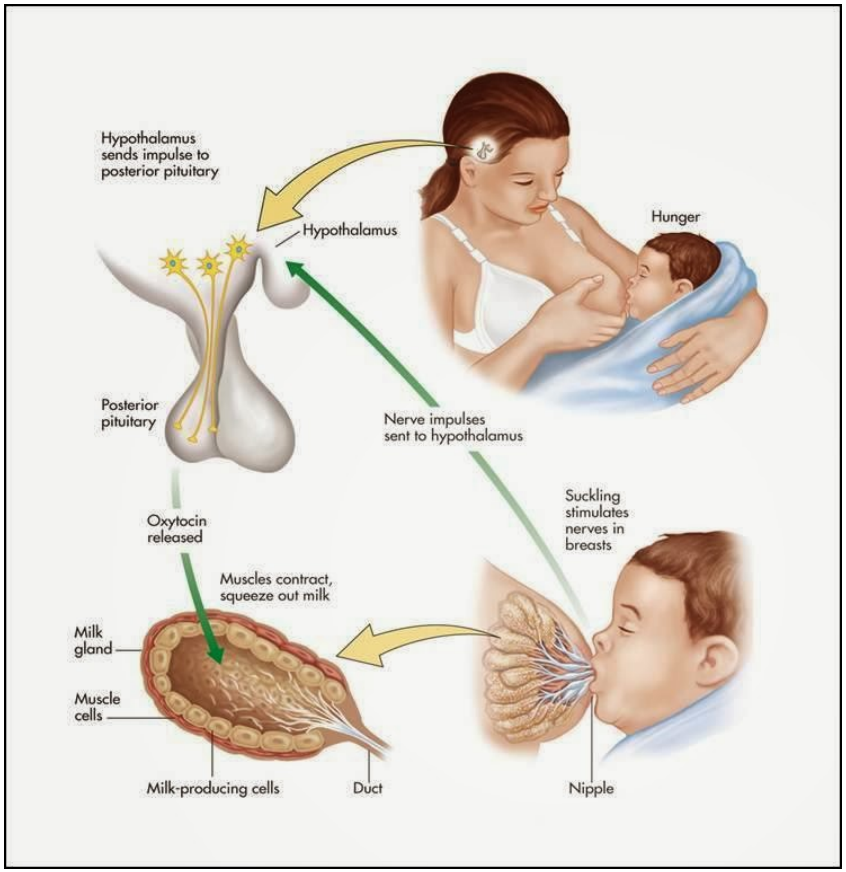
Adrenal hormones

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

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)

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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Weisman, O., & Feldman, R. (2013). Oxytocin effects on the human brain: Findings, questions, and future directions. *Biological Psychiatry*, *74*(3), 158–159. https://doi.org/http://dx.doi.org/10.1016/j.biopsych.2013.05.026