Animal Behavior

Hormones and Neurons Organize Behavior
Controlling Neural Responses

What controls neurons?

Ganglia - clusters of neuron cell bodies.

Brain - greatest concentration of cell bodies.

Praying Mantis has ganglia in head
Remove the head of male and he starts to try to mate = **Inhibition**!
Proximate cause?
Ultimate cause?
Controlling Neural Responses

Cricket male is singing and experiences air movement on the cerci, stops singing.

Proximate cause?
Ultimate cause?
Behavioral Patterns-altering responses

- Monarchs migrate using the sun. How do they compensate for the movement of the sun?
Behavioral Patterns-altering responses

Monarchs: Do they have a built in clock or do they respond to stimuli that they perceive (like stars or shadows)?
Normally fly SW. Shift 6 hours earlier, fly SE. Supports which?
Crickets: females seek males in the dark and males call in the dark.

How do they stop this from happening in the day? Could monitor light levels or have an internal clock. How can you test these?
Light Stimulus on 24/7

Free-running cycle, = internal clock
Circadian Rhythms in Crickets

Without stimulus, the internal clock “drifts”
Visual stimuli entrains the clock

Neural!

And the clock? Circadian Rhythms
Release of juvenile hormone by the optic lobe of the brain

Hormonal!
What are hormones?

- Molecules that circulate in blood
- Bind to receptors
- Cause something to happen
  i.e., Insulin targets body to remove glucose.
Comparison

• Nerves transmit action potentials
  – Neurotransmitters
  – Rapid travel, short-term, local effect

• Hormones bind to receptors
  – Can reach multiple effectors
  – Slow travel, long-term, wide-spread effect

Example: epinephrine and norepinephrine
Epinephrine and Norepinephrine

HYPOTHALAMUS
Direct control by nervous system
Indirect control through release of regulatory hormones

KEY TO PITUITARY HORMONES:
ACTH Adrenocorticotropic hormone
TSH Thyroid-stimulating hormone
GH Growth hormone
PRL Prolactin
FSH Follicle-stimulating hormone
LH Luteinizing hormone
MSH Melanocyte-stimulating hormone
ADH Antidiuretic hormone

Hypothalamus
Adenohypophysis of pituitary gland
Suprarenal gland
Suprarenal medulla
Suprarenal cortex
ACTH
Adrenocorticotropic hormone
TSH
Thyroid-stimulating hormone
GH
Growth hormone
PRL
Prolactin
FSH
Follicle-stimulating hormone
LH
Luteinizing hormone
MSH
Melanocyte-stimulating hormone
ADH
Antidiuretic hormone

Kidneys
Males: Smooth muscle in ductus deferens and prostate gland
Females: Uterine smooth muscle and mammary glands
Melanocytes (uncertain significance in healthy adults)

Thyroid gland
Glucocorticoids (cortisol, corticosterone)
Bone, muscle, other tissues
Mammary glands
Testes of male
Ovaries of female
Inhibin
Testosterone
Estrogen
Progesterone
Inhibin

Liver
Somatomedins

Suprarenal gland
Epinephrine and norepinephrine

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And the clock in humans?
(http://www.hhmi.org/biointeractive/human-suprachiasmatic-nucleus)

- **Suprachiasmatic Nucleus (SCN)**, part of the hypothalamus.
  - Releases chemical signals including **Melatonin** and **PK2**
  - Entrained by light detection

Do all animals have a circadian rhythm? Naked mole rats.
Other seasonal rhythms?

- **Circannual**: ground squirrels, hibernation
  No apparent entrainment, drifts
- Stonechats, molting and testicular size
  Needs entrainment.
Entrainment of cycles by environment

- Lunar cycle (lions prefer dark)
- Rainfall (rufous-winged sparrows). Why not light cycle?
Entrainment of cycles

Multiple cues (crossbills) light cycles and food availability, flexibility

- Predation pressure and light (Kangaroo rats)

https://www.youtube.com/watch?v=wkJLHnYy_G0
How photoperiod entrains reproduction
Male white-crowned sparrows need to re-grow their gonads!
Not the length of daylight but when the light occurs.
Causes a release of luteinizing hormone.
Hormones that affect behavior

- Paternal behavior in mice: Progesterone and infanticide.

CA mice: evaluate the above hormones.
Hormones that affect behavior

- Testosterone: and sexual behavior

  Vasopressin and oxytocin:
  Prairie voles and pair bonding.
Oxytocin and Humans

- 2 groups, oxytocin and placebo
- Moral choice, 5 killed or 1 by switching track
- 1 given similar to self name or different from self.
- Placebo group, no difference
- Oxytocin group, less likely to switch tracks to kill “same”
- When is oxytocin high?

https://www.ted.com/talks/paul_zak_trust_morality_and_oxytocin?language=en
Testosterone and Reproduction

- Often need testosterone to regulate mating behaviors.
Testosterone and Reproduction

- Mating can be independent of testosterone
- Might function in aggression-territory and mate defense, in females too.
Testosterone and Reproduction

- Expensive to survival-immune system, more fights. Distracts from parental care.
Costs of Hormone Regulation?

**Antechinus** is a marsupial that mates then dies! Why? Immune system, nutrition, injury, predation. Lizard and testosterone.
Different Reproductive Strategies

- Short life/ high reproduction, r-selected
- Long life/ low reproduction, k-selected

Why?
- Competition
- Paternal care
- Mate choice
- Territoriality
- ?

How do you exert yourself as a bird?
Stress hormones

- Corticosterone-in birds, non-primate mammals
- Cortisol-in primates, from adrenal gland
- Macaque monkeys-cortisol and social dominance
- Humans-blocks inflammation but reduces immune

https://www.youtube.com/watch?v=iyHVwUe66qw
Stress hormones-measuring

- Blood
- Saliva
- Feces or urine-breakdown products
- Fur or feathers-more problems