OUTLINE
- Neurophysiology of stress
- Short and Long Term Stress
- Psychoneuroimmunology
- PTSD
Do you think stress is a good or a bad thing? Why?
STRESS

- **Stress:**
- A response to any demand
  - Eustress
  - Distress

GENERALIZED ADAPTATION SYSTEM

- Stress resistance
- Sympathetic Nervous System
  - Stressor occurs
  - Adrenal Cortex - Cortisol
  - Phase 1: Alarm reaction (mobilize resources)
  - Phase 2: Resistance (cope with stressor)
  - Phase 3: Exhaustion (reserves depleted)

The body’s resistance to stress can only last so long before exhaustion sets in.
**AUTONOMIC NERVOUS SYSTEM**

- Rapid Response System
- Important in more acute stressors
- Results in activation of Sympathetic Nervous System
**HPA Axis**

**HPA Axis (hypothalamic-pituitary-adrenal)**
- Slower to respond
- Important in chronic stress
- Activation of hypothalamus causes release of ACTH from pituitary and release of cortisol from adrenal
- \( \text{ACTH} = \text{Adrenocorticotropic hormone (ACTH)} \)
- Cortisol mobilizes resources but can be harmful if prolonged exposure
SECRETION OF THE ADRENAL HORMONE CORTISOL

ELEVATES BLOOD SUGAR AND INCREASES METABOLISM.

HELPS THE BODY SUSTAIN PROLONGED ACTIVITY - BUT AT THE EXPENSE OF DECREASED IMMUNE SYSTEM ACTIVITY.
Stress \rightarrow \text{increased glucocorticoids}

\text{↑} \text{blood to brain}

\text{More energy for neurons}

Feedback loop – if high levels of cortisol, tells brain to not release more

**HORMONE SECRETION DURING STRESS**

- Adrenal glands release
  - **Epinephrine**: biases energy flow to muscles, blood flow from heart, and increases blood pressure
  - **Norepinephrine**: is released in brain during stress to focus attention
  - **Glucocorticoids**: break down protein and fats to glucose, increase blood flow, and stimulate behavioral responsiveness
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WHY ZEBRAS DON’T GET ULCERS (SAPOLSKY, 2004)
Does short-term stress enhance or impair memory?
Release of Glucocorticoids

Mobilize glucose to blood stream

Stimulates Long Term Potentiation (LTP) - better memory formation

Energy available to neurons

SHORT TERM STRESS EFFECTS ON CONSOLIDATION AND RETRIEVAL

During stress:
- glucocorticoids activate the amygdala,
- “turns on” the hippocampus, switching the brain into a consolidation state (favoring quick learning about the stressful event)
LONG TERM STRESS

- Can stress damage the brain?

CUSHING’S SYNDROME

- Tumors that result in secretion of glucocorticoids
- Cushingoid dementia: explicit memory problems
- So glucocorticoids over the long term may lead to memory problems
  - May be other side effect of the disease?
- People treated with glucocorticoids to treat inflammatory diseases also have explicit memory problems
STRESS CAN CAUSE BRAIN DAMAGE

- **Sapolsky**: Stress causes hippocampal damage
- Mediated by cortisol
- **Jensen (1982)**: Tortured people have hippocampal damage

Healthy - spiny neurons

Neurons after sustained stress
WHY ARE THE DIFFERENT EFFECTS FOR SHORT AND LONG-TERM STRESS?

Two hippocampal glucocorticoid receptors:
- MR = high affinity receptor, activated with low glucocorticoid levels
- GR = low affinity receptor, activated with high glucocorticoid levels

OUTLINE
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THE IMMUNE SYSTEM

- White blood cells = leukocytes
  - B cells (bone marrow): secrete antibodies which attach to antigens
  - T cells (thymus gland): attack intruders directly or help to grow more T cells or B cells
  - Natural killer cells: attack tumor cells, and cells infected by viruses
- If infection leukocytes produce cytokines – combat infection

STRESS AND THE IMMUNE SYSTEM

- Stress causes endorphin release
- Stress causes Imunosuppression
- Heroin addicts are more likely to get diseases
**Psychoneuroimmunology**

- Stress $\rightarrow$ nervous system increases immune system
  - Increase natural killer cells
  - Increase cytokine secretion
  - Creates a feeling of illness
- Three Mile Island nuclear power plant
  - People continued to live there
  - Lower levels B cells and T cells
- Bereavement causes suppression of the immune system
- Alzheimer's caretakers have suppressed immune systems

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**Coping with Stress Prediction and Control**

*Jay Weiss*
MIND/BODY CONNECTION: JAY WEISS

- Measured stomach ulcers
- **Group A**: Control of shock
- **Group B**: No control of shock
- **Group C**: No shock
- *Control* and *prediction* can reduce stress

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PSYCHONEUROIMMUNOLOGY
A MIND-BODY CONNECTION

- Brain controls the immune system
  - New discovery
  - Once thought to be independent

- Holding husband’s hand reduced the brain’s response to electric shock
OUTLINE
- Neurophysiology of stress
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- Psychoneuroimmunology
- Posttraumatic Stress Disorder (PTSD)

PTSD
- What are the symptoms of PTSD?
- What brain areas do you think are involved?
**Norepinephrine Response to Stress**

- NE release during the traumatic event event
- Those with greatest stress response aren’t those that are most likely to get PTSD
- Yohimbine blocks NE $\alpha_2$ autoreceptor
  - Increased NE
- Induces symptoms in PTSD patients
PTSD AND CORTISOL

- People with PTSD are more likely to have low cortisol immediately after trauma and weeks later
- Low cortisol = ill equipped to battle stress?
- More vulnerable to damaging effects of stress.