NEUROPSYCHOLOGY OF MOTIVATION
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- **Motivation** is defined as the process that initiates, guides, and maintains goal-oriented behaviors.
- Voluntary movements are incited to occur—or motivated—in order to satisfy a **need.**
- You have a biological need for food, water, and sleep. Therefore, you are motivated to eat, drink, and sleep.
- Motivation can be thought of as a **driving force** on behavior.
- Our goal in this topic is to explore the neural basis for this type of motivation. To illustrate, we concentrate on a subject dear to our hearts**: eating**.

THE LONG-TERM REGULATION OF FEEDING BEHAVIOR

- Brain's requirement for food, in the form of **glucose**.
- Only a few minutes of **glucose deprivation** will lead to **a loss of consciousness**, eventually followed by death if glucose is not restored.
- One primary reason we are motivated to eat is to keep these reserves at a level sufficient to ensure that there will not be an energy shortfall.
- Energy is stored in two forms: **glycogen** and **triglycerides.**
- **Glycogen** reserves have a **finite capacity**, and they are found mainly in the **liver and skeletal muscle**.
- **Triglyceride** reserves are found in **adipose (fat) tissue**, and they have a virtually **unlimited capacity.**
- If the intake and storage of energy consistently exceed the usage, the amount of body fat, or adiposity, increases, eventually resulting in **obesity**.
- If the intake of energy consistently fails to meet the body's demands, loss of fat tissue occurs, eventually resulting in **starvation.**

Hormonal and Hypothalamic Regulation of Body Fat and Feeding

- The hormone **leptin**, released by adipocytes (fat cells), regulates body mass by acting directly on neurons of the hypothalamus that decrease appetite and increase energy expenditure.
- **Leptin deficiency** stimulates hunger and feeding, suppresses energy expenditure. In the case of leptin deficiency, the brain and body respond as if the person is starving, despite massive obesity.
- Now let's take a moment to consider the body's integrated response to excessive adiposity (and **high leptin levels**). The ***humoral response*** consists of increased secretion of **thyroid-stimulating hormone (TSH)** and **adrenocorticotropic hormone (ACTH).**
- These pituitary hormones act on the thyroid and adrenal glands and have the effect of **raising the metabolic rate of cells** throughout the body. **The *visceromotor response*** increases the tone of the **sympathetic** division of the ANS, which also raises metabolic rate, in part by raising **body temperature**. **The *somatic motor response*** decreases feeding behavior.

- The humoral response is triggered by the activation of neurons in the **paraventricular nucleus** of the hypothalamus, which in turn causes the release of the hypophysiotropic hormones that regulate the secretion of TSH and ACTH from the anterior pituitary.
- The paraventricular nucleus also controls the activity of the sympathetic division of the ANS.
- Finally, feeding behavior is inhibited via connections of the arcuate nucleus neurons with cells in the **lateral hypothalamus.**

- **Anorexia** caused by damage to the lateral hypothalamus is commonly referred to as the **lateral hypothalamic syndrome.**
- **Overeating and obesity** caused by lesions to the ventromedial hypothalamus is called the **ventromedial hypothalamic syndrome**.
- For a time, the idea that the lateral hypothalamus was a **“hunger center”** acting in opposition to the ventromedial hypothalamus **“satiety center”** was popular.
- Destruction of the lateral hypothalamus leaves the animals inappropriately satiated, so they do not eat; destruction of the ventromedial hypothalamus leaves the animals insatiable, so they overeat.

The Role of Dopamine in Motivation

- **Kent Berridge** at the University of Michigan discovered that **destruction of the dopamine axons** passing through the lateral hypothalamus fails to reduce the hedonic responses to food, even though animals stop eating.
- If a tasty morsel is placed on the tongue of a rat that has sustained such a lesion, the animal will still behave as if the food evokes a pleasurable sensation (the rat equivalent of lip smacking), and the morsel will be consumed.
- The dopamine-depleted animal behaves **as though it *likes* food but does not *want* food**. The animal apparently **lacks** the motivation to seek food, even though it seems to enjoy food when it is available.
- Conversely, **stimulation of the dopamine axons** in the lateral hypothalamus of normal rats appears to produce a craving for food without increasing the food's hedonic impact.

Serotonin, Food, and Mood

- Measurements of serotonin in the hypothalamus reveal that levels are **low** during the postabsorptive period, they **rise** in anticipation of food, and they **spike** during a meal, especially in response to **carbohydrates**.
- Abnormalities in brain serotonin regulation are believed to be one factor that contributes to **eating disorders** (**anorexia nervosa, bulimia nervosa).**
- These disorders are also commonly accompanied by ***depression***, a severe disturbance of mood that has been linked to **lowered brain serotonin levels**.
- The serotonin connection is clearest in the case of bulimia. In addition to depressing mood, lowered serotonin levels **reduce satiety**.

OTHER MOTIVATED BEHAVIORS……

DRINKING

- Two different physiological signals stimulate drinking behavior. one of these is a decrease in blood volume, or **hypovolemia** (volumetric thirst).
- The other is an increase in the concentration of dissolved substances (solutes) in the blood, or **hypertonicity**.
- A rise in blood levels of **angiotensin II** occurs in response to reduced blood flow to the kidneys. The circulating angiotensin II acts on the neurons of the subfornical organ in the telencephalon, which in turn directly stimulate the **magnocellular neurosecretory cells** of the hypothalamus to release **vasopressin**.
- **Mechanoreceptors** in the walls of the major blood vessels and heart signal the loss of blood pressure that accompanies a loss of blood volume. These signals make their way to the hypothalamus via the vagus nerve and the nucleus of the solitary tract.
- **Vasopressin (ADH)** is released in the posterior pituitary by the magnocellular neurosecretory cells. Which acts directly on the kidneys to increase water retention and inhibit urine production.

- In addition to this humoral response, reduced blood volume (1) stimulates the **sympathetic** division of the ANS, which helps correct the drop in blood pressure by constricting arterioles, and (2) powerfully motivates animals to seek and consume water.
- The other stimulus for thirst, hypertonicity of the blood, is sensed by neurons in yet another specialized region of the telencephalon lacking a blood-brain barrier, the **vascular organ of the lamina terminalis** (**OVLT**).
- When the blood becomes hypertonic, water leaves cells by the process of **osmosis**.
- The OVLT neurons (1) directly excite the magnocellular neurosecretory cells that secrete vasopressin, and (2) stimulate **osmometric thirst**, the motivation to drink water when dehydrated.

Temperature Regulation

- The cells in the body are fine-tuned for a constant temperature**, 37°C (98.6ºF),** and deviations from this temperature interfere with cellular functions.
- A fall in temperature is detected by cold-sensitive neurons of the **anterior hypothalamus**. In response, **TSH** is released by the anterior pituitary. TSH stimulates the release of the **hormone thyroxin** from the thyroid gland, which causes a widespread **increase in cellular metabolism**.
- The visceromotor response is **constricted blood vessels** in the skin and **piloerection(goosebumps).**
- An involuntary **somatic motor response** is shivering, and, of course, the other somatic response is to seek warmth.

- A rise in temperature is detected by warm-sensitive neurons of the **anterior hypothalamus**.
- In response, metabolism is slowed by **reducing TSH release**, blood is shunted toward the body periphery to dissipate heat, and behavior is initiated to seek shade.
- In some mammals, an involuntary motor response is panting; in humans, it is **sweating**.

THANK YOU