Νευροφυσιολογία και Αισθήσεις

Διάλεξη 16
Κίνητρα Συμπεριφοράς ή Υποκίνηση
(Motivation)

Introduction

• Types of behavior
  • Unconscious reflexes
  • Voluntary Movements
    • Motivation
      • Driving force on behavior
        • Analogy– ionic driving force dependent upon many factors
    • Probability and direction of behavior
      • Vary with the driving force needed to perform the behavior
The Hypothalamus, Homeostasis, And Motivated Behavior

- **Homeostasis**
  - Maintains the internal environment of the body within a narrow physiological range

- **Role of Hypothalamus**
  - Regulates body temperature, fluid balance, and energy balance

- **Three components of neuronal response**
  - Humoral response
  - Visceromotor response
  - Somatic motor response

- **Examples of motivated behaviors**
  - Response when body is cold
    - Body shivers, blood shunted away from the body surface, urine production inhibited, body fat reserves - mobilized
  - **Lateral hypothalamus**
    - Initiation of motivation to actively seek or generate warmth
    - Example of motivated behavior
      - Eating

The Long-term Regulation of Feeding Behavior

- **Energy Balance**
  - Prandial state
  - Energy Storage → Glycogen and triglycerides
  - Anabolism and Catabolism

- **Body Fat and Food Consumption**
  - Hormones and the hypothalamus
    - Lateral hypothalamus
    - Reduce hormone levels released from fat cells → Incite feeding behavior
    - Detection neurons concentrated in the periventricular zone
  - Lipostatic hypothesis
  - Leptin
    - Regulates body mass
      - Decreases appetite
      - Increases energy expenditure
  - Leptin depletion
    - Incites adaptive responses to fight starvation
The Long-term Regulation of Feeding Behavior

• The Hypothalamus and Feeding
  • Anorexia
    • Severely diminished appetite for food
  • Obesity
    • Overeating caused by bilateral lesions in ventromedial hypothalamus
  • Lateral hypothalamic syndrome
  • Ventromedial hypothalamic syndrome

The Effects of Elevated Leptin Levels on the Hypothalamus

• Arcuate nucleus
  • Located at the base of the third ventricle
• Activation of arcuate neurons that release αMSH and CART peptides
  • Anorectic peptides - diminish appetite
  • Project to regions that orchestrate coordinated response of humoral, visceromotor, and somatic responses
    • Paraventricular nucleus (humoral response)
    • Intermediolateral gray matter of spinal cord
    • Lateral hypothalamus
The Long-term Regulation of Feeding Behavior

- **The Effects of Decreased Leptin Levels on the Hypothalamus**
  - Activation of arcuate neurons that release NPY and AgRP
  - Effects on energy balance: Opposite to the effects of αMSH and CART
  - Orexigenic peptides—increase appetite
    - NPY and AgRP inhibit secretion of TSH and ACTH
    - Activate parasympathetic division of ANS
    - Stimulate feeding behavior

- **The Control of Feeding by Lateral Hypothalamic Peptides**
  - Lateral hypothalamus: Motivation to eat
    - Electrical stimulation: Triggers feeding behavior in satiated animals
  - Neurons intrinsic to lateral hypothalamus; Axons passing through the lateral hypothalamus
  - Innervates most of cortex
    - MCH: Peptide neurotransmitter
      - Informs cortex about leptin levels
      - Motivates the search for food

- **Summary: The Effects of Elevated/Decreased Leptin Levels on the Hypothalamus**
  - A rise in leptin levels
    - Increases αMSH and CART in arcuate neurons → inhibit feeding behavior and decrease metabolism
  - A fall in leptin levels
    - Increases NPY and AgRP in arcuate and MCH neurons in lateral hypothalamus → stimulates feeding behavior and increases metabolism
The Short-Term Regulation of Feeding Behavior

• Motivation to eat—depends on
  • Social factors
  • Time and quantity of last meal
  • Ghrelin
    • Secreted from the stomach ➔ arcuate nucleus
    • Causes sense of hunger

• Appetite, Eating, Digestion, and Satiety
  • 3 phases of eating
    • Cephalic (sight and smell)
    • Gastric (chew and swallow)
    • Substrate (nutrients begin to be absorbed)
  • Satiety signals
    • Gastric Distension
      • Vagus nerve ➔ solitary nucleus
        (also input from taste buds)
    • Cholecystokinin
      • Enteric nervus system ➔ vagus nerve
    • Insulin
      • Vagus ➔ Pancreas ➔ Insuline ➔ arcuate nucleus

Why Do We Eat?

• Motivations in psychological terms
  • Liking: Hedonic
  • Wanting: Drive reduction

• Reinforcement and Reward
  • Electrical self-stimulation
    • Experiments to identify sites of reinforcement
    • Effective sites for self-stimulation:
      • Trajectory of dopaminergic axons in the ventral tegmental area projecting to the forebrain
  • Drugs that block dopamine receptors
    • Reduce self-stimulation
Why Do We Eat?

• The Role of Dopamine in Motivation
  • Old belief
    • Dopamine projection served hedonic reward
  • New understanding
    • Dopamine-depleted animals “like” food but “do not want” food
    • Lack motivation to seek food, but enjoy it when available
  • Stimulation of the dopamine axons
    • Craving for food without increasing the hedonic impact

• Serotonin, Food, and Mood
  • Serotonin as a neurotransmitter
  • Serotonin levels
    • Low: Postabsorptive period
    • Rise: In anticipation of food
    • Spike: During meals
  • Mood elevation
    • Rise in blood tryptophan and brain serotonin
    • Elevated also from foods high in tryptophan (e.g. carbs, chocolate)
    • Drugs that elevate serotonin levels
      • Example: Dexfenfluramine (Redux)
  • Disorders
    • Anorexia nervosa; Bulimia nervosa
    • Both often accompanied by depression
  • Treatment
    • Antidepressant drugs—elevate brain serotonin levels
      • Example: Fluoxetine (“Prozac”)
Other Motivated Behaviors

• **Drinking**
  - **Volumetric thirst**
    - Thirst triggered by hypovolemia
    - Hypovolemia
      - Decrease in blood volume
  - **Triggers**
    - Decreased flow in kidneys $\rightarrow$ angiotensin from liver
    - Decreased blood pressure $\rightarrow$ mechanoreceptors
  - **Vasopressin: Antidiuretic hormone or ADH**
    - Acts on kidneys to increase water retention
    - Inhibit urine production

Other Motivated Behaviors

• **Drinking**
  - **Osmometric thirst**
  - **Hypertonicity**
    - Increase in the concentration of dissolved substances in the blood
  - **OVLT= vascular organ of the lamina terminalis**
  - **Role of OVLT neurons**
    - Excite magnocellular neurosecretory cells
      - Vasopressin
    - Stimulate osmometric thirst
      - Drink water when thirsty
  - **Diabetes insipidus**
    - Lack of vasopressin
    - Loss of water in urine
    - Treatment—replace missing vasopressin
Other Motivated Behaviors

• Temperature Regulation
  • Cells fine-tuned for constant temperature—37°C (98.6°F)
  • Neurons for temperature homeostasis
    • Clustered in anterior hypothalamus
    • Humoral and visceromotor responses
      • Neurons in the medial preoptic area of the hypothalamus
    • Somatic motor (behavioral) responses
      • Neurons in the medial preoptic area of the hypothalamus
  • Visceromotor response: Goosebumps
  • Involuntary somatic motor response
    • Shivering, seeking warmth
  • Rise in temperature: Metabolism slowed by reducing TSH release

• Don’t worry, you are not ruled by your hormones
  • Humans can exert cognitive control
Conclusion

• Overview of motor systems
  • Addressed “how” questions of behavior
    • E.g., How is movement initiated?

• Overview of motivation systems
  • Addresses “why” questions of behavior
    • E.g., Why do we drink when dehydrated?

• The important discovery of a neural basis for feeding behavior
  • Allows us to frame new questions that will impact how we view our own behaviors

Επόμενη Διάλεξη ...

Διάλεξη 17
Το Σεξ και ο Εγκέφαλος
(Sex and the Brain)