Νευροφυσιολογία και Αισθήσεις

Διάλεξη 16

Κίνητρα Συμπεριφοράς ή Υποκίνηση

(Motivation)

Biomedical Imaging & Applied Optics
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Introduction

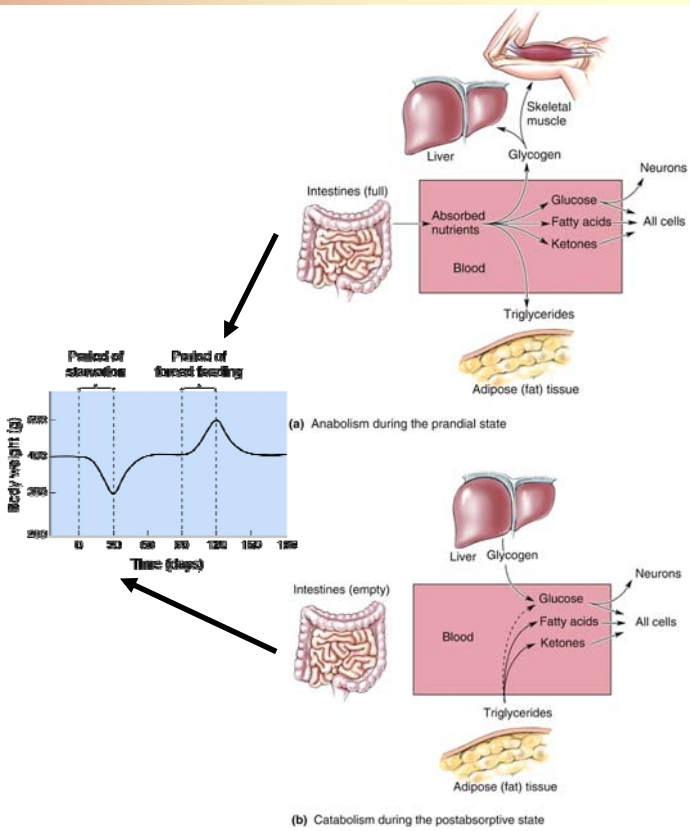
- **Types of behavior**
  - Unconscious reflexes
  - Voluntary Movements
    - Motivation
      - Driving force on behavior
        - Analogy– ionic driving force dependent upon many factors
    - Probability and direction of behavior
      - Vary with the driving force needed to perform the behavior

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→ Homeostasis
  - Example of motivated behavior
    - Eating

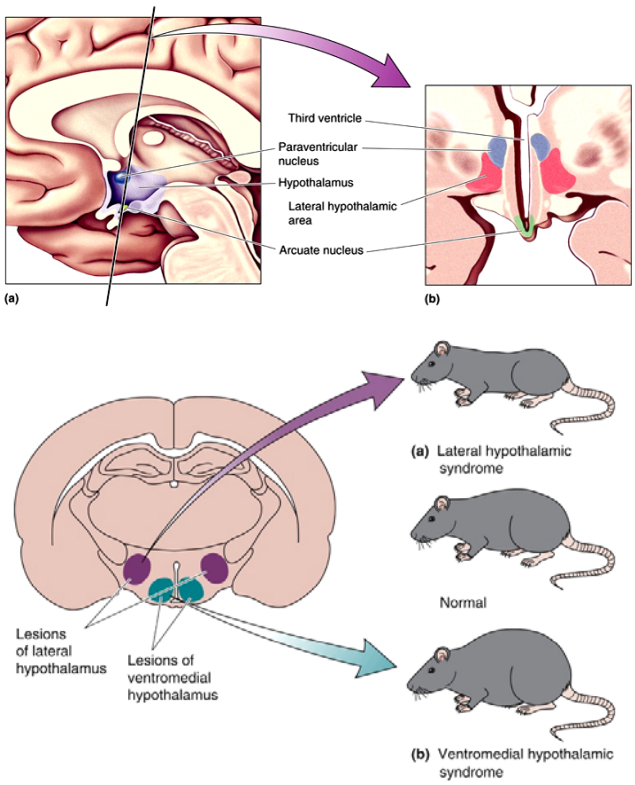
The Long-term Regulation of Feeding Behavior

- **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



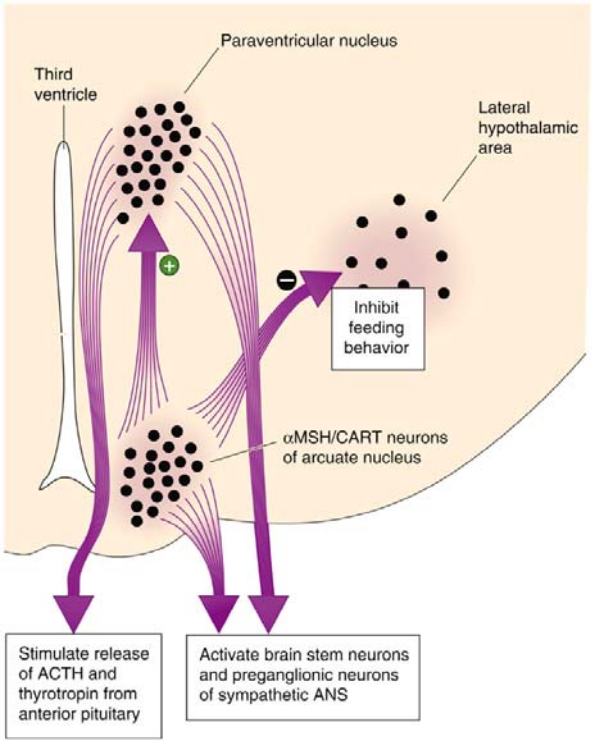
The Long-term Regulation of Feeding Behavior

- **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



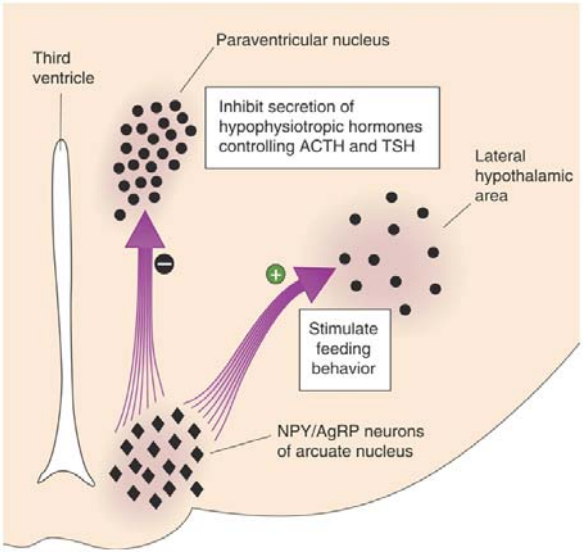
The Long-term Regulation of Feeding Behavior

- **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



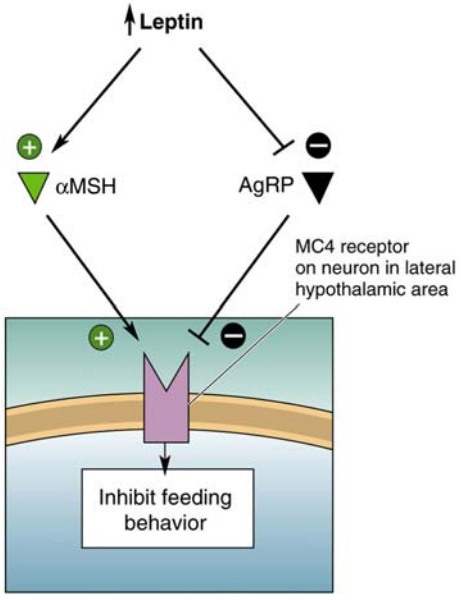
The Long-term Regulation of Feeding Behavior

- **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



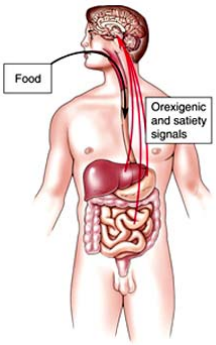
The Long-term Regulation of Feeding Behavior

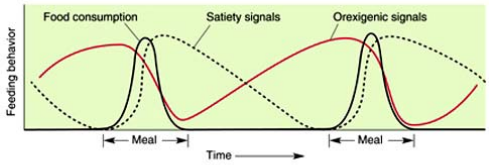
- **Summary: The Effects of Elevated/Decreased Leptin Levels on the Hypothalamus**
  - A rise in leptin levels
    - Increases αMSH and CART in arcuate neurons → inhibit feeding behavior and decrease metabolism
  - A fall in leptin levels
    - Increases NPY and AgRP in arcuate and MCH neurons in lateral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

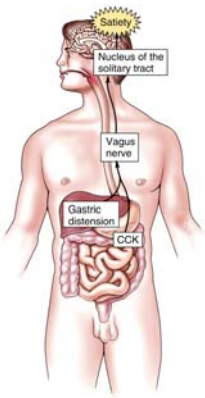


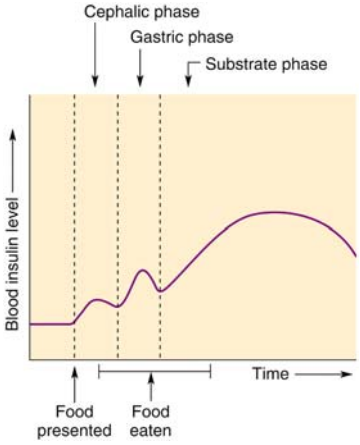
The Short-Term Regulation of Feeding Behavior

- **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 → acruate nucleus



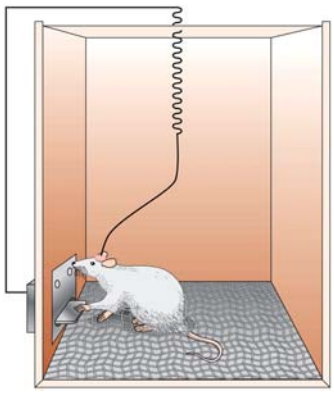


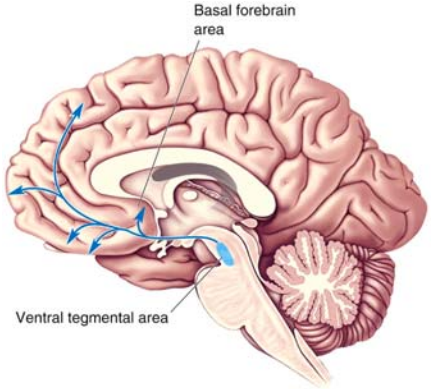




Why Do We Eat?

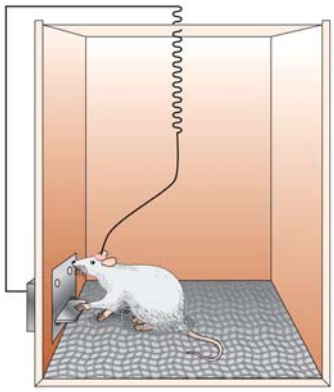
- **Motivations in psychological terms**
  - Liking: Hedonic
  - Wanting: Drive reduction
- **Reinforcement and Reward**
  - Electrical self-stimulation
    - Experiments to identify sites of reinforcement
    - Effective sites for self-stimulation:
      - Trajectory of dopaminergic axons in the ventral tegmental area projecting to the forebrain
  - Drugs that block dopamine receptors
    - Reduce self-stimulation

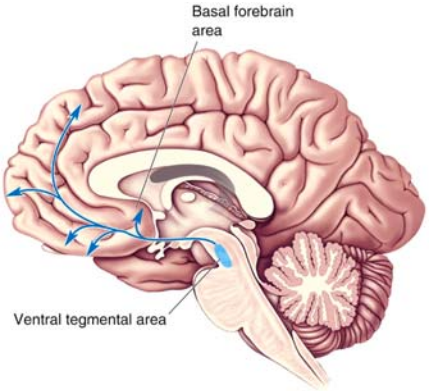




Why Do We Eat?

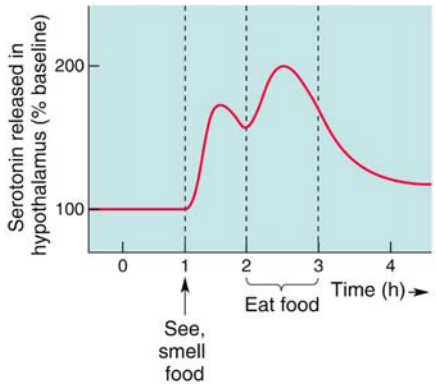
- **The Role of Dopamine in Motivation**
  - Old belief
    - Dopamine projection served hedonic reward
  - New understanding
    - Dopamine-depleted animals "like" food but "do not want" food
    - Lack motivation to seek food, but enjoy it when available
  - Stimulation of the dopamine axons
    -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

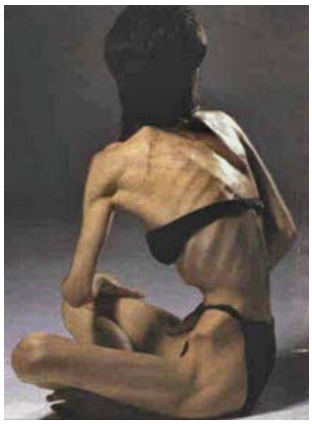




Why Do We Eat?

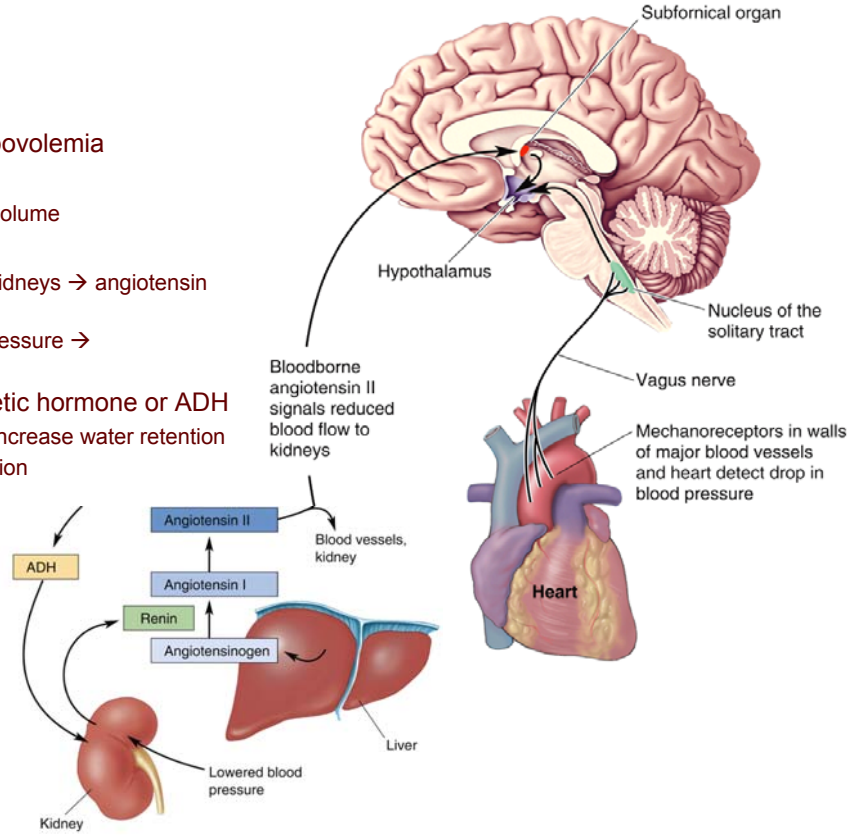
- **Serotonin, Food, and Mood**
  - Serotonin as a neurotransmitter
  - Serotonin levels
    - Low: Postabsorptive period
    - Rise: In anticipation of food
    - Spike: During meals
- **Mood elevation**
  - Rise in blood tryptophan and brain serotonin
  - Elevated also from foods high in tryptophan (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")





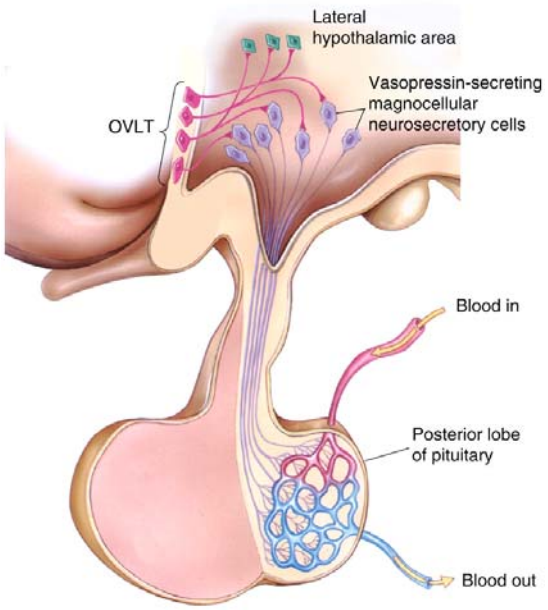
Other Motivated Behaviors

- **Drinking**
  - Volumetric thirst
    - Thirst triggered by hypovolemia
    - Hypovolemia
      - Decrease in blood volume
    - Triggers
      - Decreased flow in kidneys → angiotensin from liver
      - Decreased blood pressure → 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



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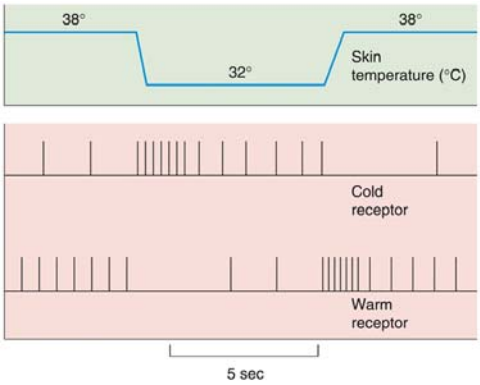
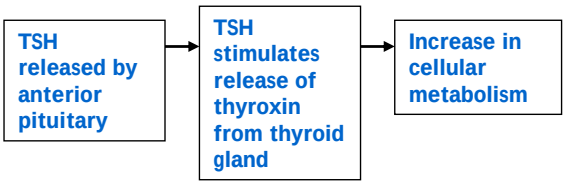
Other Motivated Behaviors

- **Temperature Regulation**
  - Cells fine-tuned for constant temperature—37°C (98.6ºF)
  - 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 of lateral hypothalamic area
  - Visceromotor response: Goosebumps
  - Involuntary somatic motor response
    - Shivering, seeking warmth
  - Rise in temperature: Metabolism slowed by reducing TSH release



Process during a fall in temperature:



Other Motivated Behaviors

Table 16.2 **Hypothalamic Responses to Stimuli That Motivate Behavior**

BLOODBORNE STIMULUS	SITE OF TRANSDUCTION	HUMORAL RESPONSE	VISCEROMOTOR RESPONSE	SOMATIC MOTOR RESPONSE
Eating signals				
↓ Leptin	Arcuate nucleus	↓ ACTH ↓ TSH	↑ Parasympathetic activity	Feeding
↓ Insulin	Arcuate nucleus	↓ ACTH ↓ TSH	↑ Parasympathetic activity	Feeding
Drinking signals				
↑ Angiotensin II	Subfornical organ	↑ Vasopressin	↑ Sympathetic activity	Drinking
↑ Blood tonicity	OVLT	↑ Vasopressin		Drinking
Thermal signals				
↑ Temperature	Medial preoptic area	↓ TSH	↑ Parasympathetic activity	Panting; seeking cold
↓ Temperature	Medial preoptic area	↑ TSH	↑ Sympathetic activity	Shivering; seeking warmth

- **Don't worry, you are not ruled by your hormones**
  - Humans can exert cognitive control

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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)