

**LECTURE 14:**  
**Mathematics, Physics, and Biology of  
Sensory Experience**

**I. SENSATION AND PERCEPTION**

**A. Experiencing the World**

- **The Assumption of Mental States**
- The Biology Chapter makes clear that mental states can not be part of psychology.
  - My dreams do not reflect my desires, rather my pons are activating and I am telling a story about them.
  - I am not feeling happy, rather the neurons in my hypothalamic “pleasure center” are activated.
- Maybe instead of using the language of folk psychology (belief and desire), we can use the language of neural impulses and neurotransmitters.

**I. SENSATION AND PERCEPTION**

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- **The assumptions of perfect perception**
  - The assumption of mental states was challenged in the chapter on Biology.
  - The assumption of perfect perception will be challenged in this the Sensation and Perception Chapter.
- Do we see the world as it truly is?
  - To answer this question, we need to know how the physical world is pick up by sensory receptors.

**I. SENSATION AND PERCEPTION**

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- How we perceive involves the study of:
  - **Mathematics:** Formal relation between the magnitude of the physical stimuli and the psychological experiences..
  - **Physics:** The studies of the energies from the physical world which arrives to **sensory receptors**.
  - **Biology:** The study of how sensory receptors translate physical energy into information that can be used by the nervous system.
  - **Psychology:** The study of how neural impulses are interpreted.

## I. SENSATION AND PERCEPTION

### A. Experiencing the World

- **Sensory receptors:** Specialized cells that convert physical energies into neural impulses which can be transmitted to the brain.
  - Many different kinds of sensory information:
    - Sight
    - Hearing
    - Smell
    - Taste
    - Touch
  - Actually there are more than 5 senses:
    - Balance,
    - Temperature (warmth, cold)
    - Pain

## I. SENSATION AND PERCEPTION

### B. The Mathematics of Experience

- The Science of Psychology was born in order to answer philosophers' questions about how the external world of physical stimuli was related to the internal world of psychological sensations.
  - One of the first areas of study in psychology was **Psychophysics**
  - Psychophysics is the study of how the physical properties of stimuli are related to the psychological experiences of them.
  - Psychophysics identifies **thresholds** which are our ability to detect stimuli.

## I. SENSATION AND PERCEPTION

### B. The Mathematics of Experience

- **1. Absolute Thresholds**
- An **Absolute Threshold** is the smallest quality of physical energy that can be reliably detected by an observer.
  - Vision: A single candle flame from 30 miles on a dark, clear night
  - Hearing: The tick of a watch from 20 feet in total quiet
  - Smell: 1 drop of perfume in a 3-room apartment
  - Touch: The wing of a bee on your cheek, dropped from 1 cm
  - Taste: 1 teaspoon of sugar in 2 gallons of water

## I. SENSATION AND PERCEPTION

### B. The Mathematics of Experience

- **2. Difference Thresholds or JNDs Just Noticeable Differences**
- **JND:** The smallest difference in stimulation that can be reliably detected by an observer when 2 stimuli are compared.
  - How small a difference can we detect when comparing the weight, size or any other magnitude of objects?
  - Our ability to detect a difference between stimuli A and B **are relative to** the initial value of value A.

I. SENSATION AND PERCEPTION  
 B. The Mathematics of Experience

- That JNDs are relative demonstrates that our perceptual system does not work objectively.
  - If comparing 2 weights and one is very light, then you will notice differences between A and B of fractions of an ounce.
  - If comparing 2 weights and one is very heavy, then your JND is much higher.
- This relativity of JNDs apply widely
  - Earn only a little money how much harder would you work to earn \$100 more a week?
  - Earn lots of money how much harder would you work to earn \$100 more a week?

I. SENSATION AND PERCEPTION  
 B. The Mathematics of Experience

- **3. Signal Detection Theory**
- Challenges the assumption of a **direct** link from magnitudes of sensation (external world) to perceptual experiences (internal world)
  - In this theory, judgments between stimuli and perceptions can be broken down into two components:
    - **Sensory process:** Process by which information is detected by the CNS.
    - **Decision or Perceptual Processes.** Process involved in making a decision that some thing is perceived.

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 B. The Mathematics of Experience

Consider a study in which a person is to say “present” when a stimulus is there (or different than before).

	Stimulus is Present	Stimulus is Absent
Response: “Present”	Hit	False Alarm
Response: “Absent”	Miss	Correct Rejection

- **A High Miss Rate:** A person from whom it takes lots of stimulus energy to judge that a stimulus is there (or different)
- **A High False Alarm rate:** A person for whom it takes little stimulus energy to judge that a stimulus is there (or different)

I. SENSATION AND PERCEPTION  
 C. Sensation vs. Perception

- The Signal Detection Theory suggests that there is an important distinction to be made between Sensation and Perception
  - **Sensation** is the study of how sensory information is detected and translated into neural information.
  - **Perception** The process by which the brain organizes and interprets information (Meaning making)
- We will spend the rest of this lecture on Sensation and pick up on Perception next time