

Lecture 2

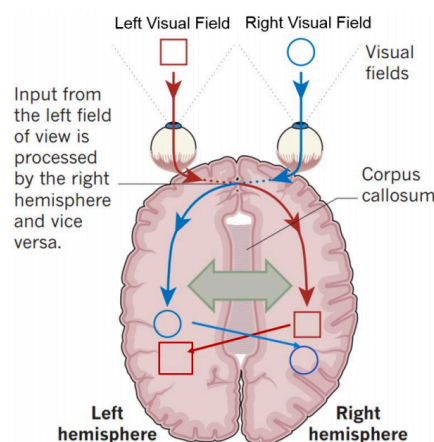
Understanding Human Consciousness: A Physiological Approach

- **Corpus Callosum**

- Large bundle of nerve fibers that connect corresponding parts of one side of the brain with those of the other

- E.g.

- Flower on the left side of visual field
 - Right visual cortex (contralateral) will see it first
 - Then send information to left visual cortex
- Flower on the right side of visual field
 - Left visual cortex will see it first
 - Then send information to right visual cortex



- **Epilepsy**

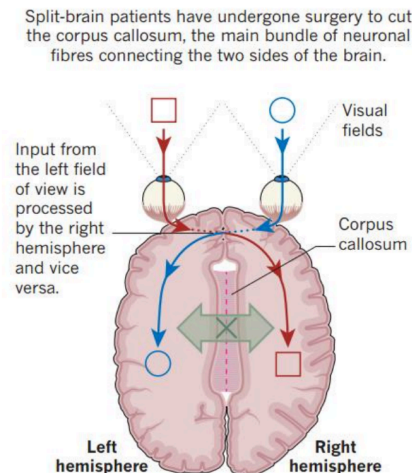
- In some cases of epilepsy, electrical activity propagates through the corpus callosum, bouncing back and forth between the two hemispheres, causing a generalized epileptic seizure

- **Split-Brain Operation**

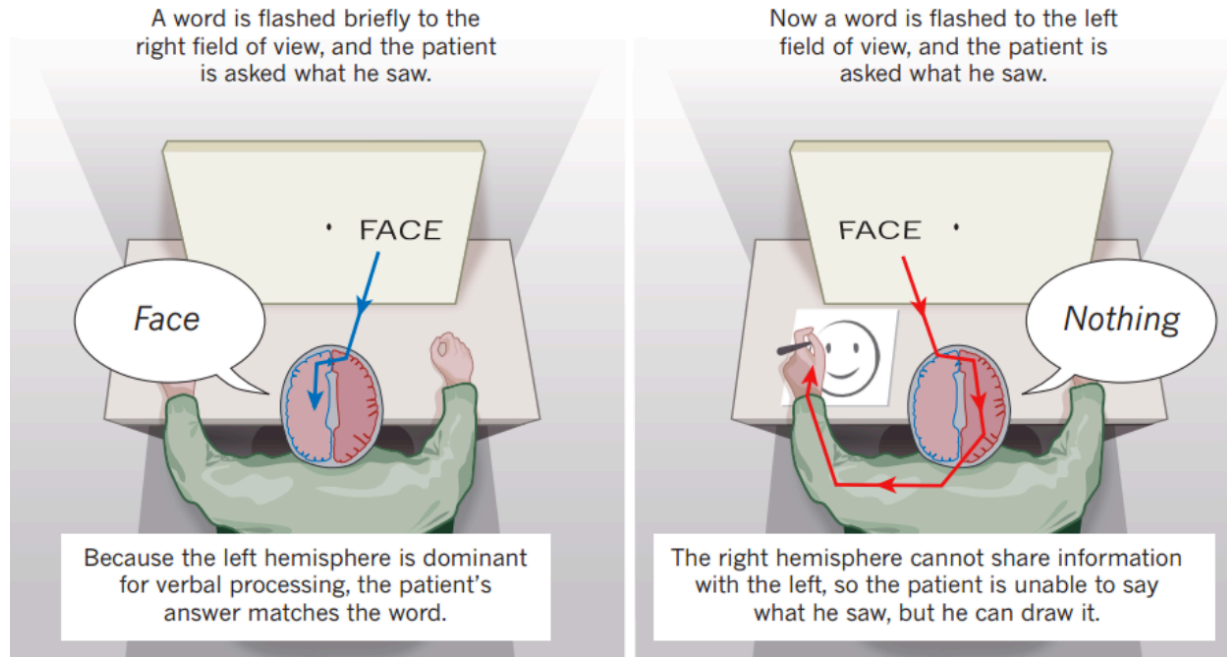
- Neurosurgeons discovered that cutting the corpus callosum greatly reduced the frequency of epileptic seizures (Sperry & Gazzaniga)

- **Agensis of the Corpus Callosum**

- One can be born without a corpus callosum but it is very rare



What happens if the two hemispheres cannot communicate?



- Word on the **left** side of visual field
 - Right visual cortex (contralateral) will see it
 - Information **cannot** be sent back to left visual cortex
 - Can't say what is seen, but can draw it with left hand
 - Can he draw it with right hand too?
- Word on the **right** side of visual field
 - Left visual cortex will see it
 - Information **cannot** be sent back to right visual cortex
 - Can say what is seen

Why do we behave the way we do?

Natural Selection and Evolution

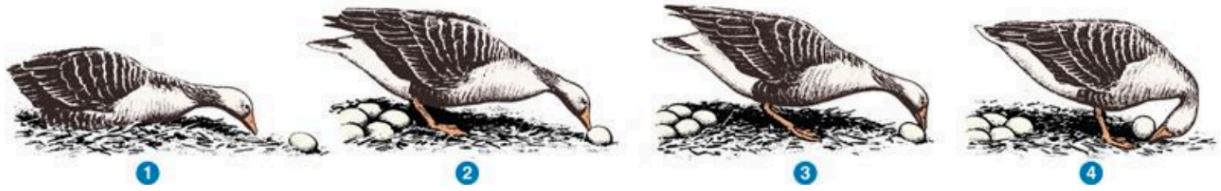
- Charles Darwin (1809–1882)
 - Formulated the principles of *natural selection and evolution*, which revolutionized biology
- **Natural Selection**
 - Gradual process by which biological traits become either more or less common in a population
 - It is a function of the effect of inherited traits on the differential reproductive success of organisms interacting with their environment
 - Natural selection is a key mechanism of evolution

From the perspective of behavior...

- Behaviors that are advantageous either because they increase the reproductive success or likelihood of survival till reproductive age would be selected for
- It might be advantageous to have those behaviors **hard coded** (already genetically encoded) -> **Fixed Action Patterns**

Fixed Action Patterns

- Sequence of unlearned, innate behaviors that is unchangeable
 - Once initiated, it is usually carried to completion
- **Trigger Stimulus**
 - Stimulus that triggers the stereotypical behavior



- E.g. Male Stickleback Fish
 - Behavior
 - A male stickleback fish attacks other male sticklebacks that invade its nesting territory
 - Proximate cause
 - The red belly of the intruding male acts as a **sign stimulus** that releases aggression in a male stickleback
 - Ultimate cause
 - By chasing away other male sticklebacks, a male decreases the chance that eggs laid in his nesting territory will be fertilized by another male

Nature vs Nurture

- All of our cells contain the same original set of genetic information, which we inherited from our parents
- The genetic information is contained in chromosomes, which are a large structure of DNA
- Only 2% of our DNA encodes for “useful” stuff
- Everything our cells have (membranes, pigments, ability to move, ability to transport oxygen, etc) is encoded in the DNA
- Different cells in our body use specific sections of DNA

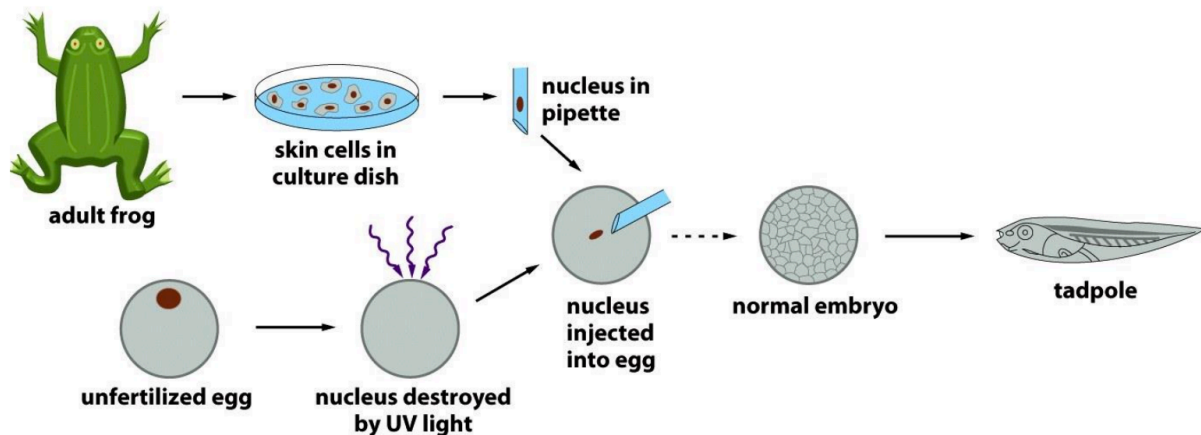
Different cells exist because they express different genes

- **Gene**

1. Part of the DNA that encodes something useful
2. If you think of the molecule of DNA as a string of random letters, a **gene** would be a set of letters that actually spell out a word

- **Cloning**

- If all cells have the same genetic information but only “read” some of it, we should be able to make a full organism from the genetic information in just one cell



Fixed Action Patterns and Genes

- If some behaviors are **Hard Wired**...
 - Cells must contain genes that result in neurons connecting in

specific ways so that when a trigger stimulus is detected, it triggers activity of a specific set of neurons -> **Fixed Action Patterns**

Patterns

- If this is the case...
 - We might be able to change the behavior by just changing one gene
- For a few behaviors this is true...
 - But most behaviors seem to result from complex interactions of genes and environment
 - Our brain is shaped to our environment through our lives
- **Fly Courtship Behavior**
 - Mutating one gene makes females behave as males
 - They show a complex sequence of behaviors that are aimed at "courting" females"

Characteristics in humans determined by one gene

- Monogenic Traits
 - Determined by one gene
 - E.g.
 - Cleft in chin
 - Hairline
 - Freckles
- But most are not
 - If we cannot yet understand how some genes work together to

determine something as simple as height

- Imagine understanding behavioral characteristics

Nature & Nurture

- **Heritability**

- Percentage of the variation in a characteristic that can be attributed to genetic factors
- Calculated by comparing **concordance rate** for types of twins
 - Identical twins share 100% of their genes
 - Fraternal twins share about 50% of their genes
- Some estimated heritability rates are
 - Intelligence: 50%
 - Schizophrenia: 60-90%
 - Height: 90%

- About half of the variability in behavioral characteristics is due to heredity; the other half is due to environmental influences

- **Vulnerability model:** Influence of genes is only partial

- Genes contribute a predisposition for the disorder
- Combination of genes & environmental factors determines whether the individual develops the disorder

- Most scientists reject the nature-vs-nurture concept; they conclude that heredity and environment interact to influence behavior