Genes, Evolution, and Environment
Investigating similarities and differences

Evolutionary psychology
Emphasizes the evolutionary mechanisms that might help explain commonalities in language learning, attention, perception, memory, sexual behavior, cooperation, helpfulness to others, emotion, and reasoning.

Behavioral genetics
Attempts to tease apart the relative contributions of heredity and environment to explain individual differences in personality, mental ability, and other characteristics.
Learning objectives

3.1 – What the chemical code in our genes encodes for

3.2 – What a complete map of the human genes reveals—and does not reveal
Unlocking the secrets of genes

**Genes**
Functional units of heredity which are composed of DNA and specify the structure of proteins

**Chromosomes**
Within cells, rod-shaped structures that carry genes

**DNA (Deoxyribonucleic acid)**
Transfers genetics’ characteristics by way of coded instructions for the structure of proteins
Mapping human genes
Studying genetic material

Linkage studies
Because genes close to each other are likely to be inherited together, researchers can look for genetic markers in families.

Genetic markers
A segment of DNA that varies among individuals, has a known location on a chromosome, and can function as a genetic landmark for another gene.
The link between genes and behavior

Even when researchers locate a gene on a chromosome, they do not automatically know its role in physical or psychological functioning.

Most human traits are influenced by more than one gene pair.

Intelligence
Shyness
Which is correct?

Traits such as hair color and eye color are influenced by more than one pair of genes.

A. True
B. False
Learning objectives

3.3 – The meaning of evolution

3.4 – Why some traits become more common during evolution and other become less common

3.5 – Why some evolutionary psychologists assume the existence of innate “mental modules” in the human mind

3.6 – Some innate human characteristics
The genetics of similarity

Evolution
1. A *change in gene frequencies* within a population over many generations
2. A *mechanism* by which genetically influenced characteristics of a population may change

Changes may occur due to
1. mutations or errors occurring during copying of a DNA sequence
2. natural selection
The genetics of similarity

Natural selection

The evolutionary process in which individuals with genetically influenced traits that are adaptive in a particular environment tend to \textit{survive} and \textit{reproduce} in greater numbers.

Their traits then become more common in the population.
What do you know?

If, in a particular environment, individuals with a genetically influenced trait tend to be more successful than other individuals in finding food, surviving the elements, and fending off enemies—and are therefore better at staying alive long enough to produce offspring—their genes will become more and more common in the population.

A. True
B. False
Evolutionary biologists

Start with an observation about a characteristic and try to account for it in evolutionary terms.

Plumage differences in male and female peacocks
Evolutionary psychologists

Ask what sorts of challenges human beings might have faced and then infer which behavioral tendencies might have been selected to overcome these challenges.

Avoiding poisonous food and an innate dislike for bitter tastes
Evolutionary psychologists often start with an observation about some characteristic and then try to account for it in evolutionary terms.

A. True
B. False
Mental modules

The human mind developed as a collection of specialized and independent “mental modules” to handle specific survival problems.

Evidence from psychology and other disciplines can distinguish behavior that has a biological origin from behavior that does not.
Innate human characteristics

- Infant reflexes
- Interest in novelty
- Desire to explore and manipulate objects
- Impulse to play and fool around
- Basic cognitive skills
Your turn

Which of the following traits is not innate?

1. An interest in new things
2. An impulse to play
3. An impulse to explore
4. An impulse to be autonomous
Which of the following traits is not innate?

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2. An impulse to play
3. An impulse to explore
4. An impulse to be autonomous
Learning objectives

3.7 – What language enables us to do that other animals cannot

3.8 – The evidence that infants’ brains are equipped with an innate facility for acquiring language

3.9 – The evidence that learning and environment influence language development
The nature of language

Language
A system that combines meaningless elements such as sounds or gestures to form structured utterances that convey meaning
Innate capacity for language

Language too complex to be learned bit by bit.

Sentences have surface and deep structures.

*Surface structure:* the way a sentence is spoken

*Deep structure:* how a sentence is to be understood

To transform surface sentence structures into deep ones, children must apply rules of grammar.
Surface and deep structures

Two Surface Structures
Mary kissed John.
John was kissed by Mary.

One Deep Structure
Mary = Kisser
John = Kissee

Two Deep Structures
Bill heard the hikers trampling (something).

One Surface Structure
Bill heard the trampling of the hikers.
Language mental module

If we don’t teach syntax to toddlers, the brain must contain an innate mental module.
An innate module that allows young children to develop language if they are exposed to an adequate sampling of conversation

Children are born with universal grammar, a sensitivity to the core features common to all languages.
Nouns and verbs, subjects and objects, negatives
Evidence for universal grammar

Children in different cultures go through similar stages of linguistic development.

Children combine words in ways that adults never would.

Adults do not consistently correct their children’s syntax, yet children learn to speak or sign correctly anyway.

Children not exposed to adult language may invent a language of their own.

Infants as young as 7 months can derive simple linguistic rules from a string of sounds.
Evidence for learning and language

Computerized neural networks can “learn” aspects of language.

Children learn the probability that any given word or syllable will follow another.

Although there are commonalities in language acquisition, there are also many differences.

Parents respond to children’s errors by restating or elaborating the phrase. Children imitate these adult recasts and expansions.
Which is correct?

Our ability to learn language is innate, but is also influenced by our experiences.

A. True
B. False
Learning objectives

3.10 – How evolutionary psychologists explain male-female differences in courtship and mating

3.11 – Some problems with evolutionary theories of courtship and mating preferences

3.12 – The basic issue that divides evolutionary psychologists and their critics
Sociobiology

Interdisciplinary field that emphasizes evolutionary explanations of social behavior in animals, including humans.

We behave in ways that maximize our chances of passing on our genes, and to help our close biological relatives, with whom we share genes, to do the same.
Sexual strategies

Due to different kinds of survival and mating problems, the sexes have evolved differently with respect to aggressiveness, physical dominance, and sexual strategies.

Males compete with other males for access to females, and try to inseminate as many females as possible.

Females conceive and carry only a limited number of children, so they choose fewer, more dominant males with good resources and high status.
Preferred age in a mate

Evolutionary psychologists consider such analogies of human and animal behaviors simplistic and misleading.

Focus more on commonalities of human mating and courtship around the world.
What do you know?

Male’s age preference for mates is specific to Western culture.

A. True
B. False
What do you think?

In terms of mating behavior, all men are promiscuous and all women are coy.

A. True
B. False
Culture and the “genetic leash”

Criticisms of sociobiological and evolutionary explanations for sexual behavior include:

Actual behavior does not conform to stereotypes of promiscuous males and coy females.

The use of interviews and surveys may produce inaccurate data – the difference between what people say and what they actually do.
Learning objectives

3.13 – What it means to say a trait is “heritable”

3.14 – Three important facts about heritability

3.15 – How researchers estimate a trait’s heritability
Genetics of difference

Heritability
A statistical estimate of the proportion of the total variance in some trait that is attributable to genetic differences among individuals in a group.

Expressed as a proportion (e.g., 0.60 or 60/100)

Some variables, such as height, are highly heritable; other variables, such as musical ability, are moderately heritable.
What do you know?

Heritability means the same thing as heredity.

A. True  
B. False
An estimate of heritability applies only to a particular group in a particular environment.

Heritability estimates do not apply to individuals, only to variations in a group.

Even highly heritable traits can be modified by the environment.
What do you know?

An estimate of heritability applies specifically to individuals and their families.

A. True
B. False
Computing heritability

Studying adopted children allows researchers to compare correlations between the traits of adopted children and those of their biological and adoptive relatives.
Computing heritability

If identical twins are more alike than fraternal twins, then the increased similarity must be due to genetic differences.

**Identical Twins**
- Single egg fertilized by single sperm, then splits in two
- Share all of their genes

**Fraternal Twins**
- Separate eggs fertilized by separate sperm
- Share only about half their genes
Computing heritability

Investigators have also studied twins who were separated early in life and reared apart.

Any similarities in traits between them should be primarily genetic.
Learning objectives

3.16 – The extent to which intelligence may be heritable

3.17 – The most common error in the argument that one group is genetically smarter than another

3.18 – How the environment nurtures or thwarts mental ability
What do you think?

Intelligence is primarily the result of environmental influences rather than heredity.

A. True
B. False
Intelligence

Intelligence Quotient (IQ)
Measure of intelligence originally computed by dividing a person’s mental age by his/her chronological age and multiplying by 100

Now derived from norms provided for standard intelligence tests

The kind of intelligence that produces high IQ scores is highly heritable.
0.50 for children and adolescents
0.60–0.80 for adults
Twins and intelligence

Intelligence scores of identical twins are always correlated more strongly than those of fraternal twins.
Adopted children and intelligence

The scores of adopted children are strongly correlated with those of their biological parents.
The question of group differences

Genetics are used to explain differences between groups.

These differences are used to justify differential treatment for these groups.

Differences between average IQ scores for African Americans and European Americans

Genetic explanations have a flaw.

Use heritability estimates based on white samples to estimate the role of heredity in group differences.
The question of group differences

The Tomato Plant Experiment
The question of group differences

Those studies overcoming past methodological problems fail to reveal genetic differences between blacks and whites on IQ.

Examples

Children fathered by black and white American soldiers in Germany after WWII and reared in similar German communities did not differ significantly in IQ.

Black and white infants perform equally well on tests for novelty.
Your turn

Ramon, who is Hispanic, is adopted as an infant by Caucasian parents. When Ramon is twenty, his IQ would be expected to be most similar to who else’s?

1. Any Hispanic person’s
2. Any Caucasian person’s
3. His Caucasian (adopted) sister’s
4. His Hispanic (birth) sister’s
Your turn

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Environment and intelligence

Experiences that hinder:
- Poor prenatal care
- Malnutrition
- Exposure to toxins
- Stressful family circumstances

Experiences that help:
- Good health care and nutrition
- Mental enrichment in home and child care or school
Beyond nature vs. nurture

Heredity and environment always interact to produce the unique mixture of qualities that make a human.

Psychological diversity is adaptive.