Chapter 3

Genes, Evolution and Environment
Unlocking the secrets of genes

- **Genes**
  - basic unit of heredity

- **Chromosomes** –
  - rod-shaped structures
  - center of every cell; carry genes
  - where genes are located
  - sperm cell and egg cell = 23 each
  - sperm + egg = 46 in 23 pairs
  - threadlike strands of DNA

- **DNA** – (deoxyribonucleic acid)
  - chromosomal molecule that transfers genetic characteristics by coded instructions for structure of proteins (hundreds of thousands).

- **Genome** –
  - full set of genes in each cell of an organism
  - some both human and animal
  - some only human; individuality
  - each human chromosome contains around 25,000 genes
  - each with a fixed locations (human genome)
Unlocking the secrets of genes

• **Linkage studies** –
  – Look for patterns of inheritance of genetic makers in families when a particular condition is common.
  – Genes close together; inherited together across generations

• **Genetic marker** –
  – Segment of DNA that varies among individuals
  – Has a known location on a chromosome
  – Can functions as a genetic landmark
  – Gene involved in physical or mental conditions
  – Depression or impulsive violence
  – Usually multiple genes working together; not “a depression gene”

• **Gene environment interaction**
  – Genes affect the environment we experience
  – Environmental factors affect the activity of genes over time
Quick Quiz

1. What does it mean to say that the gene-environment interaction works in both directions?

2. The basic unit of heredity is called:
   a) gene
   b) chromosome
   c) genome
   d) DNA molecule

3. What does the code within a gene encode for?

4. True or False Most human genetic traits depend on a single gene.
Genetics of Similarity

• **Evolution**
  – Change in gene frequencies within a population over many generations
  – Mechanism for genetically influenced characteristics to change

• **Natural selection**
  – Charles Darwin “On the Origin of Species” (1859/1964)
  – Evolutionary process – used today
  – Individual with genetically influenced traits that are adaptive in enviro.
  – Survive and reproduce in greater numbers than others (without trait)
  – Their trait becomes more common in the population (survived)
  – Giraffes / peacocks (male; fancy color – female; plain)

• **Genetic variations**
  – Cells copied differently
    • Change spontaneously
    • Mutations
Innate Human Characteristics

1) Infant reflexes
   – sucking when put to lips
   – aiding in survival; nursing

2) Interest in novelty
   – babies stop nursing
   – explore new things

3) Explore & manipulate
   – take apart & put together
   – shake rattles

4) Play and fool around
   – kittens & puppies play
   – Practice play (Children’s play = adult work)

5) Basic cognitive skills
   – Born with abilities to make it easy to interpret expressions and gestures
   – ID faces
   – Figure out what others thinking and feeling
   – Distinguish plant from animal; living from nonliving
   – Acquire language
Quick Quiz

1) Which is the best statement of the principle of natural selection?
   a) Over time, the environment naturally selects some traits over others
   b) Genetic variations become more common over time if they are adaptive in a particular environment.
   c) A species constantly improves as parents pass along their best traits to their offspring.

2) Which of the following is NOT part of our biological heritage?
   a) A sucking reflex at birth
   b) A motive to explore and manipulate objects
   c) A lack of interest in novel objects
   d) A love of play
Language

- **Language** – system that combines meaningless elements; sound & gestures to from structured utterances; convey meaning.
  - Not just speech; sign language
  - Non-humans; grunts & screeches
Language

- **Complex (Chomsky)** – Not just learn by imitation; use grammar / syntax
  - Convert 2 surface structures to 1 deep structure
    - Mary kissed John & John was kissed by Mary = Mary kisser; John kissee
  - Convert 1 surface structure to 2 deep structure
    - Bill heard the trampling of the hikers = Bill heard the hikers trampling (something)
      Bill heard (someone) trampling the hikers

- **Language acquisition device** – innate mental module that allows young children to develop language, if exposed

JFK – "Ich bin ein Berliner.”
  “I am a jelly donut”
  “I am a citizen of Berlin”
Even when parents try to correct their children’s syntax, it doesn’t usually work.
Evidence that supports Chomsky

1. Children in different cultures; similar states of linguistic development.
   - Add no to beginning - “no get dirty”
   - Double negative – “he don’t want no milk”

2. Children combine words in ways that adults never would.
   - “Daddy taked me”, “Go store”, “I waked up”

3. Adults do not consistently correct their children’s syntax.
   - Usually parents reward incorrect syntax
   - “want milk” = mother will serve milk

4. Children not exposed to adult language may invent their own.
   - Deaf children create their own sign language

5. Infants (7 months) can derive simple linguistic rules from string of sound.
   - If learn ABA pattern until bored will want ABB
   - If learn ABB pattern until board will want ABA
     - ABB = “Wo fe fe”
     - ABA = “Wo fe wo”

- Therefore…..language acquisition replaced language learning
- Some think experience has a greater role
Quick Quiz

1) The central distinction between human language and other communication systems is that language
   
a) Allows for the generation of an infinite number of new utterances
   b) Is spoken
   c) Is learning only after explicit training
   d) Expresses meaning directly through surface structures

2) What did Chomsky mean by a “language acquisition device”?

3) What 5 findings support the existence of an innate “universal grammar”?

4) Those who reject Chomsky state this...
Courtship and Mating

• Sociobiology – evolutionary explanations of social & sexual behavior; human/non behave in ways to maximize passing on our genes
  males and female learn behaviors for survival

  – Males - compete with other males (Twilight – Edward & Jacob)
    colorful to gain attention – cardinals; peacocks
    more female inseminated = higher chance of genes being carried on
    Human record: one man = 899 children

  – Females – choose leader of the pack
    assume dominant male = superior genes
    long pregnancy (big investment) – needs to payoff

• So...... men want sex more often than woman; possessive; dominant
  men want youth & beauty = fertility
  women choosy; faithful
  women want stability (raise children) = older / status

• Therefore..... Older, wealthy men with young, beautiful woman (Hugh Heffner)
“It’s a guy thing.”
Shopping at the Evolutionary Theory Store

Long Genetic Leashes

Sure, they lack something in old-fashioned masculinity, but you can wear them so many different ways!

Short Genetic Leashes
Quick Quiz

1) Which of the following would an evolutionary psychologists expert to be more typical of males than of females?
   A. Promiscuity
   B. Choosiness about sexual partners
   C. Concern with dominance
   D. Interest in you partners
   E. Emphasis on physical attractiveness of partners

2) What major issue divides evolutionary theorists and their critics in debates over courtship and mating?

3) A friend of yours, who has read some socio-biology, tells you that men will always be more sexually promiscuous than women because during evolution, the best reproductive strategy for a male primate has been to try to impregnate many females. What kind of evidence would you need in order to evaluate this claim.
Heritability

• Differences: are they genetic, or result of experience and environment?

• Heritability – statistical estimate
  (of the portion of the total variance)
  in some trait that is attributable to genetic differences
  among individuals within a group.

  – Height – highly heritable
  – Table manners – low heritability, more upbringing
3 Aspects of Heritability

1) Heritability applies only to a particular group living in particular environment.
   - Similar environ. = higher heritability (affluent; good schools; doting parents; nutrition)
   - Diverse environ. = lower heritability (some rich / poor; good/bad schools, nutrition/un)

2) Heritability does not apply to individuals, only to variations within a group.
   - ½ genes from mother; ½ from father = a unique you (unless identical twin)
   - Influences for an individual can be genetic, environmental or combination of both

3) Highly heritable traits can be modified by the environment
   - Height highly heritable – malnutrition can stunt growth
Heritability

- Adopted children - share genes from each bio. parent (biology) raised by adoptive parent (environment) compare correlation btw traits of bio & adopted
Heritability

• Identical twins (monozygotic)
  – 1 egg fertilized by 1 sperm
  – Fertilized egg (zygote) – divides into 2 parts = 2 separate embryos
  – Same egg = same genes
  – Same sex

• Fraternal twins (dizygotic)
  – 2 eggs fertilized by 2 sperm
  – Womb-mates
  – No more genetically alike than w/ other siblings
  – Same or different sex

• So..... Why study identical twins?
  – study identical twins living with biological parents
  – study identical twins living with adoptive parents
Quick Quiz

1) Diane hears that basket weaving ability is highly heritable. She assumes that her own low performance must therefore be due mostly to genes. What is wrong with her reasoning?

2) Bertram hears that basket weaving ability is highly heritable. He concludes that schools should not bother trying to improve the skills of children who lack this talent. What is wrong with his reasoning?

3) Basket weaving skills seem to run in Andy’s family. Why shouldn’t Andy conclude that his own talent is genetic?

5) Why do behavioral genetics find it useful to study twins?
Separated at birth, the Mallifert twins meet accidentally.
Genes and Individual Intelligence

- IQ (intelligence quotient) – norms from standardized tests
  average score of 100 set
  2/3 fall between 85-115
  15 points +/- 100
  - Most think IQ measures a general quality; affects most aspects mental ability
  - Some believe culturally bias (middle class; white)
- IQ = highly heritable
Environment and Intelligence

- Poor prenatal care
  - Malnutrition
  - Alcohol and other drugs
  - Smoke
  - Ill health; infections

- Malnutrition
  - Average IQ gap btw severely malnourished and well-nourished; up to 20 points

- Exposed to toxins
  - Lead – paint; dust; soil; pipes
  - Air pollution
  - Chemicals – fossil fuels

- Stressful family circumstances
  - 2 parent family vs 1 parent
  - Mental health issues
  - Domestic violence
  - Many stressful events
Nature vs Nurture

• Why are we alike/different?

• What do you think?