

PSYC2500A – Developmental Psychology
Lecture 2, Sept 13/13

Foundations to Child Development & Its Genetic Basis: Chapter 2

1. mechanisms of heredity
 - a) the biology of heredity
 - b) single gene inheritance
 - c) genetic disorders
2. heredity, environment and development

- genes by themselves do not stimulate themselves; they need something to be triggered

The Biology of Heredity

Gametes (sperm and egg cells)

- sperm and egg have 23 chromosomes each – the chromosomes are in the nucleus of every cell

Karyotype

- one chromosome of each pair comes from the dad, one comes from the mom
- 23rd pair: called sex chromosomes
- first 22 pairs called autosomes – not sex-linked
- sex chromosomes: determine gender; women have 2 X chromosomes; males have an X Y chromosome
- chromosomes are made of DNA – deoxyribonucleic acid (main component of the chromosome)

Rosalind Franklin – not on exam

- biophysicist in London
- took x-rays of atoms to understand their structural elements
- hinted that the structure of DNA is on the outside; genetic inside is on the inside; no one had suggested before her

Double helix

- genetic information is a series of chemicals:
 - **phosphate group; sugar group; nitrogen-containing base**
- the sides of the 'ladder' on the double helix are the phosphate and sugars
- the **nitrogen bases are what contains the genetic code**

4 chemical bases:

adenine (A), thymine (T), guanine (G), cytosine (C)

- in all genetic publications, categorized by first letters
- * remember that the letters represent a different nitrogen base
- C combines with G and A with T
- in a single chromosome you can have from 1-250 million different bases
- * genes contain dna, dna is in nucleus, dna is compact and can make up to 3 feet, genetic composition: nitrogen basis, it's the constitution of the basis that determines a person's genetic code; each pair of chromosomes has a different sequencing

Genes make proteins

- genes are not enough; the code will make proteins when it is activated
- the proteins will make different kinds of cells

- from 1953 to 1990, identified some new genes
- from 1990 to 2001, project initiated in US; called the human genome project. Mission: to identify the sequence of the entire 3 billion letters in our genetic code
- in the span of 15 years, had succeeded
- only 1% of our genome is comprised of genes
- we only have 25,000 genes – surprising at the time to discover; thought of as having more

Heredity located on different regions of the chromosome

- as we re-map the genetic code, we map the location of the specific gene
- some diseases/disorders are single gene disorders
- most disorders/diseases are clearly genetic
- 99.9% of genes that we have are common across everyone; a single location of genes can be significant because of people's differences despite their gene sequencing

Single Gene Inheritance:

Genotype

Phenotype – entire set of characteristics that make a person a human being

- chromosomes identified by number; starting with long one all the way to the smallest; first 22 pairs are autosomes; last one is sex
- single gene inheritance means either the mom or the dad

Alleles – means a **single gene** of a pair of chromosomes; same gene at the same location – example: chromosome 15, zooming in on a specific gene at a specific location

How do we inherit characteristics?

Single gene inheritance – when one inherited characteristic is dominant

- sometimes **alleles are the same: called homozygous**
- sometimes the genetic code of alleles are not the same
 - the sequencing of letters not the same – how will our system decide which form to choose?
 - can be transmitted from generation to generation

Recessive genes

- if you have a pairing of a genetic code that's recessive w/one that's dominant, it's the dominant code that is used
- if you inherit a dominant trait from one parent and a recessive one from another, it's the dominant one that will be inherited – **called genetic expression**

What happens when you inherit 2 recessive alleles?

- if 2 recessive alleles are inherited, then that genetic information will be expressed. The allele that has, for example, cystic fibrosis, will create a child w/it
- if a recessive and dominant allele (same gene at same location on specific pair of chromosome); when specific and dominant it's the dominant one; if 2 are recessive then the recessive info is expressed
- sometimes can have **incomplete dominance**

Genetic Disorders:

Examples in text: sickle cell, cystic fibrosis

Capital A – dominant gene; small a – recessive gene

Mom Dad
AA aA

- Dad has one dominant (capital A) and small a (recessive); meaning recessive gene carries information of cystic fibrosis
- Mom gives the one to the left (capital A) and the dad gives the smaller a (recessive)
- chromosome 7: dominant vs recessive; dominant one will be expressed

AA – mom gives to left, dad to right

- both dominant; no possibility of child passing on recessive gene for cystic fibrosis
- if both mom and dad are carriers of recessive genes of cystic fibrosis, child will inherit it – recessive genes can only be expressed when there are 2 recessive genes (25% chance of this happening)
- when families are given genetic counselling, if there is no cystic fibrosis in family then the couple doesn't know but might be carriers anyway

Genetic Disorders, Cont'd:

- some people are born w/too many, too few, or damaged chromosomes
- Down Syndrome: extra 21st chromosome

Behavioural Genetics

- twin studies and adoption studies
 - monozygotic (identical) twins
 - dizygotic (fraternal) twins
- compared monozygotic twins raised together to those raised apart
- most studies done on animal models

Paths from Genes to Behaviour

Reaction range:

- the same genotype can produce a range of phenotypes in reaction to environment
- not all genes modified by a specific environment, but some are

Heredity and environment interact dynamically throughout development

Epigenetics: a functional change in the genome that does not alter the DNA sequence

- epi means 'above'; an influence above your genetic influence
 - genes produce protein – functional change in DNA without altering its sequence; genetic code not different
 - biochemical mechanisms that regulate gene transcription

Genome – entire sequence of DNA from all a person's chromosomes

Prior to 2001, 20,000 papers were published in epigenetics – not many scientists dealing w/this phenomenon. In 2012 only, 20,000 papers were published.

Chapter 3: Prenatal Development, Birth and the Newborn

1. from conception to birth
2. influences on prenatal development

3. happy birthday
4. the newborn

1. From Conception to Birth

- period of the zygote (weeks 1-2)
- period of the embryo (weeks 3-8)
- period of the fetus (weeks 9-38)