

9.20 M.I.T. 2013

Lecture #21

Sociobiology subject matter

Genetic influences on social behavior

E.O. Wilson's "Sociobiology" (1975, 1980)

Ch 4: The relevant principles of population biology (selected)

- Calculation of the inbreeding coefficient, which is the same as the coefficient of kinship: use of **“path analysis”**
 - Represents the probability that both alleles at one locus are identical because of common descent.

++ Wright's model found advantages when a large population was composed of multiple smaller demes, each having at least the effective pop no.: more genetic variability between groups, so better able to adapt to environment.

E.O. Wilson's "Sociobiology" (1975, 1980)

Ch 4: The relevant principles of population biology (selected)

- Inbreeding taboos? (p. 38-39). Intro. by "effective population number"* (p.37; the numbers are usually in the range of 10-100), and Wright's island model. ++
 - Opposed selection tendencies affecting sociality (p.39):
 - Small groups of related individuals favor altruistic behavior and close cooperation;
 - but inbreeding often lowers individual fitness, depresses performance, lowers genetic adaptability
- Assortative mating (homogamy)
 - A tendency to choose a mate that looks similar to oneself or one's close relatives

* the number of individuals in an ideal, randomly breeding population with 1:1 sex ratio which would have the same rate of heterozygosity decrease as the real population under consideration

John Alcock, The Triumph of Sociobiology, ch 3:
Genetic determination?

1. What is the difference between genetic determination of behavioral traits and sociobiologists' views concerning genes and behavior?

(p 41-43, p 20)

Genetic determination of behavior

- Do the genes determine the development of specific social behaviors?
 - Recall our discussions of Konrad Lorenz and FAPs. Ethology was founded on the basis of the heritability of FAPs, many of which can be considered social behaviors.
 - An instinctive action pattern occurs only when the level of motivation for it exceeds a certain level. The motivational intensity is influenced by many environmental variables.
 - Remember the solution to the “nature-nurture” problem (and controversy): **Both** are always involved, even in the case of “fixed action patterns”.
 - See Alcock p 41-43

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Is sociobiology “the study of genetically determined [social] behavior”?

- This definition appeared in 1998 in a review of E.O. Wilson’s book, *Consilience (1998)*. (See Alcock, p 43.)
 - genes are required for behavior, but do not determine it alone
- Richard Alexander (1979) pointed out that the claim of genetic determinism excludes environment outside the DNA, so it is a ridiculous argument. [\[So why has it persisted ? See next question.\]](#)
 - Alcock summarizes the point by writing, “once sperm meets egg, the development of the resulting zygote is as dependent on the chemical environment surrounding the organism’s DNA as it is on the DNA itself.”

Although this is true, many who argue against the influence of genes are more concerned with the influence of environment and learning. They are also upset by thinking about behavior in a totally deterministic way--they object to the basic assumption of any scientist who seeks to explain the physical causes of the effects she/he is investigating, whether it be behavioral or something else.

John Alcock, The Triumph of Sociobiology, ch 3:

Debunking a myth

2. Sociobiology has often been deprecated by recitation of the “myth of the deterministic sociobiologist.” Give some **reasons why this myth has been so enduring** since the publication of E.O. Wilson’s book that gave the field its name.

(p 44-46)

It is enduring despite the fact that all biologists know that every trait of every organism develops through an interaction between genes and environment.

Debunking a myth

(p 44-46)

- It is a convenient straw man.
- It is the nature of human psychology: We believe in our ability to change our behavior, and other people's behavior.
- For some, the flexibility of human behavior is “mistakenly taken as evidence that cultural factors are the *only* real determinants of our actions.” Common among cultural anthropologists
- Championing free will and freedom of action is understandably popular: Humans appear to have evolved an enthusiasm for freedom of action, with a belief in free will. Why has this been adaptive?

John Alcock, *The Triumph of Sociobiology*, ch 3:

Can a difference in one allele change behavior?

3. Interpret figure 3.1 by explaining how a difference in one allele (B *vs* b) could result in a behavioral difference between two adults.

(p 46-47; *cf* p 72)

Note that the figure depicts a kind of multiplier effect. (See next slide.) Because of the long period of development during which the genetic difference interacts with different environmental influences.

Adult #1 ← Behavioral Differences → Adult #2

← Neuronal Differences →

← Developmental Differences →

Gene x Environment Difference

Different effects of environment

From different proteins interacting with different environments

Genetic difference

AA BB CC x E1

↑
Genes x Environment

Fertilized Egg #1

AA bb CC x E1

↑
Genes x Environment

Fertilized Egg #2

John Alcock, The Triumph of Sociobiology, ch 3:

Changing gene frequencies in a population

4. Explain exactly how and why the relative frequency of alleles B and b in Q3 could change over multiple generations.

John Alcock, The Triumph of Sociobiology, ch 3:

Changing gene frequencies

4. Explain exactly why and how the relative frequency of alleles B and b in Q3 could change over multiple generations.

For example, “B” could increase and “b” decrease in frequency for various reasons:

- **If b resulted in death before the age of reproduction more often than B**
- **If b resulted in a behavioral difference that reduced the probability of successful reproduction in a particular environment, but not in other environments**
- **If b resulted in no change in probability of reproduction, but it resulted in reduced parental care**
- **Etc.**

John Alcock, *The Triumph of Sociobiology*, ch 3:

Breeding for behavioral traits

5. Give an example of an artificial selection experiment that has shown strong genetic influences on behavior. How has this been supported by studies of humans?

(p 49-52)

Breeding for behavioral traits

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(p 49-52)

- Selective breeding in laboratory studies for particular behavioral traits
 - Crickets (loud singing group, silent group)
 - Fruit flies (learning mutants, first produced by Chip Quinn)
 - Mice (spatial learning differences in different groups; groups that differ in nest-building activity)
 - Rats (maze-bright, maze-dull strains)

Breeding for behavioral traits

5. Give an example of an artificial selection experiment that has shown strong genetic influences on behavior. **How has this been supported by studies of humans?**

(p 49-52)

- Human twin studies

- Studies of concordance rates

Examples of concordance rates for monozygotic twins:

Schizophrenia: ~67% concordance

Type I diabetes: ~67% concordance

Breeding for behavioral traits, continued:

For more examples of artificial selection, see the book by Temple Grandin (2005), *Animals in Translation*.

- Dogs: *What behavioral traits have they been bred for?*
 - Herding ability; retrieving; hunting; pointing; guarding; guiding
- Farm animals
- Bulls
- Horses

6. What problems often happen when animals are bred exclusively for a single physical trait?

- **When animals are bred exclusively for a single trait, e.g. a particular physical trait, it is common for behavioral problems to appear.**
- **Examples: collie dogs since 1950-60 have been bred for narrower and narrower skulls to emphasize a needle nose. The result has been “brainless ice picks” (from Temple Grandin).**

7. Is it true that “no genes for human behavior have been found”?

- See:
 - Lewontin, Richard C. "Sociobiology: Another biological determinism." *International Journal of Health Services* 10, no. 3 (1980): 347-363.
- See also:
 - Lewontin, Richard C., Steven Peter Russell Rose, and Leon J. Kamin. *Not in our genes: Biology, ideology, and human nature*. New York: Pantheon Books, 1984.

“But no genes for human behavior have been found!”

Alcock cites this criticism, then answers it, p 52-56:

- Is the absence of evidence really evidence of absence of non-involvement of genes in social development? (Such an absence of evidence seemed to be the case not many years ago.)
- More recent evidence of specific genes “for” a social behavior: How do we interpret it?
 - Specific genes are being found, but they are not really "for" a behavioral trait except indirectly. They code for proteins.

[See the next slide]

And, social behavior is always influenced by multiple genes.

Current research on genes and social behavior

- Autism
- Schizophrenia and other mental diseases
- ADHD

Multiple genes are nearly always involved in genetic studies of abnormalities that affect such diseases.

*** 8. How could a gene that has what appears to be maladaptive consequences be present in some animals or people today? Why was it not lost?**

- It is a recent mutation, and will be lost; or
- it has its bad effects after reproduction; or
- it has its effects only in certain environments, and otherwise has benefits.
- Modern medical treatments
- Genetic swamping—see notes on E.O. Wilson. This interacts with the above factors.

John Alcock, *The Triumph of Sociobiology*, ch 3:

9. Each student be prepared to discuss answers to the three questions in the Appendix for ch 3 and in the first appendix question in chapter 2.

Homework #6: Discussion questions from Alcock book. Be sure to read the questions carefully as posed by Alcock.

In each case, give a response that a sociobiologist would give.

➤ Appendix p 225: Chapter 2

- 1) Why does the product of a gene that improves memory decrease with age? See Alcock's description of the research. Criticize the explanation of one of the researchers described by Alcock.

➤ Appendix p 226: Chapter 3

- 1) Are certain behavioral differences between individuals or races genetic in origin? (*E.g.*, criminality, intelligence, athletic ability, etc.) How might a sociobiologist approach this?
- 2) Are instincts more strongly controlled by genes than is learned behavior?
- 3) Do male prairie voles possess a “gene for monogamous behavior” according to the research described by Alcock?

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9.20 Animal Behavior
Fall 2013

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