Bio 45 – Lect. #I-6/7 - GENES & BEHAVIOR - Possibilities and Approaches

I. The Problem: What do we mean by "Genetic Basis" for a behavior?

A. You must be able to explain what could be meant and what should be meant by statements like:

"genes for behavior" "genetic basis for behavior" "differ genetically"

"underlying genetic basis" "our behavior is ultimately determined by our genes"

B. Alcock thoroughly explores the question of how genes connect to behavior (Chs 3&4).

C. The key is to distinguish between two possible meanings of 'genetic basis':

1) There is a genetic basis for differences in the behavior of individuals, or

2) The genes control or produce the behavior

D. We usually mean #1 -- **basis for differences** is genetic-- the different types will breed true

II. How could the environment influence the behavior of an individual?

A. No influences at all, on either the behavior, or its development within a generation (examples?)

B. It could influence the development, but not modify the behavior once it developed.

C. It could modify the behavior after it developed (examples?).

D. All of the above -- depends on the organism and its evolutionary history.

III. How to tell if behavior has a genetic basis: (See Alcock Ch. 3)

There are two basic questions: 1) "Is the behavior caused by genes?" , and 2) "What are the relative contributions of genes and environment to the behavior?" Here are some ways to answer both:

A. Constancy of behavior -- Stereotypic "Innate" types of behaviors seem to remain constant across a wide range of habitats or conditions, suggesting they are largely controlled by genes. **Weak test**.

B. Find simple underlying physiological bases for differences in behavioral variants where the different physiologies are know to be genetically different. Here you focus on the mechanism (= "structure") and the degree to which it can be programmed or is flexible in terms of behavior produced.

C. Do **Mendelian breeding or hybridization experiments** that can reveal genetic influence. Breeding experiment - does it breed true? Does it obey Mendelian laws? Hybridization experiment. What is the behavior of a hybrid between two species like? A special case of breeding experiments, but an important one.

D. Do **response to selection experiments** -- If you select for one variant vs. another will a change occur in their relative frequency in following generations? **If there is a response to such selection there must be a genetic basis.** Many attempts at selecting for behavioral variants produce results; therefore we assume much behavior is heritable.

E. Do **Transplant or Norm of Reaction experiments**. Basic idea is to keep the environment the same and vary the genes, or keep the genes the same and vary the environment. But how? Put phenotypicly similar siblings in different environments or raise non-sibs that differ phenotypicly in same environment. Can be done in lab (vary environment) or in nature (vary habitat). Could this be done on a **long** time scale? This approach includes "twin studies" -- see Alcock's discussion.

F. Make estimates of heritability or parent offspring correlations. These are more sophisticated variants of "D" and "E". Basically it is what Alcock refers to as "Comparing offspring and parents"

- Heritability: Total phenotypic variation in population = VAR due to genotype differences + VAR due to environment + epistatic effects. You design an experiment where you vary both genes and environment at the same time and use statistical tests (e.g., analysis of variance) that will allow you to determine how the variation is partitioned between genetic and environmental effects.
- Offspring behavior is expected to correlate with that of parents – we have to control for environment. The stronger the correlation, the greater the role of genes.