Kin Selection and Social Behavior
Chapter 10

I) General Aspects

A) What is Behavior?

1) Conscious or unconscious acts that involve a complex combination of physical, physiological, and emotional reactions

2) Instinct and learning are like genes and environment

B) Individuals of the same species vary

1) Aggression in dog breeds and aloofness in cats (instinct) or culturally varying traits (learned) such as mocking bird songs, etc.

C) Different species act differently

D) Definitions

1) Mutualism – actions that result in fitness gains for both the actor and the recipient.

2) Altruism – actions that result in a fitness gain of the recipient and loss in the actor.

3) Selfishness – actions that result in a fitness gain of the actor and loss for the recipient.

4) Spitefulness – actions that result in a fitness loss for both the actor and the recipient.

	Actor Benefits	Actor is harmed
Recipient benefits	Mutualism	Altruism
Recipient is harmed	Selfish	Spite

5) Mutualism and selfishness can clearly evolve by means that we have already discussed, however, altruism is harder to explain (and spite is thought not to actually exist in nature).

II) Evolution of Altruism – AKA there is no such thing as Altruism

A) Manipulation – individual that appear to be being altruistic are being manipulated

B) Cryptic Individual Advantage – altruistic individuals are actually getting a greater benefit than cost

a) Schooling in fish – negative food, positive in predator protection.

C) Tit-for-tat – individuals that interact repeatedly will engage in costly behavior if they are reasonably sure that it will be offset in the future by receiving a benefit from others costly behavior.

1) Individuals must repeatedly interact

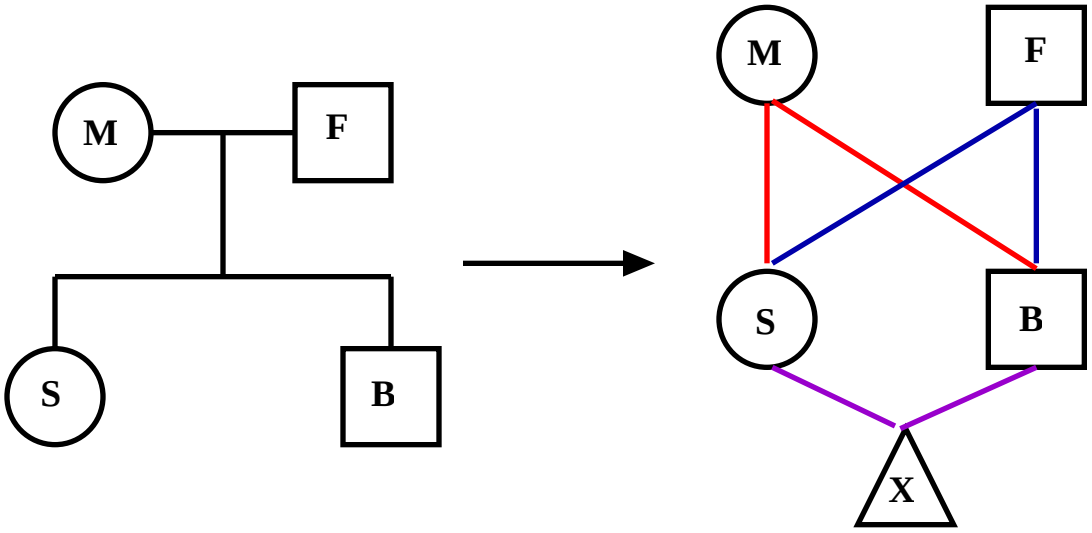
2) Must be multiple opportunities for altruism

3) Individuals have good memories

4) Potential among individuals is symmetrical (i.e., C ≈ B)

D) Kin selection – it may be that individuals that are acting altruistically are actually recouping some of the fitness loss by increasing the fitness of their relatives.

1) Coefficient of relationship (r) – the percentage of genes in two related individuals that are autozygous and is two times the inbreeding coefficient of a hypothetical offspring of the two individuals.



$$F_X = \left(\frac{1}{2}\right)^3 + \left(\frac{1}{2}\right)^3 = 0.25$$

r = 2 x 0.25 = 0.5

2) Hamilton's rule – Altruism will evolve when the benefit (B) adjusted by the degree of relationship (r) are greater than the cost (C) or Br – C > 0

3) Inclusive Fitness – the fitness of an individual can be extended to the combined fitness of related individuals
a) Direct fitness – number of offspring an individual has
b) Indirect fitness – the number of offspring a related individual has.

III) Game Theory

General way to look at evolution and behavior by considering choices (cost/benefit) that individuals make. First developed during WWII to predict Russian nuclear moves. John Nash was a leading figure (A beautiful mind by Sylvia Nasar)

A) Evolutionary Stable Strategies (ESS)

1) General
a) Behavior of an individual often depends on the behavior of others.

b) What is a "good" behavior is often frequency dependent (either positively or negatively)

c) A strategy is a behavior or a collection of behaviors that an individual does

d) Definition – an ESS is a strategy that if all members of a population adopt all other strategies are less fit (i.e., the population cannot be invaded by a "mutant" strategy)

2) Strategies

a) Pure – any one individual performs only one strategy

b) Mixed – any one individual performs one strategy with probability p and an alternate strategy with probability 1 – p

3) Hawks and Doves, pure strategies

a) Hawks fight for resources (B) but can incur a cost (C) for doing so

b) Doves never fight for resources

c) Payoff matrix

		When opponent is: Dove	Hawk
Pay off to:	Dove	$\frac{1}{2}B$	0
	Hawk	B	$\frac{1}{2}(B - C)$

4) ESS with Hawks and Doves, pure strategy

a) Dove is never an ESS since payoff to (D, D) is always less than to (H, D)

$$\frac{1}{2}B < B$$

b) Hawk is an ESS if the cost of fighting is less than the benefit.

$$\frac{1}{2}(B - C) > 0 \text{ only when } B > C$$

c) If B < C then neither is an ESS

5) ESS with Hawks and Doves, mixed strategy

a) If B < C is there an ESS with a mixed strategy?

b) Probability of an individual acting like a Hawk is p and the probability of acting like a Dove is 1 – p

		When opponent is: Dove	When opponent is: Hawk
Pay off to:	Dove	$(1-p)\frac{1}{2}B$	$p(0)$
	Hawk	$B(1-p)$	$p\frac{1}{2}(B-C)$

There is an ESS at the frequency that an individual uses one strategy (i.e., p) such that the advantages outweigh the disadvantages

While playing a Dove, I get: $(1-p)\frac{1}{2}B + p(0)$

While playing a Hawk, I get: $B(1-p) + p\frac{1}{2}(B-C)$

WHEN

$$(1-p)\frac{1}{2}B + p(0) + B(1-p) + p\frac{1}{2}(B-C) \geq 0$$

There is an ESS.

If B < C Mixed Strategy Hawk/Dove has an ESS at p = $\frac{B}{C}$

B) Other Games

1) Tit-for-tat – if unknown cycle.

2) Prisoner's Dilemma

		Accomplices Actions	
		Silence	**Squeal**
Your Actions	**Silence**	**Freedom**	**40 years**
	Squeal	**10 years**	**Life**

3) Bar pickup

		Them	
		Drunk	**Sober**
You	**Drunk**		
	Sober		