Nepotism and Kin Selection

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September 29, 2011

Outline of Lecture on Nepotism

- The theory of kin selection
- Evidence from Belding's ground squirrels
- Evidence from Japanese macaques
- Evidence from human homicides

What is altruism?

Definition: altruism occurs when one individual helps another at a cost to himself.

Natural selection affects altruism to the extent that the costs and benefits of altruism affect Darwinian fitness, and to the extent that the behavior involved is heritable.

Why altruism is surprising

- Selection favors those with highest fitness (survival and/or reproduction).
- Altruism involves sacrificing one's own fitness to increase that of another.
- Consequently, selection should oppose altruism.

Altruism among genetic relatives is less surprising

- Suppose that an allele encourages altruism towards relatives.
- This "altruist" allele is often carried not only by the altruist, but also by the relative.
- Consequently, the altruist allele receives a disproportionate share of not only the costs, but also the benefits.
- If the benefits are large, altruism will be favored.

Hamilton's Rule

An allele promoting altruism is favored if

$$rb > c \qquad \text{(Hamilton's Rule)}$$

where

- b is the benefit of altruism to the recipient,
- c is the cost to the donor, and
- r is the fraction of genes shared by altruist and recipient.

Coefficient of Relationship

r	Relationship
1/2	full siblings
1/4	half siblings
1/8	cousins

Hypothetical Example

- Normal females have fitness 1.0.
- Altruist females give alarm calls when predator approaches.
- Calls attract predator, so so altruist's fitness is 0.9.
- The alarm calls are heard by a full sister.
- Her fitness rises to 1.3.

Is this behavior favored by natural selection?

Answer

Benefit to recipient is $b = 0.3$; cost to the altruist is $c = 0.1$. For full siblings, $r = 1/2$. Hamilton's Rule says that the altruist allele is favored by selection if

$$rb > c$$

With the values in this example, Hamilton's Rule becomes

$$\frac{1}{2} \times 0.3 > 0.1$$

or

$$0.15 > 0.1$$

Since inequality this is true, the altruist allele will spread.

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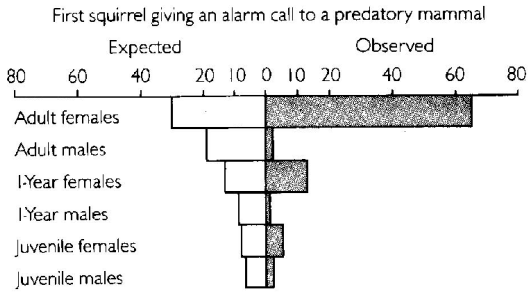
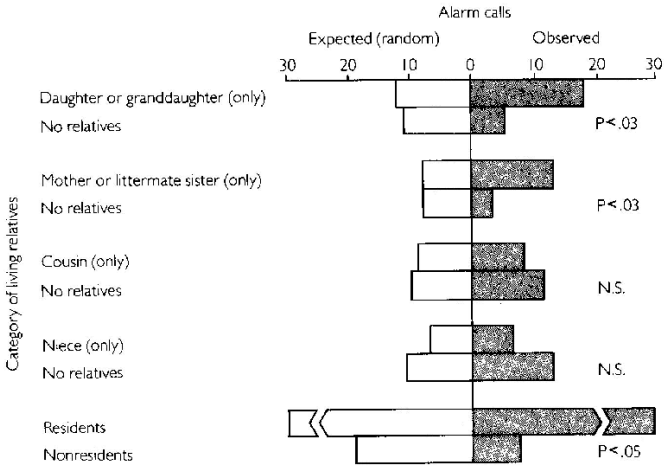
- Belding's ground squirrel
- Females live near relatives
- Males near non-relatives
- Expect more altruism from females

- Alarm calls are dangerous
- Which sex calls more?

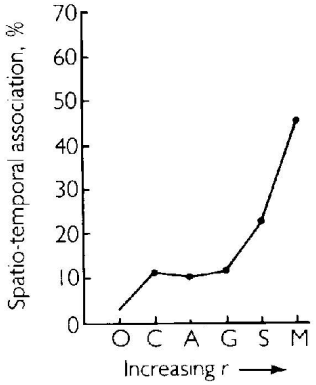


- Left: if all squirrels called at same rate
- Right: reality
- Females call more

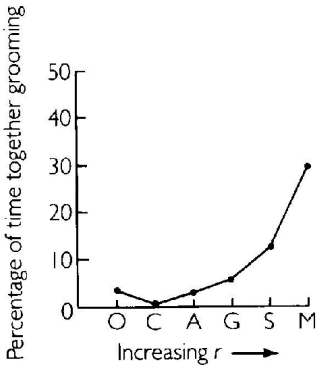
Those near daughters, mothers, or sisters call more



Japanese Macaque
studied by Jeff Kurland



Close relatives spend more time near each other.



- Relatives groom each other more often.
- Even after correcting for proximity.

Homicide in Detroit

Detroit homicides in 1972	
690	Nonaccidental homicides
512	Cases "closed"
508	Relationship of killer & victim known

(Daly & Wilson 1988)

We will focus on the last category.

Among the 508 homicides, there were

243	unrelated acquaintances
138	strangers
127	"relatives" (25%)

One victim in four was a relative!

However, blood kin account for only 25.2% of these 127 "relatives". The rest are *affine* kin (spouses, mothers-in-law, etc).

Controlling for proximity

- People are often near relatives.
- Homicide would often strike a relative, even if directed at random.
- Control: study only homicides within household.
- Reduces sample to 98 homicides.
- Is murder random within households?

How many victims should be spouses of murderer if murder is at random w/i household?

- 20% of the people within the household of the average Detroiter were spouses.
- If murder were at random, 20% of victims should be spouses.
- 20% of 98 is 20
- We expect 20 murdered spouses

Results

Victim	# of victims		Relative risk $\left(\frac{\text{obs.}}{\text{exp.}}\right)$
	Observed	Expected	
Spouse	65	(20)	3.32
Nonrelative	11	(3)	3.33
"Offspring"	8	(29)	0.27
"Parents"	9	(13)	0.69
Other "relatives"	5	(33)	0.15

Source: Daly & Wilson 1988, Table 2.1

There were 65 murdered spouses: 3.32 times the number expected.

Few victims are blood relatives of killer

- Household members who are *not* blood relatives are more than 11 times more likely to be murdered than blood relatives.
- Not because of friction between spouses: their relative risk is like that of other non-relatives.

Two sources of bias

1. The "offspring" category includes stepchildren. The 8 offspring victims include 2 killed by a stepfather and 2 by a mother with a stepfather present.
2. The "parent" and "other relative" categories also include affine kin.

If these biases could be removed, the difference in relative risk would be even greater.

Murder in 13th Century England (Daly & Wilson 1988)

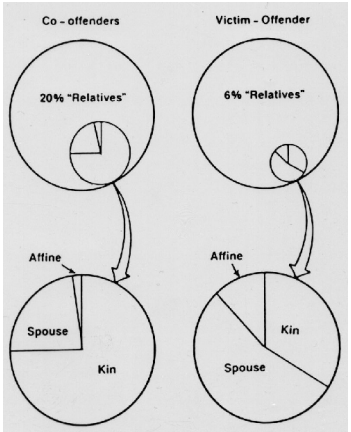
- Medieval England had itinerant courts.
- Records survive.
- Tell us who killed whom, and how they were related.
- But how to control for proximity?

Two kinds of relationship

- killer and victim
- co-offender

Both require intimacy.

- If collaboration and conflict both arise in proportion to intimacy,
- then the various types of relationship should be as frequent in killer-victim pairs as in co-offender pairs



- More relatives among co-offender than victim-offender pairs.
- "Related" offenders more likely to be blood kin.

Summary

1. Selection favors cooperation between relatives.
2. The theory that describes this phenomenon is called "kin selection" and was developed in 1964 by W.D. Hamilton.
3. The quantitative version of the theory is summarized by "Hamilton's Rule."
4. A great deal of data supports the view that kin selection is a real phenomenon.
5. Examples covered here: Belding's ground squirrels, Japanese Macaques, human homicides.