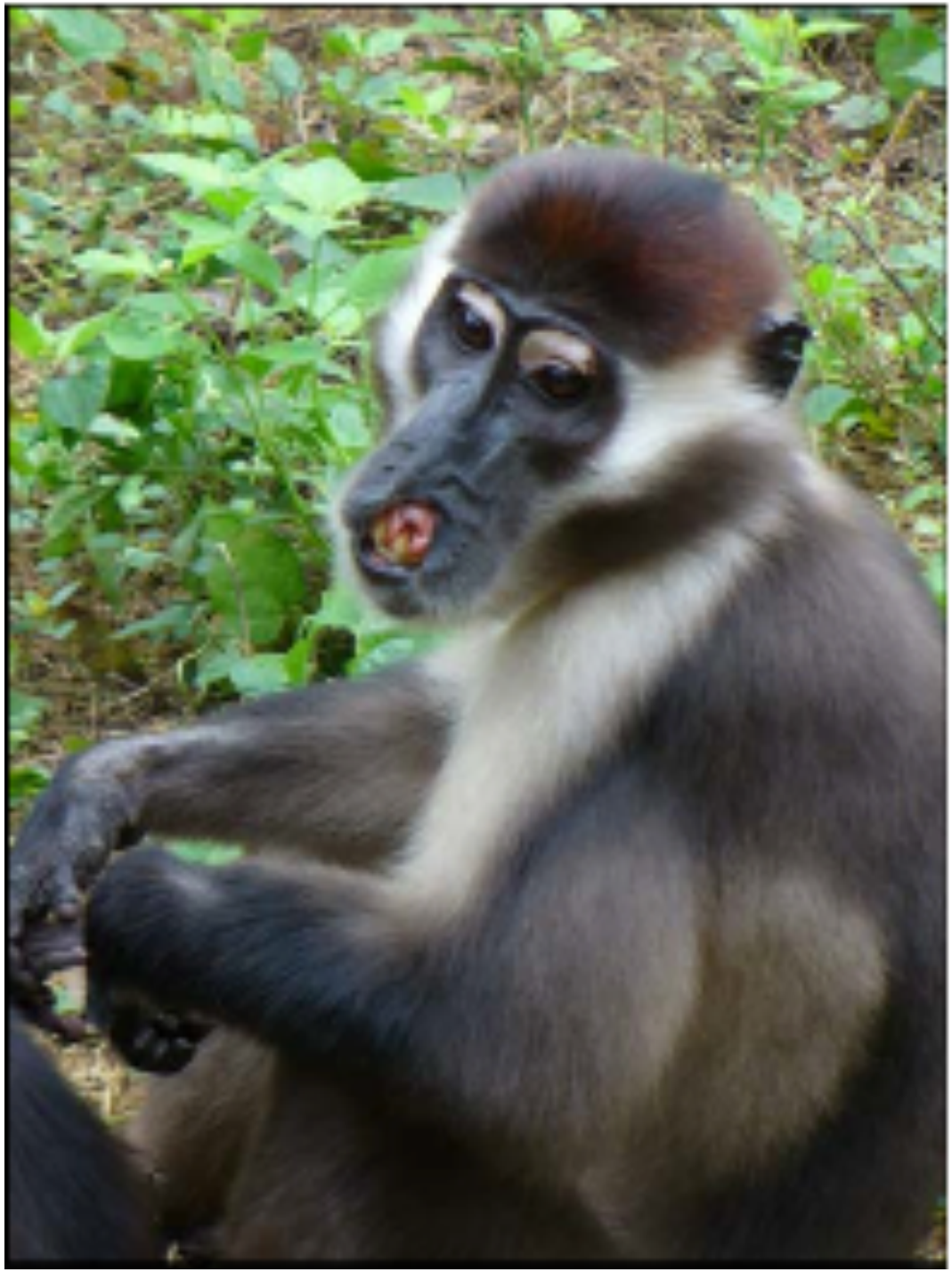
The Evolution of Social Behavior

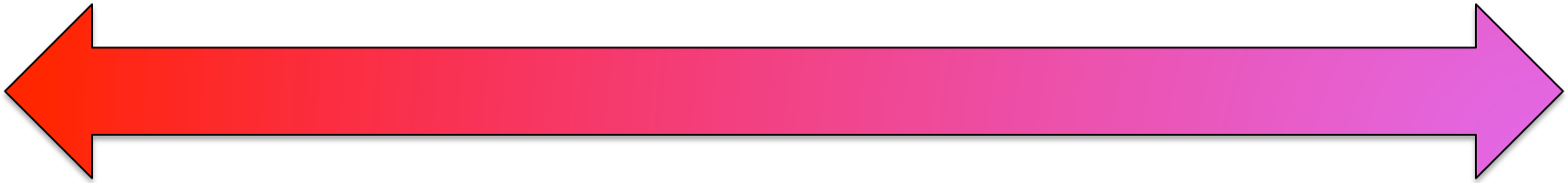


Today's Plan

- Why be social?
  - The costs and benefits of living with others.
- How to be social.
- Mutualism.
- Altruism.
  - Group Selection.
  - Kin Selection.
  - Levels of Selection.

What is Sociality?

Types of Sociality



Eusociality

Solitary

Why Be Social?

The Costs and Benefits of Living with Others

COSTS	BENEFITS
More conspicuous to predators.	Predator defense via dilution effect/ mutual defense.
Disease and parasite transmission increases.	Receive assistance from others in dealing with pathogens.
Increased competition for food.	Improved foraging.
Energy expended in determining and holding social status.	Subordinates granted permission to stay in group.
Greater male vulnerability to cuckoldry.	Some males may cuckold others.
Greater female vulnerability to reproductive interference by others.	Opportunity to interfere with reproductive efforts of others.

Predator Defense

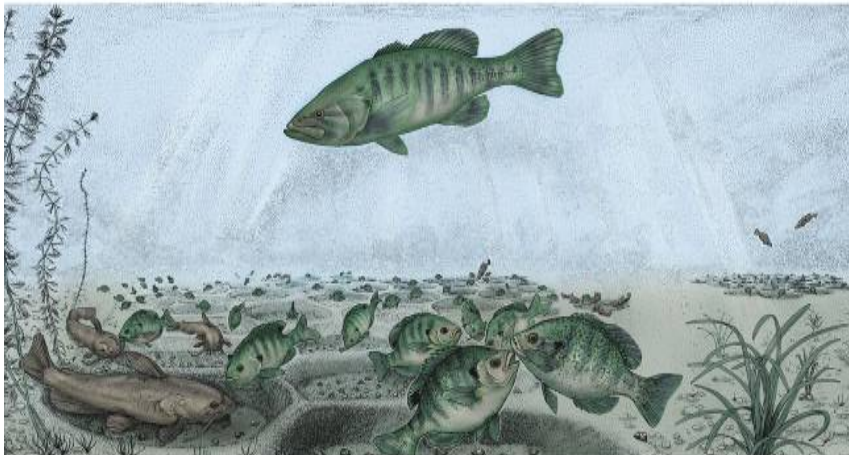
- More conspicuous to predators.

Predator Defense

Predator Defense

Example of Predator Defense

- BLUEGILLS
  - Drive egg-eating bullhead catfish away from their nests.
  - Closely related solitary species, the pumpkinseed sunfish, has powerful jaws and can therefore repel enemies on it's own.



Parasite/Disease Defense

- Parasites/diseases are transmitted more rapidly.
- More grooming assistance.
  - Honey bees and monkeys.

"It's just until the head lice problem at school clears up."

Parasite/Disease Defense

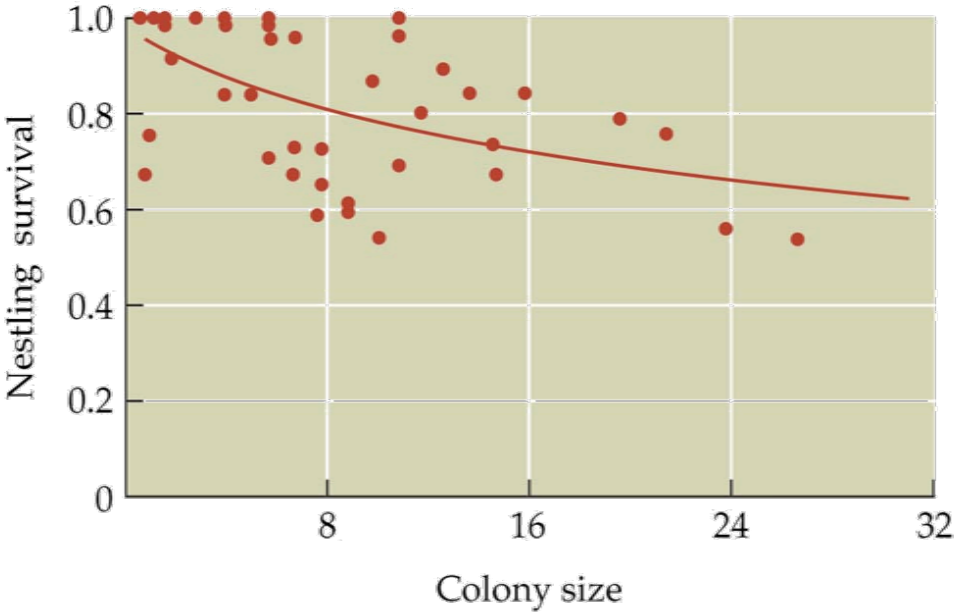
Foraging

- Competition for food is higher in social groups.

Foraging

- Competition for food is higher in social groups.

Fieldfare



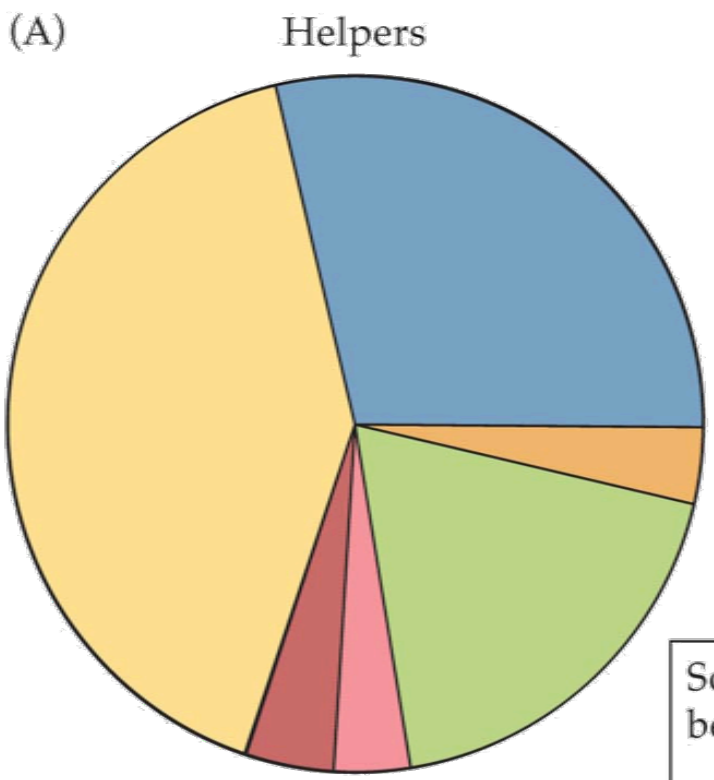
Foraging

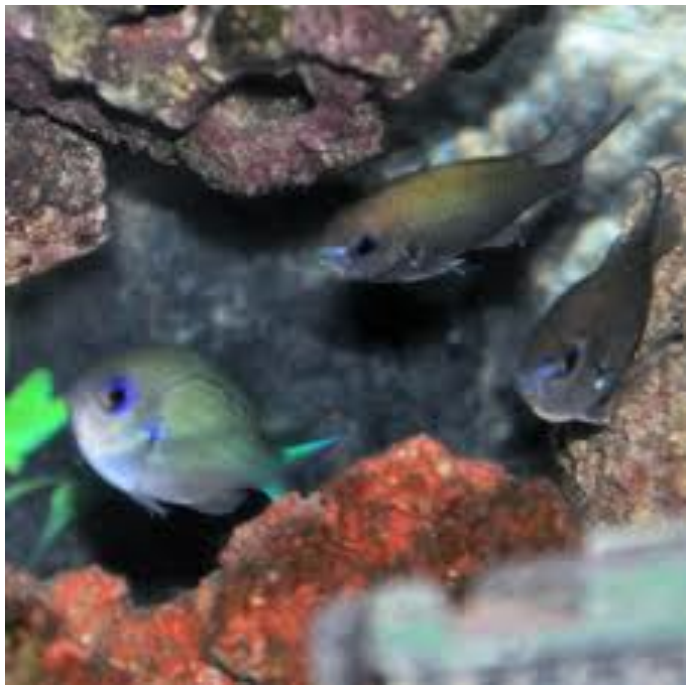
- Cooperation in the collecting of food can vastly increase supply.

Social Competiton

- Social displays of dominance/subordination, the formation of alliances, and friendships all take a lot of energy to establish and maintain.

Social Competition





Social behaviors
- Agonistic behavior
- Submissive behavior

Direct brood care
- Egg cleaning

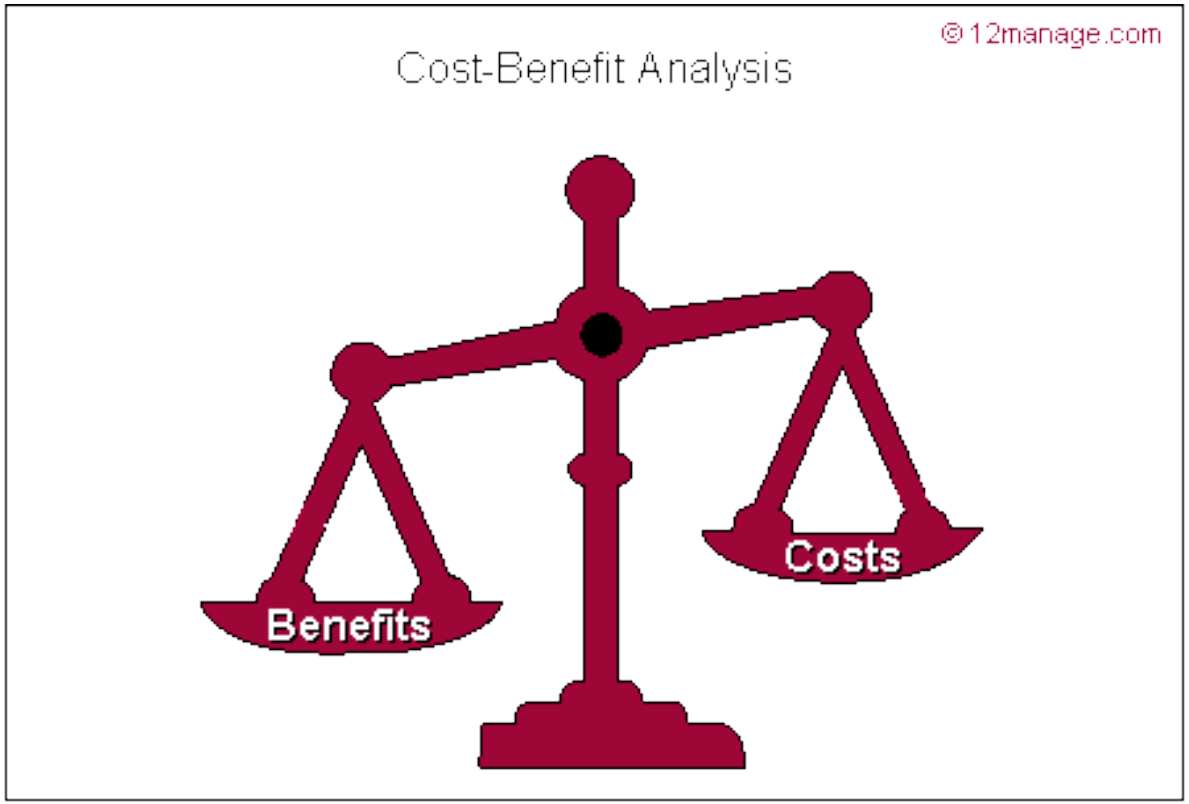
Territory maintenance
- Substrate cleaning
- Digging
- Carrying

Reproduction

- Some may want to kill your babies.

For Sociality to Evolve…

COSTS OF BEING SOCIAL MUST BE OUTWEIGHED BY THE BENEFITS.



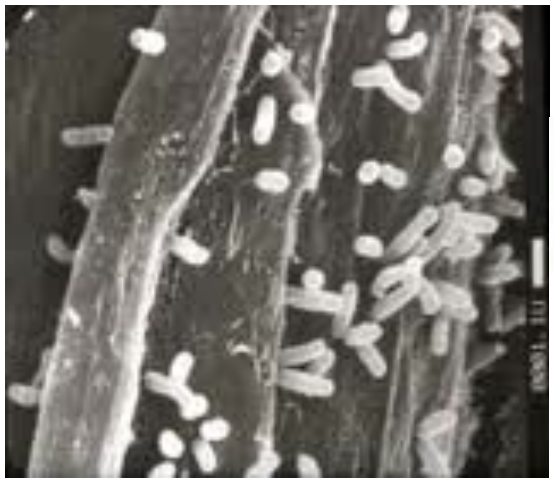

How To Be Social

Types of Social Behaviour

		Actor	
		+	-
Recipient	+	MUTUALISM/ COOPERATION/ RECIPROCITY	ALTRUISM
	-	SELFISH	SPITE

Mutualism/Cooperation (+/+)

- BOTH individuals derive a fitness benefit.
- Resource-resource relationships.



Mutualism/Cooperation (+/+)

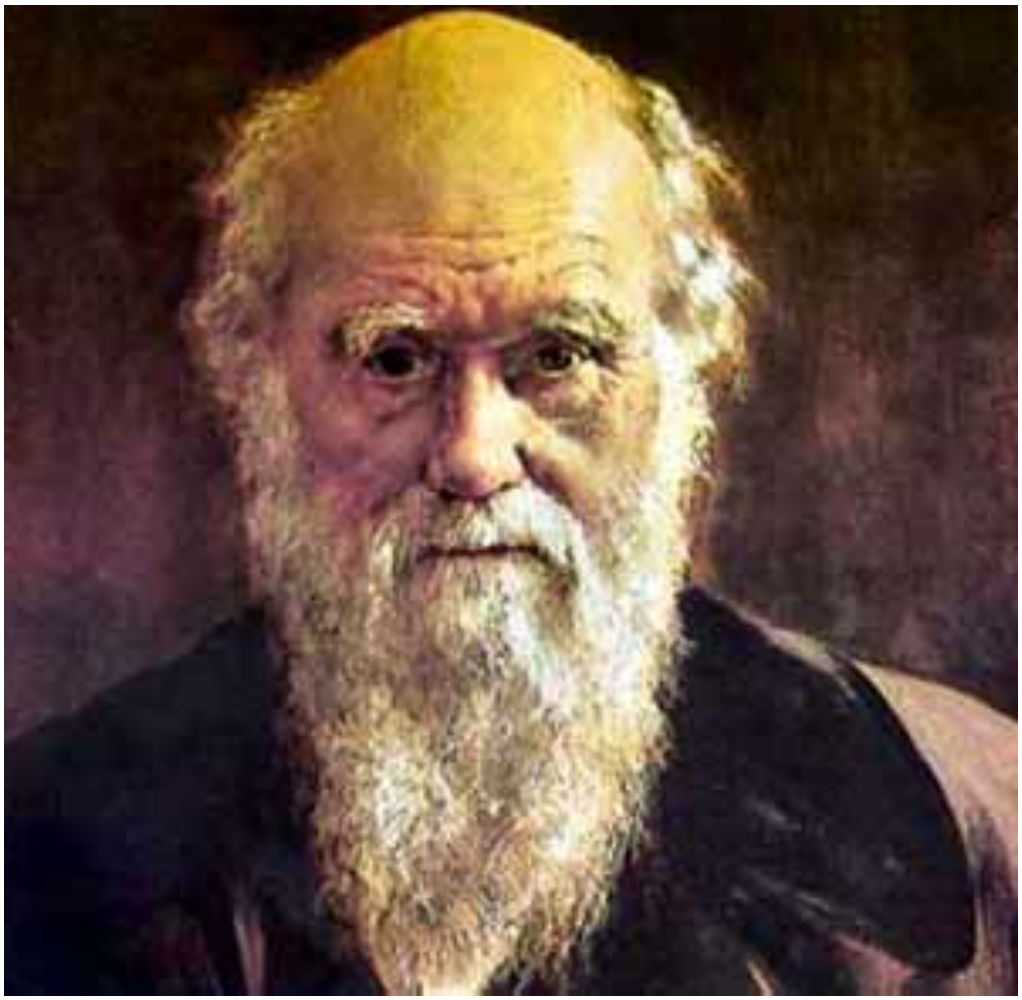
- Service-resource relationships.

Mutualism/Cooperation (+/+)

- Service-service interactions.

Altruism (+,-)

'If ever it could be shown that individuals repeatedly and reliably sacrificed their own fitness to increase the fitness of others, the theory of natural selection would be refuted.'



Group Selection

- Reduce reproduction to prevent over-cropping of food supply.
- Easily invaded.

Group Selection

Unlikely as individual level selection has greater:

1 Correlation between traits and reproductive success.

2 Variation in reproductive success.

3 Gene variation in a trait.

4 Generation time.

5 Number of individuals.

6 Number of incidents of selecton.

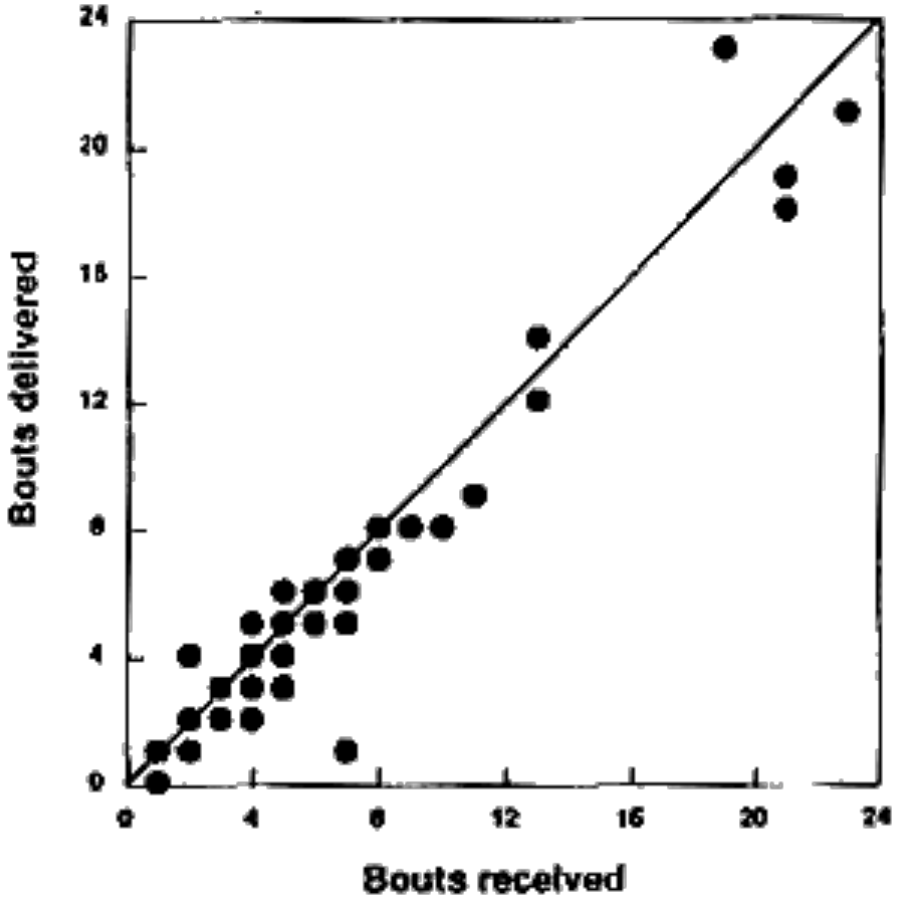
Reciprocal Altruism (+/+(delayed))

- You help because you know you'll get something back in return at a later time (Trivers, 1971)

"Oh sure, he's the fastest in the west alright, until it comes to buying a round."

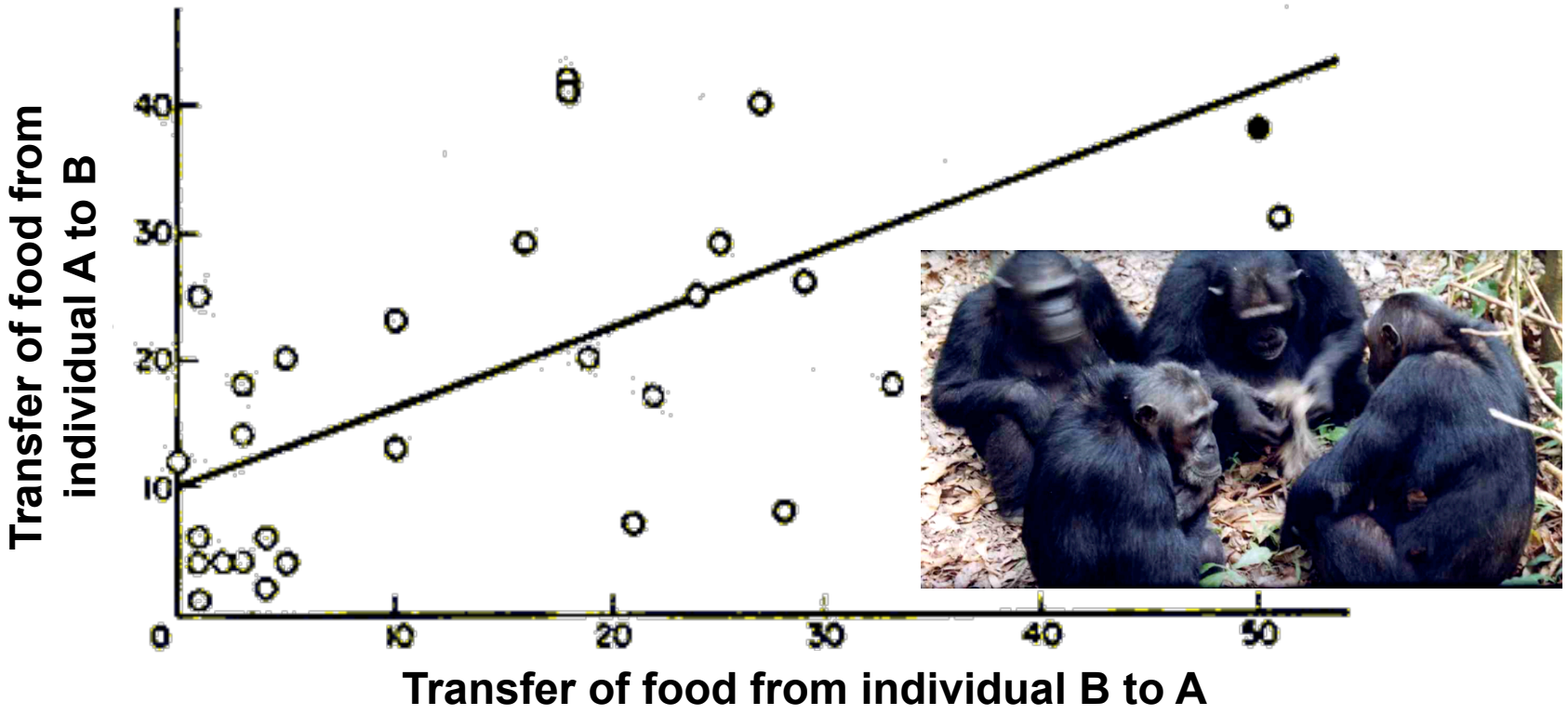
Reciprocal Altruism (+/+(delayed))

- Grooming



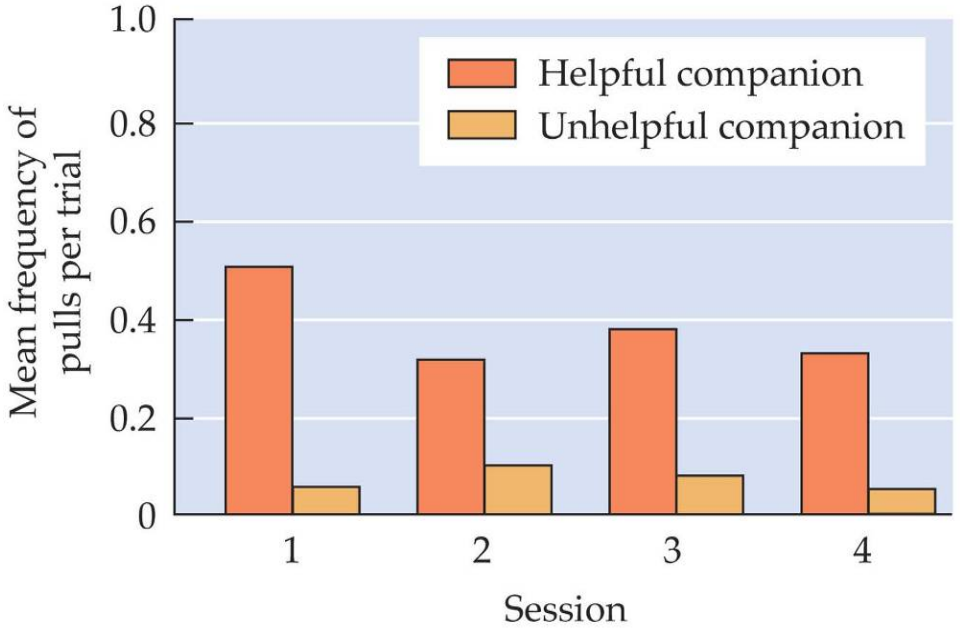
Reciprocal Altruism (+/+(delayed))

- Food sharing in chimps.



Reciprocal Altruism (+/+(delayed))

- Cotton-topped Tamarin experiment.



Cheater

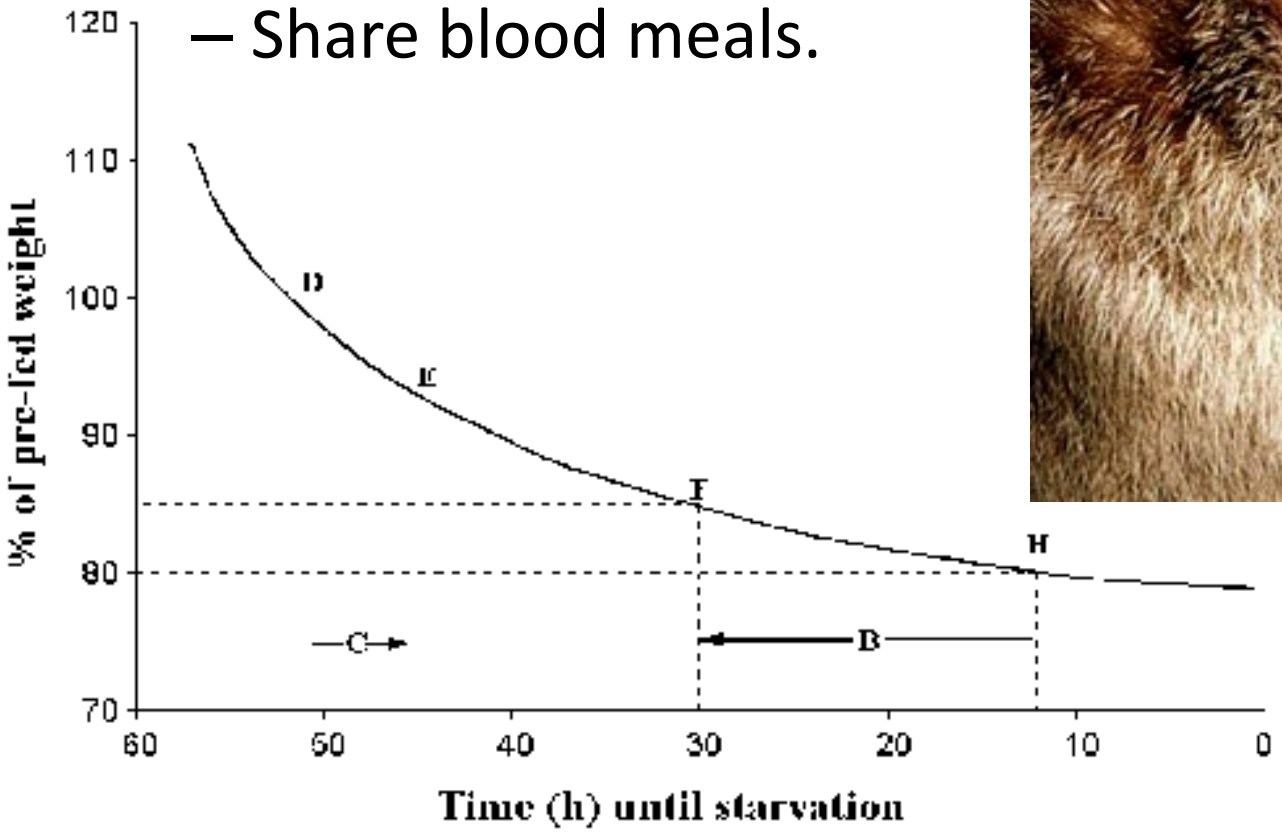
- Reciprocal altruism in animal societies is rare. Why? Because it's easy to cheat. So why do we observe it at all?

Tit-For-Tat

- Repeated interactions.
- First move cooperate.
- After that copy move of individual interacting with.
- Individuals using Tit-For-Tat do better than individuals who always defect.
- Need to have fairly advanced cognition to keep track of individuals and what move they played last.

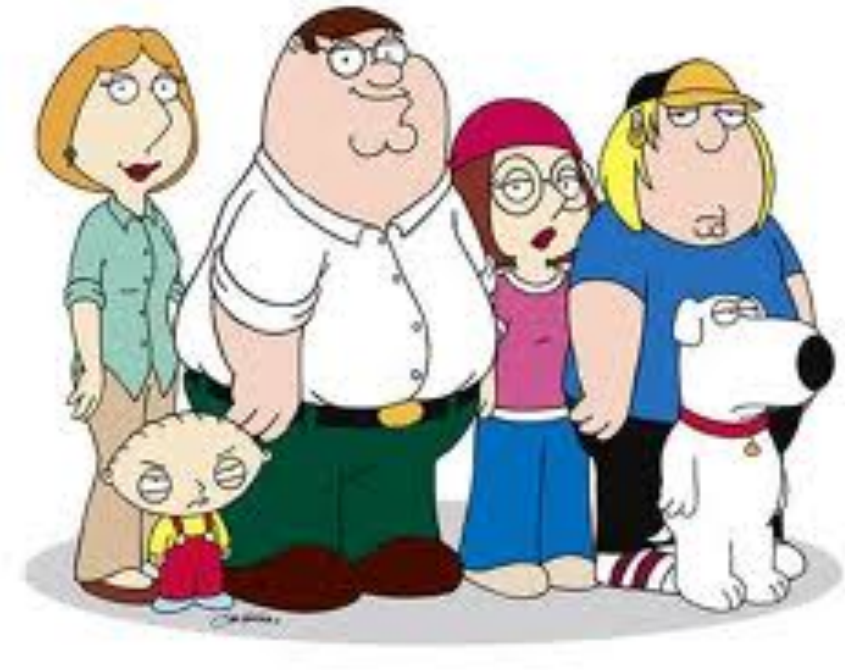
Tit-For-Tat

- Vampire bats.
  - If don't eat die.
  - Share blood meals.

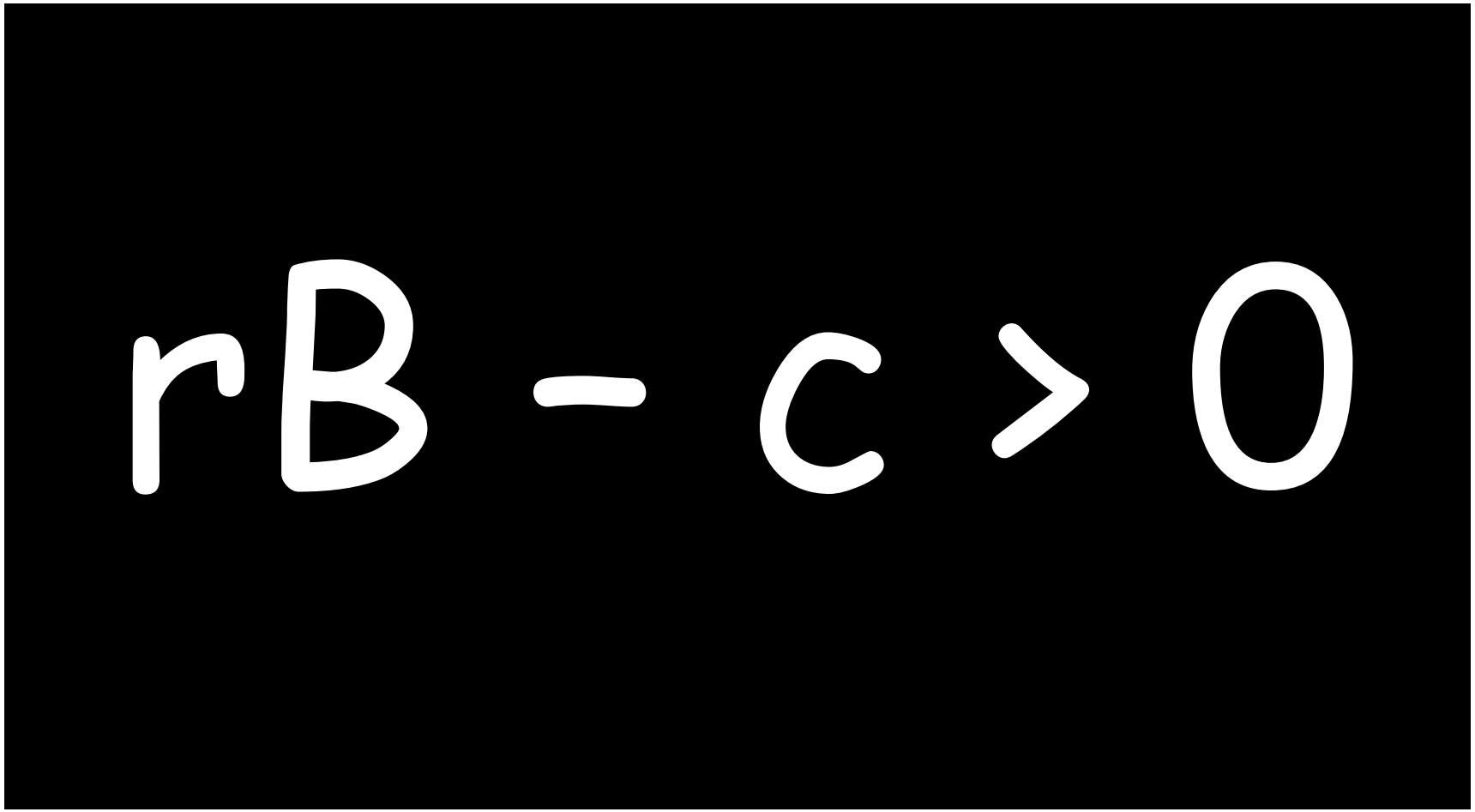


Kin Selected Altruism

- Individuals help their kin. Because kin share a proportion of their genes the actor gains an indirect fitness benefit.
- Direct fitness = your own offspring.
- Indirect fitness = your genes in the additional offspring of a related individual that were made possible by your actions.

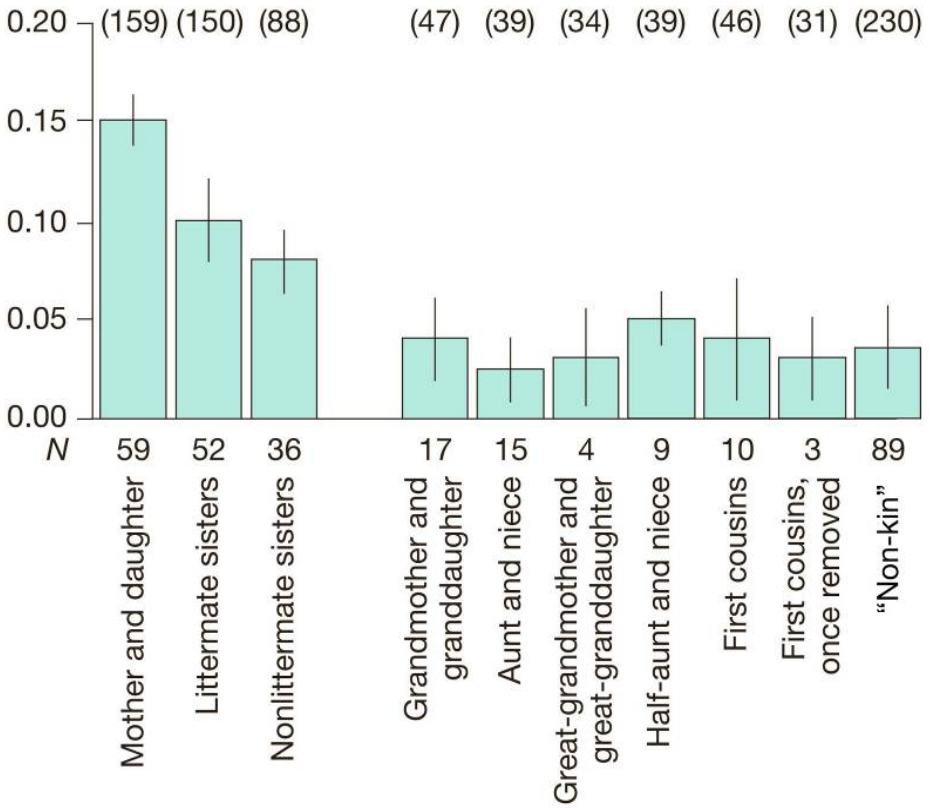


Hamilton's Rule



Kin Selected Altruism

- Belding's Ground Squirrel.



Kin Selected Altruism

Marmots:

•Males give alarm calls.

Kin Selected Altruism

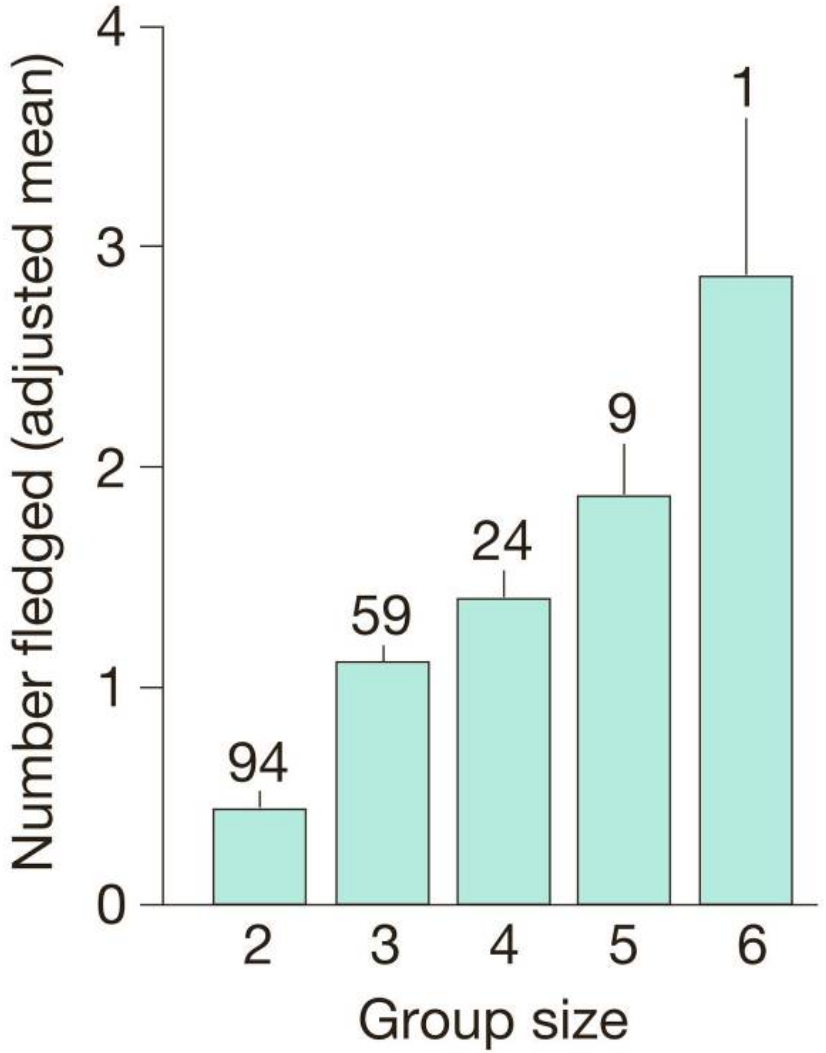
Emlen & Wrege 1988

white-fronted bee-eater
Merops bullockoides

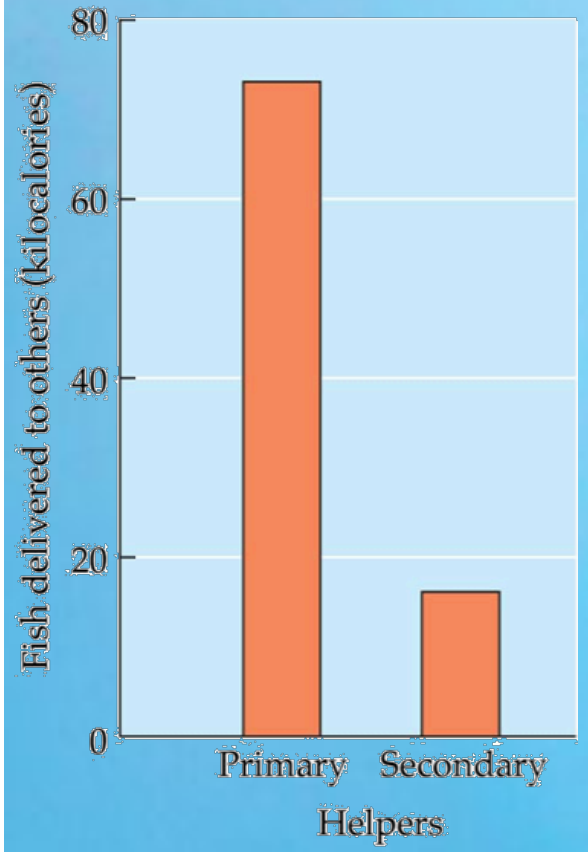
Komdeur 1994

Seychelle warbler
Acrocephalus sechellensis

Kin Selected Altruism



Kin Selected Altruism

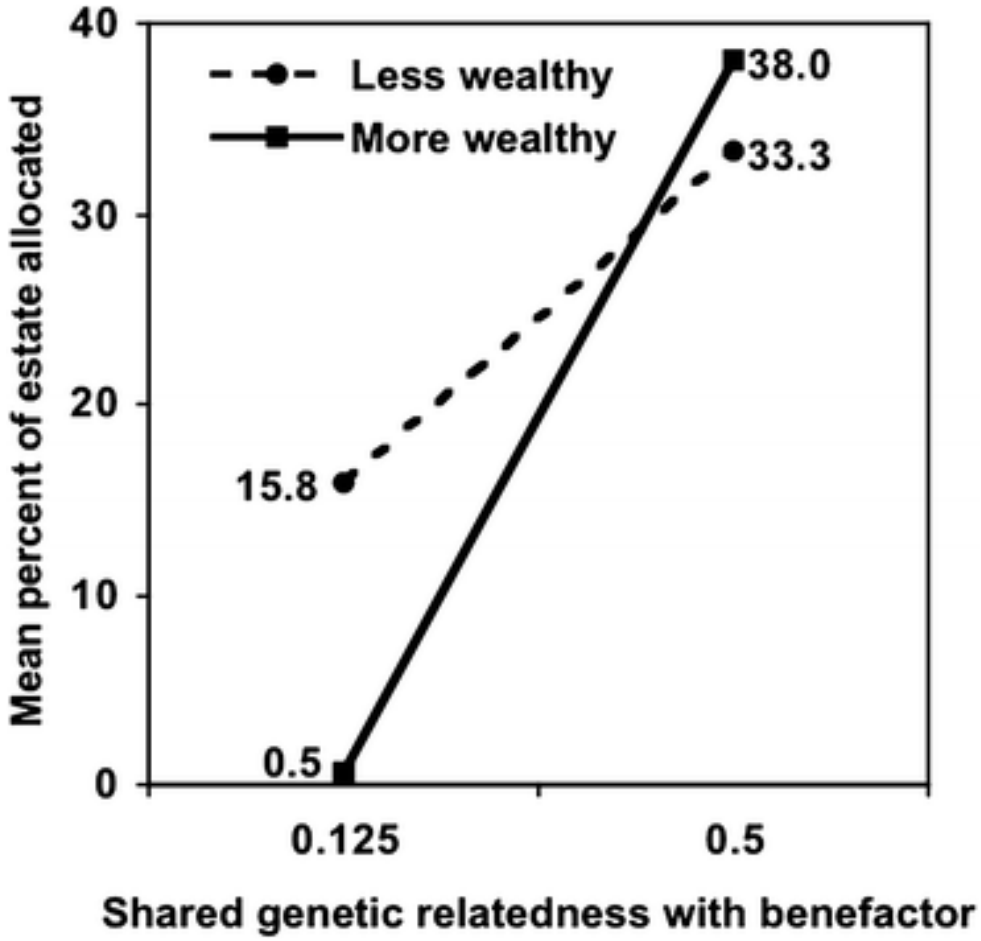


Kin Selected Altruism

	First Year			Second Year				
	y	r	F1	o	r	s	m	F2
Primary Helper	1.8	0.32	0.58	2.5	0.5	0.54	0.6	0.41
Secondary Helper	1.3	0	0	2.5	0.5	0.74	0.91	0.84
Delayer	0	0	0	2.5	0.5	0.7	0.33	0.29

Primary helpers increase fitness as average gain through indirect fitness is more than the average loss to their direct fitness.

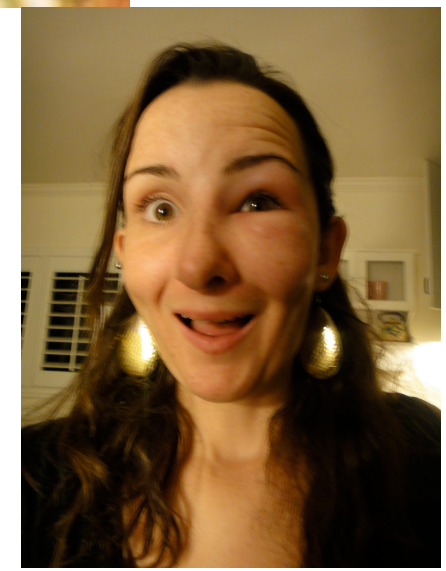
Kin Selected Altruism



Kin Selected Altruism

Kin Selected Altruism

- Suicidal Behavior



Kin Selection or Reciprocal Altruism in Animal Societies?

- Vampire bats
  - Feed those that have fed you before (reciprocal altruism).
  - Begging prevents well-fed bats from resting so it may pay to donate some resources to begging neighbours (manipulation).
  - Proportion of group members are relatives (kin selection).

Kin Selection

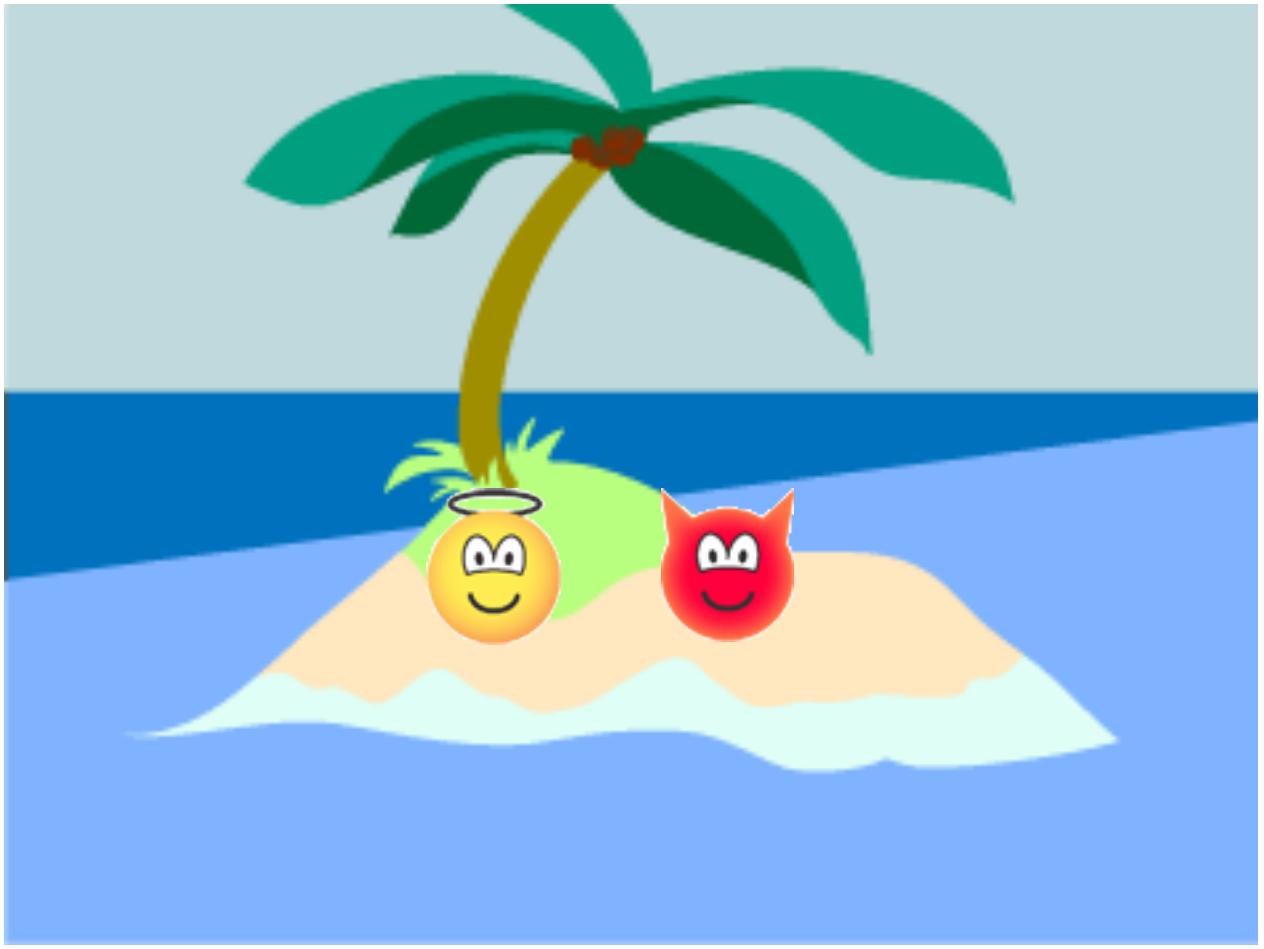
- Problems:
  - Individuals in eusocial societies no more related than those in simpler societies.
  - Importance of indirect fitness benefits has often been overestimated.
  - Importance of direct fitness benefits has often been underestimated.

Multi-Level Selection

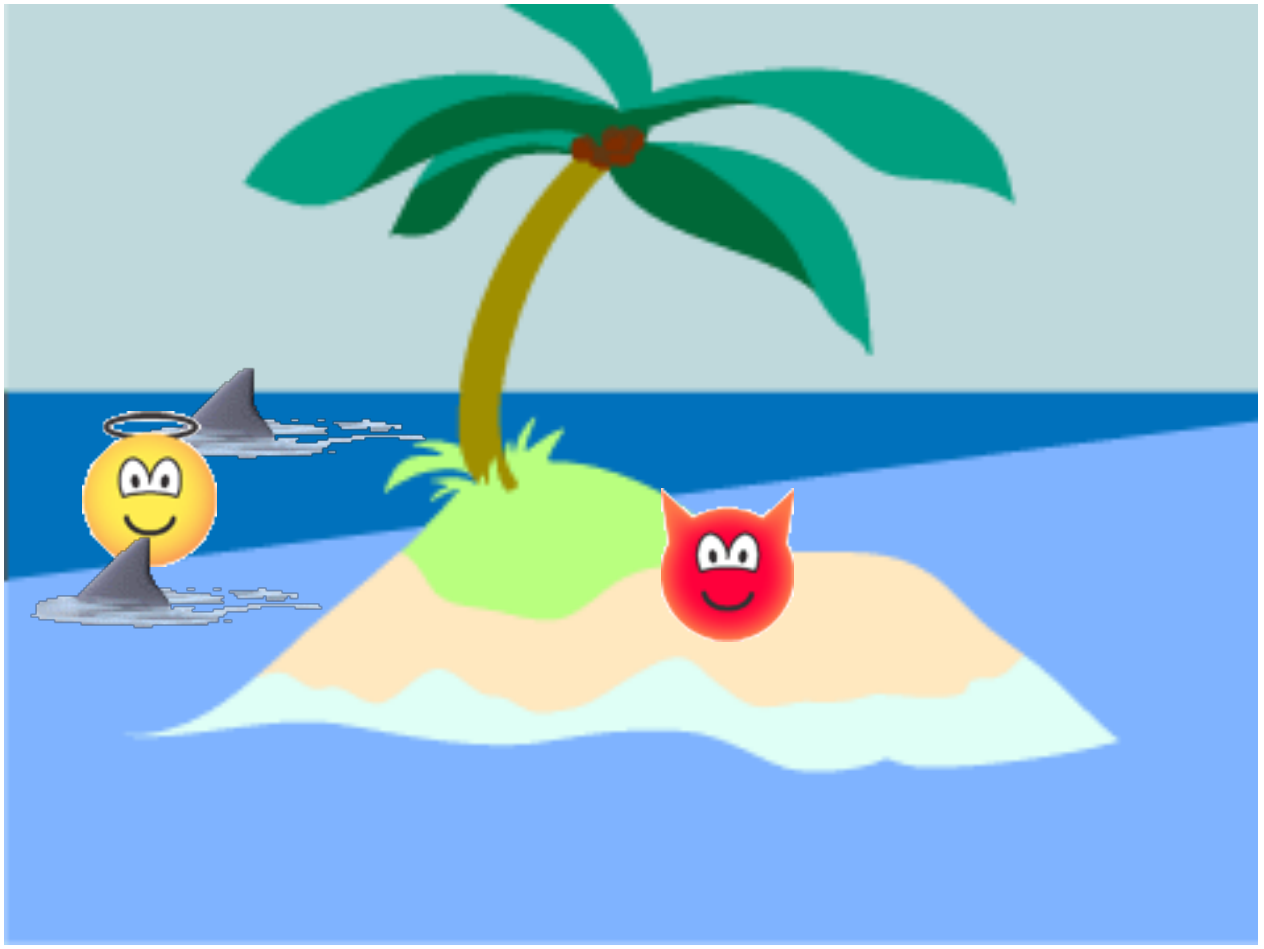
- List the traits that you associate with evil.

- List the traits that you associate with good.

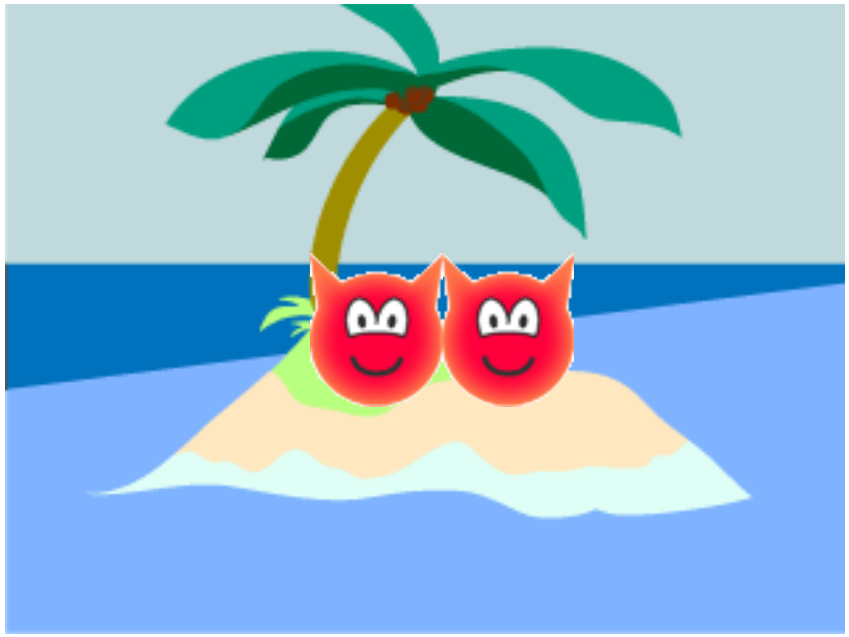
Multi-Level Selection



Multi-Level Selection



Multi-Level Selection



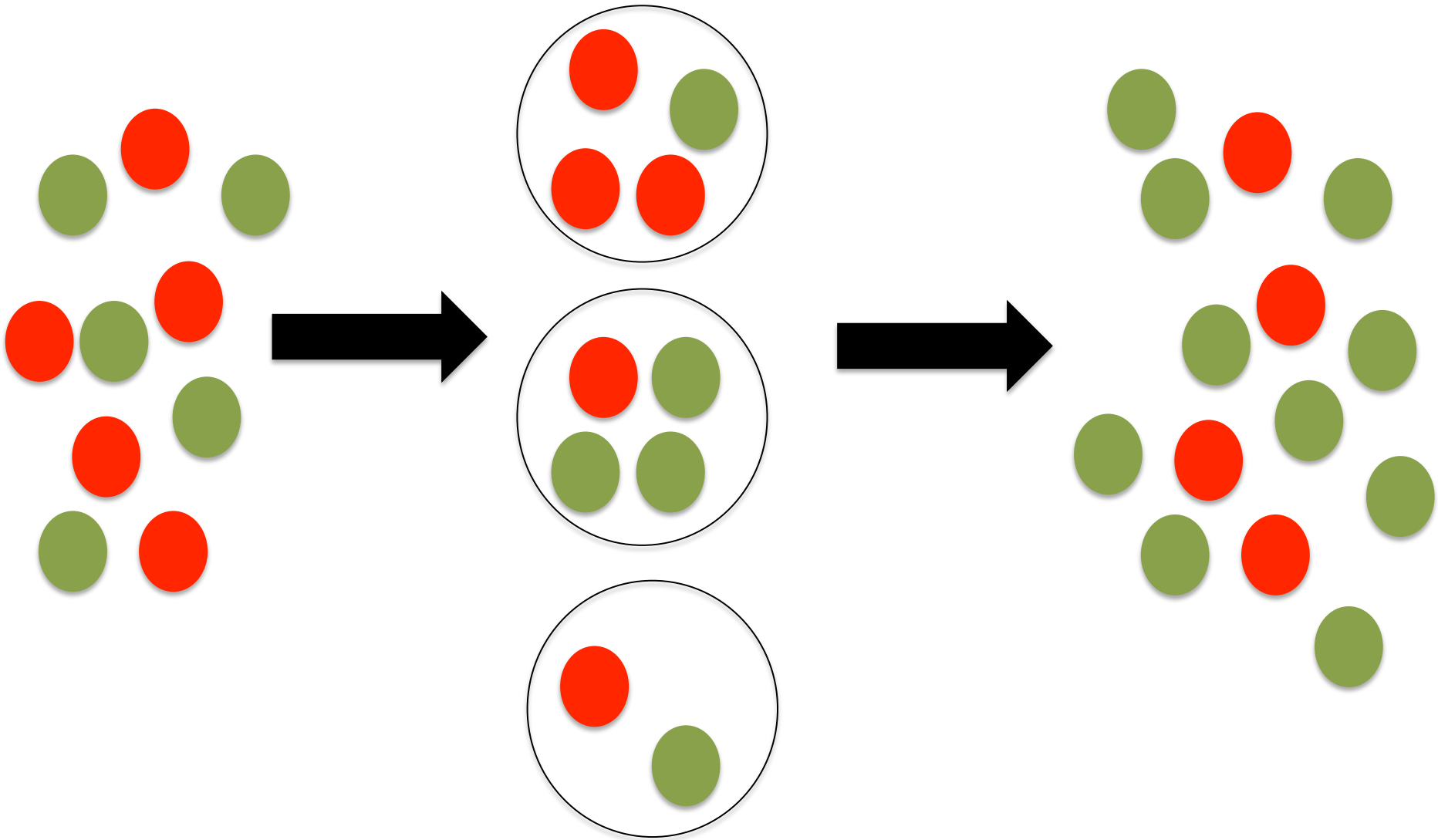
Multi-Level Selection

Multi-Level Selection

Multi-Level Selection

- Traits associated with goodness can evolve when appropriate conditions are met.
- Altruism is still vulnerable to cheaters.
- Groups of altruists are more likely to survive and reproduce better than other kinds of groups.
- Outcome of evolution depends upon the balance of opposing forces of within- and between- group selection.

Multi-Level Selection



Multi-Level Selection

Selection will operate on any entities that exhibit heritable variation in fitness.

Richard Lewontin

Multi-Level Selection

- Many disease agents that infect new hosts and display a high virulence eventually display reduced virulence. While one obvious explanation is that the host develops resistance, another possibility is that the disease agent becomes more "altruistic" (e.g., allowing the host to live). How might group selection be legitimately used to explain the evolution of lowered virulence in this case?

Why Do Animals Live In Groups?

- Direct fitness benefits:
  - Mutualisms.
  - Reciprocal Altruism.
- Indirect fitness benefits:
  - Kin selection.
  - Multi-level selection.