

# Cycle 12: Cooperation and Conflict



## Introduction

Interactions between individuals of the same community can be classified under four distinct categories: **cooperation, altruism, spite, and selfishness**. Looking at these interactions through a lens of 'how will this impact the doer's **reproductive** fitness and the receiver's **reproductive** fitness?' can help us perform these classifications. For example, male sea lions like to sing choruses, which discourage intruders from entering their territory and protect their community. Here, the **doer** would be a male sea lion in the chorus, and the **receiver** would be another male sea lion in that group that hears the chorus. This second male sea lion (the receiver) will join in on the chorus. Since the choruses protect a territory that belongs to both sea lions, this would be considered beneficial to both their fitnesses and be classified as cooperation.

Knowing this, we have to ask—what is the point of altruism? How does it evolutionarily make sense to sacrifice your own reproductive success (i.e. let your own fitness take a hit) for someone else? *How can selection favor altruistic traits?*

As it turns out, there are several key phenomena—that actually fall under the category of **cooperation**— that could provide an explanation for this: **group selection, kin selection, and reciprocal altruism**.

FITNESS COST-BENEFIT ANALYSIS

		recipient	
		benefit	cost
actor	cost	altruism (selflessness)	spite (both parties suffer)
	benefit	cooperation (both parties gain)	selfishness (recipient suffers)

## Theories Behind Cooperation

1. Group selection: your 'altruistic' acts benefit the greater good of the community  
A group with a high percentage of altruistic individuals have greater survival rate than a group with a high percentage of selfish individuals → between-group selection will allow the altruistic genes present in the former group to be passed down/evolve.

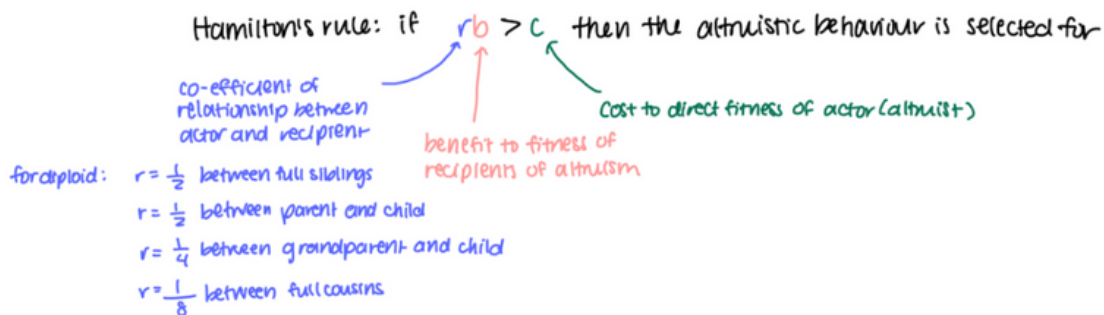
This is actually a very weak explanation since it only takes one selfish individual in a majority altruistic group to ruin everything. The one selfish individual will have an obvious fitness advantage over the rest of the group since he/she is effectively freeloading and exploiting the group. That selfish individual will have greater reproductive success compared to the altruistic individuals and pass down more of his own selfish genes!

2. Kin selection: helping out close relatives, allowing them to reproduce more and pass along genes that are likely similar to yours

Relatives will likely carry genes similar to yours, so helping your relatives increase their fitness (while diminishing your own direct fitness i.e. the number of offspring you produce) means you could still be benefiting your indirect fitness (i.e. the number of offspring your genetic relatives produce with your help). This explains how altruistic genes are evolutionarily selected—the relatives you help out could also have the same altruistic gene as you and pass that gene down to their descendants, and so on. The general idea is that the closer the relationship, the greater the degree of altruism.

Hamilton's rule: if the absolute value of the benefit to your close relatives' fitness outweighs the absolute value of the cost to your own fitness, kin selection will favour the altruistic act since your inclusive fitness (defined below) will increase

- $r$  = likelihood that the actor and the recipient will share genes that are identical by descent (i.e. copies of a single gene in a shared ancestor), including altruistic genes
- $b$  and  $c$  are measured in terms of fitness, i.e. number of offspring
- Calculating  $r$ : draw a family tree → every link is 0.5 → count the number of links between donor and recipient → add the numbers up
  - FORMULA:  $(0.5)^L$  WHERE  $L$  = NUMBER OF LINKS



$$\begin{array}{c} \text{direct fitness} + \text{indirect fitness} = \text{inclusive fitness} \\ \uparrow \qquad \qquad \qquad \uparrow \\ \text{your reproductive success} \quad \text{your relatives' reproductive success} \end{array}$$

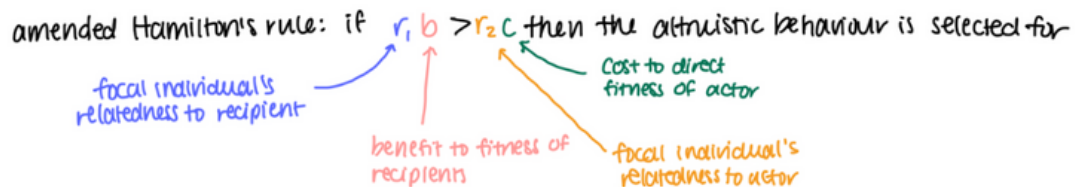
"altruism" towards relatives:

$$\Delta \text{direct fitness} + \Delta \text{indirect fitness} = \Delta \text{inclusive fitness}$$

cost (-ve) + benefit (+ve) = depends on cost/benefit values

When there is possible conflict regarding whether an altruistic act should take place, **asymmetry in relatedness** can occur, i.e. you and your relatives have slightly different genetic interests.

The **focal individual** is the point-of-view of any individual involved in the situation



**Example:** Ally helps her half-sister Jane (same mother) and Jane's direct fitness will increase by 20 units. What cost is Ally willing to incur according to Ally, Ally's mother, and Ally's father perspectives?

- Helper = Ally, therefore  $c$  is always the cost to Ally no matter who's POV we're looking through
- Recipient = Jane, therefore  $b$  is always 20
- Ally's POV:  $r_1 = 0.25$ ,  $r_2 = 1$ ,
- Ally's mother's POV:  $r_1 = 0.5$ ,  $r_2 = 0.5$
- Ally's father's POV:  $r_1 = 0$ ,  $r_2 = 0.5$

3. Reciprocal altruism: helping out nonrelatives while hoping that they'll return the favour/pay you back in the future

Reciprocal altruism is essentially temporarily reducing your own fitness with the promise of repayment. It only really works if the individual you're helping doesn't cheat and backstab you by not fulfilling their promise. Here is an example: monkey A grooms monkey B today, monkey B grooms monkey A tomorrow. Note that the repayment doesn't necessarily have to be the same as the initial action, e.g. the exchange could consist of sharing food in return for staying on someone's territory.

Reciprocal altruism requires the following conditions to be satisfied:

- Social groups are small and stable
- Individuals in the community are able to distinguish between "selfless" and "selfish" individuals thus "encouraging" the evolution of reciprocal altruism
  - Recognizing selfless and selfish individuals takes place through social score-keeping, i.e. keeping a mental record of another individual's tendency to be helpful or greedy
  - Emotions might have evolved to help with this... being helped by another individual can bring about feelings of gratitude and trust, while being backstabbed/cheated by another individual could cause feelings of resentment

Prisoner's dilemma: demonstrates how two altruistic individuals paired together have a greater chance of success than an altruistic individual paired with a selfish individual. Therefore, reciprocal altruism only evolves if, statistically, altruists tend to help only other altruists (i.e. "pair up") and not selfish individuals

**Example:** Hailey is thinking about helping out her cousin Brody. If Hailey helps Brody, Brody's direct fitness will increase by 12 units. What cost is Hailey willing to incur from the perspectives of Hailey, Hailey's mother (Brody's aunt), Hailey's father (Brody's uncle-in-law), and Brody's mother (Hailey's aunt). Note that Hailey and Brody's mothers are blood-related full sisters.

- Helper = Hailey
- Recipient = Brody therefore  $b$  is always 12
- Hailey's POV:  $r_1 = 0.125$ ,  $r_2 = 1$ ,  $c = 1.5$  at most
- Hailey's mother's POV:  $r_1 = 0.25$ ,  $r_2 = 0.5$ ,  $c = 6$  at most
- Hailey's father's POV:  $r_1 = 0$ ,  $r_2 = 0.5$ ,  $c = 0$  at most (meaning Hailey should not incur any cost to help AKA Hailey should not help Brody)
- Brody's mother's POV:  $r_1 = 0.5$ ,  $r_2 = 0.25$ ,  $c = 24$  at most

## Quick Recap/Final Notes

1. "Real" altruism is very rare and is vulnerable to being selected against
2. Most acts of altruism are actually cooperation/mutualism or delayed self-interest in the context of reciprocal altruism
3. Spiteful acts are also generally selected against since spite lowers both parties' fitness

*Disclaimer: We cannot guarantee that this resource will stand the test of time and therefore we are not responsible for any outdated information. This resource is student-made, and should be supplementary to resources provided by your instructors. It is not an alternative to your lectures and office hours. We are not responsible for the outcome of anyone's course evaluations based on this resource.*

*We will do our best to update this resource if there are any drastic changes. Please reach out to us at [team@webstraw.org](mailto:team@webstraw.org) if there are any issues with our current version and we will do our best to make changes promptly. We appreciate you using our resource!*