

Philosophy 3334: Philosophy of Biology  
Summer 2018  
First homework assignment

This homework is due at the start of class on Monday, June 11<sup>th</sup>.

1) In the preface to the 1<sup>st</sup> edition of *The Selfish Gene*, Richard Dawkins says, “We are survival machines—robot vehicles blindly programmed to preserve the selfish molecules known as genes.”

Explain what he means by this sentence. In doing so, you should explain key terms and answer questions such as:

1a) What does Dawkins mean by calling us “survival machines” and “robot vehicles”?

1b) What does Dawkins mean by saying that we are “blindly programmed”? How do our genes control us?

1c) Why does Dawkins call genes “selfish”?

2) What does chromosomal crossing over have to do with how Dawkins defines what a gene is?

3) In many snake species, males fight each other with their necks without seriously injuring each other. Yet it seems clear one bite from their fangs would basically end the fight. What is the basic explanation for why they don’t use their fangs? (Hint: I would expect the same answer if the question is about why rams use their horns to hit other rams on their well-armored heads and not to gut each other in the chest).

4) Imagine the following scenario: A species of carnivore is such that there are two different hunting strategies in the population. Strategy 1 is to pursue the ‘group hunt’ strategy of attacking big game which is only successful with help. Strategy two is to pursue the ‘lone wolf’ strategy of hunting smaller game which is always successful. When the time comes to get food, the hunters find themselves nearby another hunter. If a ‘group hunter’ meets another ‘group hunter’ they each receive 4 units of benefit. ‘Lone wolf’ always receives 2 units of benefit no matter who they meet. But if a ‘group hunter’ meets a ‘lone wolf’, then ‘group hunter’ gets 0 benefit while ‘lone wolf’ gets 2.

In other words, we have the following payoff matrix:

|              | Group hunter | Lone wolf |
|--------------|--------------|-----------|
| Group hunter | 4,4          | 0,2       |
| Lone wolf    | 2,0          | 2,2       |

Which of these two strategies, if any, is an evolutionarily stable strategy? Explain how you know.

5) Imagine a two-player game where individuals in the population are paired at random. There are two possible strategies: heads and tails. If both players play heads or both players play tails, then nobody gets any payoff. However, if a head is paired against a tail, then the head receives 4 units of payoff and the tail receives 6. In other words, we have the following payoff matrix:

|       | Heads | Tails |
|-------|-------|-------|
| Heads | 0,0   | 4,6   |
| Tails | 6,4   | 0,0   |

5a) Explain why neither strategy is an evolutionarily stable strategy.

Now imagine that the population is 80% heads and individuals are paired at random.

5b) What is the expected payoff of the heads strategy?

5c) What is the expected payoff of the tails strategy?

5d) Over time, this population will reach a stable state. What is the percentage of heads and tails in this stable state? Show your work and explain how you know this state is stable.

6) In each of these two following scenarios, explain which trait will be favored by natural selection and why.

6a) Organisms of species Alpha typically find themselves in groups of size 5 on average. Organisms in this species leave their homes soon after they are born and wander widely and so are no more likely to be nearby kin than nearby more unrelated organisms. When a predator attacks, there are two possible strategies: Strategy A is to simply run away. If you do so, the chance of being killed yourself is 5% and the chance of some other member of your group being killed is 80%. There is a 15% chance you will all get away. Strategy B is to send up an alarm call warning everyone in your group. The chance of being killed yourself is now 10% but there is only a 40% chance of someone else in your group being killed and a 50% chance that you will all get away. Will natural selection favor strategy A or strategy B?

6b) Organisms of species Beta live in family units consisting of a mother and all her children. Sometimes there are 2 children, sometimes 3, sometimes 7, etc. On average, the group consists of 5 individuals. When a predator attacks, there are two possible strategies: Strategy A is to simply run away. If you do so, the chance of being killed yourself is 5% and the chance of some other member of your group being killed is 80%. There is a 15% chance you will all get away. Strategy B is to

send up an alarm call warning everyone in your group. The chance of being killed yourself is now 10% but there is only a 40% chance of someone else in your group being killed and a 50% chance that you will all get away. Will natural selection favor strategy A or strategy B?

7) What would be the coefficient of relatedness between me and my mother's half-sister? (Half-siblings share one parent but not both). Explain your answer.