CASE TEACHING NOTES
for
"My Brother's Keeper: A Case Study in Evolutionary Biology and Animal Behavior"

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INTRODUCTION / BACKGROUND

This is an interrupted case where students work in teams to interpret behavioral data with respect to evolutionary biology. [Editor's Note: For a description of the interrupted case method, see the prologue to "Mom Always Liked You Best," another case on our website.] This case is suitable for courses in behavior, evolution, and ecology, and sections may be used in an introductory biology course if evolution and ecology get sufficient coverage in the course. The case demonstrates how selection enhances the likelihood that genes shared through common descent will be favored, rather than selection favoring actions for the good of the population or species.

I have used this case for years to reinforce an understanding of kin selection and to encourage students to consider the levels of selection controversy. The case was inspired by work done by Paul Sherman initially published in *Science* in 1977. Sherman discovered that the apparently altruistic behavior of alarm calling in Belding's ground squirrels is, in fact, nepotism. That is, it is not evolutionarily stable to assist non-related individuals at a cost to yourself (without sufficient opportunity for reciprocation or group selection). Rather, evolutionarily, it is beneficial to aid those individuals that share your genes by common descent (even if they are not your direct offspring).

Hamilton (1964) proposed kin selection to explain the adaptive value of assisting kin. Toward the end of the case, advanced students examine a simplified version of Hamilton's model and make predictions about kin selection based on relatedness. However, all students examine relatedness and the evolutionary value of providing assistance.

Students of all levels are quick to recognize kinship in the patterns of providing help (in this case, warning conspecifics about predators). However, they will typically recognize that it is "shared blood," without evaluating what the colloquial expression represents. An open discussion usually quickly reveals that the individuals share genes (by common descent). Then, the expanded discussion of human kin selection (relative to step-parenting) becomes pertinent. I include this discussion (although it is not necessary) because it reinforces that evolutionary principles apply to humans and can be explanatory to our actions. If included, I think that it is important to clarify that these data address tendencies (in the entire population), and do *not* suggest that non-traditional families are habitually problematic.

Students learn to identify some terms (*natal*, *predator*, *kin*), and some potential means of studying behavior. Teams of students must develop hypotheses and describe what data may be used to test these hypotheses (ideally, you encourage them to develop alternative hypotheses in discussion). Then, you describe (or present) the data collected by Paul Sherman and others and the teams interpret the evolutionary significance of the results.

This case can be adapted in several ways. In an animal behavior or evolution class, I would use all of the parts. However, in a different class (ecology or introductory biology) I might only use a few of the parts. In my introductory course, I describe some of the explanations, have the students present hypotheses, then I present the data and encourage group discussion rather than emphasize discriminating between alternative hypotheses and having the students work through all of the alternatives.

By using the parts in different ways and, in some situations, omitting some parts, the time demands and pre-requisites may vary widely. I have used this case in introductory courses in an abbreviated fashion, namely, by limiting discussion to three or so alternative hypotheses and omitting Parts V and VI as well as limiting discussion of Part VII (taking 10-20 minutes). In an upper-level animal behavior course, I have provided Part I ahead of time and used a 75-minute period. Each part's detailed teaching notes, provided in the Detailed Case Analysis (see below), describes how the part may be used in an introductory course or in an upper-level course.

The case requires that the student understand the basic principles of natural selection. The student should recognize that selection requires fitness benefits to some heritable trait. Thus, natural selection results in differential success of specific alleles in a population. Students must recognize that there are fitness benefits to certain alleles if they are to conclude that genes shared by common descent can confer a fitness advantage to an individual. It may be further helpful to emphasize that natural selection acts on phenotypes but results in changes in allele frequencies in a population.

Objectives

- Reinforce the following aspects of natural selection:
  - Natural selection does not (necessarily) act for the "good of the species."
  - Natural selection can favor traits that do not directly enhance individual fitness.
  - Kin selection can explain many behaviors that seem otherwise maladaptive.
  - Humans are animals and evolutionary strategies may be revealed in human behavior.
- Interpret graphical information.
- Develop testable hypotheses.
- Reinforce the value of students collaborating in groups.

In addition, in upper level classes, students must generate predictions to discriminate between competing hypotheses and interpret data relative to predictions.

You could assess your student's understanding of the levels of natural selection and on interpreting graphical analysis on pre- and post- tests to evaluate the effectiveness of the case. The specific nature of the questions would be individually derived relative to your emphasis on the goals and objectives of the case.

DETAILED CASE ANALYSIS

Detailed case analysis is provided in a separate file that is password-protected. To access this information, go to the detailed case analysis. You will be prompted for a username and password. If you have not yet registered with us, you can see whether you are eligible for an account by reviewing our password policy and then apply online or write to answerkey@sciencecases.org.

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