

CHAPTER 1: AN EVOLUTIONARY APPROACH TO ANIMAL BEHAVIOR

1. Work discussion questions 1-4 and 6 from the text.
2. Distinguish between proximate and ultimate questions about animal behavior. For each of the behaviors discussed in the chapter, write two of each type of question.
3. Outline the general method used to answer questions about animal behavior (i.e., the scientific method). For each of the studies of behavior in this chapter, identify the question, hypothesis or hypotheses, predictions, and tests of the predictions as appropriate. Select one of the described behaviors and develop one proximate and one ultimate question, hypothesis, prediction, and test of your own.
4. Compare and contrast Darwinian vs. group selection as a basis for ultimate questions about behavior. Outline the process of natural selection. Which of the two general hypotheses for the evolution of animal behavior is currently accepted? Why?
5. Discuss how scientific conclusions about behavior are strengthened over time. Discuss possible alternatives to Darwinian natural selection for hypotheses about the evolution of behavior.

CHAPTER 2: PROXIMATE CAUSES OF BEHAVIOR: ANALYZING COMMUNICATION

1. Work discussions questions 1 and 3 in the text.
2. Discuss the basic model underlying proximate analyses of behavior. Briefly describe the way(s) in which this model is an oversimplification (i.e., what, if anything, does it “leave out”?). Identify the two general levels of proximate analysis and distinguish between them. Is the division between the two always clear? Explain briefly.
3. Clearly distinguish between the phrases “behavior X is genetic (or environmental)” and “differences in behavior X are due to differences in genes (or environment).” Which is correct, which is incorrect, and why?
4. Outline the two “extremes” of hypotheses at the genetic/developmental level for differences in behavior. Illustrate how such hypotheses have been tested using galah/cockatoos, fruit flies, and sparrows as examples. What tests were done and what conclusions were drawn?
5. Using studies of zebra finches as examples, explain how differences in gene x

environment interactions can lead to differences in development, physiology, and behavior (i.e., outline the “cascade” of differences that arise as a consequence of sex differences).

6. Outline the various studies in the chapter on song learning in white-crowned sparrows. What do they tell us about the proximate mechanisms underlying differences in dialect among individuals of this species?
7. Compare and contrast song learning in white-crowned sparrows and brown-headed cowbirds, with special attention to (1) the role of environmental differences during early post-hatching development and (2) the role of social learning on song development in fledglings.

CHAPTER 3: THE DEVELOPMENT OF BEHAVIOR -- THE ROLE OF GENES

1. Work discussion questions 1-5 in the text.
2. Describe the techniques used to study “single-gene” behaviors, giving examples of both the techniques and the kinds of behaviors that have been so identified. What, exactly, is meant when we use the term “single-gene behavior”? What common misunderstanding might such a term imply?
3. Describe the use of controlled breeding experiments to study the genetic influences on behavior, using the studies of funnel web spiders and blackcap warblers as examples. Under what conditions (for what kinds of problems and what kinds of organisms) are these techniques especially valuable? What specific predictions were the investigators in these studies able to test? What were their conclusions?
4. What techniques are available to study the genetic influences on human behavior? Describe how, ideally, you could use twin and non-twin sibling studies to study differences in behavior among individuals (be sure to explain the basis for the comparisons you would make).
5. What is heritability and how, in general terms, is it measured? Does low heritability mean that a trait has no genetic basis? Why or why not? For what kinds of comparisons -- within or among populations -- are heritability measures appropriate? Give examples of estimated heritabilities for human personality traits.
6. How can artificial selection experiments be used to study the genetic underpinnings of behavior? What is the reasoning underlying this approach?

7. A common question asked by individuals who haven't studied evolutionary biology in depth is "If selection acts on a trait, why does variation in that trait persist within and among populations? Why isn't the "best" phenotype the only one present?" This question is as appropriate for behavioral traits as it is for others -- and has the same answer. What is it?

CHAPTER 4: THE DEVELOPMENT OF BEHAVIOR – THE ROLE OF THE ENVIRONMENT

1. Work discussion questions 1, 2, and 4 from the text.
2. Describe the evidence that levels of sex hormones experienced in utero affects the development of behavior in house mice.
3. Describe the evidence that the experience of storing seeds is, for marsh tits, correlated with the development of the hippocampus. What is the significance of that relationship for this species?
4. Discuss the concept of environmental cues acting as "developmental switches". What, exactly, does that phrase mean? What kinds of environmental cues can have this effect; what kinds of behaviors can they influence? Illustrate your answer with the examples discussed in class (including experimental/observational evidence as appropriate). Are the differences among behavioral phenotypes always dramatic? Justify your answer.
5. Define learning. In what way(s) might learning be considered a special kind of "developmental switch". In what way (if any) might it be considered a distinct kind of environmental effect on the development of behavior?
6. Define associative learning; compare and contrast habituation, classical conditioning, and operant conditioning. Which (do we think is) the most common in animals in natural settings?
7. Discuss the evidence from the text that operant conditioning is subject to biases and limits – that animals can't be conditioned to associate any stimulus with any response.
8. Why is it reasonable to predict that different species will exhibit specific forms of associative learning that are appropriate for their particular "life styles"?
9. Under what conditions might kin recognition be an important form of learning? Compare and contrast imprinting (both filial attachment and sexual imprinting),

“recognition by association”, and recognition by phenotype matching. Describe the characteristics of each form of learning and give examples as appropriate (including relevant experimental/observational evidence).

10. Under what conditions might spatial learning be an important component of an animal's behavioral repertoire? Describe the evidence that spatial learning, at least in some bird species, is a “distinct” form of learning (rather than a component of a more general “ability to learn”). What variables affect spatial learning in voles? Explain the adaptive significance of this variation (i.e., explain why the variation we see “makes sense” in the context of the ecology of various vole species).
11. Describe the experimental apparatus used to study how honeybees learn to associate color with food. What have we discovered about how that process works? What other cues to bees use to find food? What kinds of other associations do they make?
12. What is developmental homeostasis? What is the evolutionary significance (adaptive advantage) of this phenomenon?

CHAPTER 5: THE CONTROL OF BEHAVIOR – NEURAL MECHANISMS (part)

1. Describe Tinbergen's and Lorenz's experiments with “beak pecking” in Herring gulls and egg retrieval in greylag geese. What key observations did they make, and what conclusions did they draw from them?
2. Define the terms fixed action pattern, sign stimulus, and innate releasing mechanism. Compare and contrast fixed action patterns with learned behavior. From an evolutionary perspective, what is the significance of sign stimuli (i.e., what is their adaptive function)? What is the general adaptive value of innate behavior (i.e., why wouldn't selection favor more learning and less innate behavior)?
3. What is a supernormal releaser? Give an example.
4. In the context of innate behaviors, what is code breaking? Describe code breaking in avian brood parasites, rove beetles, and cleaner wrasse.

CHAPTER 6: THE CONTROL OF BEHAVIOR – ORGANIZING MECHANISMS

1. Work discussion questions 1-4 in the text.

2. Describe the command center hypothesis for the organization of behavior. What function do command centers play?
3. According to Roeder, what are the major command centers that organize feeding and locomotion in praying mantises? Describe the observational and experimental evidence in support of his hypothesis.
4. According to Dethier's work on feeding in blowflies, what major command centers organize feeding behavior in these animals? Describe the observational and experimental evidence in support of this hypothesis (note -- you'll need to get some details from the text).
5. Describe the general function of pacemaker or clock mechanisms in the context of the command center hypothesis (i.e., what do pacemakers or clocks "do to" command centers, and why is this adaptive).
6. What is a circadian cycle?
7. Describe the evidence that the circadian cycle in singing in male crickets is organized by a combination of environment-dependent and environment-independent mechanisms. In this context, define the terms free-running cycle and entrainment. What is the adaptive significance of this kind of combination of mechanisms?
8. Describe the experimental evidence that, for male crickets, entrainment is a function of the eyes, while the neural mechanism of the free-running cycle is housed in the optic lobes.
9. Describe the evidence that the clock mechanism that controls emergence time in silkworm moths is housed in the brain of the larvae.
10. What seems to be the central pacemaker for circadian rhythms in mammals? Describe its general function and the general mechanism by which mammalian circadian rhythms seem to be entrained.
11. Give at least one example each of animals for which moonlight, temperature, food availability, and social interactions (give one example each for visual, mechanical, and acoustical signals) seem to be important cues for the organization of behavior.

CHAPTER 7: THE EVOLUTION OF COMMUNICATION – HISTORICAL PATHWAYS

1. Work discussion questions 1-5 from the text.
2. What are the two broad categories of ultimate questions that can be asked about behavior? Give several examples of each.
3. What, in general, is the comparative method? Using the case studies from the text, discuss some of the specific forms that method may take.
4. What basic assumptions do we make when we first develop hypotheses about the historical development of a behavior? What general kinds of information do we need to develop and test those hypotheses?
5. Discuss the current consensus hypotheses for the evolution of the female pseudopenis and "greeting ceremony" in spotted hyenas. Include predictions and tests of the hypotheses as appropriate. What general "lessons" about historical analysis does this case illustrate?
6. Outline the general process by which investigators developed their hypothesis for the sequence of events involved in the evolution of the rapid-flutter wing-waving display in pelagic shag. What general line(s) of reasoning did they employ? How did they test their hypothesis? Will this approach work for all behaviors? Why or why not?
7. Answer the same questions as asked in #6 above for the evolution of signals in male whistling moths.
8. Describe the general hypothesis of sensory exploitation for the evolution of signals. What key prediction(s) does this hypothesis make? Illustrate how the hypothesis has been applied and tested in Tungara frogs, water mites, and sword-tail fish.
9. What is the "panda principle"? What does it have to do with the reconstruction of historical sequences of evolutionary change?

CHAPTER 8: ADAPTATION IN SIGNALERS AND RECEIVERS

1. Work discussion questions 1 and 3-6 from the text.
2. Explain why we generally make the assumption that complex behavioral traits have adaptive functions. What are some of the general alternatives to adaptive hypotheses (i.e., what other factors might explain the presence of a behavior)?

3. State the general adaptive hypothesis for why elaborate bird song is more generally found in male than female birds. Clearly state the major fitness benefits this hypothesis might include, and discuss the predictions and tests derived from each. Which are supported and which not? Do the results we discussed allow us to unambiguously support one specific fitness benefit over another as the ultimate explanation for this phenomenon? Why or why not?
4. State the major “non-adaptive” and “adaptive” hypotheses for the presence of song dialects. Discuss the major predictions and tests of each. Which are supported and which not? Are the “non-adaptive” and “adaptive” explanations truly mutually exclusive? Explain.
5. What is a Darwinian puzzle, and how does making adaptationist assumptions help us solve them?
6. Why do ravens share? Discuss the major hypotheses and tests proposed and performed by Heinrich to answer this question.
7. Why do male Túngara frogs sometimes avoid giving the whine-chuck call? Justify your answer with the usual information (hypotheses, predictions, tests, results).
8. Give examples of exploitative receivers and deceptive signalers. What general hypothesis is most often proposed to account for these phenomena? Be sure to explain the hypothesis fully. How would you test this hypothesis in the fireflies and garter snake behaviors discussed in the text?

CHAPTER 9: ADAPTIVE RESPONSES TO PREDATORS

1. Work discussion questions 1, 2, and 4 from the text.
2. Distinguish between fitness benefits and performance benefits. According to Alcock, what kinds of traits fit into each category? According to me, what kinds of traits fit into each? Is the “dividing line” between the two always easy to draw? Explain. Explain (from both practical and theoretical perspectives) why performance benefits are often used in studies of adaptation .
3. Describe the “classic” comparative method. What hypotheses is it used to test? Illustrate using the example of mobbing in gulls.
4. What is an optimality model? What is a game theory model?
5. Describe the major adaptations we discussed for avoiding detection. Describe the

evidence supporting the proposed fitness benefits of mobbing and cryptic behavior.

6. What are the potential costs of cryptic behavior in Belding's ground squirrels and Trinidadian guppies? Describe the optimality models we used to understand how the "best" behavior varies among individuals.
7. Give at least one example each of associating with protective species and advertizing unprofitability as adaptations for reducing attack rate. List the major hypotheses (the predictions that follow from them) for stotting in Thompson's gazelles. Which hypothesis or hypotheses best explains this behavior?
8. Define the term "aposematic coloration" and describe the kinds of colors generally associated with this phenomenon. Describe the general function of this behavior and explain why this general function makes it difficult to understand its evolutionary origin. Describe the three major hypotheses that have been proposed to explain the origin of aposematism.
9. Why are so many aposematic insects also gregarious? Describe the three major hypotheses and Sillen-Tullberg's studies examining each. What evidence supports or falsifies each hypothesis? Is it necessarily the case that her results will apply to all insects?
10. Compare and contrast Batesian and Mullerian mimicry and give examples of each. Is mimicry limited to visual patterns, or can other types of sensory signals be mimicked? Support your answer with examples.
11. Describe the major mechanisms proposed to help reduce the likelihood of capture in social groups. What kinds of evidence would support each? Give examples.
12. Describe and give at least one example each of "startle response" and evasive action as mechanisms that reduce capture rates.
13. Describe and give at least one example each of using chemical defenses/deterrents, misdirection, and attracting other predators as mechanisms to reduce consumption rates.
14. List all the adaptations of monarch butterflies to reduce predation.

CHAPTER 10: ADAPTIVE FEEDING BEHAVIOR

1. Work discussion questions 1-5 from the text.

2. What is a search image? What evidence do we have from studies of jays that this phenomenon is real and provides a performance benefit?
3. Describe the basic characteristics of the “waggle dance” of honeybees. Discuss the three fitness benefits proposed by Seeley and Visscher for the dance, the predictions they derived for each, and their tests of those predictions. Which hypothesis (or hypotheses) seem to be best supported?
4. What central predictions derive from the hypothesis that breeding colonies and/or roosting aggregations of birds can act as “information centers” where information about food resources can be shared. Discuss the evidence for this hypothesis in barn swallows, black-headed gulls, and ospreys.
5. Describe the deceptive signals used by bolas, golden orb-weaving, and garden spiders to lure prey. List as many other examples of deceptive signaling as you can.
6. Describe and discuss the optimality models (verbal or graphical) we used to explain the Darwinian puzzles of feeding strategies in Howler monkeys, oystercatchers, leafcutter ants, and New Mexico spadefoot toad tadpoles. For each, identify the factor being optimized and any relevant variation in costs and benefits of feeding on a particular type of prey or at a particular time of day. As appropriate, discuss the evidence supporting each model.
7. Describe some of the special “handling” strategies that may be required to deal with noxious prey.
8. What benefits may be provided by social foraging? Give examples from gulls and social carnivores. For the latter, describe the optimality models that attempt to predict group size.
9. Compare and contrast the “rate of energy extraction” and “family gain” hypotheses for optimal quitting time in foraging starlings. Which is better supported by the available evidence? What surprising results did this study produce?
10. Describe Zach’s optimality model for whelk-dropping in northwestern crows. What information did he start with, what general model did he develop, and how did he test it? How well did his model fit the evidence?

11. How does predation risk influence decisions about where to consume captured food? Describe Lima's work on chickadees. Did his results support this general model?
12. When should we eat dirt?

CHAPTER 12: MALE AND FEMALE REPRODUCTIVE TACTICS

1. Work discussion questions 1-6 from the text.
2. Describe the "general model" for differences in reproductive behavior based on differences in reproductive potential. Be sure to explain the term "operational sex ratio". What kind(s) of evidence supports this model?
3. Define and describe the basic components of sexual selection. How (if at all) is sexual selection different from natural selection?
4. Describe the major patterns and processes of male-male competition, giving examples and including the kinds of traits selection should favor for each. Compare and contrast "separate strategies" and "conditional strategies", and explain how you might distinguish one from the other experimentally (or observationally).
5. Describe the traits females use to select mates from among competing males. Discuss the benefits to females of using those criteria, the conditions under which the various forms of mate choice might be most adaptive. Give examples.
6. Compare and contrast the different models for female preference for ornamented males, giving examples of each and explaining how they might be distinguished experimentally or observationally (as appropriate based on our coverage in lecture and in the text).
7. Briefly list and describe the potential outcomes of male behaviors "designed" to circumvent female mate choice.

CHAPTER 13: THE EVOLUTION OF MATING SYSTEMS

1. Work discussion questions 1-4 from the text.
2. List and define the major types of mating systems (based on number of partners) found in animals.

3. Defend, using sexual selection theory, the statement that “all else being equals, males should be polygynous.”
4. What kinds of monogamy are expected when the benefits of male parental care are high? Explain the benefits to both males and females of each strategy and give examples.
5. When the benefits of male parental care are low, under what conditions might monogamy be expected? Explain the benefits to both males and females and give examples.
6. What is “extra-pair copulation”? What are the potential benefits to males and females of obtaining EPC’s?
7. Compare and contrast the three basic forms of polygyny. Be sure to describe the conditions under which each is expected to occur and the benefits to males and females; give examples.
8. Describe the general pattern of lek polygyny (include a definition of “lek”). Describe the three hypotheses we discussed for evolution of lek polygyny, including the conditions under which it might occur and the benefits to males and females.
9. Why is polyandry expected to be rare among animals? Describe the major types, with attention to the conditions under which each occurs and the benefits to males and females.
10. Define the term “cooperative breeding” and distinguish between helpers-at-the-nest and communal breeding. Do helpers at the nest really help? Why might helpers stay in their natal territories, and what benefits might they gain from actively helping at the nest?
11. List and briefly describe the various mating strategies found in dunnocks (the brief description should include the ecological/social factors associated with each).
12. What mating strategy do humans employ?

EVOLUTIONARY PSYCHOLOGY

1. What is evolutionary psychology?
2. Briefly describe the contributions to EP from both evolutionary biology and

psychology.

3. Discuss the major misconceptions about and abuses of EP that have historically generated opposition to it as a scientific enterprise.
4. Describe the basic principles underlying EP, with special attention to the fundamental model of the brain/mind it proposes.
5. What are the basic methods and questions of EP?
6. Describe Cosmides and Tooby's test of the general hypothesis that the human mind contains cognitive circuits specialized for reasoning about adaptive problems posed by the social world of our ancestors.
7. Describe at least one hypothesis and two tests (of that one hypothesis) about differences between human male and female mating behavior stemming from basic sexual selection theory.