Biology 352, Spring 2019 **Exam Number KEY**

First midterm exam

Part 1 (short answer) worth 1 – 4 points each

1-1) Provide clear and unambiguous definitions for each of the terms below in the context of behavior studies (1 pt each):

Innate: ***A behavior that requires no prior experience to be performed in the correct context***

Sign Stimulus: ***The essential feature of a stimulus that releases a behavior (a "releaser")***

Habituation: ***The waning of a behavioral response as a result of repeated exposure to a stimulus***

Communication: ***"Intentional" (selected for) transmission of information between sender & receiver***

1-2) Define the following (2 pts)?: ESS: ***Evolutionarily Stable Strategy*** FAP: ***Fixed Action Pattern***

1-3) Give an example of a "structural" display and explain how it differs from a "behavioral" display. (2 pts)
Many possible examples, most relating to body shape, size, color, etc. Structural displays, unlike behavioral displays are always "on"… i.e., they are always present.

1-4) Label the following steps (1 = first step, etc) in the order that they occur during classical conditioning. Do not label any steps that are not part of this conditioning process (4 pts)?

3 A conditioned response follows a conditioned stimulus
2 A conditioned stimulus precedes an unconditioned response
1 An unconditioned stimulus elicits an unconditioned response
_____ An unconditioned stimulus precedes a conditioned response

1-5) Fill in the blanks in the table below describing basic characteristics of signals for different signal modalities (4 pts):

	Signaling Modality			
Signal Characteristic	Chemical	Auditory	Visual	Electrical
Range (short to long)	Long	***LONG***	***MEDIUM***	Medium
Rate of signal degradation (fast to slow)	***SLOW***	Fast	Fast	***FAST***
Ability to pass obstacles (good to poor	***GOOD***	Good	***POOR***	Medium
"Locatability" (low to high)	Variable	Medium	***HIGH***	Medium
Energetic cost (low to high)	Low	***HIGH***	Low	Medium

1-6). According to Dugatkin, learning is best defined as (2 pts):

a) a process by which only aversive stimuli elicit changes in behavior
b) changes in behavior that result from past experience
c) a permanent change in behavior resulting from hormonal but not neurobiological changes
d) a relatively permanent change in behavior as a result of prior experience

1-7) A When compared to a male who surrounded by brothers, in utero, a male rat fetus that lies between two sisters, in utero is likely to develop into an adult that is (2 pts).

_____ more aggressive and less sexually active
_____ more aggressive and more sexually active
_____ less aggressive and more sexually active
X less aggressive and less sexually active

1-8) Match the following examples of learning with the type of learning on the right. You may use a type of learning more than once (2 pts)

d habituation
b operant or instrumental conditioning
d sensitization
b classical or Pavlovian conditioning

a) trial and error learning
b) associative learning
c) cultural learning
d) non-associative learning

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Part 2 (Short answer) worth 10 pts each

2-1) Detecting predators before they detect you is a critical feature of survival for many animals. Given what you know about the hunting capabilities of moth-eating bats, describe the sensory capabilities and associated responses of moths to the presence of hunting bats (i.e., how do moths avoid being eaten by bats)?

Moths have two receptors (A1 and A2) that can detect the "sonar" of bats. A1 detects signals of low intensity/amplitude (not frequency!) that are indicative of a bat that is near (within ~ 30 m), but not very close. Stimulation of A1 causes the moth to orient away from the signal source and fly off. A2 detects signals of high intensity/amplitude (i.e., when the bat is close, ~ 1 m). Stimulation of A2 causes the moth to shut off the signals that stabilize flight and wing movement and the moth plummets randomly to the ground. It then crawls away.

2-2) Your discussion readings on damselfish and fiddler crabs highlighted a variety of the general *methodological* approaches that biologists use the study of animal behavior. In the space below, identify at least two of these by referring to specific aspects of one or more of the two studies. For each, describe at least one advantage and one disadvantage associated with this type of method.

Many possible answers here. Experimental vs. Observational and Lab vs. Field approaches were two of the most obvious categories… The citing of a theoretical/modeling approach in the fiddler crab paper was acceptable, though this was not really a clear example of such an approach. Also the use of replicated trials, the use of many individuals, marking individuals, etc were all potentially usable answers. The key to a good answer was making clear the type of approach that was demonstrated in one (or more) of the papers and articulating at least one strength and weakness of the approach.

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Part 2 (continued)

2-3) Many organisms respond to only a subset of the environmental signals that bombard their sensory organs. Below, give examples of such neurophysiogical "filters" by giving one clear, real-life example, each, of auditory, olfactory, & visual filtering. For each, explain how it is adaptive.

While there are many possible examples that could be used to answer this question, a complete and successful response used examples that clearly demonstrated how only a subset of environmental stimuli were received because of the filter and why this filtering is adaptive (reduces confusion from background "noise", increases sensitivity to signal, etc). Some examples from lecture: Auditory: the neuronal sensitivity of cricket frogs to only two narrow windows of sound frequency (high frequency matching male calls and lower frequency matching predator calls). Olfactory: the bombykol detection of male silk moths via highly specific receptors on the antenna allows them to find females. Visual: the light filtering of the European toad via specific retinal sensitivity that allows them to capture worms more effectively.

2-4) What types of environmental conditions might lead to natural selection favoring the ability to learn? Discuss your answer in terms of environmental stability/predictability and where the costs and benefits of learning arise.

In terms of environmental stability/predictability, learning would be favored when predictability is high within generations but low between generations (Table 4.1 in Dugatkin highlights this condition). To make this clear, the costs of learning (mistakes, time, neuro-physiological investment in memory, etc.) had to be compared to the costs of innate responses (i.e., learning costs should be greater, all else being equal, otherwise, it seems that learning would be equally as good as innate response when the environment is always unpredictable). The best answers provided an example of the type of environmental conditions that would lend themselves to learning (e.g., food types, predators, etc.)

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Part 3 (Short essay answer) 20 pts each

3-1) A Cascade Frog (amphibian), an Elk (mammal), and a Song Sparrow (bird) simultaneously arrive at the edge of a small mountain lake on a windless afternoon, near the base of Mt. Hood. All are males and they each begin to vocalize in an attempt to attract mates. The resulting cacophony is less than symphonic to human ears, but seems to work. Soon after calling, each is successfully paired up with a mate of the appropriate species.

Based on what you know about basic patterns of sound production in these three very different animals, describe the design of mating calls you might expect from **one** of them. Support your answers with a consideration of the physiological, environmental, and social factors that may constrain their production of sounds.... Be as specific as possible.

Here, you needed to consider how signal type relates to both the sound generation capabilities of different vertebrate groups and the environment. Key to this answer was the recognition that long-distance signaling was important to males (to attract as many females as possible) and that the signal would have to be distinguishable against a background of noise. Most noise considerations would arise from the other species… the windless conditions would reduce the need to consider attenuation or degradation).

Since signal propagation is important, the power (amplitude) of the sound needs to be considered, and it should be obvious that the elk can make louder sounds than the other two species and that all are probably making the loudest sounds possible. At the same time, the fact that three different types of animal were simultaneously signaling means that selection would favor signals that are distinct and recognizable from the sounds of the other two animals. Again, differences between the different animals in terms of the physiology of sound generation would come into play, with an increasing potential for complicated sound production occurring as you moved from the elk, to the frog, to the bird and in positive relationship emerging between amplitude and body size.

Social constraints may arise from several sources. Dominance interactions (i.e., differences in competitive abilities within a species) between males might limit or modify the benefits accruing to individuals when they make a particular signal and there could be additional competitive interactions that might influence how an individual signals, depending on who is around them… Female choice is another potentially important social issue, since we might expect females to prefer certain aspects of a male's call. In particular, lower frequency sounds that can only be produced by larger males might be an important honest signal of male quality that females could use for making choices.

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Part 3 (continued)

3-2) The South American knifefish lives in turbid (low visibility) fresh water habitats. They emit pulses of electricity to communicate with conspecifics. During the mating season, the duration of a male's electric signal is generally greater than that of females and juveniles. Dominance hierarchies exist among males and they can be ranked from the results of pair-wise contests. Experiments show that when several males and a single female are together, the dominant (high ranking) male increases the duration of its electric signal while the lowest ranking males reduce the duration of their electric signals. When males are paired alone with a female (i.e., no other males present), however, no relationship between male signal duration and relative rank is found.

In the space below, consider the selective pressures acting on signaling in this species by discussing both: a) the constraints that appear to be acting on communication by these fish; and b) how these may influence the "honesty" or "dishonesty" of male signals. Be sure to consider both the context of signaling (i.e., the circumstances in which certain signals are given) as well as the costs and benefits that may be accruing to males of different rank and to females.

There are three basic sources of constraint upon communication: Environmental, Physiological, and Social. In the example given, environmental constraints on the ability to communicate via other modalities (vision, sound, chemicals) may contribute to the use of electricity and, not surprisingly, these eels live in turbid water that presumably reduces the effectiveness of vision, sound, and smell as modalities for communication. Electric signals do not propagate very far in fresh water, so sender and receiver must be fairly close to one another, so this may be another environmental constraint. Physiological constraints will limit the degree to which an eel can generate an electric signal and, if costly to produce, may limit how often or how strong a signal can be made. Social constraints are evident from the change in signaling duration as a function of whether males are paired with females or present in male groups. This observation provides information that can inform a discussion about honesty and dishonesty. Good answers included a consideration of all three types of constraint, as well as a discussion of how costs and benefits to senders (males) and receivers (other males and females) might influence the nature of the signal (perhaps most obviously, if signals are costly to produce, they may act as honest signals of male quality that can be used by both males and females as receivers).