9.20 M.I.T. 2013

Lecture #23

The domestic cat

Scientific method in sociobiology

National Geographic, *Caressing the tiger* (Video)

A. Introductory section (not shown in class)

1. Cat shows: keeping cats has become a major industry
2. History (notes also from 2nd video)
   a. Egypt 3000 yr ago, Cat mummies were very common--huge numbers have been found. Cats were a symbol in Egyptian religion
   b. Romans brought cats to Europe, where they became hated and feared and persecuted, whereas rats & mice were seen as good. Hatred found even in colonial America.
   c. Attitudes started to reverse in 14th century with the plague (black death), because rats were involved in its spread.
   d. In 17th century the reputation of cats was boosted again because of needed food that was stolen or spoiled by rodents.
   e. Spread of cats from Europe *via* ships, including to America and to many islands including the Galapagos, where they are a major threat to wildlife.

B. Domestic cats & other cats

1. Adaptive details of their bodies
2. Scent marking using various glands: urine spraying, rubbing of body or face against objects or other cats, clawing with addition of scent from paw glands.

(Continued) National Geographic, *Caressing the tiger* (Video)

3. Encounters with other cats
   a. Aggressive: mostly postures, intimidating bluffs [outcome usually determined not only by size/strength but also by intensity of motivation to defend territory, especially home territory.]
   b. Friendly: very transient rubbing together
4. Sleep ~2/3 of the time (other video estimates 80%) with alertness to sounds most of the time
5. Ovulation and mating: females are reflex ovulators (details of mating sequence shown in 2nd video for both domestic cats and tigers).
6. Birth; care of kittens
   a. Protective mothers
   b. Live prey brought to kittens (for their experience)
   c. Aside: the notion that humans who keep cats become "surrogate mothers"
   d. Purposes of play debated, or is it just for fun? [Ethologists do not debate it so much. Remember out discussion of this, when we began discussing Lorenz.]
7. Hunting instinct builds up in house cats: kept indoors, their "pent-up instincts erupt into a frenzy" (the "afternoon crazies").
8. Illustration of the fact that the cats' drive to hunt is distinct from drive to eat.

(Continued) National Geographic, *Caressing the tiger* (Video)

9. Senses of cats
    a. Olfaction: odors especially important for defining home ranges and territories (although these are not completely exclusive)
    b. Vomeronasal sense [*via* Jacobsen's organ on roof of mouth] important in social encounters
    c. Hearing is especially acute, with very accurate localization ability
    d. Whisker senses (somatosensory) important in attacking prey, in maintaining normal orientation.
    e. [Aside] Grooming: Cats are very fastidious, using tongue with its special anatomy
    f. Vision: Lab studies of Mark Berkeley, who conducted tests of acuity & of sensitivity in low light conditions (cats are 6-7 times as sensitive as humans at night)
10. Cats have great tree-climbing ability with excellent balance
    a. Falling from heights without being injured
    b. Cats in cities: "high-rise syndrome"—less injury after falls from greater heights, probably due to greater relaxation/preparation for landing

(Continued) National Geographic, *Caressing the tiger* (Video)

C. Studies of domestic cats by David MacDonald of Oxford University (see separate summary with some details from his publications)

1. He found that lions are not the only social cats: Farm cat females form a cooperative society made up mostly of related females.
2. Communal nursing
3. Infanticide by a male who was not the father of the kittens being cared for, very similar to what has been observed in African lions [and in a number of other species] What is its purpose? Note how the interests of male and female conflict.
4. Females form groups for 2 purposes: Mutual aid in care of kittens, and mutual defense against aggressive males/

D. Study of hunting by house cats in England, by Peter Churcher (See also the separate summary in the posted document on the videos)

1. Survey found that town cats killed and brought home an average of 14 prey animals per year.
2. Extrapolating the results to the whole of England indicates that town cats make a very significant impact on the ecology of populations of small animals.

"Caressing the tiger" (from PBS)

1. Studies of farm cats by David MacDonald of Oxford University have resulted in changes in how domestic cat sociality is viewed. What has been the major change?

"Caressing the tiger" (from PBS)

2. How are domestic male cats similar to male lions in their social behavior?

"Caressing the tiger" (from PBS)

3. Describe fixed action patterns of domestic cats that are very similar to those of large, wild cats, engaged in
    - mating,
    - predation,
    - scent marking

"Caressing the tiger" (from PBS)

4. Describe altruistic behavior in cats.

"Caressing the tiger" (from PBS)

5. How did a British high school biology teacher, a few years ago, make a significant contribution to the study of domestic cats in England?

"Caressing the tiger" (from PBS)

6. Concerning the scene where kittens are shown playing with a small rodent brought to them alive by their mother, is it true that the kittens are "too inexperienced to deliver the fatal bite"?

Video from PBS, “Nature” with George Page: “Cats”

- See brief summary in the separate pdf file on the cat videos that is posted on the course website.

"Caressing the tiger" (from PBS)

7. Where have originally domestic cats become feral, and are endangering the survival of some native species of animals?

Video from PBS, "Nature" with George Page: "Cats"

8. How did the domestic cat expand its range from Europe to America?

9. How large are the hunting ranges of feral cats?

10. Describe the functions of the "claw sharpening" FAP shown by cats, other than claw sharpening.

11. What is known about the auditory communication of cats?

John Alcock, The Triumph of Sociobiology, ch 4:

Are EPCs in songbirds really adaptive?

1. Describe one study supporting the adaptationist claim that EPCs by female red-winged blackbirds are adaptive. (See p 58)

Male red-winged blackbird in cattail swamp

Courtesy of Larry Meade on Flickr. License CC BY-NC-SA.

Female red-winged blackbird

John Alcock, The Triumph of Sociobiology, ch 4:

Are EPCs in songbirds really adaptive?

1. Describe one study supporting the adaptationist claim that EPCs by female red-winged blackbirds are adaptive.

(See p 58)

Hypothesis: Extra-pair matings are adaptive for a female because they reduce the likelihood of laying infertile, and hence wasted, eggs.

Test by Elizabeth Gray:

- 1% of eggs from clutches sired by 2+ males failed to hatch.
- 6% of eggs from clutches sired by the male mate alone failed to hatch.

John Alcock, The Triumph of Sociobiology, ch 4:

Are EPCs in songbirds really adaptive?

2. Are female red-winged blackbirds adaptively selective in their choice of a male for EPC?

See p 59

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Hypothesis: Males visited by females for EPC have unusual attributes, promising in an adaptive sense, relative to males that are not favored for EPCs.

Observations

- Female red-wings appear to choose older over younger males in the neighborhood (*studies by Patrick Weatherhead and his group*).
- Observations on other songbirds: Females make such choices in non-random fashion, preferring males that have found mates early in the mating season, indicating that they had attributes making them more attractive.

John Alcock, The Triumph of Sociobiology, ch 4:
Non-adaptive evolution?

3. What could cause a non-adaptive change in the evolution of social behavior?

   p 60-61

   (Exclude any significant change in climate or environment.)

John Alcock, The Triumph of Sociobiology, ch 4:

Non-adaptive evolution?

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- Incidental effects of pleiotropy (multiple effects of the same gene)
  - One of the hypotheses about pet love in humans
  - Why has the tail bud persisted in the human embryo? Its loss may cause maladaptive effects by loss of a gene that has pleiotropic effects.
- Degenerative effects of genetic drift (see definition and discussion on next slide)
  - Can occur most easily in small populations
  - Hypothesis about the deficient immune system of the modern cheetah, a species which is believed to have gone through a population bottleneck about 10,000 years ago

Genetic drift

See the definition on Wikipedia (http://en.wikipedia.org/wiki/Genetic_drift).

Genetic drift (continued)

- genetic drift is important (especially in small or isolated populations), but much less so than natural selection.

widely accepted

Cheetah

Cheetahs seem to have acquired some reduction in the competence of their immune system because of loss in variability in the underlying genes. (Cited by Alcock, p 60)

John Alcock, The Triumph of Sociobiology, ch 4:

David Barash's preliminary report on mountain bluebirds

4. Explain why Alcock spends so much time (space) on discussion of a short preliminary report by David Barash (1976) on mountain bluebirds.

   See pp 65-71

John Alcock, The Triumph of Sociobiology, ch 4:

David Barash's preliminary report on mountain bluebirds

See pp 65-71

Alcock uses this as an example of the controversies about sociobiology, because of S.J. Gould's attack on Barash's 1976 "scientific note" in *American Naturalist.*

"Gould claims that Barash has produced a just-so story—an untested and untestable fable. …Gould asks rhetorically whether consistency with evolutionary theory is enough to convince us that Barash's 'story' is correct. …"

What Barash did

- He wanted to test the hypothesis that a male mountain bluebird should show anti-cuckoldry behaviors in order to increase the probability of his being the father of chicks hatched in the nest of his partner and himself.
- He conducted a small, preliminary experiment to test this, by placing a stuffed male bluebird into the territories of two male bluebirds at various times in the reproductive cycle and observing their responses.
- The results were that each of the two males attacked the models, and one also attacked his mate. The intensity of these aggressive responses was greatest just before the first egg was laid.
- Barash concluded that the aggressive responses confirmed the evolution of anti-cuckoldry behavior since the presence of another male in a male's territory increased the probability of extra-pair copulations, and also that driving an unfaithful mate away would allow the male to acquire another mate if females were sufficiently plentiful.

John Alcock, The Triumph of Sociobiology, ch 4:

David Barash's preliminary report on mountain bluebirds

See pp 65-71

Contrary to Gould's claim, Barash's hypothesis was testable, and it led others to test it further (with only partial support). Moreover, it led to much interest in EPCs, mostly in birds: 498 articles between 1995 and 1999.

Barash was doing a real scientific investigation, but only in a preliminary way since he observed only a few birds.

In general

Without the ideas, no data are likely to be collected. Even wild ideas can stimulate productive research.

Mountain bluebird, male

Mountain bluebird, female

John Alcock, The Triumph of Sociobiology, ch 4:

Comparative methods

5. How is the comparative method used by adaptationists (sociobiologists) to test hypotheses about adaptive social behavior? (p 72-73)

John Alcock, The Triumph of Sociobiology, ch 4:

Comparative methods

Animals of different species should show the same type of adaptive behavior if (1) they are faced with sufficiently similar selective factors (pressures), and (2) they have a similar social organization.

Examples: Responses by males of various species to the detection of other males near their mate in her receptive period, or detection of actual EPCs: They quickly copulate with the mate (two finch species, two shorebirds, two species of hawk, a shrike; bighorn sheep).

John Alcock, The Triumph of Sociobiology, ch 4:

Comparative method applied to human behavior: The territorial imperative?

6. What is wrong with the arguments presented by Robert Ardrey in his book, *The Territorial Imperative* ?

John Alcock, The Triumph of Sociobiology, ch 4:

Comparative method applied to human behavior: Failure or mis-use of the method?

6. What is wrong with the arguments presented by Robert Ardrey in his book, *The Territorial Imperative* ?

In this 1966 book, the science writer Ardrey argued from the widespread occurrence of territoriality in non-human animals that humans have territorial instincts.

However, his assumptions were not correct:

- Territoriality is far from universal in animals
- Territorial practices of humans vary widely from culture to culture.

Hence, most biologists did not take Ardrey seriously.

Ardrey's book was written for the public. Such books are not like scientific papers, although they can contain interesting ideas which sometimes attract the interest of scientists.

John Alcock, The Triumph of Sociobiology, ch 4:

Intraspecific wars

7. *"Humans and chimps are, after all, the only species among the 4000 species of mammals in which male relatives form groups to raid other groups while living in and defending the area of their birth."* *(p 76)*

   Where would you look for possible exceptions to this claim?

John Alcock, The Triumph of Sociobiology, ch 4:

Intraspecific wars

7. *"Humans and chimps are, after all, the only species among the 4000 species of mammals in which male relatives form groups to raid other groups while living in and defending the area of their birth."* *(p 76)*

Where would you look for possible exceptions to this claim?

Other mammalian groups with similar social organization (e.g., dolphins? Any birds?)

We have inadequate information on cetaceans, as well as on many other mammalian groups.

Questions: Is the behavior adaptive, so it could have evolved by natural selection? If so, should it not be more common?

Suggestion: Warfare among human nations stems from conflicts between the much smaller human tribes and villages that predominated during most of human evolution. Nationalism is loyalty to the group--once only loyalty to the much smaller groups that were mostly relatives. The evolution occurred before the invention of modern weapons. What was once adaptive can no longer be considered so.

John Alcock, The Triumph of Sociobiology, ch 4:

Behavior of a male red-winged blackbird when a mate engages in EPC with a neighboring male

8. **See Appendix, ch 4: Q2**: Male red-winged blackbirds are observed interfering with the foraging activity of mates that have engaged in EPCs with neighboring males.

How might this be adaptive? (Alcock summarizes an hypothesis.)

Alcock proposes several questions concerning use of the comparative method to test this hypothesis—see p226:

1) Must we restrict our comparisons to other members of the family (Icteridae) to which red-winged blackbirds belong? no

2) Are bird species that are strictly monogamous of any use to us? yes

3) What about animals other than birds? of course

John Alcock, The Triumph of Sociobiology, ch 5:

Cultural and sociobiological explanations:

9. See Appendix, ch 5: Q2: Suppose someone said to you that given a choice between a cultural explanation for human behavior and a sociobiological one, you ought to give precedence to the cultural explanation because our behavior is so obviously shaped by the culture in which we live. How would you respond (if you were a sociobiologist)?

   Should one type of explanation be given preference in explaining human behavior?

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Should one type of explanation be given preference in explaining human behavior?

It is a nature-nurture issue. As always, both are involved, so the scientist must keep an open mind about investigating the contributions of both.

John Alcock, The Triumph of Sociobiology, ch 5:

Gender bias in science?

10. Appendix, ch 5: Q1. In the study of EPCs by birds, are there gender biases in the topics of study? Are male and females scientists different in their approaches and biases? (See Alcock's wordings of several questions on p 227.)

    Why did earlier studies of EPCs in birds focus only on males?

    Most of the earlier studies were done by male scientists. Was it just a case of gender bias, and is such bias built into selectionist theory?

    Can you suggest a sociobiological hypothesis in which male and female scientists are proposed to have different perspectives and interests on matters of animal reproduction?

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    Why did earlier studies of EPCs in birds focus only on males?

    Most of the earlier studies were done by male scientists. Was it just a case of gender bias, and is such bias built into selectionist theory?
    (Note: There were fewer female scientists then.)

    Can you suggest a sociobiological hypothesis in which male and female scientists are proposed to have different perspectives and interests on matters of animal reproduction?

As persons, not scientists, they do have different interests. As scientists, they are obligated to use as many perspectives as possible.

The different perspective brought by female scientists has resulted in great advances in the study of social behavior, especially in the study of primate social groups.

9.20 Animal Behavior

Fall 2013