Behavioral Evolution and Sexual Selection

BIOL 4415: Evolution
Dr. Ben Waggoner

Why does mate choice happen?

- Several hypotheses have been proposed:
  - assortative / dissortative mating
  - direct benefit
  - "good genes" hypothesis
    - "handicap principle"
    - avoidance of hybridization
  - pre-existing sensory bias
  - "runaway sexual selection"
- These aren't mutually exclusive. Real-world cases may be explained by a combination of these causes

Hybridization avoidance

American anole, *Anolis carolinensis*

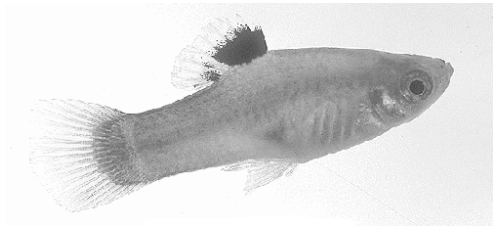
- There are over 350 species of anole lizard in Central America and the Caribbean.
- Males display to females with a colored throat pouch (called a *dewlap*) and a set of nodding or "push-up" movements.
- Different species of anole have different dewlap patterns and do "push-ups" in different rhythms. Anole species in the same habitat tend to have very different dewlap patterns and "push-up" rhythms. (Compare *Anolis sagrei* on the left and *A. mestrei* on the right, found together on lower tree trunks in western Cuba)

- Females who mate with the wrong species will probably have decreased fitness—hybrid *Anolis* are rare, and when they are found they are usually sterile.
- Females with strong preference for their own species have increased fitness. . .
- . . . and males that can match the females' preferences will also have increased fitness.
- Result: Each species should evolve a specific and distinctive display pattern.

Pre-existing sensory bias

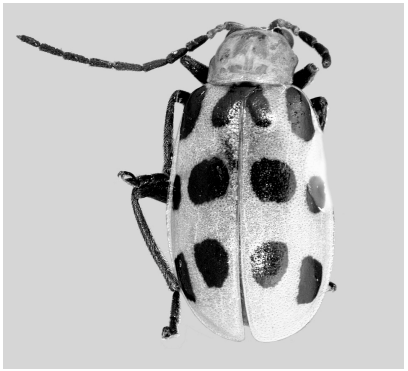
Male and female banded swordtails, *Xiphophorus multilineatus*

- *Xiphophorus* is a genus of small freshwater fish native to Mexico (about twenty species, including some popular home aquarium fish).
- Males in some species of *Xiphophorus* have elongated "swords" on their tails, as in this male green swordtail, *X. helleri*. Females never have swords.
- In other species, the males lack swords.



- Females of species with swords show preference for males with swords.
- Females in swordless species of *Xiphophorus* also show preference for males with swords.
- It has been shown that female *Xiphophorus* prefer larger males—and swords make a male fish look larger.

"Runaway selection"



Spotted cucumber beetle, *Diabrotica undecimpunctata*

"Runaway selection"

- Suppose we have males that have some variable trait.
- And suppose we have females that vary in their degrees of preference for this trait.
  - And let's assume that both the trait and the degree of preference for the trait are heritable.
- Females with a strong preference will choose males with an extreme trait. . .
  - Over time, the genes for the trait and genes for the preference become linked—not necessarily physically linked on a chromosome, but they will behave as if they are linked since they will be inherited together.

"Runaway selection"

- If genes for a male trait and a female preference are effectively linked, then anything that happens to favor one to become more common will cause the other to become common.
- Given the right conditions, we may end up with "runaway sexual selection"
  - The preferred traits don't confer any particular benefit on either the male or the female, nor do they assure genetic quality. . .
  - . . . *except* for one thing: Females that prefer "sexy" males will tend to have "sexy sons".

"Runaway selection"

- Female spotted cucumber beetles prefer males that stroke them with their antennae during the first phase of copulation
  - This confers absolutely no benefit on the females
  - It also confers no benefit on the offspring: the offspring of fast-stroking males are no more or less likely to survive or reproduce than the offspring of slow strokers
  - HOWEVER: Fast-stroking males tend to have fast-stroking sons, which females prefer to mate with
    - SOURCE: Tallamy et al., 2001, *Proc. R. Soc. London B* 270: 77-82.

The same explanation has been proposed to explain the traits of Malaysian stalk-eyed flies (*Cyrtodiopsis* spp.)

Does this apply to humans?

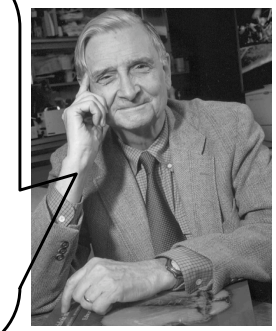
- The use of evolutionary thinking to explain all behavioral sciences is *sociobiology*
  - Sociobiology applied to humans is now more commonly called *evolutionary psychology*
  - As you might expect, it's been a highly controversial subject. . .
  - All the same, it seems to explain a number of human behaviors

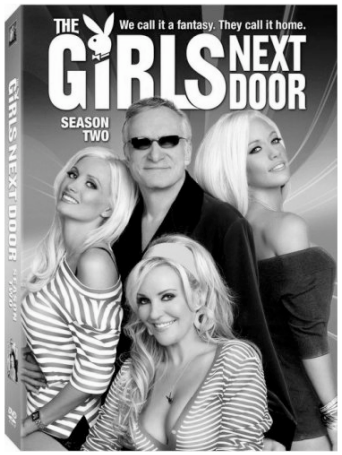
NARA/Harvard 306-PS-E-76—2052

E. O. Wilson's 1975 book *Sociobiology* launched the field, to a storm of controversy—at an 1978 conference held by the AAAS, a protester poured a pitcher of water on his head as he was about to speak. Wilson was accused of racism, sexism, and "biological determinism"—the idea that humans must inevitably act and behave in certain ways because of their biological nature.

The prevailing opinion at the time in sociology and anthropology was that virtually all of human culture is learned behavior. Wilson said no.

> The genes hold culture on a leash. The leash is very long, but inevitably values will be constrained in accordance with their effects on the human gene pool. The brain is a product of evolution. Human behavior —like the deepest capacities for emotional response which drive and guide it—is the circuitous technique by which human genetic material has been and will be kept intact.
> —*On Human Nature* (1978)





Why so controversial? Here's one example: Recall *Bateman's rule*: the sex with less to invest in reproduction (usually males) will maximize fitness by reproducing as much as possible. Applied literally to humans, this could be viewed as giving an aura of scientific approval to what some would consider immoral, unsavory, or sexist behavior.

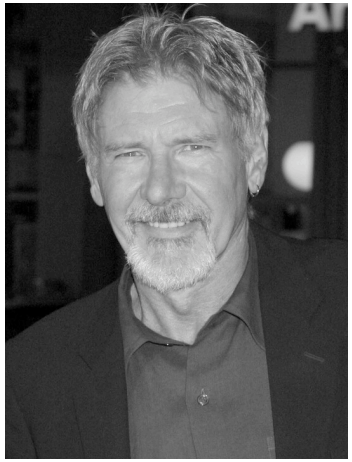
And it is quite true that human behavior is extremely, almost unfathomably complicated compared to other species. . . and much of it does seem to depend on learning and on culture. Perhaps more so than in any other area of science, we have to beware of simplistic, "Just-So Stories" that aren't testable hypotheses.

Example 1: Sexual Selection

- Humans are a pair-bonding species, and human infants require a *huge* amount of effort and investment from both parents, plus other relatives.
- So Bateman's rule may not be so straightforward among *Homo sapiens*. . .
- Standards of beauty and attractiveness tend to vary among human cultures a great deal.
- Still, cross-culturally, there are some common themes that make evolutionary sense.

Both human sexes tend to prefer signs of good overall health (good hair, good teeth, etc.) Features considered attractive in women correlate with fertility (and youth, which in humans is directly correlated with fertility). Simply put, men who prefer young and fertile mates will have more offspring than men who don't.

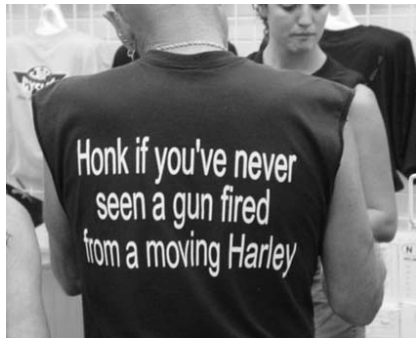
Male fertility, however, does not correlate with youth, making it quite possible for a man of almost 70 to still be considered a sex symbol. What women in cultures worldwide tend to select for is status—the levels of resources that a potential mate could provide.



Example 2: Dissortative Mating

- Wedekind et al. (1995) studied odor preferences in humans
- Each male volunteer was given a clean cotton T-shirt, which he wore for two nights
- Each female volunteer was presented with six worn T-shirts and asked to rate the attractiveness of the odor of each one
- All volunteers were typed for their MHC alleles (major histocompatibility complex)

Women tended to rate as most pleasant odors from men who were least similar to themselves in MHC genotype— suggesting that women might (subconsciously?) prefer mates who are genetically different from themselves. This may be a case of inbreeding avoidance.

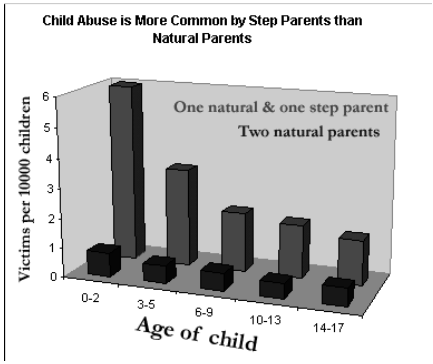


Example 3: Because human babies have such a long childhood, human parents must invest an enormous amount of energy to raise a child successfully.

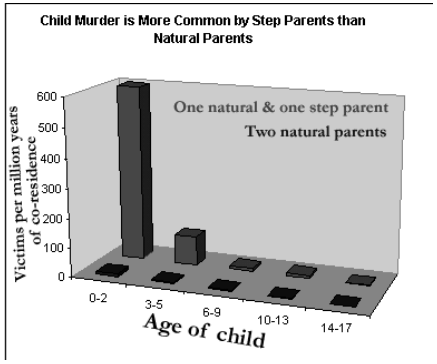
This is selectively advantageous for a trivial reason: Children share 50% of their genes with each parent. Parents who care for their children pass on their genes; parents who don't care for their children don't—so any genes that positively influence parenting behavior would be favored by selection.

Stepchildren, however, don't share genes with their step-parents, and don't contribute directly to their fitness—setting up what Daly and Wilson (1996) call the "Cinderella effect".

The single greatest risk factor for child abuse is the presence of a step-parent in the household. The incidence of abuse in step-parent households is six times higher than in households with both biological parents.



The incidence of child murder is about 600 times higher in step-parent households than in households with both biological parents. (Fortunately, it's still very low—read the Y axis caption. . .)



When an abusive parent has both biological children and stepchildren in a household, the parent usually spares his or her biological children. On average, step-parents also make less positive investment in their stepchildren (play, college funds, medical care) than they do in their biological children.

This isn't because step-parents inherently want to beat their stepchildren, or because it's advantageous for them to do so—we're not talking about infanticide among lions or langur monkeys here. All other considerations aside, a stepparent may have to invest resources in a stepchild in order to be able to mate with the child's biological parent.

But child-raising requires an enormous, and frequently extremely frustrating, investment of resources. While most step-parents do a good job of parenting, it may take more conscious effort on their part, and their tolerance may be lower.