

Animal Behavior

Introduction

Purposes of studying animal behavior

- **Utilitarian: for dealing with:**
 - Animal production
 - Hunting and fishing
 - Pest control
- **Environmental:**
 - Dealing with conservation issues
 - Understanding ecological relationships
- **Scientific**
 - Understanding evolutionary processes
 - Relating behavior to neurobiology
- **Social and psychological:**
 - Understanding human behavior

How is the study of animal behavior approached?

We can illustrate this using examples.

Monogamy in The prairie vole



- **Monogamy** = staying with one mate for an entire reproductive cycle, or lifetime)
- The prairie vole (*Microtus ochrogaster*) is monogamous.
- Many other species of voles are **polygynous** (mating with many females)



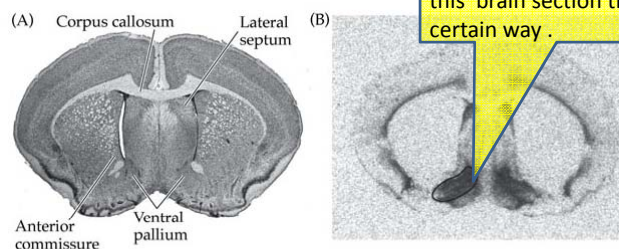
Question: **Why** is the prairie vole monogamous?

This Question could be approached from more than one perspective;

Neurophysiological Basis

(Larry Young, Emory University)

- When a vole copulates, some brain cells → vassopressin in bloodstream
- → ventral pallium



- Pallium: anatomically distinct brain “center” containing vassopressin-binding centers.
- (Pallium = structure found at base of brain in various species; responds to hormonal signals.)

Neurophysiological Basis

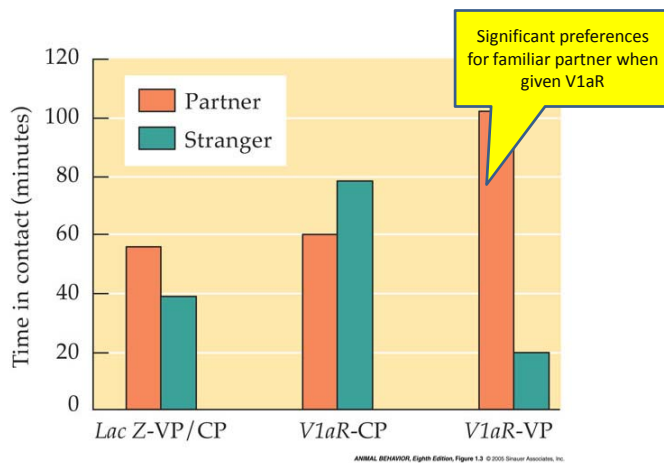
(Larry Young, Emory University)

- Receptor proteins in the ventral pallidum, (called V1-a receptors), bond with vasopressin
 - chemical events → trigger activity in the receptor-rich cells
 - affecting neural pathways in brain
 - positive feedback for the vole (rewards)
- Male encouraged to remain in the company of his mate
- a long-term social bond with her
- V1-a receptors not as numerous in other polygynous voles. (not as much reward → move to another mate.)

Genetic Basis

(Larry Young, Emory University)

- *V1-a* receptor protein, encoded by *V1-aR* gene.
- One segment of the DNA is lacking in polygynous voles.
- Inserting prairie vole's *V1-aR* gene in polygynous voles' brain cells → genetically modified voles → pair-bonding.



Choices of partners by male voles

Cp = caudate putamen,

VP= ventral pallium.

LacZ= gene different from *V1aR*

Therefore, *V1-aR* → monogamous behavior.

Evolutionary Basis: 1. Selective processes

(Jerry Woolf, Memphis State Univ.)

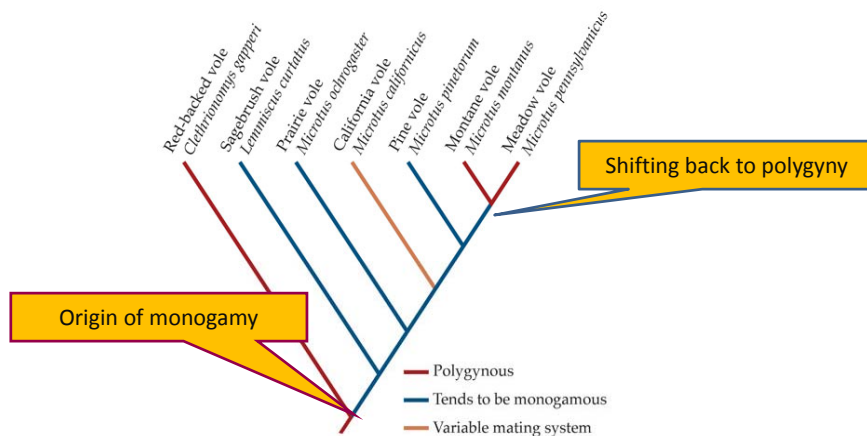
- Monogamous males leave more offspring than others?
- Benefits;
 - Keep females from copulating with other males.
 - 55% of females copulate with other male, if males prevented experimentally from pair-bonding.
 - More reproductive success
 - Males with this behavior will sire most of the female's off-spring
 - → selective advantage → more voles with this behavior.
- Costs: losing mating opportunities.

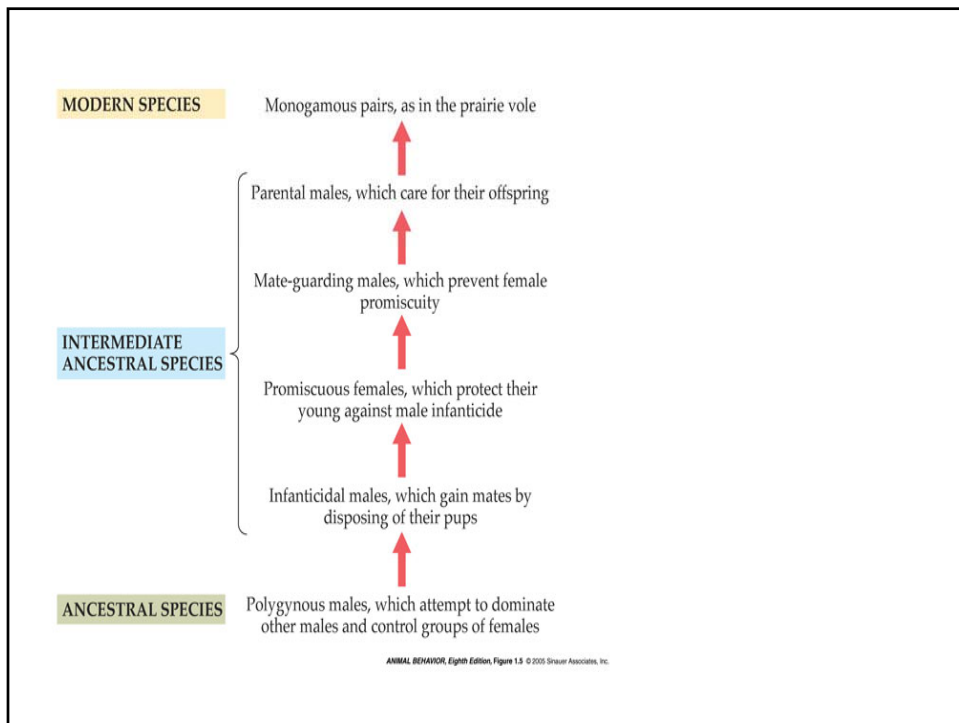
Evolutionary Basis: 2. History

- Requires tracing sequence of events → monogamy.
 - Examining ancestry of vole species.
 - Most probably ancestors were not monogamous (most mammals are not) → evolution of monogamy
 - Tracing ancestry via phylogenetic tree.
 - e.g. Comparing DNA sequences in various species → phylogenetic tree.

Evolutionary Basis: 2. History

- Vole phylogenetic tree.





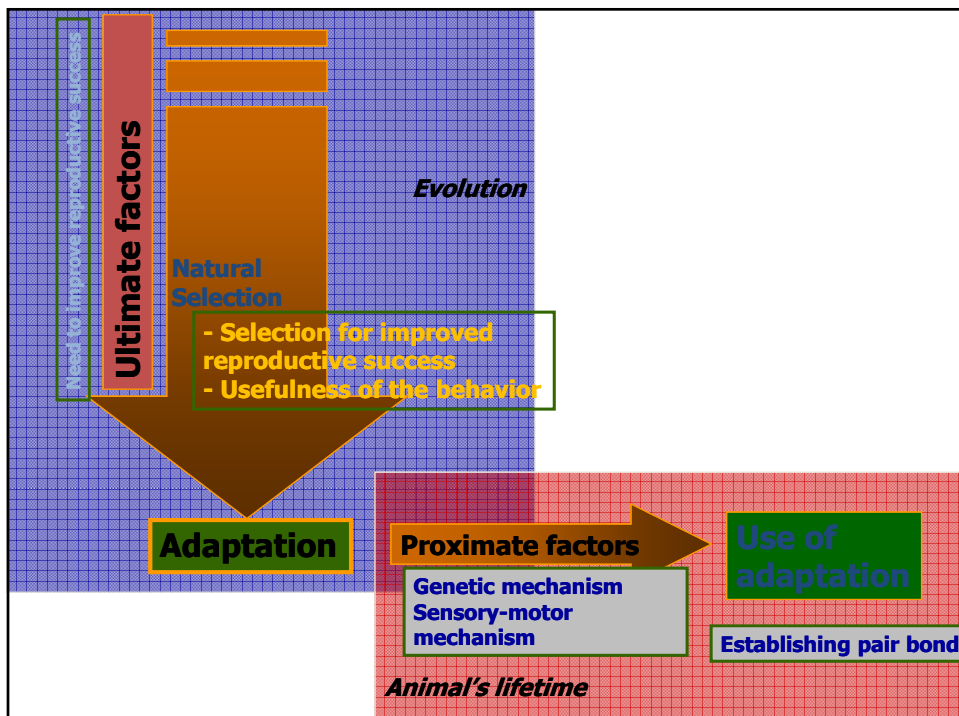
Levels of analysis

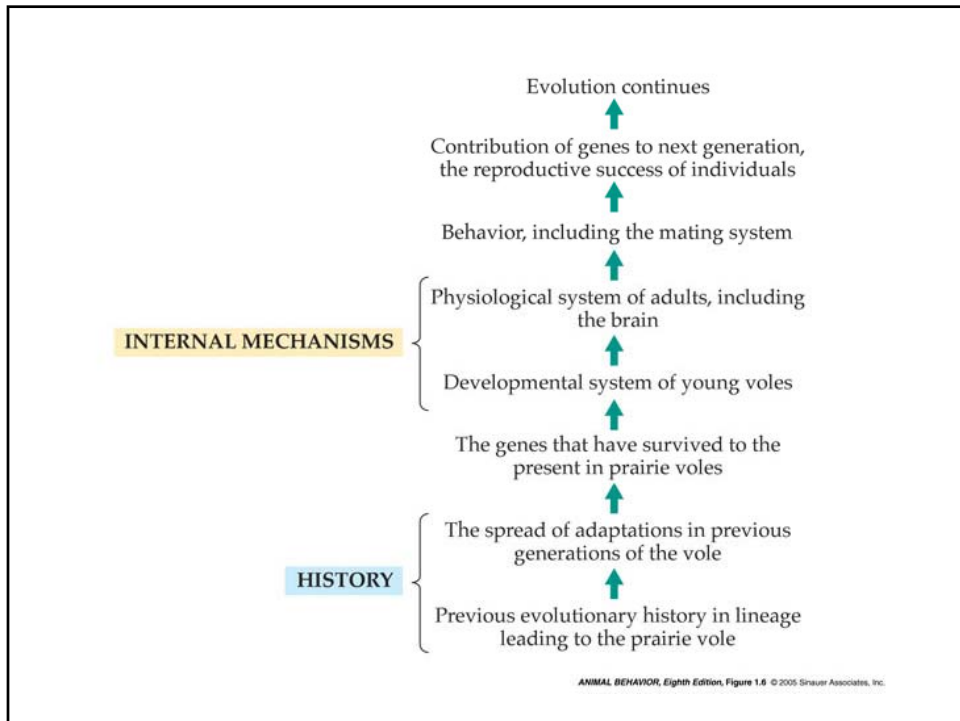
Researchers had the following approaches:

- 1) how a gene contributes to the development of the behavior in male voles,
- 2) the physiological foundation for the behavior in terms of the operation of the male vole's brain,
- 3) the adaptive value of the behavior in terms of its contribution to male reproductive success, and
- 4) the transformation of a polygynous ancestor into the monogamous modern prairie vole

Levels of analysis

Proximate Causes	Ultimate Causes
<p>1. Genetic-developmental mechanisms</p> <ul style="list-style-type: none"> Effects of heredity on behavior Development of sensory-motor systems via gene-environment interactions <p>2. Sensory-motor mechanisms</p> <ul style="list-style-type: none"> - Nervous systems for the detection of environmental stimuli - Hormone systems for adjusting responsiveness to environmental stimuli - Skeletal-muscular systems for carrying out responses 	<p>1. Historical pathways leading to a current behavioral trait</p> <ul style="list-style-type: none"> - Events occurring over evolution from the origin of the trait to the present <p>2. Selective processes shaping the history of a behavioral trait</p> <ul style="list-style-type: none"> - Past and current usefulness of the behavior in promoting lifetime reproductive success



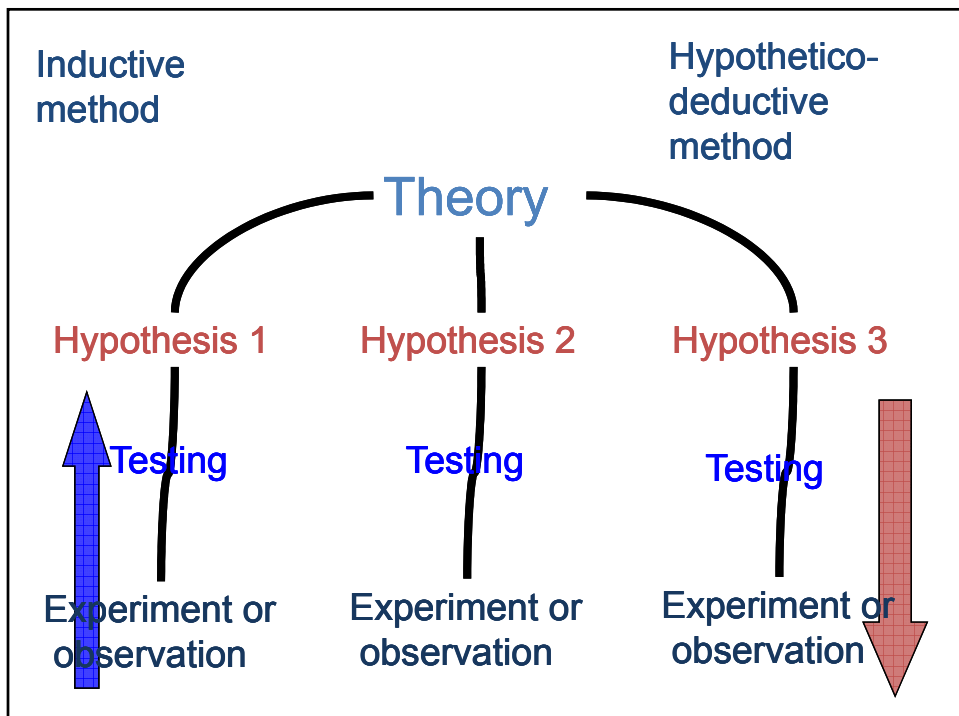


Scientific Study of Animal behavior

- Theory and Hypothesis
- Proximate and Ultimate Hypotheses

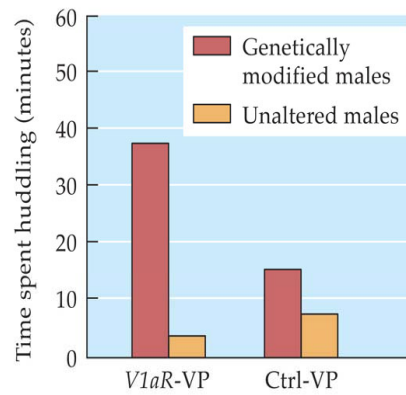
Theory and hypothesis

- **Theory** = a statement of cause not directly tested by experiment.
- **Hypothesis** = a statement of cause that can be directly tested by experiment.
 - Could be formulated as “if..then..”.



Proximate hypothesis

- Example:
How could we state this hypothesis?



Ultimate hypothesis

Darwinian Theory



Ultimate Hypotheses

Darwinian Evolution

Evolution will occur given the following conditions:

- 1. Variation:** members of a species differ in some of their characteristics.
- 2. Heredity:** parents able to pass on some of their distinctive characteristics to their offspring
- 3. Differences in reproductive success:** some individuals have *surviving* offspring > others in their population, thanks to their distinctive characteristics

Genetic variation

- Occurs when a given gene exists in 2 or more **alleles**,
- species' gene pool = Various alleles
- genetically different individuals → different alleles → diff. proteins
- If some alleles are more successful than others
 - make individuals reproductively successful, → those alleles will get themselves passed on from generation to generation → more common over time
 - gradually displace other "competitors" over the course of evolution.

Genetic variation + differential reproduction = evolutionary change at the genetic level

- alleles will spread in proportion to how well they make their bearers good at reproducing.

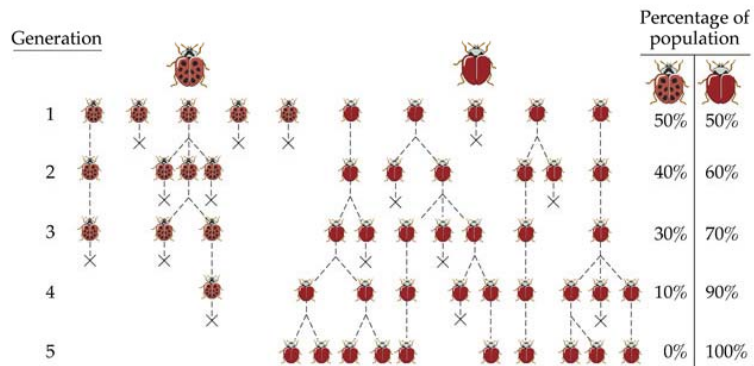
Natural Selection

- E.g. Ladybirds



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Natural Selection



Darwinism and Behavior

- Darwinian evolution could account for many problems in the evolution of behavior.
- Evolutionary explanations do not **seem** to account for other behaviors.
- Infanticide:
 - Behavior found in many species

Infanticide

e.g. Hanuman langurs

- Advantages: male gets exclusive access to females in group that bear his offspring.



Infanticide

- Disadvantages
 - Involves time and energy expenditure
 - Involves risk to infanticidal male (females fight back)
 - Might not endear male to female.



Infanticide: 3 possible explanations

1. Pathological inclinations due to stress caused by overcrowding and shortage of food.

2. Darwinian selection:
Males boost their reproductive success, where females have no choice but to mate with them.

3. as a means of population regulation, to prevent overpopulation .
i.e. for the good of the group??

(Group Selection?)

Group Selection

- Selection between groups rather than individuals.
- Groups (or species) with infanticide have a better chance of survival than groups without infanticide, because they would regulate their densities in harmony with resources.
- Problems of group selection:
 - Individual (Darwinian) selection is stronger.
 - Group selection can occur in limited circumstances that involve keeping group integrity for long periods, i.e. not be invaded by 'selfish" alleles which will replace group-oriented individuals.

Infanticide: 3 possible explanations

1. Social pathology hypothesis:

If true, infanticide would occur only in crowded situations

NOT TRUE

2. Quicker reproduction hypothesis (Darwinian selection)

3. Population regulation hypothesis

If true, infanticide would occur only in crowded situations

NOT TRUE

Infanticide: possible explanations

2. Quicker reproduction hypothesis (Darwinian selection)

(cannibalism might be an explanation but not observed)

Implications of Quicker reproduction hypothesis

1. Males should not kill their own young: DNA testing proves this.
2. Females would resume reproductive cycle, and mate with the infant-killer: Observations show this is true.

Infanticide



Anthropomorphism

("of human form")

= Attribution of human qualities to non-human things.

e.g. in animal behavior.

Uncritical anthropomorphism:

==> Purposeful behavior

e.g. caring for young as if "knowing" the purpose.

Problems:

- Observations → animal behavior is purposeful
- Animals respond to stimuli; absence of stimulus inhibits behavior e.g. maternal behavior.
- Even human behavior includes poorly-understood compulsive behavior (e.g. Alcoholism, overeating, odd sexual behavior)

Rejected Anthropomorphism

- There is a tendency to reject anthropomorphism completely
- i.e. an animal is viewed as a machine with senses and pre-programmed responses
- Even humans can be viewed as not much different from other animals (but more advanced).
- "anthropomorphism is dead" because it constrains the formulation of well informed theories and hypothesis.

Critical anthropomorphism

- Bridge between two extremes
- One Could use human thoughts and feelings, imagining being the animal, observations of human subjects → understanding animal behavior.
- The debate continues