Environment and behavior

"In the wild, of course, they'd be natural enemies — but they do just fine together if you get 'em as pups."

Learning

- Learning
  - Modification of behavior based on experience
    - Confers behavioral flexibility
    - Favored mechanism when there is environmental unpredictability

Some types of learning

1) Habituation
   - Gradual waning of response with repeated exposure
     - Benefit: lack of responsiveness to unimportant stimuli
     - Ex. => young ducks and predatory shadows

2) Imprinting
   - Irreversible learning limited to a "sensitive" or "critical" period

Some types of learning

Filial Imprinting

Learn characteristics of "parent"

- Imprint on first suitable, moving stimulus within short period after birth/hatching (36 hours for geese)

Some types of learning

Sexual imprinting

Learn characteristics of a mate
—Generally requires long periods of exposure

- Zebra finches: albinos, nail polish, and confused males

  – Male-choice experiment #1:
    - Males given choice of female with mom's bill color vs. female with dad's bill color
      – 12 of 14 males approached females with mom's bill color

Zebra Finch

Some types of learning

Sexual imprinting

Learn characteristics of a mate
—Generally requires long periods of exposure

- Zebra finches: albinos, nail polish, and confused males

– Male-choice experiment #2:
  - Female with dad's bill color vs. male with mom's bill color
    – Majority of males courted the male with mom's bill color!

Zebra Finch

Some types of learning

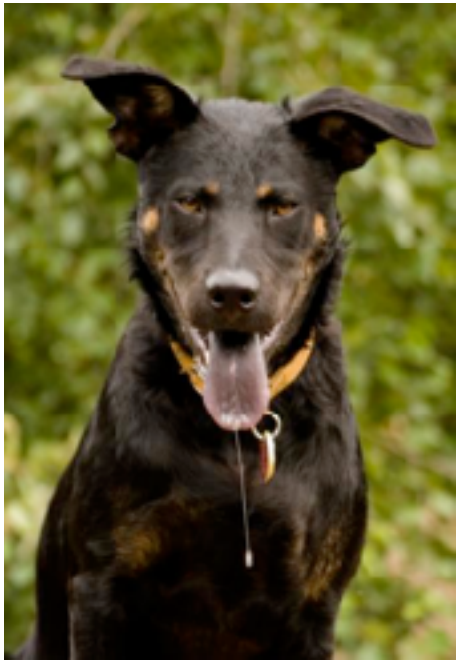
3) Play

– May be “practice” for future social interactions

Some types of learning

4) Associative learning: Classical conditioning

- Association of arbitrary stimulus with consequences
  - e.g., Pavlov's dog
    - Association of **arbitrary** stimulus with consequences
    - Pavlov exposed dogs to a bell ringing and simultaneously sprayed their mouths with powdered meat
      - » Dogs always salivate after hearing bell, with or without meat




PLAY SP 4CH
THE OFFICE
NBC HD PRESENTED WHERE AVAILABLE

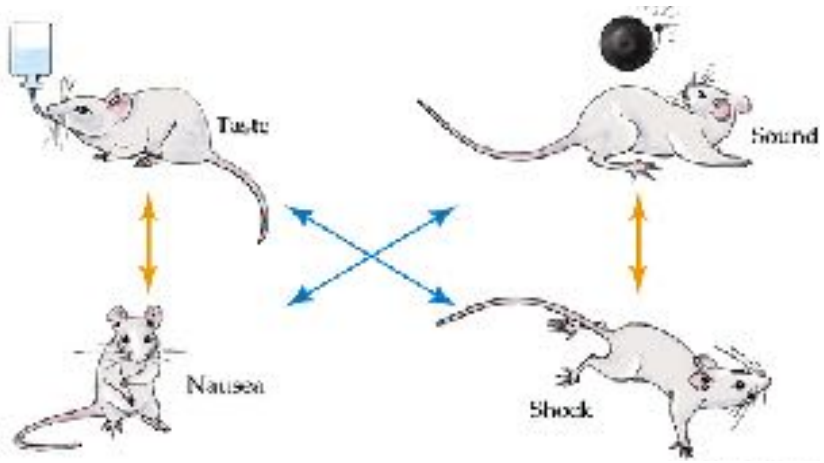
Some types of learning

5) Associative learning: Operant conditioning

- Association of voluntary action with consequences (good or bad)
- “trial-and-error” learning

Natural selection and learning

- Limitations to the breadth of learning abilities based on history of natural selection



Rats **can** learn to avoid:

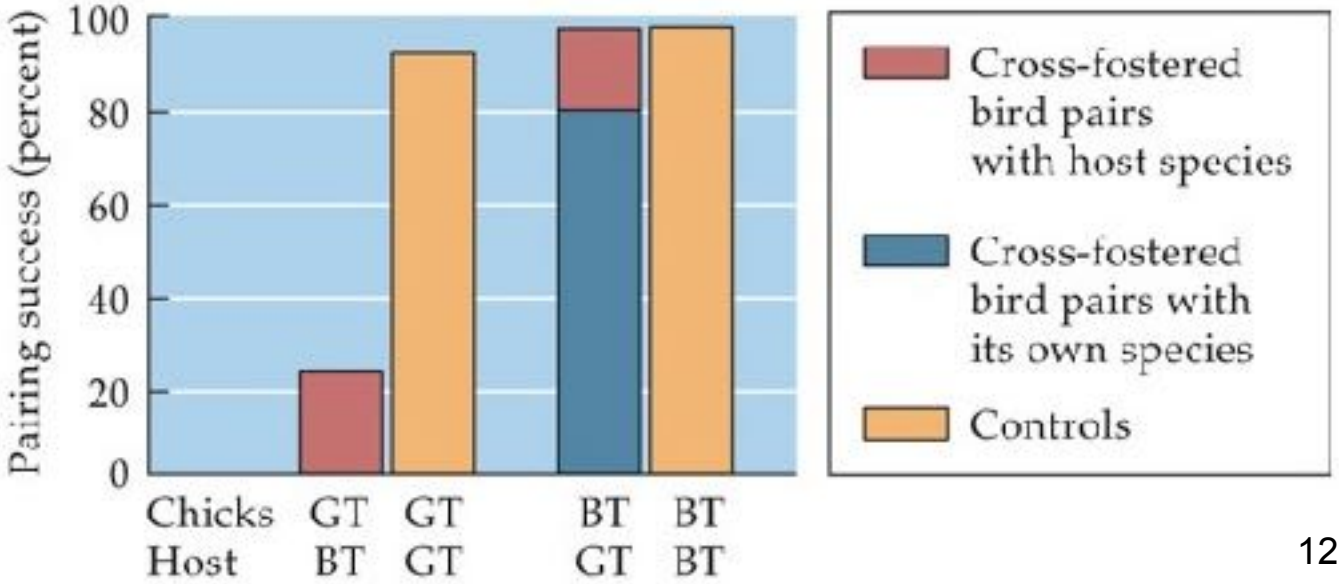
- Taste of foods that cause nausea
- Sounds associated with shock

Rats **cannot** learn to avoid:

- Tastes associated with shock
- Sounds associated with foods that cause nausea

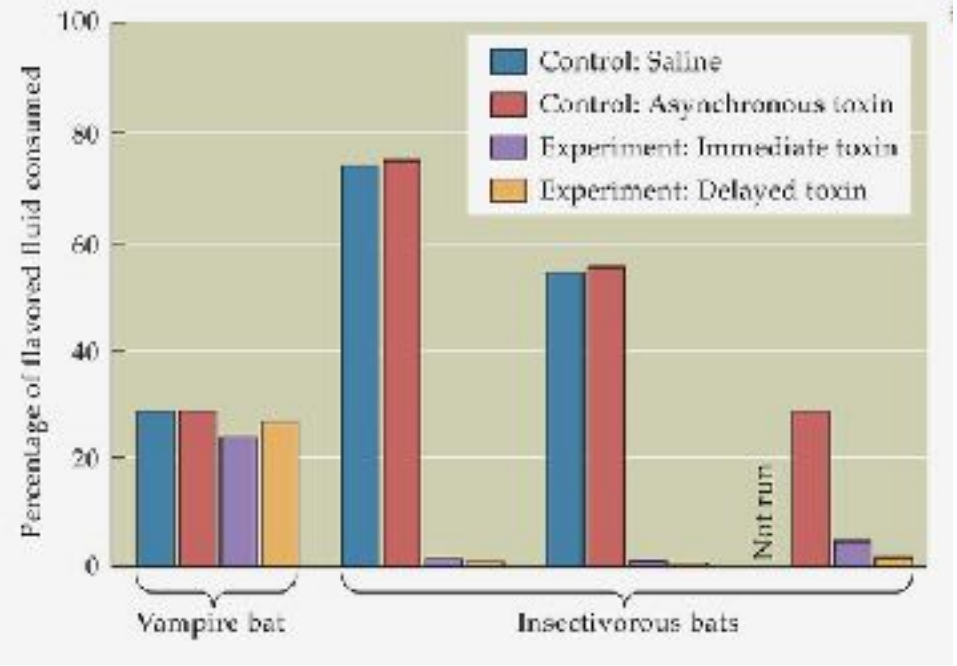
Natural selection and learning

- Limitations to the breadth of learning abilities based on history of natural selection
  - Cross-fostering with Great Tits (GT) and Blue Tits (BT)
    - GT reared by BT: imprint on BT and try to mate with BT
    - BT reared by GT: rarely imprint on GT
      - **why the difference: in wild, BT sometimes reared by GT**
        - **so BTs have evolved resistance to mis-imprinting**



Natural selection and learning

- Limitations to the breadth of learning abilities based on history of natural selection
  - Bats only learn relevant information
    - Experiment: Nausea was paired with a novel taste
      - YES, CAN LEARN: Dietary generalists (insectivorous bats)
      - NO, CANNOT LEARN: Dietary specialists (vampire bats)



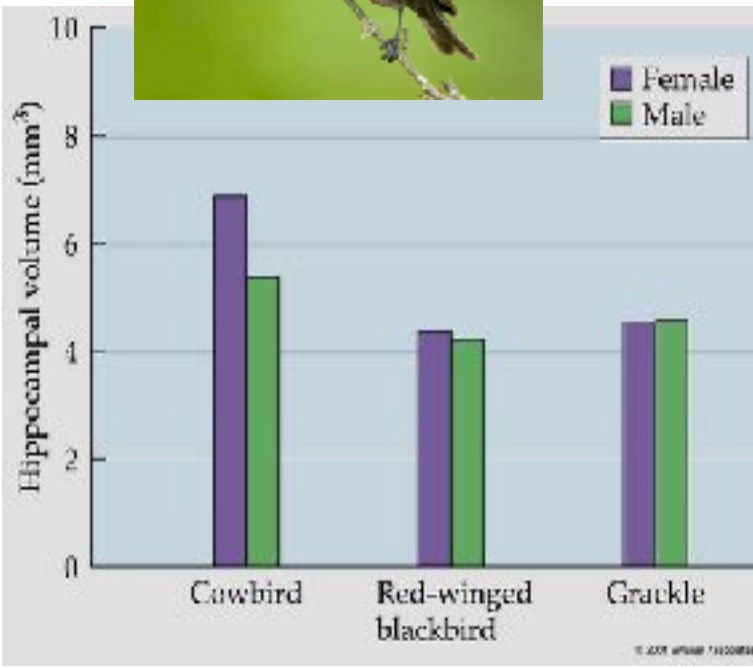
Benefits of learning

- Adaptive value of developmental flexibility
  - Adaptation to avoid exploitation by “code-breakers”
  - Adaptation to changing conditions
    - Exploit new resources
      - “Cultural transmission” in blue tits
      - Fishing in Green Herons

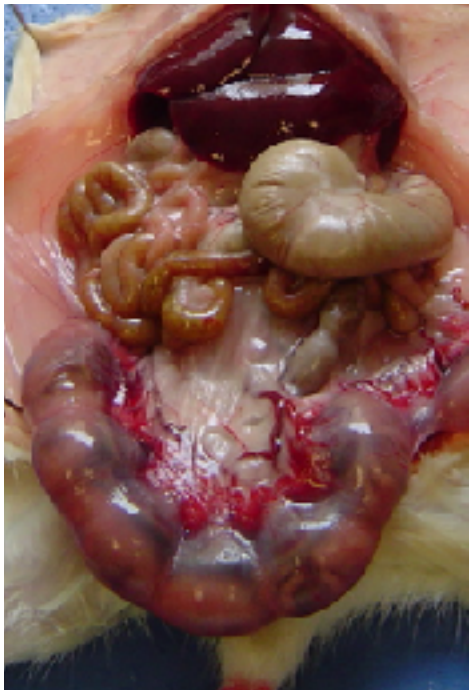
Costs of learning

- ↑ Brain Size = ↑ Energy
  - Human brain
    - 2% volume
      …but 20% metabolic budget

- Only develop neurons if needed
  - Sex differences in hippocampus
    - Female cowbirds have better spatial memory than males



Embryonic environment and development

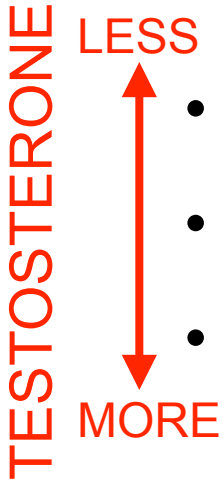


- Fetus subject to chemicals in the womb that influence development
  - Hormones from siblings can diffuse across amniotic membranes

- Rats/Mice:
  - Embryonic males produce T
  - Hormone levels influence brain development
    - Testosterone - masculinizing
    - Estradiol - feminizing
      - Males typically more aggressive because of more testosterone/receptors

Embryonic environment and development

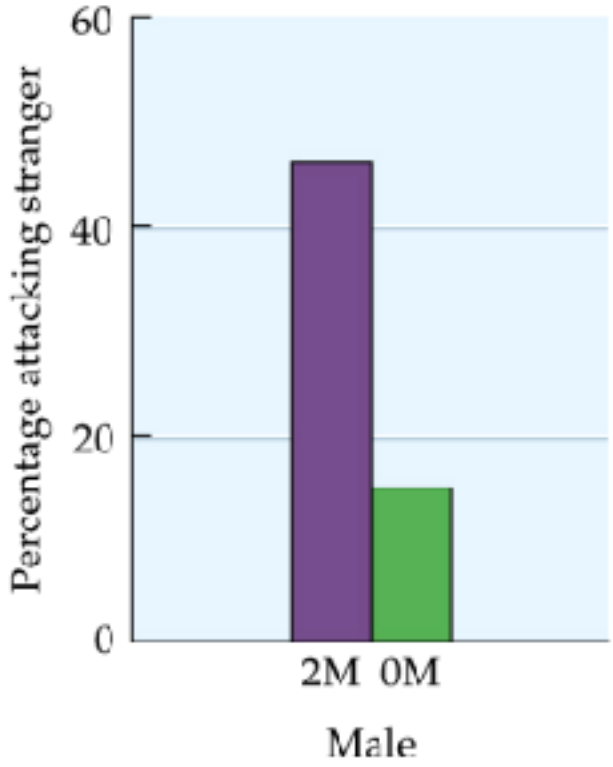
- Birth order
  - In a litter, birth order is random with respect to gender, but birth order creates different in utero environments



- Female between 2 females (0M)
- Female between 1 male and 1 female (1M)
- Female between 2 males (2M)

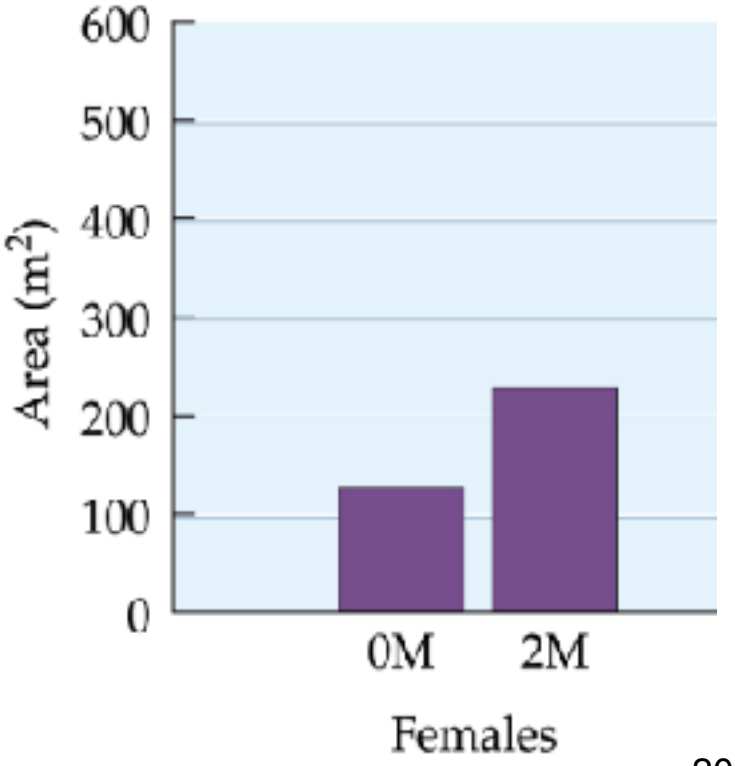
Embryonic environment and development

- In utero environmental difference affect adult **males**
  - Methods:
    - Delivered pups by caesarean section
    - Males castrated – later given T implants
  - Results:
    - 2M males more aggressive (towards male) than OM males



Embryonic environment and development

- In utero environmental difference affect adult **females**
  - Results:
    - 2M females occupied significantly larger home ranges than 0M females
    - 2M females more aggressive, more likely to explore, less attractive to males (b/c masculinized)

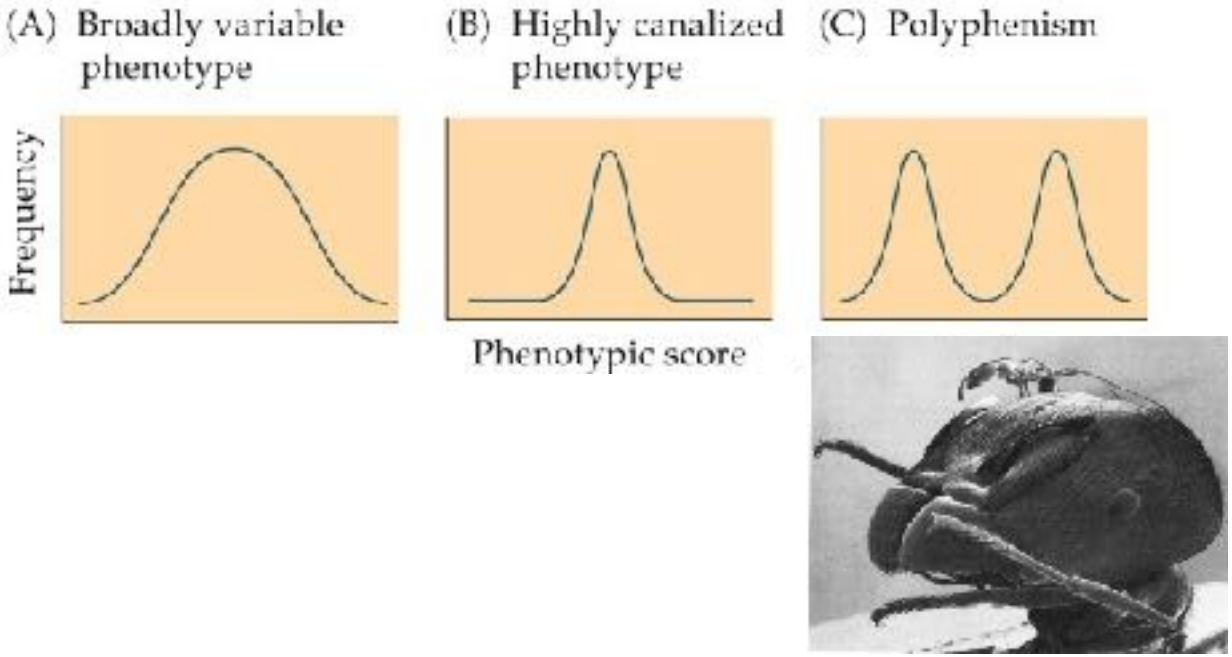


Environmentally-induced discrete varieties: polyphenisms

- In some species, individuals can develop into distinct discrete phenotype— they have the 'suite of genes' that allow them to develop alternate phenotypes
  - a type of: phenotypic plasticity

- Environmental cues determine which genes are activated. Phenotype can permanent for entire life, or reversible
  - sex of turtles is determined by nest temp (higher temps usually lead to ♀♀ bias)

Environmentally-induced discrete varieties: polyphenisms

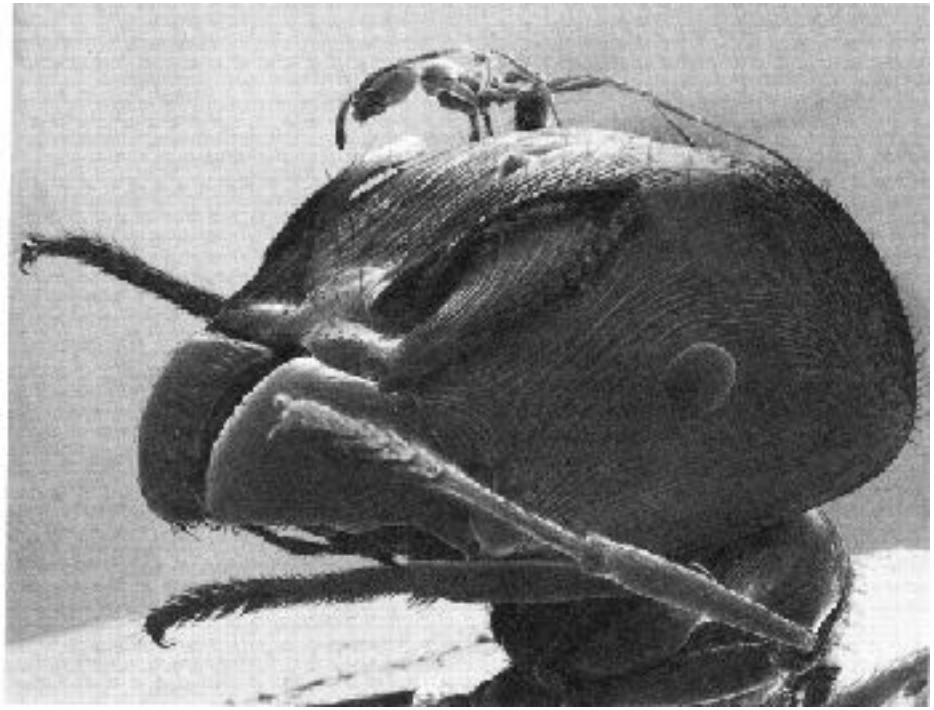


polyphenic trait is a trait for which multiple, discrete phenotypes can arise from a single genotype as a result of differing environmental conditions.

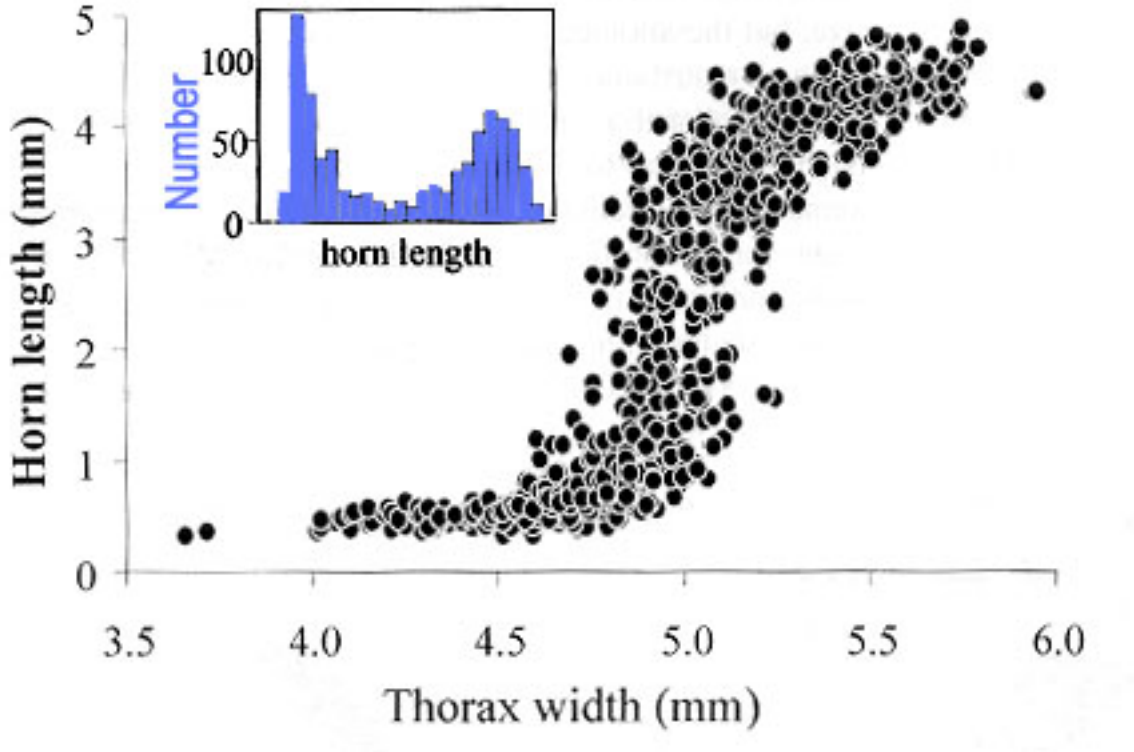
Favored when environments are highly variable/unpredictable.

Trophic-induced polyphenism

- Hymenopterans (ants, wasps, bees)
  - Trophogenic effects
    - Castes determined by the larval food

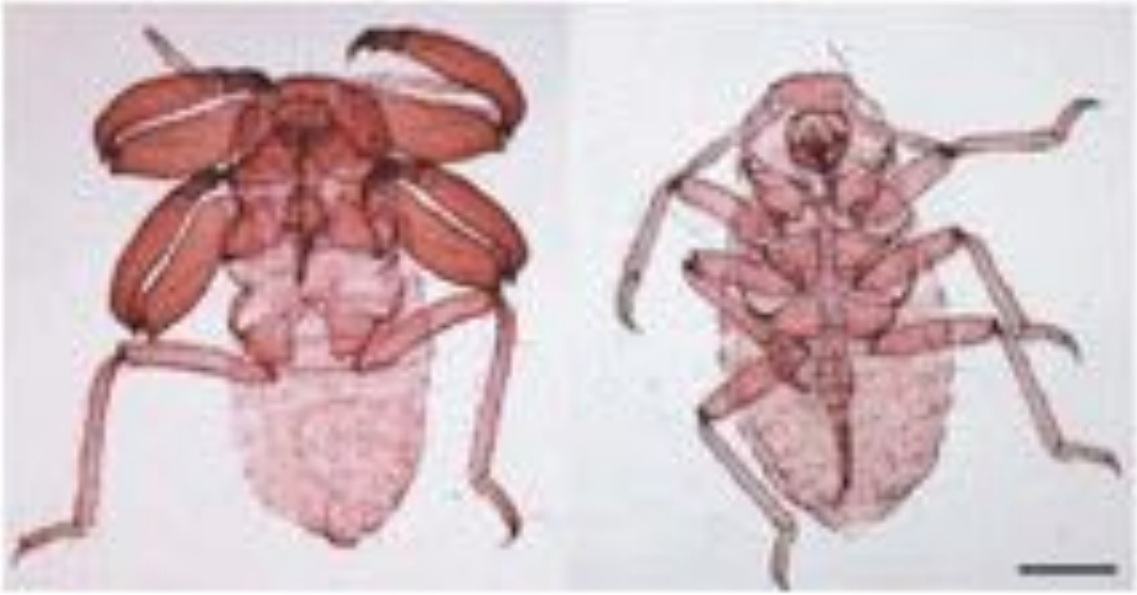


Trophic-induced polyphenism



Predation-induced polyphenism

- Aphid morphs
  - Increase in soldier forms in the presence of predators



Socially-induced polyphenism

- Tiger salamander morphs
  - Typical
    - Eats invertebrates, grows slowly
  - Cannibal
    - Eats salamanders, has large head & teeth, grows quickly

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LOA:

Ontogenetic explanations for cannibalism

Developmental switch occurs during development based on density of population; size discrepancies; presence of kin

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LOA:

Ontogenetic explanations for cannibalism

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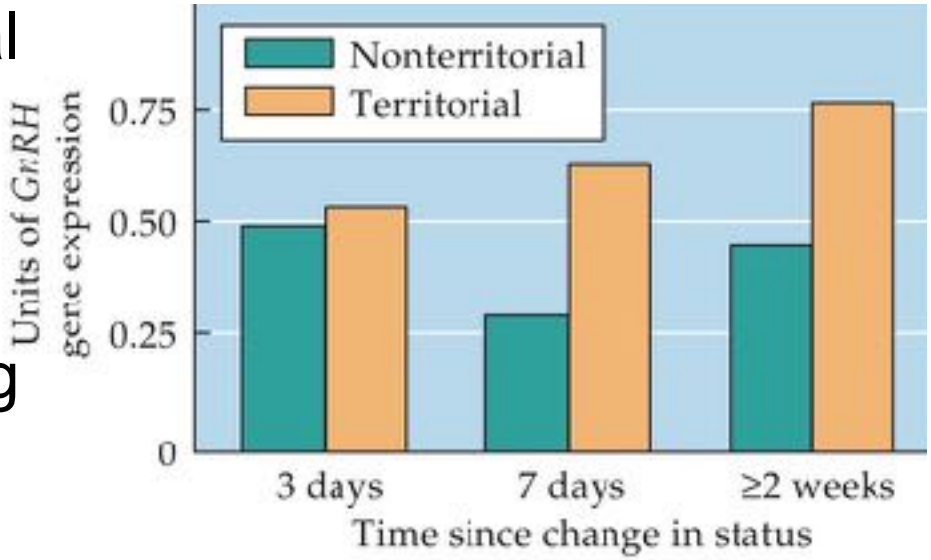
Functional explanations for cannibalism

Both density&size discrepancies provide feeding opportunities: exploitation of available food in unpredictable environment increases fitness; kin: bad to remove your genes —shared by your kin— by eating them.

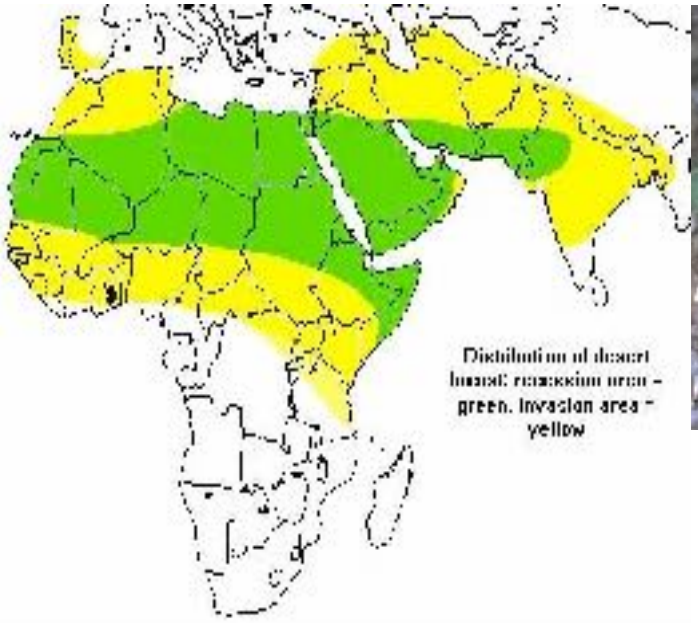
Reversible socially-induced polyphenism

- Most polyphenisms are irreversible
- But there are exceptions:
  -African cichlids
  - Males have two morphs
    - switch between territorial and satellite
  - Current form based on ability to hold territory
    - switch involves changing coloration, brain, gonadal tissues, hormones



Socially-induced polyphenism

- Desert locust
  - Erratic changes in habitat quality leads to development of morphs
  - Physical contact between locust nymphs provides the major stimulus = density dependent



Solitary **Gregarious**

Locust swarms:

- can cover over 100 km^2
- up to 50 million locusts per km^2
- travel about 100 km per day
- can eat 250 metric tons/km^2/day
  ≈ food for 80,000 people/day