

# AP Biology



## Animal Behavior



AP Biology **meerkats**

## What is behavior?

- Behavior
  - everything an animal does & how it does it
    - response to stimuli in its environment
  - innate**
    - inherited, “instinctive”
    - automatic & consistent
  - learned**
    - ability to learn is inherited, but the behavior develops during animal’s lifetime
    - variable & flexible
      - change with experience & environment








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## Why study behavior?

- **Evolutionary perspective...**
  - ◆ part of phenotype
  - ◆ acted upon by natural selection
    - lead to greater fitness?
    - lead to greater survival?
    - lead to greater reproductive success?

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## What questions can we ask?

- **Proximate causes**
  - ◆ immediate stimulus & mechanism
  - ◆ “how” & “what” questions
- **Ultimate causes**
  - ◆ **evolutionary significance**
  - ◆ how does behavior contribute to survival & reproduction
    - adaptive value
  - ◆ “why” questions



**male songbird**  
 → what triggers singing?  
 → how does he sing?  
 → why does he sing?



**Courtship behavior in cranes**  
 → what...how... & why questions

→ how does daylength influence breeding?  
 → why do cranes breed in spring?

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## Evolutionary perspective

- **Adaptive advantage?**
  - ◆ **innate behaviors**
    - automatic, fixed, “built-in”, no “learning curve”
    - despite different environments, all individuals exhibit the behavior
    - ex. early survival, reproduction, kinesis, taxis
  - ◆ **learned behaviors**
    - modified by experience
    - variable, changeable
    - flexible with a complex & changing environment

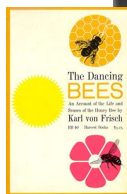
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1941 | 1973

## Ethology

pioneers in the study of animal behavior

Karl von Frisch

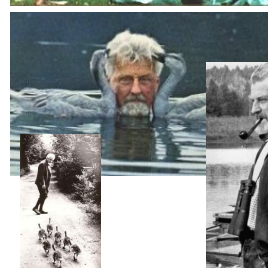


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Niko Tinbergen



Konrad Lorenz




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**Innate behaviors**

- **Fixed action patterns (FAP)**
  - ◆ sequence of behaviors essentially unchangeable & usually conducted to completion once started
  - ◆ **sign stimulus**
    - the releaser that triggers a FAP

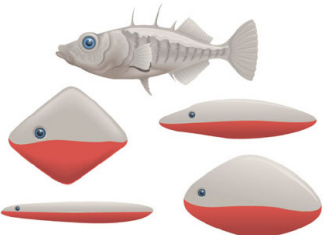
**male sticklebacks exhibit aggressive territoriality**



**PROXIMATE CAUSE:** The red belly of the intruding male acts as a sign stimulus that releases aggression in a male stickleback.

**ULTIMATE CAUSE:** By chasing away other male sticklebacks, a male decreases the chance that eggs laid in his nesting territory will be fertilized by another male.


Actual colour & shape	Male stickleback: red belly, bluish-white back	Female stickleback: greyish-green body, swollen silvery belly
Model characteristics	Red belly	Swollen belly
Reaction of males to model	Attack	Court




**attack on red belly stimulus**  
**court on swollen belly stimulus**

**Fixed Action Patterns (FAP)**

**Digger wasp**




**egg rolling in geese**



**Do humans exhibit Fixed Action Patterns?**

**The "eyebrow-flash"**

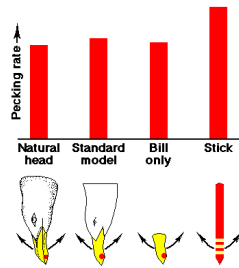
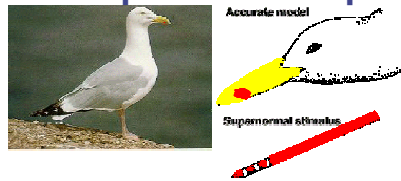


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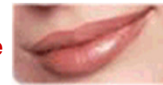
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## Supernormal Stimulus

- Responding more to a larger sign stimulus
  - ◆ adaptation or experimental artifact?



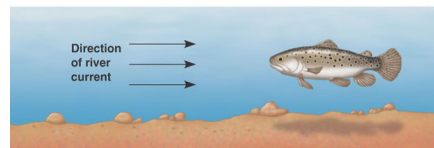
does lipstick create a supernormal stimulus in humans



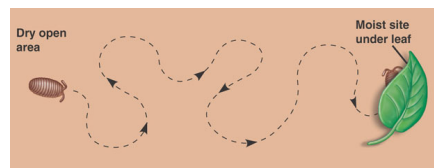
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## Innate: Directed movements

- **Taxis**
  - ◆ change in direction
  - ◆ automatic movement toward (positive taxis) or away from (negative taxis) a stimulus
    - phototaxis
    - chemotaxis
- **Kinesis**
  - ◆ change in rate of movement in response to a stimulus



(b) Positive rheotaxis keeps trout facing into the current, the direction from which most food comes.



(a) Kinesis increases the chance that a sow bug will encounter and stay in a moist environment.

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## Complex Innate behaviors

### Migration

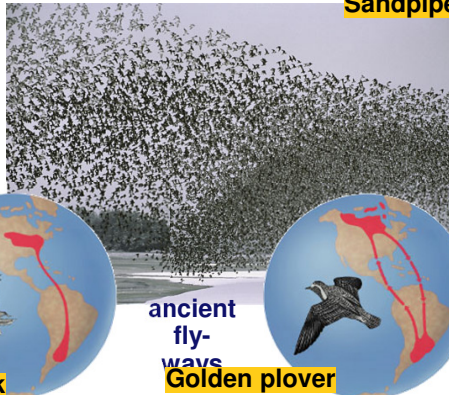
- ◆ “migratory restlessness” seen in birds bred & raised in captivity
- ◆ navigate by sun, stars, Earth magnetic fields



Monarch migration



Bobolink



Sandpiper

ancient fly-ways



Golden plover

## Innate & Learning: Imprinting

- ◆ Learning to form social attachments at a specific **critical period**
- ◆ both learning & innate components



AP Biology Konrad Lorenz



**PROXIMATE CAUSE:** During an early, critical developmental stage, the young geese observe their mother moving away from them and calling.

**ULTIMATE CAUSE:** On average, geese that follow and imprint on their mother receive more care and learn necessary skills, and thus have a greater chance of surviving than those that do not follow their mother.

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## Conservation

Conservation biologists have taken advantage of imprinting by young whooping cranes as a means to teach the birds a migration route. A pilot wearing a crane suit in an Ultralight plane acts as a surrogate parent.



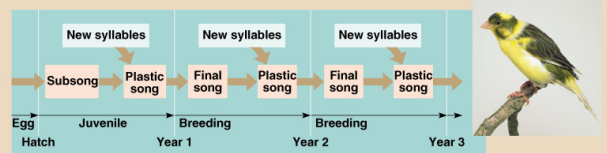
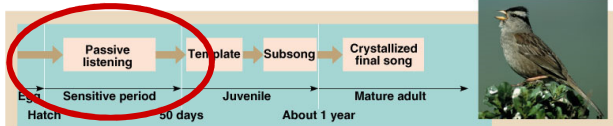
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## Critical period

- Sensitive phase for optimal imprinting
  - ◆ some behavior must be learned during a receptive time period



As a brood parasite, the Cuckoo never learn the song of their species as a nestling. Song development is totally innate.



imprinting/critical period in humans?



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## Learned behavior

- **Associative learning**
  - ◆ learning to associate a stimulus with a consequence
    - **operant conditioning**
      - ◆ trial & error learning
      - ◆ associate behavior with reward or punishment
      - ◆ ex: learning what to eat
    - **classical conditioning**
      - ◆ Pavlovian conditioning
      - ◆ associate a “neutral stimulus” with a “significant stimulus”



QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

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## Operant conditioning

- **Skinner box**

**mouse learns to associate behavior (pressing lever) with reward (food pellet)**





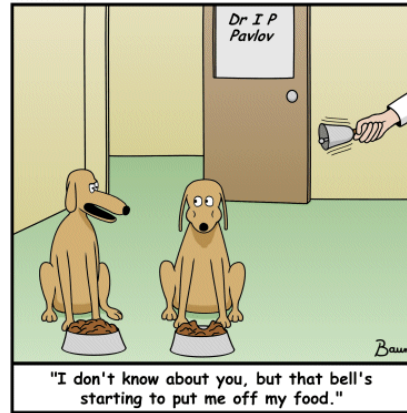
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## Classical conditioning

- Ivan Pavlov's dogs
  - ◆ connect reflex behavior (salivating at sight of food) to associated stimulus (ringing bell)



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## Learning: Habituation

- Loss of response to stimulus
  - ◆ "cry-wolf" effect
  - ◆ decrease in response to repeated occurrences of stimulus
  - ◆ enables animals to disregard unimportant stimuli
    - ex: falling leaves not triggering fear response in baby birds



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## Learning: Problem-solving

### Do other animals reason?



chimpanzee



crow

problem-solving

tool use

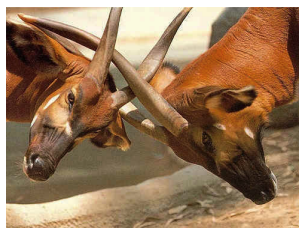


sea otter



## Social behaviors

- Interactions between individuals
  - develop as evolutionary adaptations
  - communication / language
  - agonistic behaviors
  - dominance hierarchy
  - cooperation
  - altruistic behavior




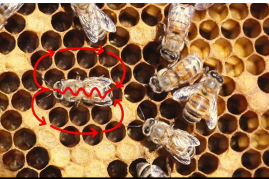


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## Language


- Honey bee communication
  - ◆ dance to communicate location of food source
  - ◆ waggle dance



(a) Bees clustering around a recently returned worker



(b) Round dance





(c) Waggle dance



Let's go to the videotape!

## Communication by song

- Bird song
  - ◆ species identification & mating ritual
  - ◆ mixed learned & innate
  - ◆ critical learning period
- Insect song
  - ◆ mating ritual & song
  - ◆ innate, genetically controlled



Red-winged blackbird

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## Social behaviors

- **Agonistic behaviors**
  - ◆ threatening & submissive rituals
    - symbolic, usually no harm done
  - ◆ ex: territoriality, competitor aggression



Let's go to the videotape!

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## Social behaviors

- **Dominance hierarchy**
  - ◆ social ranking within a group
    - pecking order



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## Social behaviors

### ■ Cooperation

- ◆ working together in coordination

Pack of African dogs hunting wildebeest cooperatively



White pelicans “herding” school of fish

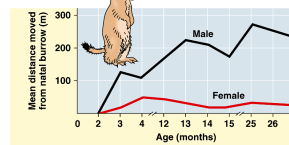


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## Social behaviors

### ■ Altruistic behavior

- ◆ reduces individual fitness but increases fitness of recipient
- ◆ kin selection
  - increasing survival of close relatives passes these genes on to the next generation



I would lay down my life for 2 brothers or 8 cousins!



How can this be of adaptive value?



Belding ground squirrel

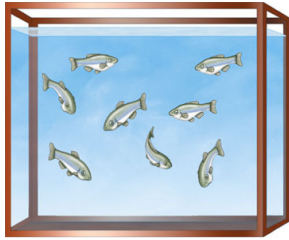
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## Social interaction requires communication

### ■ Pheromones

◆ chemical signal that stimulates a response from other individuals

- alarm pheromones
- sex pheromones



(a) Minnows are widely dispersed in an aquarium before an alarm substance is introduced.



(b) Within seconds of the alarm substance being introduced, minnows aggregate near the bottom of the aquarium and reduce their movement.



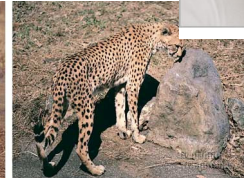
## Pheromones

human sex pheromone?



Female mosquito use CO<sub>2</sub> concentrations to locate victims

marking territory



Spider using moth sex pheromones, as allomones, to lure its prey



The female lion lures male by spreading sex pheromones, but also by posture & movements



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## Colonial mammals

**convergent evolution:**  
bees, ants, termites...  
mole rats

### ▪ Naked mole rats

- ◆ underground colony, tunnels
- ◆ queen, breeding males, non-breeding workers
- ◆ hairless, blind

"Picture a hot dog that's been left in a microwave a little too long...add some buck teeth at one end, and you've got a fairly good idea of what a Naked Mole Rat looks like."



**Any Questions??**



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**EXTRA SLIDES**

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## Mating & parental behavior

- **Genetic influences**
  - ◆ changes in behavior at different stages of mating
    - pair bonding
    - competitor aggression
- **Environmental influences**
  - ◆ modifies behavior
    - quality of diet
    - social interactions
    - learning opportunities



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## Pheromones

### Human pheromones?



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"Hold it right there, young lady! Before you go out, you take off some of that makeup and wash off that gallon of pheromones!"