

# Parental care1



Tragedy struck when Conroy, his mind preoccupied with work, stepped into the elevator—directly between a female grizzly and her cub.

# Parental care

- Definition
  - Any investment by provider (parent or other individual) that increases the offspring's chances of surviving&reproducing at the cost of the provider's ability to invest in itself or other/future offspring



# Parental care: Benefits and costs

- **Benefits** (ways of getting genes to next generation)
  - Increased birth/hatching success
  - Increased growth of young
  - Decreased predation
  - Increased condition of offspring
- **Costs**
  - Energy
  - Time
  - Increased predation risk
  - Decreased future breeding

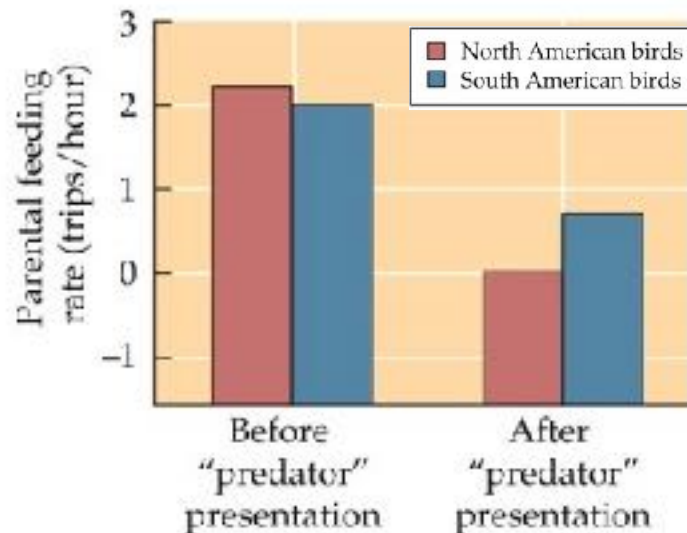




# Parental care: Benefits and costs

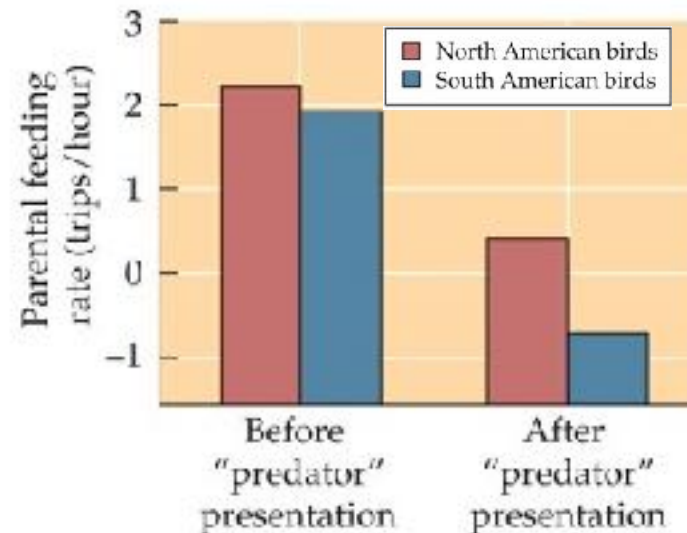
- Comparative example: reactions of birds to predatory threats in relation to annual mortality rates
  - Shorter-lived North American birds protect offspring, while longer-lived South American birds protect themselves

(B) Nest predator



NA birds more cautious about nest predator (jay)

(C) Adult predator



SA birds more likely to give up feeding when adult-killing hawk is present

# Proximate constraints on parental care

- What are patterns (sex roles) of parental care, and why?
  - Contrast cases of birds, mammals, and fish



# Bird parental care

- RS in birds strongly affected by rate of food delivery (two parents can raise more nestlings)
  - thus biparental care most common
- When uniparental care occurs
  - Associated with fruit eaters (food can be very abundant)
  - Usually female cares, male deserts
    - Why male desertion?
      - Internal fertilization constrains female ability to desert
      - Males have more to gain through desertion (greater male potential repro. rate)



# Mammal parental care

- Physiological constraints on females free males from care

- Internal gestation: only female
- Early feeding (lactation): only female



- Rare when males contribute care

- Can occur when males contribute by carrying/protecting young (primates) or feeding young (carnivores)





# Fish parental care

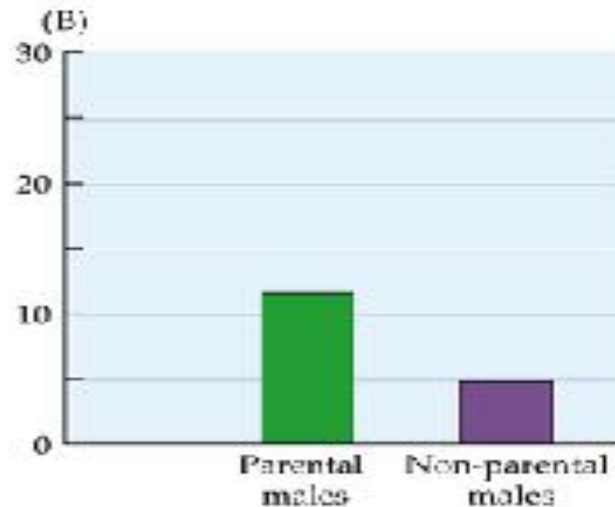
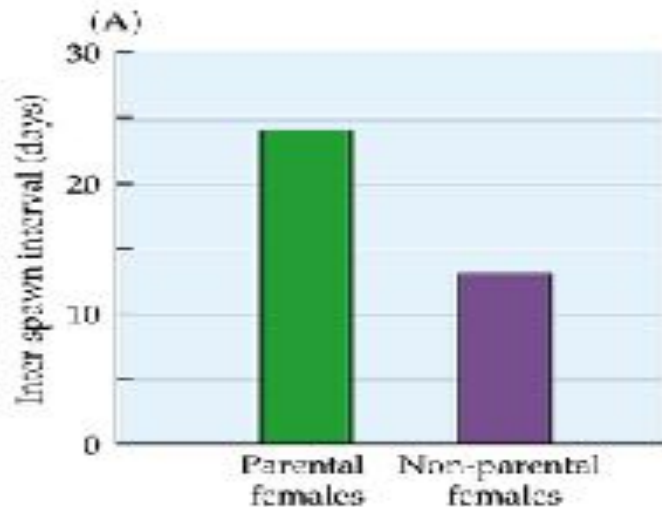
- Most families (79%) have no parental care
- Of those that do care, 75% have uniparental care
  - Simple care of guarding or fanning eggs, so only one parent needed
    - Which sex cares?
      - 86% female care in sp. with internal fertilization
      - 70% male care in sp. with external fertilization





# Why do male fish care?

- Hypotheses for why males care with external fertilization
  - Higher paternity certainty
    - Males more likely to be genetic parent, so benefit by staying
  - External gestation: opportunity for female desertion
    - Females dump gametes first, so can run first
  - Male association with embryos (\*most important)
    - If males are already staying put defending a territory, not much cost to additionally defend and care for eggs (attract more females)
      - Unlike females, which pay big costs of lost future clutches



# To desert or not to desert

- Strategies that the sexes play: should I stay and care, or desert and re-mate?
  - Both sexes desert
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  - Both sexes care
    - Two parents can raise many more offspring than one, chance of re-mating is low (**birds**)



# Giant water bug

## Male parental care

- How did this system evolve?
  - Why parental care at all
    - Aeration necessary due to small surface area/volume ratio and poor diffusion of gases
      - » Thus, one parent better than no parent
  - Why male care?
    - Male can carry many clutches (so no reduction in RS by taking one)
    - Female's need to forage is greater than male's need (as females make eggs), so selection greater on females to desert

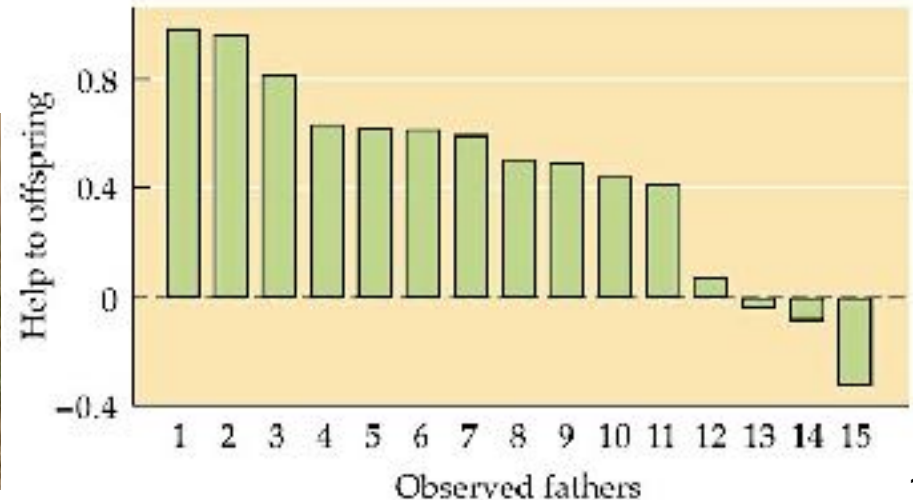
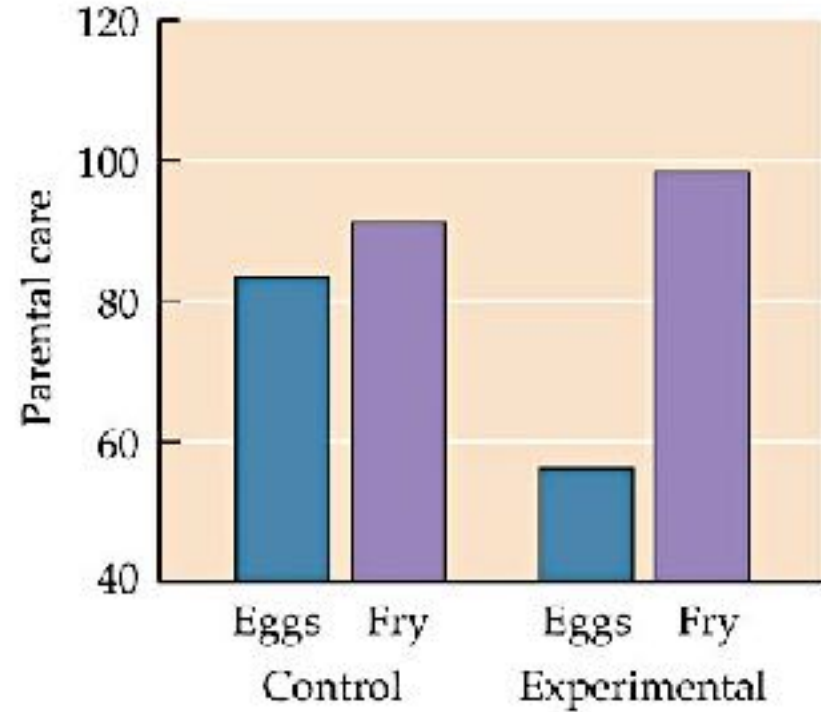


# Parental care and relatedness

- Bluegill sunfish
  - Defend eggs less vigorously in presence of rivals!  
(uncertain paternity)



- Male baboons
  - More likely to interfere on behalf of own offspring than unrelated youngster



# Offspring recognition

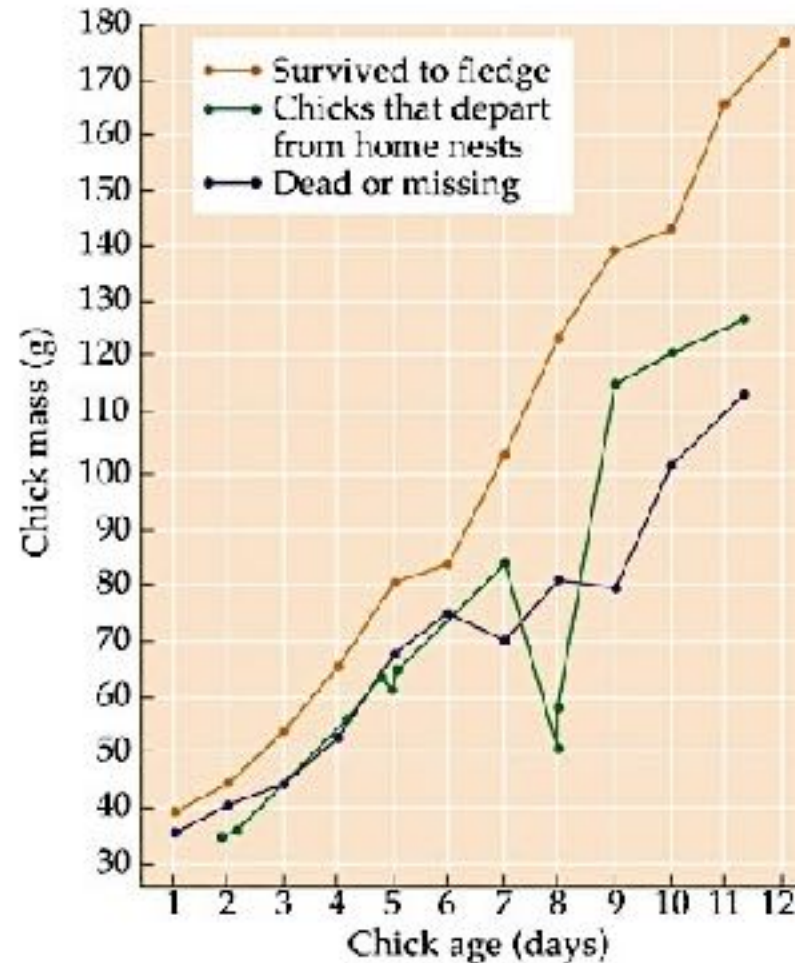
- Parent benefits from restricting care to own offspring (avoid misdirected parental care); young benefit from getting care from anyone who will provide it





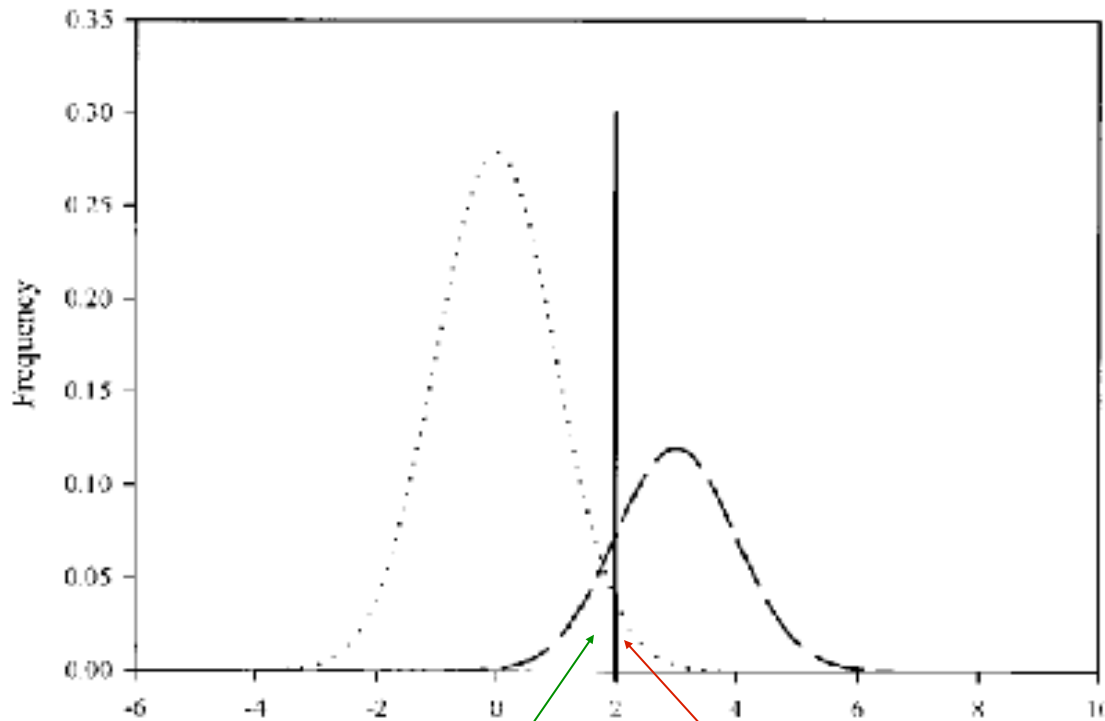
# Adopting genetic strangers

- Adoption: rare... but does happen
  - Gull chicks sometimes get adopted, and improve their chances of survival
- Costly mistakes
  - Ring-billed gulls adopt begging chicks
    - Lose 0.5 chick worth of RS if adopt
    - Could lose more RS by having rejection errors



# Offspring recognition

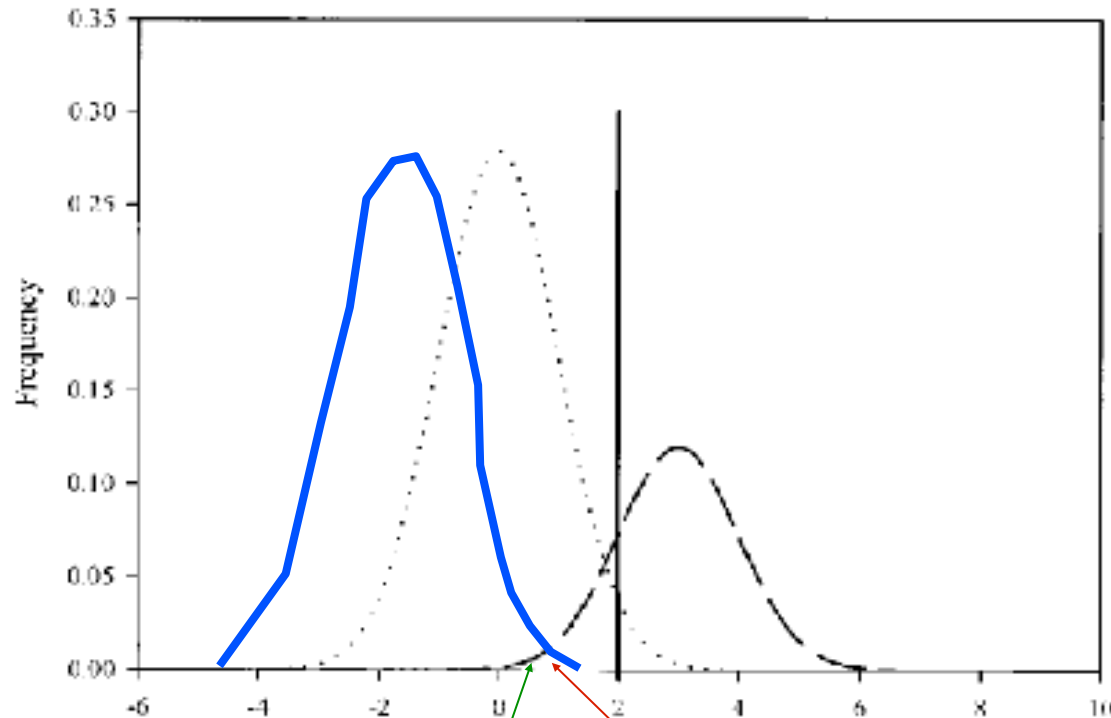
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**Acceptance errors** vs. **Rejection errors**

# Discrimination thresholds

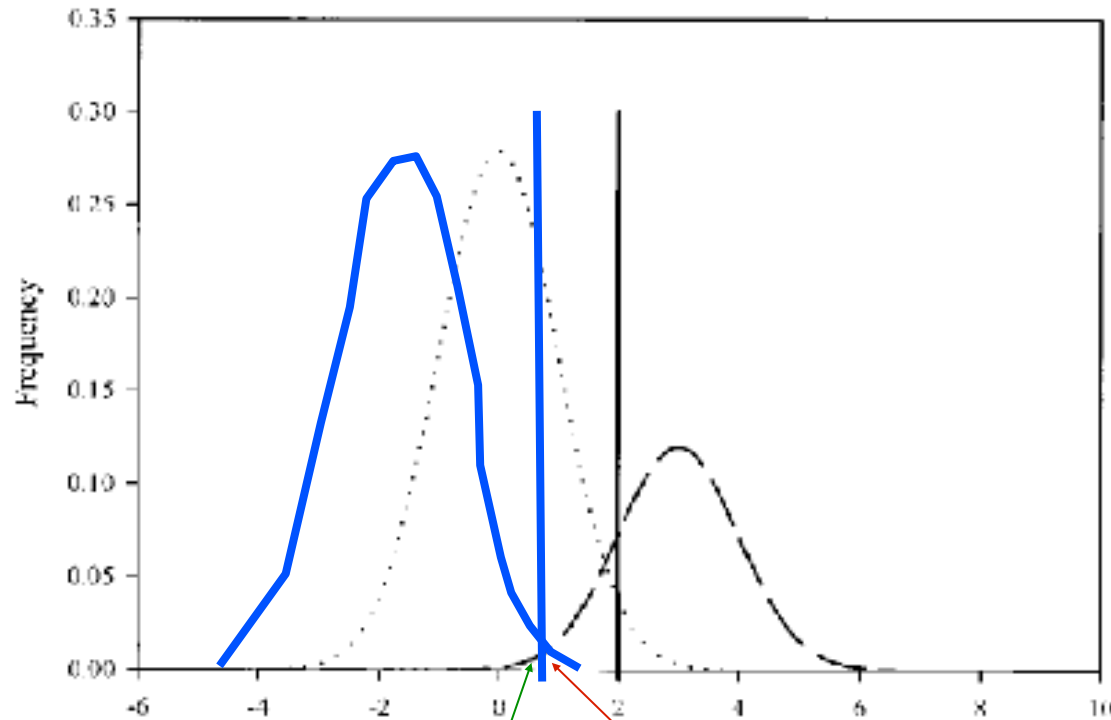
- Offspring discrimination threshold
  - Another way to respond to cost of errors
    - Traits can evolve to be more distinct



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**Acceptance errors** vs. **Rejection errors**



# Offspring recognition

- Parent-offspring recognition mechanisms
  - Most elaborate in species where there is a good chance of kids getting mixed up
    - Examples
      - Sea lions
      - Emperor penguins
      - Mexican free-tailed bats
        - » 500 pups per square meter!





# Conflicts over parental care

- Parent-offspring conflict
  - Parental favoritism
    - Not all kids are of equal value
  - Sibling rivalry
    - Kid  $r$  itself = 1.0
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  - Mother versus one-child
    - Clear example of kid being selected to want more care for itself than for current/future offspring

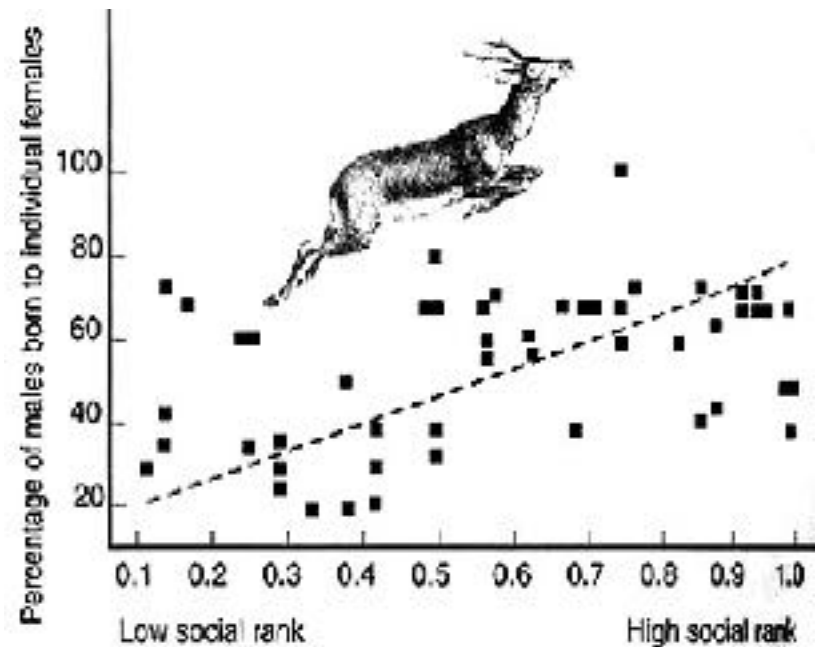


# Favoritism based on condition

- “Silver Spoon” hypothesis for polygynous species (Trivers & Willard)
- Mothers in good condition benefit by producing sons
  - Assumes ♂♂ can have great RS if they have enough resources growing up to make them highly competitive
- Mothers in poor condition do better if produce daughters
  - Assumes that ♀♀ more likely to have some success even if have few resources/poor condition



Red deer

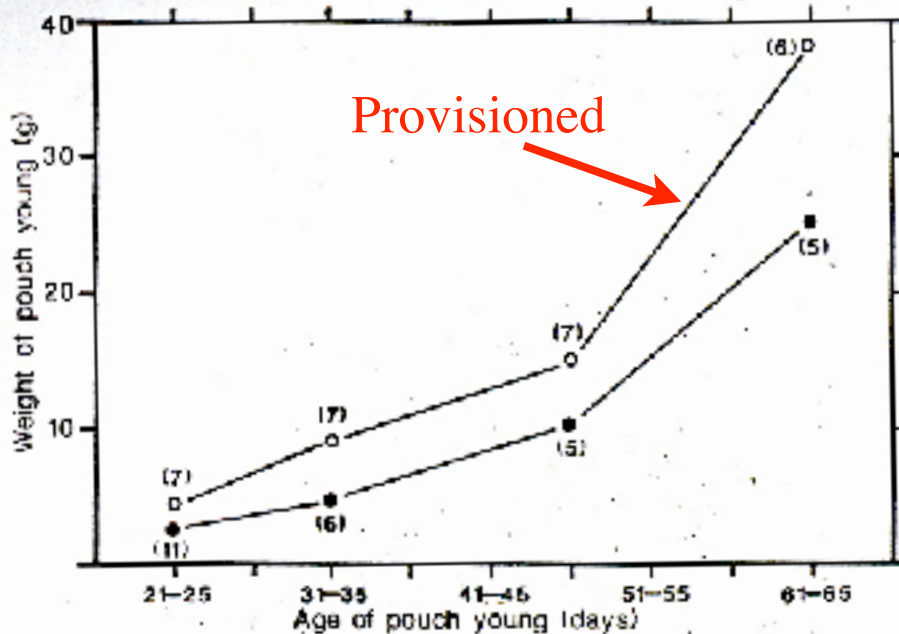


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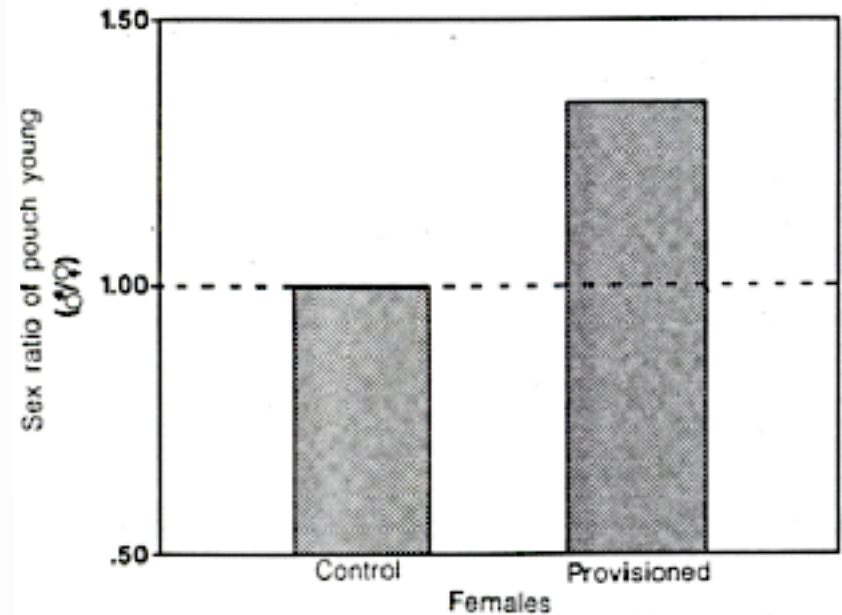
- Manipulative experiment of Trivers & Willard hypothesis
  - Mothers fed during the breeding season and gestation period, and controls received no food



Virginia Opossum



young had greater mass

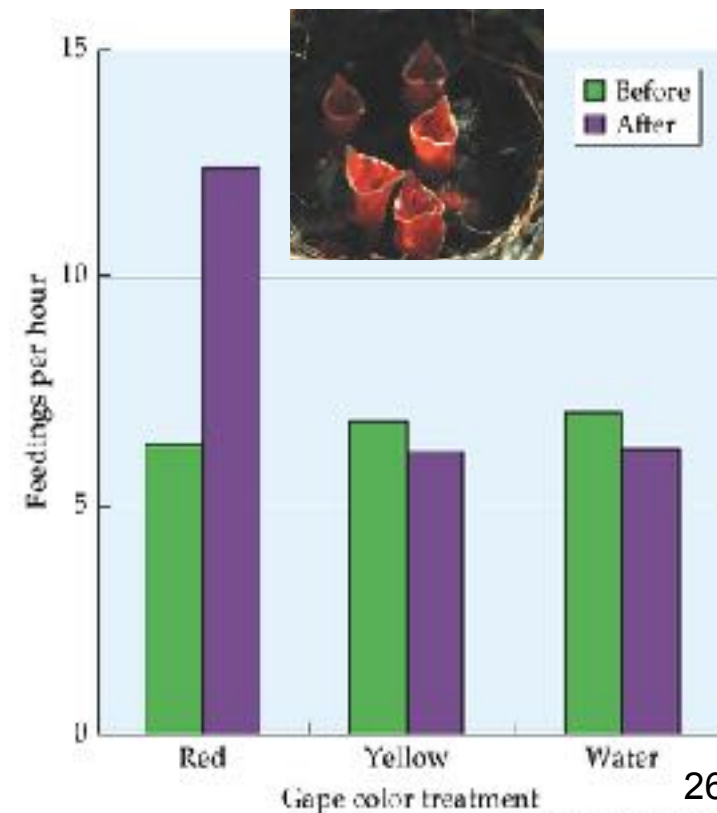


male biased sex-ratio



# Favoritism based on condition

- Parents do not invest equally in offspring
  - Natural selection favors getting “most bang for the buck”
    - support the ‘best’ offspring
  - 1) Feeding of more active/larger offspring preferentially
  - Response to variation in offspring quality
    - Honest advertising: if kids have signals that show they are of high quality, parents benefit by responding
    - Lower quality kids out of luck

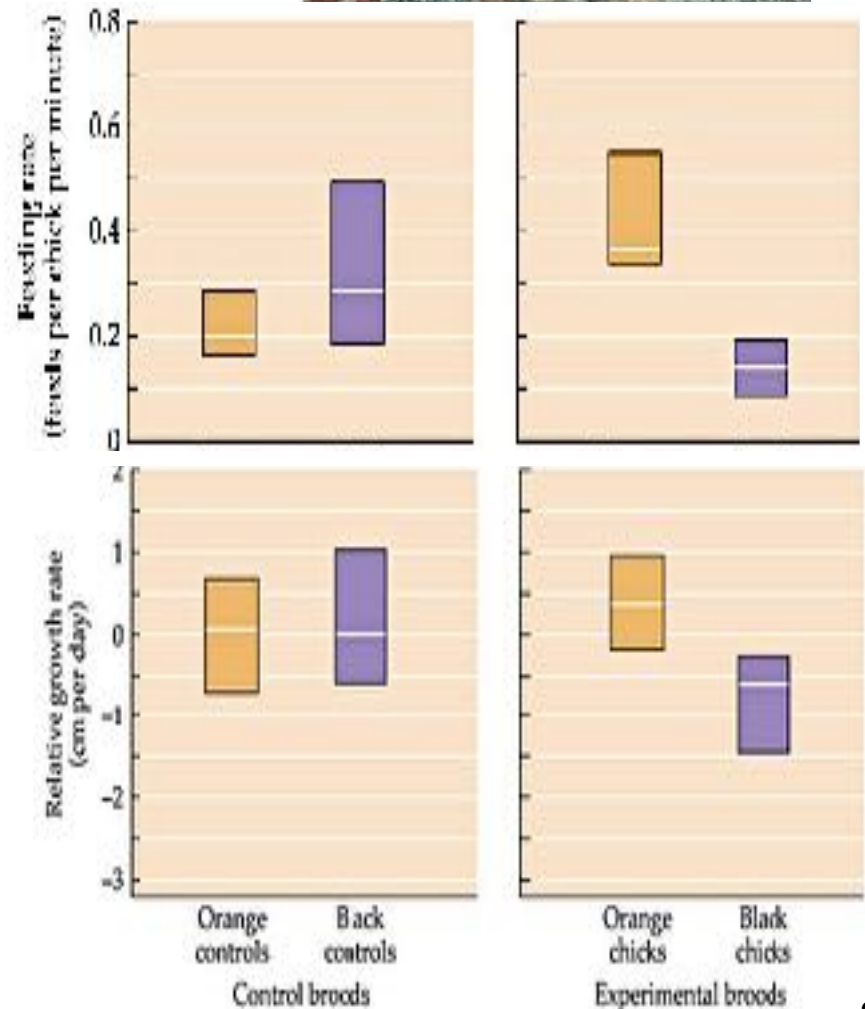


# Favoritism based on condition



– 2) Reduced feeding (and increased killing) of lower quality offspring

- All orange groups fed at same rate as all black groups
- Mixed orange & black brood: orange fed preferentially
  - Indicates that parents pay attention to *relative* condition within brood





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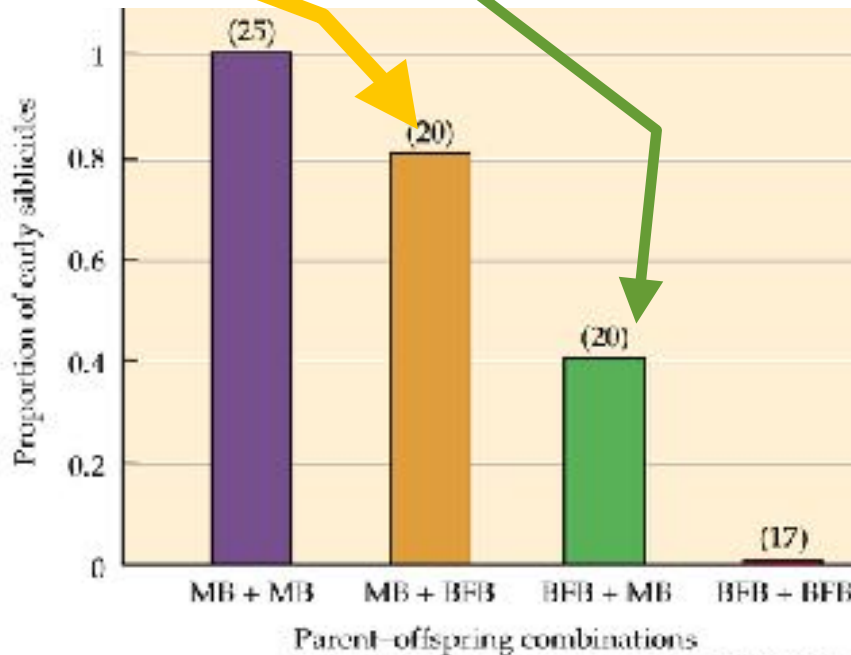
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  - ex. by killing sibling: killer gives up 3 nieces/nephews ( $r=1/4$  ea), but gains 2 offspring ( $r=1/2$  ea)
- **BUT:** Parents pay cost with this example of siblicide (gain 2 versus 3 grandkids), so often selected to try to stop siblicide. But when food is scarce, non-interference may be adaptive....



# Sibling competition/rivalry

- Parental control over siblicide
  - Masked booby (generally siblicidal) vs Blue-footed booby (rarely siblicidal). In cross-fostering experiment:
    - siblicidal MB less siblicidal when fostered by rarely-siblicidal BFB parents
    - rarely siblicidal BFB raised by siblicidal MB: BFB become more siblicidal due to lack of parental interference



# Sibling competition/rivalry

- Five traits that favor siblicide
  - 1. Resource competition
    - usually food
  - 2. Food provisioning in small units
    - monopolizable food resource
  - 3. Weaponry
    - hooked, pointy beaks
  - 4. Spatial confinement
    - limited space, cannot escape
  - 5. Competitive disparities among sibs
    - size & strength (hatching asynchrony), T



# Sibling competition/rivalry

- Role of parents in siblicide: hatching asynchrony (HA)
  - HA = eggs don't all hatch at once
    - Development begins with first-laid eggs
    - Kids that hatch first get “head start” in size & strength
  - Why has HA evolved? How could parents benefit from differential survival of kids (and siblicide)?
    - **Insurance egg hypothesis**
      - If chance of 1st egg hatching is low, good to lay a 2nd, and then to have it ‘disappear’ quickly if superfluous





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    - **Brood reduction hypothesis**
      - Allow for flexible response to available food supply
        - take advantage of “good times” in resources
        - let the strongest/best win



# Sibling competition/rivalry

- Types of siblicide
  - **Obligate**
    - First-hatched offspring kills sibling (even in years when resources seem abundant)
      - “Never” really enough food for all, so natural selection preserves “automatic” siblicide
      - Consistent with insurance egg hypothesis
        - » Adaptive when benefit of insurance  $>$  cost of producing egg



# Sibling competition/rivalry

- Types of siblicide
  - **Facultative**
    - Doesn't always happen; incidence varies with environment
      - Occurs when not enough food to keep old sib “happy”
      - Consistent with brood reduction hypothesis



# Sibling competition/rivalry

- Role of parents in siblicide:  
testosterone and hatching asynchrony
  - Cattle egrets = “stack the deck”
    - Early offspring get more T
      - Exaggerates advantage for asynchronous hatching



# Sibling competition/rivalry

- Role of parents in siblicide: testosterone and hatching asynchrony
  - Cattle egrets = “stack the deck”
    - Early offspring get more T
      - Exaggerates advantage for asynchronous hatching
  - Canaries = “level the playing field”
    - Later offspring get more T
      - Reduces advantage for asynchronous hatching
      - Promotes success of late-hatched





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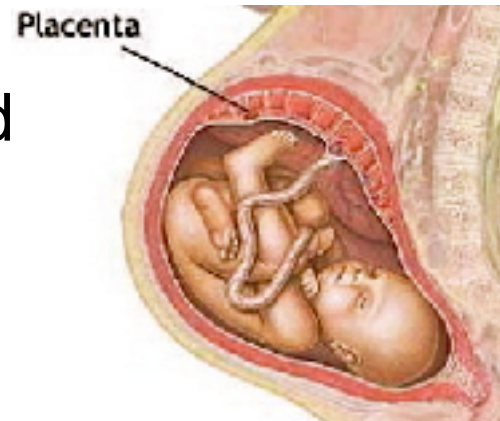
# Mother versus one-child

- How does conflict occur when only one offspring at a time?
  - Pregnancy
    - Why is it so problematic?
      - Two organisms with relatedness asymmetry
      - Tug-of-war for resources
        - » Mother wants to retain resources to invest in current/future young, and offspring wants more for itself



# Mother versus one-child

- Fetus-mother interactions
  - Placenta is a battleground for resources
    - Pre-eclampsia: dangerously high blood pressure for mom
      - Caused by high levels of protein produced by fetus, results in increase flow of blood/nutrients to fetus (can damage the mother's later reproduction)



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      - Caused by high levels of protein produced by fetus, results in increase flow of blood/nutrients to fetus (can damage the mother's later reproduction)
    - Placental hormones manipulate maternal physiology
      - hPL from fetus-made placenta increases maternal resistance to insulin, results in more glucose for baby (can lead to gestational diabetes)

