Cogs 143

Lecture 5: Primate Foraging Skills

Given the Socio-Ecology of Foraging in primates, what cognitive demands do they face?

Some Cognitive Issues

- **Ecological Validity** - Research in lab should be designed to test the real-world problems the animals face
  - However, this has often NOT been the case!
  - These lectures will attempt to redress this, by translating experimental findings into likely functions
    - In particular, we will look at the cognition required to Identify, Locate, and Process foods
- "**Goals**": Studying the cognition of foraging tends to involve attributing "Goals" to the animals
  Can we identify behavioral criteria for this (invisible) abstract concept?
  - Path efficiency? Per degree of linearity, travel speed, points & abruptness of direction change
    BUT! - e.g. Many species take efficient route when resources **scarce**, circuitous when **abundant**
    - e.g. Wooly monkeys typically do not go directly to ripe fruit trees, visit all, poss to **monitor** ripening
  - See *Janson & Byrne 2007* reading re: challenges for studying foraging cognition, assessing "value", etc!
- **Individual Differences** - In cognitively sophisticated species, ability and experience differ across individuals
  - Especially in species with prolonged development, many influences shape adult performance
  - Age also a factor - Orangs eat palm, but as size & strength changes, eat diff parts, stages, using diff skills

Cognitive Demands of identifying, locating & processing foods

IDENTIFYING

- **Eat What Mom Eats**
  - Observe, share, imitate – Infant's first foods are from mother's mouth & hands
    - Re **Mirror Cell** assumptions: Note many infant primates watch Mom's hands *before* their own
      - So, mapping may not be from own, to other's hands, but vice versa!
  - Medicinal use of foods
    - e.g. Bristley leaves scrape, clear internal parasites; Certain flowers settle upset stomach
      - Infant possibly associate foods with mom's symptoms, like bad breath, fever, lethargy, etc?

- **Discriminating** "**things**" (The world is a cluttered and dynamic place!)
  - **Object Permanence** = Object moves, gets occluded (can't be seen), still exists!
    - Most animals act accordingly even predatory insects! (tho can take time to develop, e.g. in humans)
  - **Match-to-Sample** (**MTS**) - Found a good one, find another just like it! A skill shown across the phyla…
    - Show sample, remove, show 2 alternatives, subject must pick 1 that matches sample
      - "**Transfer**" = subjects require fewer trials on subsequent examples to reach criteria for success
      - Primates get so proficient, can correctly choose match on "**first trial**" w/novel stimuli

- **Assessing Patch Size & Quality**
  - Others things being equal, primates prefer clumped resources & bigger is better!
    - In lab, will tolerate delays for larger reward = **Delayed gratification** (per Prefrontal Cortex devel)
    - In wild too, walk farther for more, though trade-offs for avoiding predators, competitors, etc

- **Building Associations**
  - **Sensori-motor Integration**; developed, for example, through PLAY
    - Develop basic sensory & motor skills like size constancy, distance judgments, hand-eye coord, etc.
  - **Cross-Modal/Matching**: Perceive in one modality, respond to another
    - Primate sees object X; can then select matching X (vs. Y) by touch alone (So, can grab tho vanished)
    - Also succeed at auditory to visual matching (& vice versa) based on temporal patterns.
      (So, in wild, how thing looks when moves also recognized by how it sounds when moves)
  - **Learn Affordances** through interaction w/physical & social environments
    - e.g. Will this branch hold my weight? Will this fit in my hand? Do I have to peel before eating? Etc!
      - Canonical Cells in Parietal Cortex recognize relevant affordances of objects
  - **Regularity detection/prediction** Detecting regularities, building associations >> Predictions
    - e.g. Menzel (1991) placed store-bought persimmons on ground in Japanese macaque home range
      - After finding, monkeys then traveled to (as yet unripe) persimmon trees in range
    - e.g. Mangabeys learn to alert to Hornbill alarm calls to a shared predator
      - Then give own alarm ("whoop gobble"), warning other local primates

- **"Rule Based**" vs. "Associative" Learning - Cognition concerns not just what, but HOW animal learns
  – **IMTS** ("Identity Match-to-Sample") Sample is identical to one (correct) alternative
  - C**MTS** ("Conditional MTS"): No stimuli match; "Correct" alternative is arbitrarily assigned
    - Pigeons show transfer between these tasks; Treat both tasks as: "See 1, pick 1 of 2"
    - Primates do NOT - Performance retarded: i.e. takes more trials to learn CMTS after IMTS
    - BOTH show some transfer from IMTS to Oddity (Oddity = Pick the alt that is *not* same as sample)
  - Pigeon uses "Associative" learning = Per reinforcement contingencies of each new set of stimuli
  - Primate uses "**Rule Based**" = Pick "same" (or, modified for Oddity, "Find same, pick other")
    - Enables subject to respond to NOVEL situations w/out further learning = **First Trial Success**
      - Pays off esp in species with **more variable diets** of unpredictable, patchy, ephemeral foods
- **Inferences** e.g. re: competitors & targets
  - Chimp sees Experimenter leave w/2 objects, return with 1 >> stops search after finds one
  - Chimp sees Exp hide apple @X, pear @Y, distracted, then see Exp eating apple >> only seek @Y
    - Many others! (e.g. based on what competitor can/not see) We will discuss in detail later --

LOCATING

- **Searching Environment**
  - In Field: Most use landmarks and re-use paths, subject to predator avoidance, obstacles like rivers, etc
    - Also tend to move faster and more directly toward preferred (more "valued") resources
  - In Lab: Can successfully navigate virtual environments, via VISION only
    - Chimps (few) can even use 3D model to represent real-world locations *(Kuhlmeier et al 1999; 2002)*
- **Moving Targets** - Track animate prey (insects) & plants handled/transported by others
  - **Invisible Displacement** = Object into container, container moved to diff places, then shown to be empty
    - Harder than "Visible Displacement" Humans: Vis@6mo, Invis@18 mo; Most nonhumans fail Invis
    - Several ape species, and only one adult *Cebus* (of various monkey species tested) pass!
      - Might this be related to food bit disappearing into (moving) hand of other?!!
- **Controlling Resources**
  - Defend territory – Monogamous pairs secure smallish feeding ranges for nuclear family's needs
    - e.g. Lesser Apes (Gibbons & Siamangs) & New World Callitrichids (Marmosets & Tamarins)
    - Drive off non-family; Older offspring often stay to help; Pairs may duet to mark claim
  - Compete for a given resource
    - e.g. Higher ranking animals can often displace others from resources
    - Food fought over, stolen, allowed to be taken (tolerated scrounging), but **rarely given**, except M/Y
- **Other Social Factors**
  - Social structure: e.g. *Pan* vs. *Pan*
    - *Pan troglodytes* – fairly intolerant, avoid competition, forage in small groups (e.g. mother/young)
      - e.g. Altho will give food calls if resource is sufficiently plentiful (e.g. abundance of figs)
    - *Pan paniscus* – more tolerant, feed in larger groups, when nervous all have sex to promote calm
      - i.e. Bonobos rub genitals with all gender & age partners (except moms & non-infant sons)
  - Gender - Female chimps more likely than males to divert to fat-rich fruits (often eating for 2)

PROCESSING

Follivory – Leaves as primary diet; Easy but relatively poor nutrition requires significant time investment
- Correlation between gut length & brain size (more leaves, **longer gut, smaller brain**)
- EXCEPT: Large-brained Gorilla largely follivorous, but particularly bi-manually dexterous
  - That, and simultaneous independent finger control, requires more brain
    - Enables it to eat special foods, such as nutritious but well-defended nettles *(Byrne et al 2001)*
    - Processing shows subgoal structure; e.g. Loops within/not between subgoals,

Frugivory / Omnivory – Ripe fruit major part of diet, but also tends to include wider variety of foods
- Much more demanding: Variety of locations, types, processing etc. >> **Larger brain**
- Must track seasonal & weather-related changes (Tho data on "when" generally scarce)

Extractive Foraging – A few species use **tools** to extract foods (from shell, ground, mound, etc.)
- Only Cebus, Chimps & Orangutans (& of course, humans) commonly seen to use tools in wild
  - Traditions: Crack nuts w/stone or log, prepare stick to "fish" for ants or termites in mound, etc.