Bio 1M: Hominins (complete)

1 Hominins

- **Hominins** refer to people and our upright ancestors
- Characterized by:
  - Walking upright
  - Specific changes in chewing design: teeth, jaws and skull

Taxonomy

- Homonoidea, Hominidae, Homininae, Hominini, Hominina, Homo
- Why so much detailed splitting?
  - **Answer:** We're a little bit full of ourselves
  - **Answer:** Observer bias

Putting together the puzzle

- What did our common ancestor with chimpanzees look like?
- Which fossils are related to which other fossils?
- The key is which features are reliable indicators of relatedness?
  - **Answer:** How do we tell the difference between convergence and homology?
  - **Answer:** It's all in the details

Evaluating evidence

- There are a lot of theories and a great deal of expertise
- But expertise can also lead to over-confidence
- As with other examples, we try to make and test theories
  - **Answer:** Make predictions about things that haven't been seen yet

Apelike ancestors

- Were our ancestors more like us, or more like apes?
  - **Answer:** We *are* apes, if apes are a clade; both books make this mistake
    - **Answer:** They also make a similar mistake with hominoids
  - **Answer:** Among living apes, the closest *relatives* of our ancestors is us
  - **Answer:** In some important ways, we have evolved more than chimpanzees have
  - **Answer:** But chimpanzees have probably evolved more than we assume
    - **Answer:** It is hard for us to study ourselves
    - **Answer:** Observer bias

Observer bias

1.1 Upright posture

- How did upright posture and upright walking evolve?
- It's not known, but there are many theories:
  - Adaptation to walking on the ground instead of swinging through trees
    - **Answer:** If so, probably dependent on **gradual** evolution from existing form
  - Adaptation for keeping cool
  - Adaptation for harvesting food
  - Adaptation for carrying food

Gradual evolution

- Hominins' evolution of upright posture was likely dependent on evolutionary history and circumstance
  - Built on previous adaptations
- Evolution of upright posture almost certainly led to further evolutionary change:
  - Carrying and storing things
  - Making and using tools
- There should be lots of "loops" – changes leading to other changes – to explain how dramatically our ancestors evolved

Studying evolution

- Evidence from fossils
  - knees, hips, backs, skulls all provide evidence about posture
  - teeth and jaws provide evidence about diet
- Evidence from archaeology
  - hominin fossils may be found in particular placess
  - associated with fossils from things that hominins used to eat
  - or with tools

1.2 Complex foraging

- A key part of human evolution was shaped by **complex foraging** strategies of our ancestors – they relied on many types of food, including types of food that are difficult to get or process
- What adaptations likely favored this strategy?
  - **Answer:** Clever hands, upright walking
- What further adaptations might this strategy have favored?
  - **Answer:** Big brains
  - **Answer:** co-operation, including male-female co-operation
  - **Answer:** Social behaviour

Back and forth evolution

- Very early hominins (6 mya) had facial and dental features that were similar to later hominins (2 mya)
  - Less similar to chimpanzees
  - But also less similar to *Australopiths* (3 mya)
- Is this surprising?
  - **Answer:** Radiation and contraction
  - **Answer:** Changing conditions
    - **Answer:** Evolution is not goal-oriented

Hominin phylogenies

- Hominins had a large number of speciation and extinction events
  - **Answer:** Radiation and contraction
- The tree is not well understood, despite intensive study
  - **Answer:** Changing environments and convergent evolution

2 Sociality

Complex foraging and co-operation

- Complex foraging may have promoted co-operation between females and males, since primate child care is not well suited to a hunting life style
- It may have promoted co-operation between people with different skills, since they might have access to food at different times
- It may have promoted co-operation among hunters, since hunting success is highly variable
- It may have promoted co-operation in teaching and learning

Complex foraging and thinking

- Complex foraging favors large brains that can learn a lot
- It also favors a long learning period
  - Sensitivity vs. crystallization
- It also favors communication

Complex foraging and gender roles

- How might complex foraging affect child care and sexual dimorphism?
  - **Answer:** If males and females co-operate, then child care might be more equal
  - **Answer:** If child care is more equal, we expect sexual dimorphism to be less

Social behaviour

- As behaviour becomes more social, a wide variety of other adaptations may become available
  - Mostly related to thinking and communication
- Leading to more opportunities for looping:
  - **Answer:** Bigger brains may facilitate more food-gathering and survival strategies
  - **Answer:** Communication may favor co-operation

How social were early hominins?

- What kind of clues might be available?
  - **Answer:** Sexual dimorphism
  - **Answer:** Physical structures consistent with vocal communication
  - **Answer:** Dental enamel

Sexual dimorphism

- The extent of sexual dimorphism tells us at least something about social structures
  - **Answer:** Large amounts of sexual dimorphism probably mean less sociality and co-operation
  - **Answer:** At least among adult males
- How do we know whose bones are male and female?
  - **Answer: Pelvises** (hip bones) are very different in all of our ancestors
  - **Answer:** Because childbirth
- How do we know whose teeth are male and female?
  - **Answer:** We don't, usually
  - **Answer:** Bimodality can tell us about dimorphism anyway

Bimodality

- Bimodality means having two peaks in a distribution
  - For example, a modern human height distribution would have a peak for men, and a peak for women
- If traits are strongly dimorphic, we should be able to tell by sampling, even if we don't know which teeth come from men and which from women

Rate of development

- Why do human children develop *so* slowly?
  - **Answer:** Presumably related to elaborate sociality
- We are therefore very interested in how long it took our ancestors to mature
- Some clues are available
  - Dental enamel
  - Molar development
- But it's a hard problem

3 Tool making

- Several species can make tools, but only people make tools that can project lectures directly from a computer onto a screen
  - *Comment:* Which is awesome
- More broadly, hominins make far more sophisticated tools than non-hominins do

Other species

- What other animals make tools?
- Not counting programmed behaviours (spiky nests, ant traps)
  - **Answer:** Chimpanzees, orangutans
  - **Answer:** Elephants
  - **Answer:** Crows!

Looping

- Tool making is likely an important part of the "loop" that provided many opportunities for new adaptations along the hominin tree
- Others include:
  - **Answer:** Complex foraging
  - **Answer:** Sociality
  - **Answer:** Communication
- All these things probably interacted with and encouraged each other along the way

Difficulties

- We find *amazing* stone tools from 2-3.5 mya
  - **Oldowan tools**
- It's hard to know who made them and used them
  - **Answer:** Stone keeps better than bone
- It's hard to figure out how they were used

Active science

- Scientists have practiced *making* and *using* tools similar to the Oldowan tools
- Surprising conclusions:
  - Cores are made by striking off flakes
    - Flakes are surprisingly useful
    - cores may just be leftovers
  - Spheroids may be discarded hammers
  - Tool makers were mostly right-handed

3.1 Tools and adaptation

- Tools opened up new strategies that likely favored co-operation, communication and culture:
  - Hunting and scavenging with weapons
  - Advanced foraging

Active science

- Scientists lived with, and attempted to learn from, remaining forage-based societies
  - Skills are very detailed, and take a long time to develop
  - Possible support for looping with culture and language
- What can we learn from modern humans about our ancestors?
  - **Answer:** It's complicated
  - **Answer:** A lot of evolution has happened since then, and it's hard to figure out which parts are how relevant

Scavenging

- **Scavenging** is eating meat that is found, or taken from predators
- Evidence of early hominins **butchering** large animals including elephants raises the question of whether they were hunting or scavenging
  - It's not so easy to kill an elephant
  - Could they have had techniques or tools we don't know about?

Scavenging and hunting

- Scavenging and hunting are complementary activities
  - Most hunters scavenge
  - Most mammalian scavengers hunt
- Our ancestors probably did both
- Scavenging requires the ability to:
  - Take kills from other predators, or
  - Use resources others can't use

Tools for scavenging and hunting

- Some tools may have been used as weapons
  - For killing prey, or for fighting off other carnivovers
  - There is no evidence of this
- Tools could be used to process leftovers
  - **Answer:** Cracking large bones for marrow, for example

Tools for complex foraging

- Tools and knowledge can make a wide range of food sources available
  - Colonial insect resources
  - Deeply buried plant resources
  - Poisonous things that can be processed

4 Humans

Radiation and contraction

- Early humans replaced other hominins starting about 2 mya
- Modern humans replaced other humans starting about 0.2 mya
  - **Answer:** Probably through competition
  - **Answer:** But we still don't know all of the reasons
- Both early and modern humans evolved in Africa and spread from there

Early humans

- Acheulean industry lasted almost 1 million years
- It took people longer to move on from Acheulean industry than to move from Acheulean industry to self-driving cars!

Modern humans

- Characterized by small face and teeth
- Less robust skeletal structure
- Evolved in Africa around 200 **kya** (thousand years ago)
- Took over most of the world in the last 50,000 years

Why are we here?

- Modern humans arose around 200 kya, but took over the world around 50 kya
- What happened?
  - A sudden evolutionary change?
  - Gradual evolutionary change?
    - **Answer:** Why don't we see evidence?
    - **Answer:** Might be about our brains, and not reflected in fossils
  - A sudden cultural change?
  - Gradual cultural change?

Summary

- People evolved by the same basic rules as other organisms
  - **Answer:** Adaptation by natural selection
- Followed a very different path
  - **Answer:** Strong loops that continually created new adaptive opportunities
- There is a lot we can learn about ourselves from biology
  - **Answer:** We are affected by all of the same basic processes as other organisms
- And also a lot that we can't learn
  - **Answer:** We are also strongly affected by our complex brains (and complex cultures)