Bio 1M: Hominins (complete)

1 Emergence

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

Taxonomy

- Homonoidea, Hominidae, Homininninae, 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

Competition and replacement

- *H. erectus* replaced everything that came before it
- *H. sapiens* replaced everything that came before *it*

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?
  - Cultural change?
  - Evolutionary change?
    - Sudden or gradual?
  - Why don't we see evidence?
    - **Answer:** Might be about our brains, and not reflected in fossils

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:** Trick question: we *are* apes, if apes are a clade
  - **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 think
    - **Answer:** Observer bias
    - **Answer:** Our ancestors are less like chimps than we thought

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

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

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
  - Consistent with radiation and contraction
  - Likely provided more opportunities for adaptation in the long run
- The tree is not well understood, despite intensive study
  - **Answer:** Changing environments and convergent evolution

2 Sociality

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

Looping

- Lots of adaptations may be partly explained by adaptive loops

  - **Answer:** Complex foraging $\implies$ more sociality $\implies$ bigger brains $\implies$ more opportunities to adapt complex foraging techniques ...
  - **Answer:** More communication $\implies$ more complex social interactions $\implies$ bigger brains $\implies$ more opportunities to evolve better communication or language

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 pair bonds might be more stable
  - **Answer:** If pair bonds are more stable, 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! Preserves amazingly detailed history of growth and growth rate

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 fossils come from males and which from females

Teeth

- Chimpanzees and (especially) gorillas have extreme sexual dimorphism in tooth size
- We can tell our ancestors have less dimorphism than that *even if we can't tell the males from the females*
  - **Answer:** We would expect to see two clear peaks in the distribution

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
- Clues are available
  - Dental enamel
  - Molar development
- But it's a hard problem

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)