Human Cognitive Evolution
who and where we are

BCS153 Week 5.1
2/12/2019
Roadmap

• Recap from last time
• Brain evolution
• Human vs. Non-human primates
• What sets us apart from animals
  ➢ Mimesis
  ➢ Emergence of language
  ➢ Symbolism
Recap from last time...

- Mental state or process = function + event/stimulus

What if we have impaired sensory functions?

e.g. Damage to primary somatosensory cortex

- Central touch disorder → object recognition problems (source: https://goo.gl/D3PAJ5) → altered mental representation

- Paralysis

![Brain Image](http://m.caltech.edu/news/paralyzed-patient-feels-sensation-again-81934)
What’s next?

• What makes us human and how our cognitive system evolves into the current stage?

https://goo.gl/ztB7R5
How much our brain has evolved over time?

Schoenemann PT. 2006.
Proportion of prefrontal cortex to brain size

Data from Glezer (1958); Graph courtesy of P. Schoenemann
Comparison between chimp’s and human brain

• CT scans of chimp’s and human brain endocasts

(Endocast: internal cast of skulls; used to estimate brain size and shape)
So non-human primates are really much dumber than humans?

Visual working memory performance between human and chimps
https://www.youtube.com/watch?v=zsXP8qeFF6A

Why chimps are good at this??

Strategies?
Formation of mental representations?
(i.e., can it be that our linguistic knowledge actually somehow limit the processing efficiency?)
What’s special in human cognition (compared to animals)?

- What sets us apart from animals

- Context-independent mental processes (Donald 1993)
  - Animal behavior conditioned by environment
  - Same behavior in human is not necessarily a reaction to the environment (e.g. “autocuing”)

- Can animals also show context-independent mental process?
What did we have before a complex symbolic system (i.e., language) emerged?

• Mimesis: representing the external entities through actions or emotions

• We are good at mimesis since childhood!

• Related findings
  ➢ Mirror neurons
  ➢ Common coding theory: perception/action co-activation
What’s special in human cognition (compared to animals)?

• What sets us apart from animals

- Emergence of language
- Might be co-evolved with tool making
- Similarities between tool-making and language
  • Both involve sequential learning
  • Being good at tool making → strengthen the regions for language
What’s special in human cognition (compared to animals)?

• What sets us apart from animals

➤ Emergence of language
  o When?
    ➢ Protolanguage (*Homo erectus*)
  o Why?
    ➢ Adaptation
  o How?
    o Lowering of larynx to produce variable speech sounds
    o Autocuing ➔ lexical invention
What’s special in human cognition (compared to animals)?

- What sets us apart from animals
  - Emergence of language
    - Comparison of chimp’s and human’s larynx

Vaneechoutte et al. 2011)
What’s special in human cognition (compared to animals)?

- What sets us apart from animals
  - Emergence of language

Yes. Animals don’t have what we so-defined “language”. But what about those nonverbal skills? How do those evolve before language?
What’s special in human cognition (compared to animals)?

• Lexical invention: emergence of words
  - Emergence of a complex symbolic system (most likely speech)
  - But how do we define a word? What’s the first word like?
  - Sounds sequences → meaning
    - Could be arbitrary (by convention)
    - Onomatopoeia
What’s special in human cognition (compared to animals)?

• Lexical invention
  ➢ Why words are needed
    - Label things
    - Signal dangers
    - Pass on knowledge
    - Social
What’s special in human cognition (compared to animals)?

• Lexical invention
  ➢ New words are created almost everyday!

  Zoodles
  Ribbie
  Instagramming
  Mocktail
  Latinx
  TL;DR
What’s special in human cognition (compared to animals)?

• Invention of symbols (Donald 1993)
• But...wait...what is a symbol?

Quiz: Which of the following is a symbol?
What’s special in human cognition (compared to animals)?
• What sets us apart from animals

➢ Use of symbols to represent complex mental processes
  o Concepts
  o Thoughts
  o Communication
  o Record: to pass on knowledge
From spoken to written: what symbols our ancestors invented ~40,000 years ago?
Why written symbols became necessary

• Information to be remembered beyond memory capacity

• Keep records

• BUT remember, even in modern world, many languages don’t have writing systems!
Development of written symbols

Not just carving something on the stones!
Also requires...

• High-level processing: recognizing the symbols
• Manipulation of fingers to create the symbols
• Cultural convention: could be random at first, but then must be accepted by the social group
Can these symbols be re-arranged to make a “sentence”?

Symbols etched on deer teeth (~16,000 years ago)  https://goo.gl/RkqoNg
Take-home messages

• Evolution is long process and not completed overnight. What happened between 1 million years ago and now is still a mystery. We can only rely on “indirect evidence” to infer the evolutionary process.

• One crucial feature of human cognition: the ability to use “abstract” symbols and create meanings

• More than that, we can write down the symbols.

• Invention of writing has cognitive implications. It requires high-level processing, and also reduce demand to remember lots of things.