Lecture 7: Evolution, Language & Cognition

Cognition, Language & Communication 2013
MSc Brain & Cognitive Science

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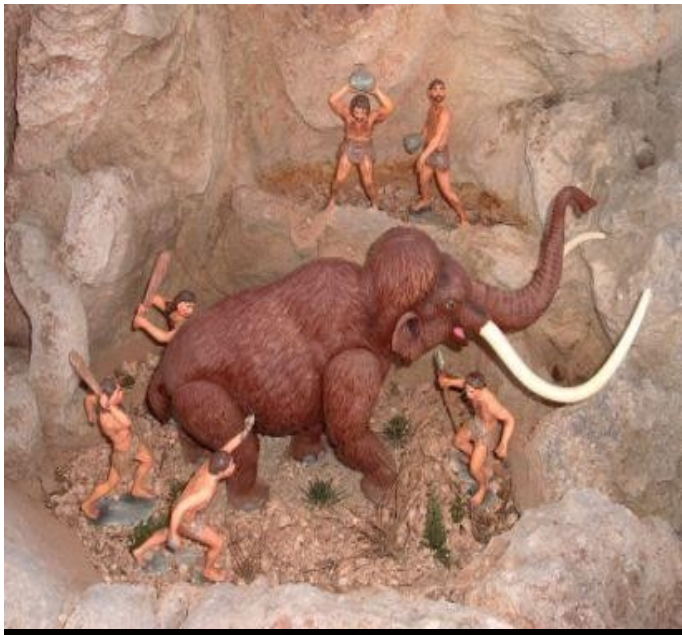
10 October 2013

Outline

- Recap
  - What's special about human cognition, human communication, human language?
- Theories of Language Evolution
  - intermediate stages
  - just-so stories
- Structure of Evolutionary Explanations
- Scenarios for the Evolution of Language & Cognition

Human Cognition

- Problem solving, planning, cooperation (e.g., collaborative hunting)
- Mathematics, technology (e.g., moon landing)
- Social organisation, social cognition, division of labor (e.g., free market economy)
- Music, art (e.g., -..-- --)



Human Communication

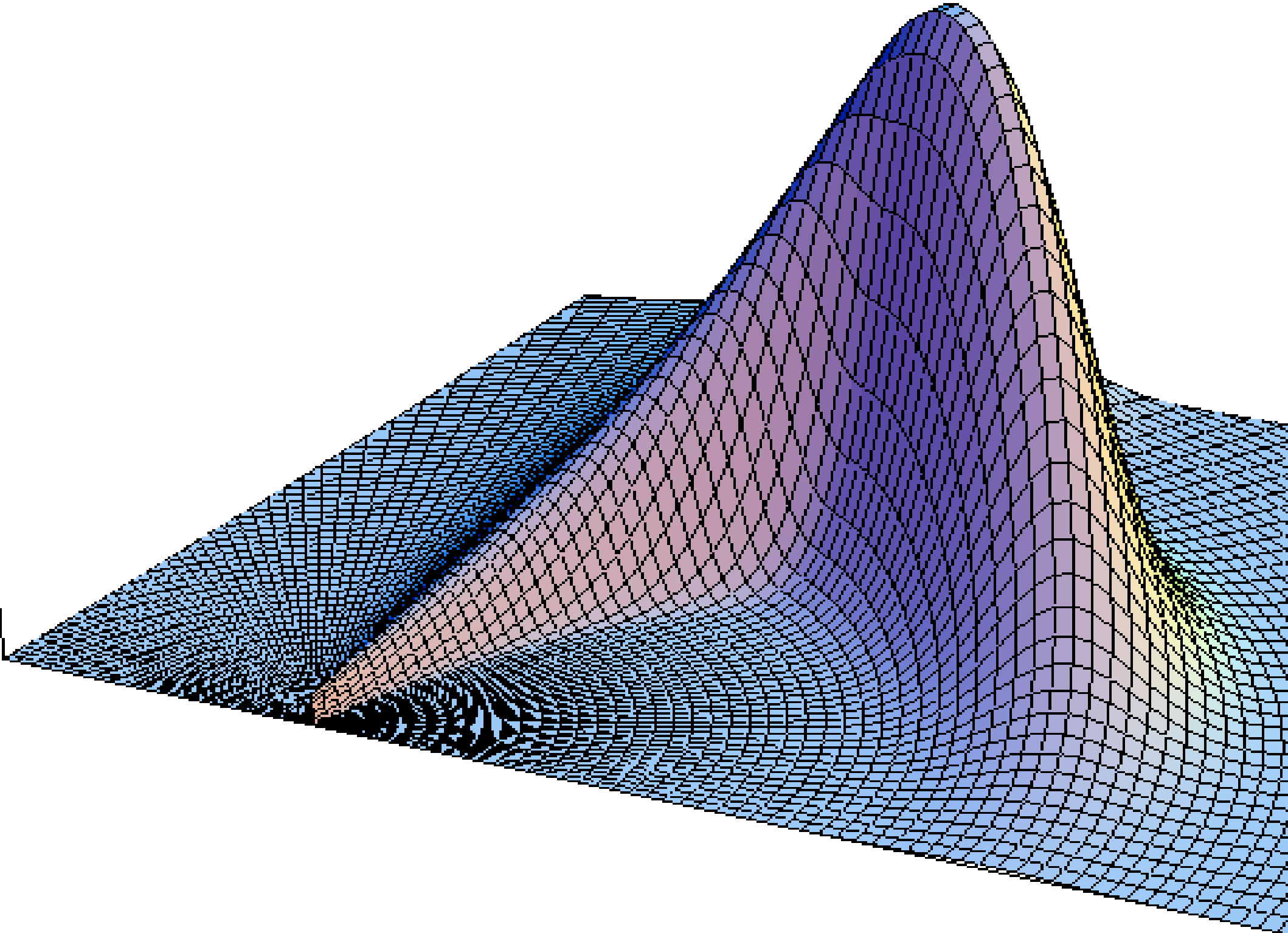
- Many aspects not unusual among great apes
  - e.g., crying, laughter, facial expressions, agression/fear signals, (iconic) gestures
- Other aspects do seem special
  - Amount of information transferred
  - Degree of honesty & cooperativity
  - Language & co-gesturing

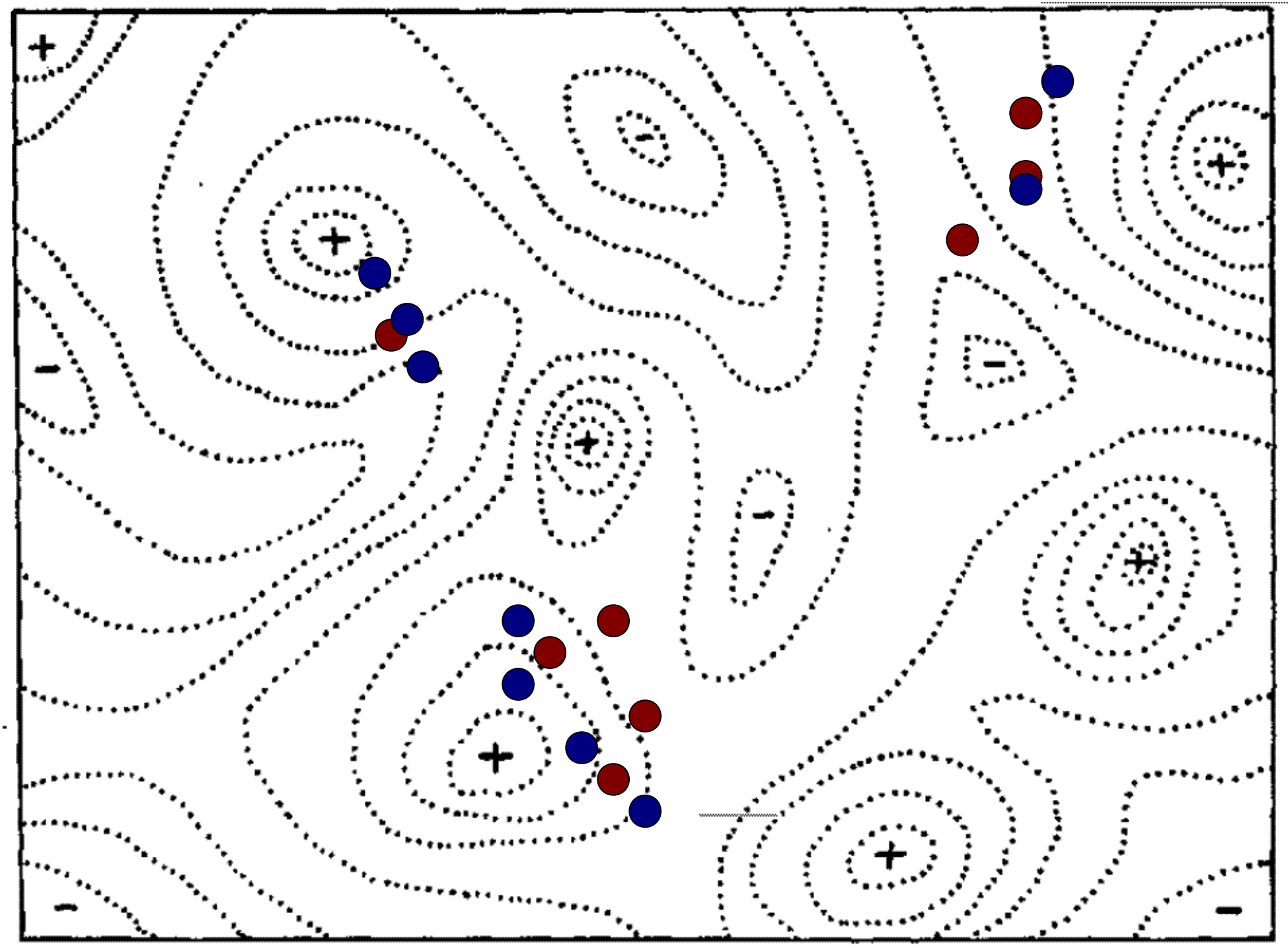
Human Language

- Channel:
  - e.g., vocal tract shape, articulatory control, extreme accuracy/speed in perception & production
- Code
  - Phonology: e.g., combinatoriality
  - Semantics: e.g., symbolism, compositionality
  - Morphosyntax: e.g., phrase-structure, recursion
  - throughout: seemingly arbitrary constraints on variation

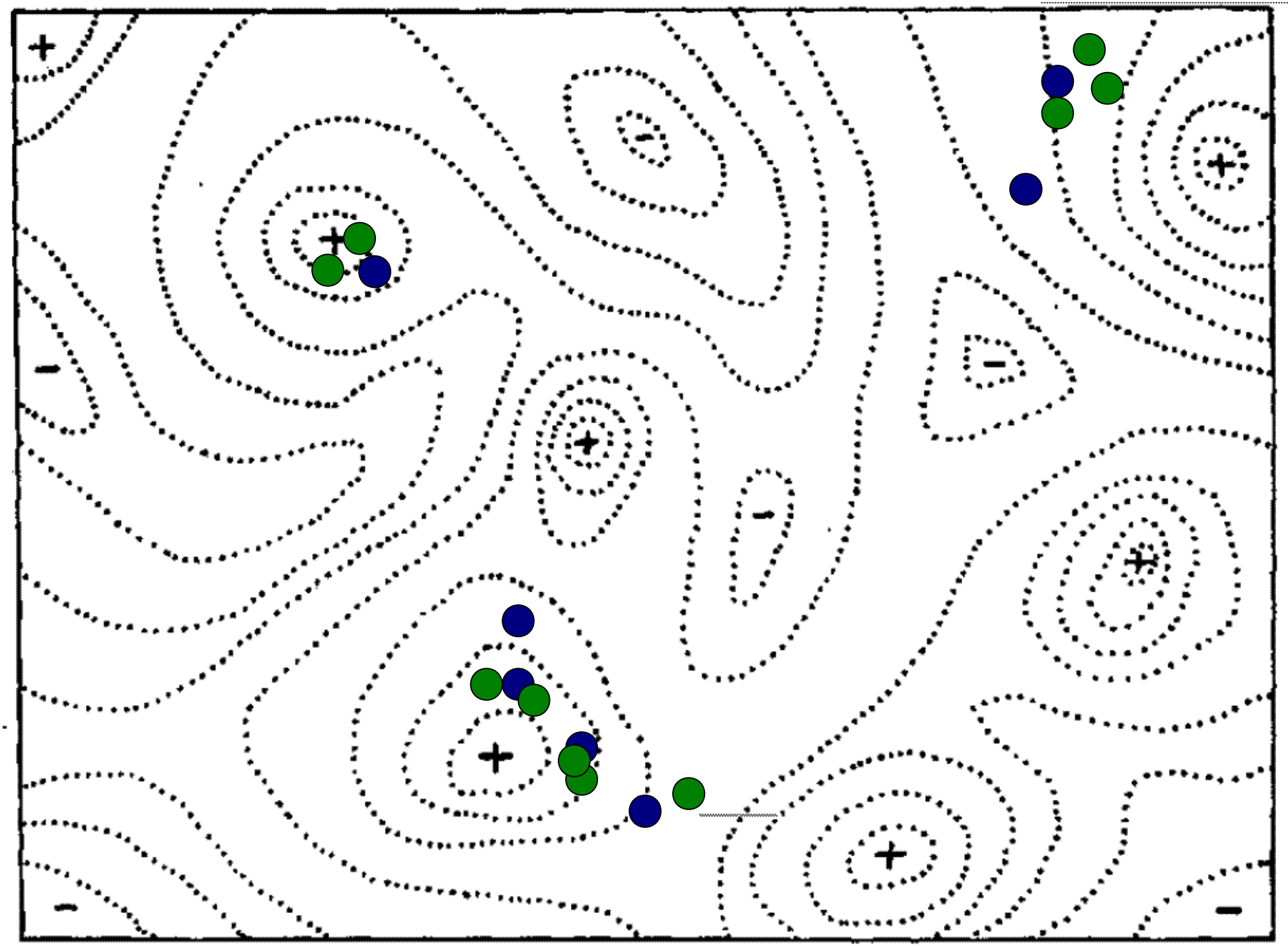
Human Language & Cognition

What is it? Who has it? And how did it evolve?





Sewall Wright, 1932



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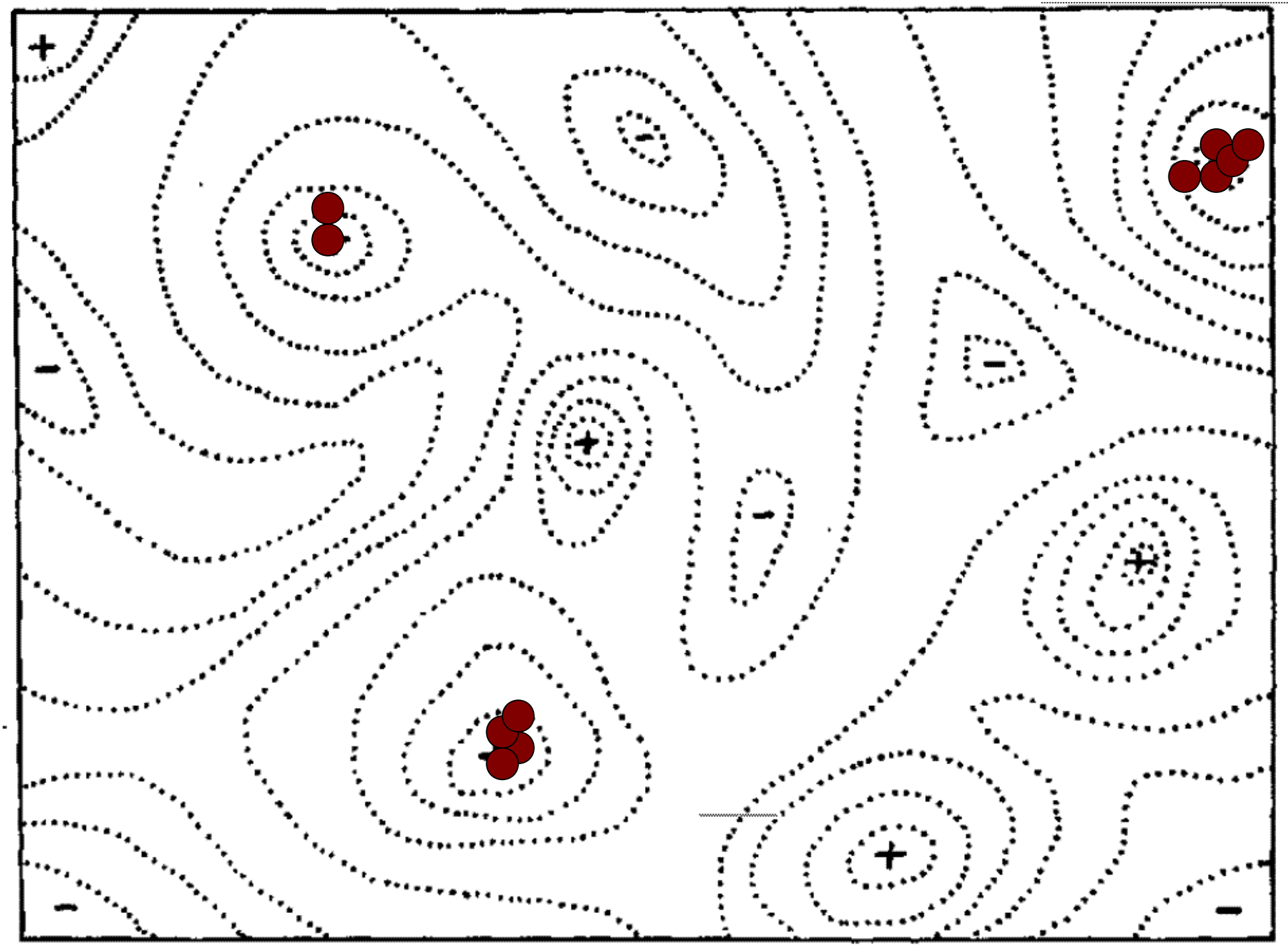

Sewall Wright, 1932

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The problem of cooperation

- Many theories to explain honest signaling

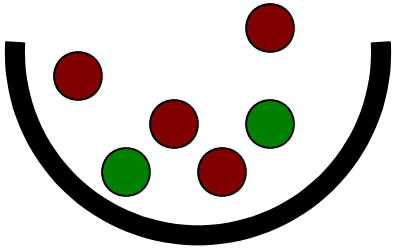
- Benefit for the sender (status, manipulation of receiver)
  - But humans are extraordinarily altruistic
- Kin selection
  - But humans share information with non-kin

Language & cooperation

- Why do we even send honest signals?

- Sending a signal has a cost
- Benefits often for the receiver
- This is a form of altruism

Evolution in structured populations



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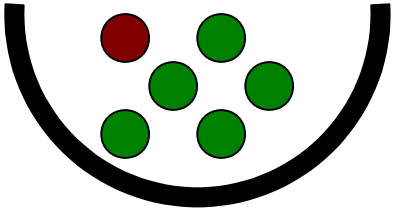

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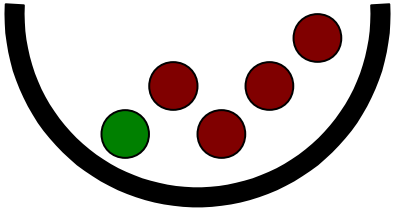

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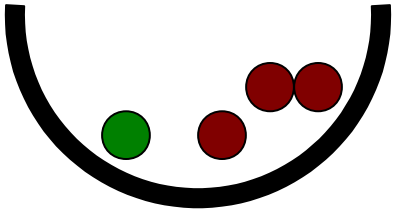

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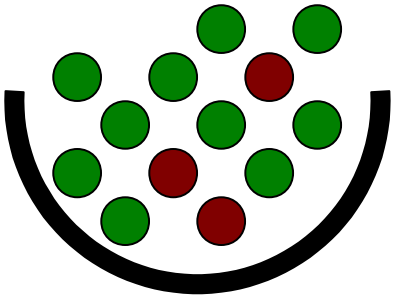

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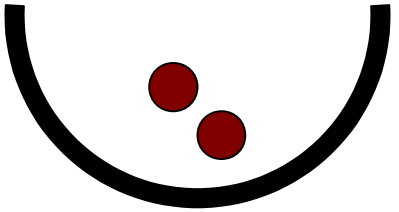

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Evolution in structured populations

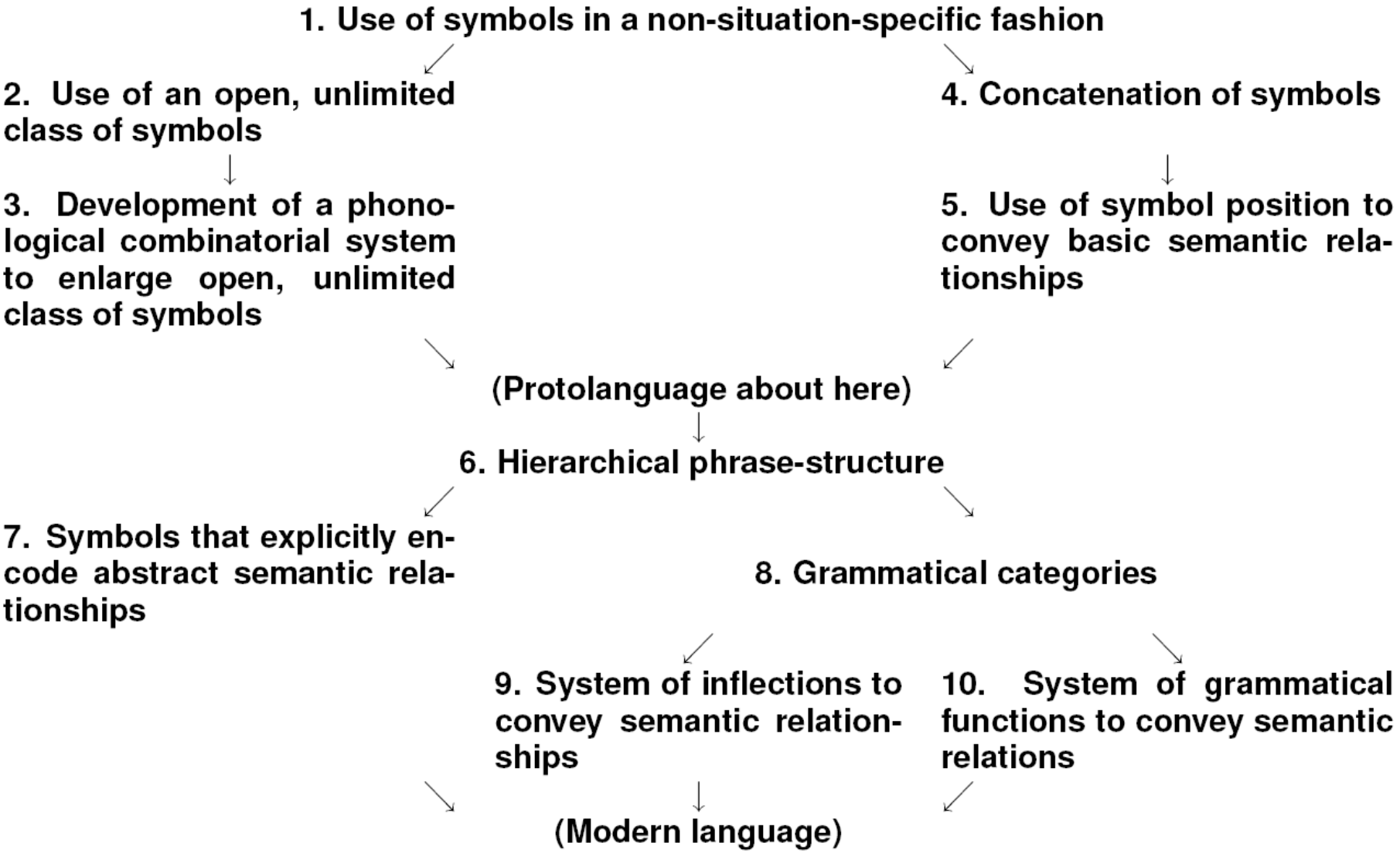
- Defectors outcompete cooperators in every group, but total number of cooperators grows
  - Because groups with many cooperators grow faster

A recipe for evolving altruism

- Divide population in competing groups that cooperate internally
  - In the right condition, proportion of cooperators increases
  - But only in the short run
- Therefore: re-distribute groups randomly
  - Some groups have higher than average ratio of cooperators
  - Number of cooperators will grow again
- Repeat the process

scenarios

Gradualist/adaptationist scenario
(e.g., Jackendoff 2002)



Gradualist/adaptationist scenario
(e.g., Jackendoff 2002)

- Language
  - Vocal learning, speech production/perception, symbolism, compositionality, comb. phonology, hier. phrase-structure, synt. categories, inflections
- Reasoning
  - Counterfactual reasoning, n^{th} order theory of mind, mathematical skills
- Music
  - Harmony, beat induction
- Consciousness, planning, culture, ...

Linguistic sweep scenario

Pre-existing
- hierarchical, conceptual structure
- non-combinatorial communication
- limited cooperativity & social cognition
- hidden potential for more complex cognition

biological evolution

Biological adaptations to new niche
- larger social groups
- increases in social intelligence, cooperativity & communication
- increased reliance on learned, combinatorial signaling

cultural evolution

Cultural adaptations
- learned communication system adapts to preexisting biases of hominin brain (can thus be much more complex than random code)
- communication system becomes representational system for internal thought too
- knowledge transfer from previous generations unlocks potential for complex cognition

biological evolution

New cultural niche
- creates intense selection pressure for linguistic & cognitive skills

cultural evolution

Language & cognition

- Reasoning: logic <-> language (not, and, or, if, then, all, every, some, X is Y, ...)
- Planning: hierarchical plans <-> hierarchical phrase-structure
- Theory of mind: intentional embedding <-> sentential embedding
- Mathematics: number words, context-free syntax of algebra
- Music: pitch, rhythm, phrasal structure, cultural transmission
- Consciousness: inner voice
- Society/technology: eg, Pizarro's capture of Atahuallpa

Key questions

- Is language involved in the uniquely human components of other cognitive skills?
- Is language the 'cause', or did the influence go the other way around (eg, general intelligence)?
  - Spelke: core knowledge & language
  - Social cognition
  - Sequence learning
  - Number cognition