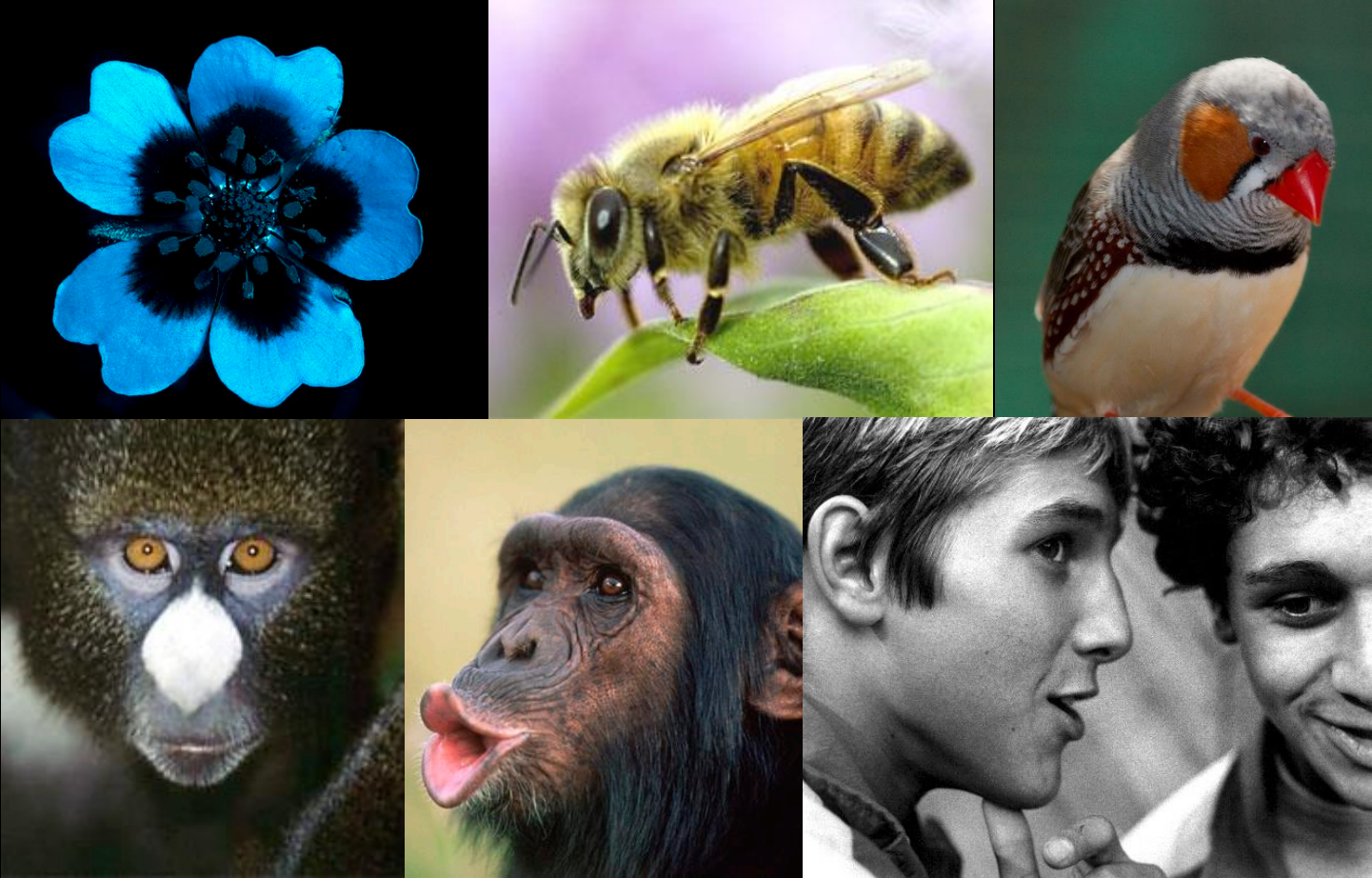# Origins and Evolution of Language
Week 1: Introduction

Kenny Smith

kenny.smith@ed.ac.uk

Communication is widespread, but language is unique
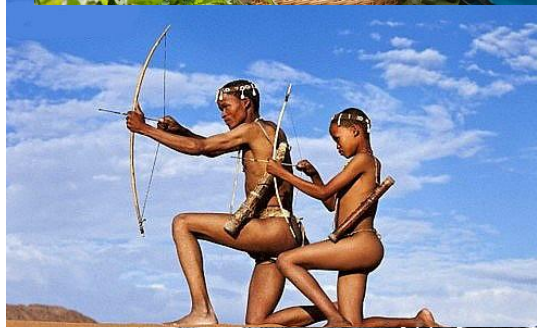
How did language evolve?

Language is **universal** in our species
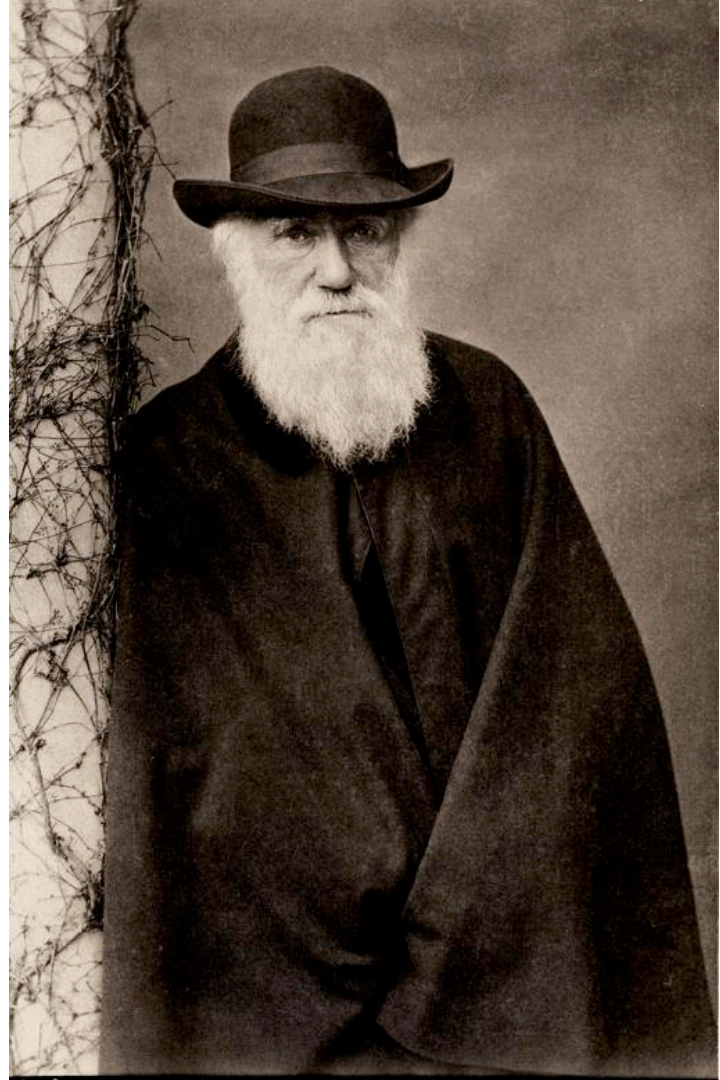
Language is a hugely **adaptive** trait

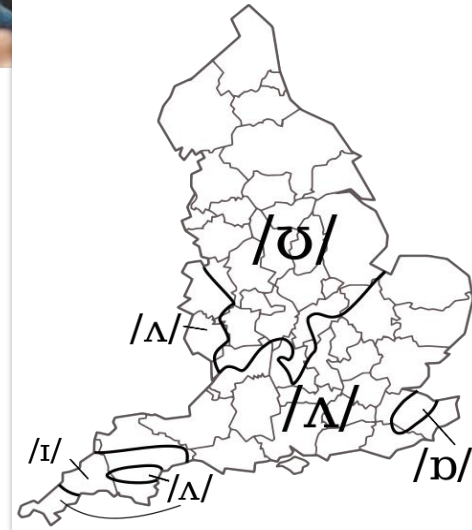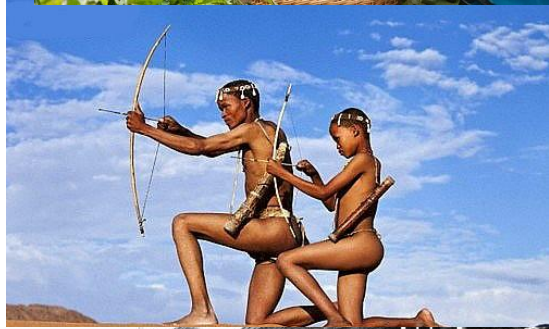# A tool for the communication of knowledge and internal states
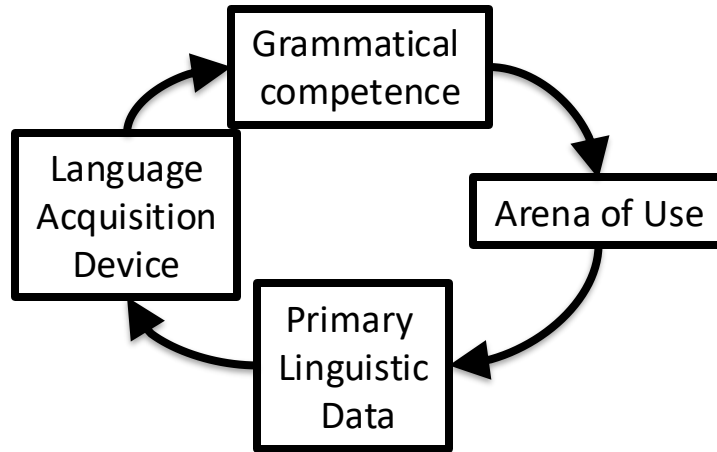
One possible explanation

- Language is just like any other adaptive feature of an organism's biology

- It's an **innate** feature of the human mind

- It evolved by natural selection under pressure for communication

More on this next week

Social learning is ubiquitous in humans

Language is transmitted via repeated **learning** and **use**

Language is shaped as a consequence of these processes
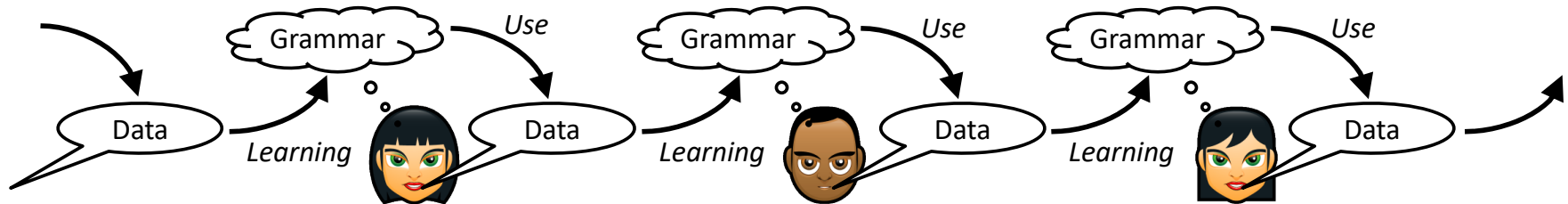
Upper: from Hurford, J. R. (1990). Nativist and functional explanations in language acquisition. In I. M. Roca (Ed.), *Logical issues in language acquisition* (pp. 85–136). Dordrecht: Foris.
Lower: from Smith, K. (2022). How language learning and language use create linguistic structure. *Current Directions in Psychological Science, 31,* 177-186.

Learning, **culture** and biology
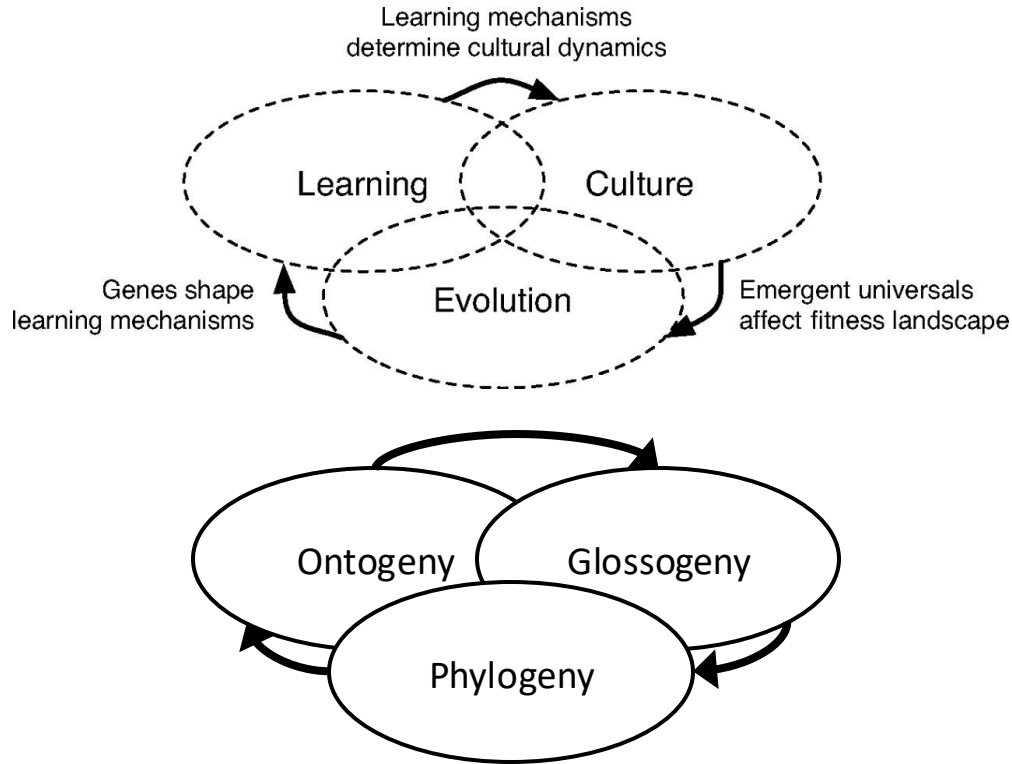
Upper: from Kirby, S., Dowman, M., & Griffiths, T. (2007). Innateness and culture in the evolution of language. *PNAS, 104,* 5241-5245.
Lower: adapted from Fitch, W. T. (2010). *The Evolution of Language.* Cambridge: Cambridge University Press

https://kennysmithed.github.io/origins24/

Schedule

Week	Topic
1	Introduction
2	Natural selection, adaptation and language
3	Intention and structure in animal communication
4	Social learning and cumulative culture
5	Vocal learning, grammar learning
6	Evolution of social cognition
7	Cultural evolution of language
8	Sign language and language origins
9	Gene-culture co-evolution

Pre-lecture preparation

- **Readings must be done in advance**
- Do the reading, answer the quiz questions on Learn
  - Most useful bit for me is the free comment box at the end
- I will assume you have done the readings, we'll talk about them in class

Tutorials

- Tutorials start in week 2
- First tutorial: evolution games
- Later weeks: usually paper discussion / evaluation
- **Attendance will be taken**

Maisy Hallam

Lauren Fletcher

Claire Graf

+ me for MScs

Be prepared for tutorials

Assessment

- 1.5k word essay (50% for undergrads, 40% for postgrads)
  - List of topics to be provided (end of week 3 at the latest)
  - **Due 24th October**

- 1.5k word essay (50% for undergrads, 60% for postgrads)
  - Same list of topics, postgrads can set their own topic (see instructions)
  - **Due 12th December**

Any questions on course structure, assessment, admin etc?

A short preview of where
we are headed

Learning, use, and language design
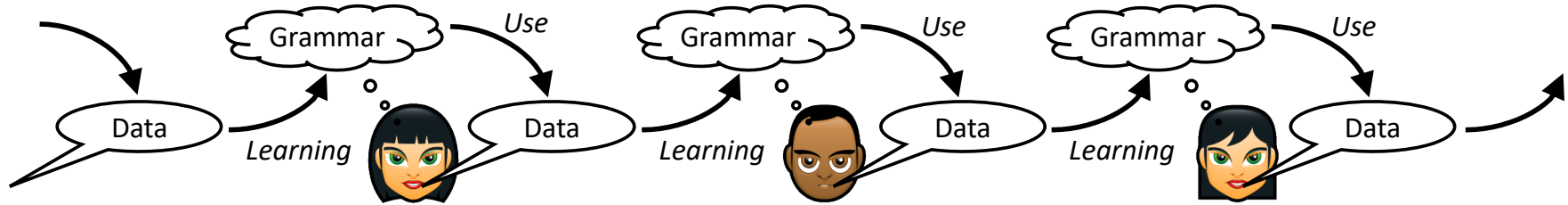
- Language is passed from person to person by **learning**
- People learn from language as it is **used in communication**
- Language **evolves** in response to its learning and use

Rather than us being adapted for language, language has adapted to us
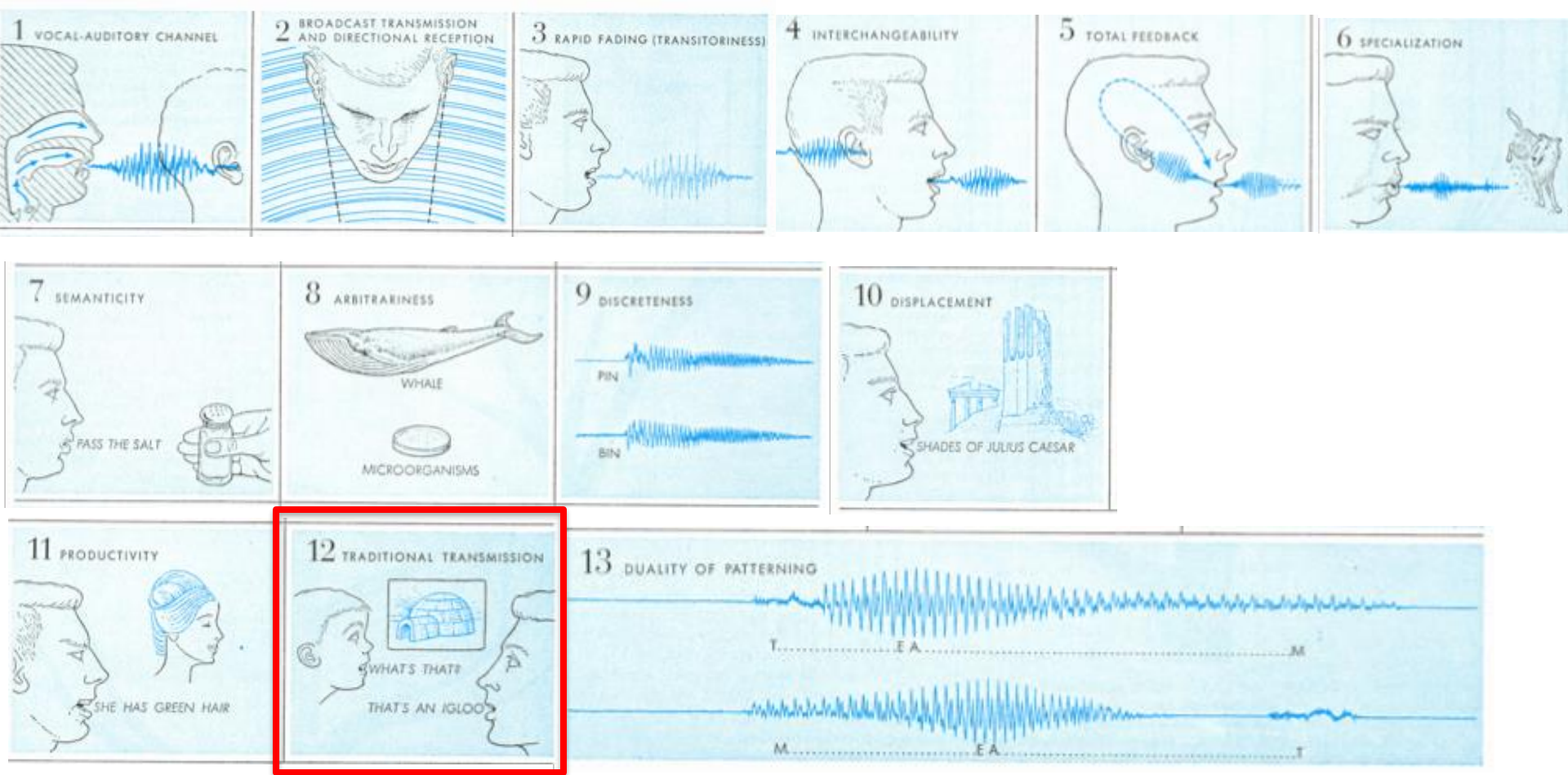
Hockett's **design features**

Hockett, C. F. (1960). The origin of speech. *Scientific American, 203,* 88–96.

What's required for this to happen?

Social learning,
vocal learning,
grammar learning

Mitteilungsbedürfnis
and mindreading

What's required for this to happen?

Social learning,
vocal learning,
grammar learning

Mitteilungsbedürfnis
and mindreading

The idea

- Humans ended up with an unusual combination of traits: ubiquitous social learning (including of vocal signalling) and deep mental interpenetration
  – We can see similar capacities in non-human animals, allowing us to understand their evolutionary history
- This set in place a cultural evolutionary process that shaped how language works
  – We can study these processes in the historical record in the lab

What's the evidence?

- We'll look at social learning and mental interpenetration in humans and other animals
- We'll look at how learning and use of linguistic (or pseudo-linguistic) systems shapes their structure

A word about the bad old days of evolutionary linguistics

"the field has certain advantages. […] To enter it costs little: you can't do experiments, so no expensive equipment is required […] It's still a pencil-and-paper field, though with immeasurable amounts of reading and thinking involved. It is, accordingly, an ideal field for any ambitious young scholar itching to make his [sic] academic bones." (Bickerton, 2007, *Lingua,* p. 525)

Modern evolutionary linguistics is a data-driven, empirical field
(It already was in 2007, but Bickerton was behind the times)

Some fun examples of what learning and use can do (with a focus on Hockett's design features)

Where do symbols come from?

7 SEMANTICITY — PASS THE SALT
8 ARBITRARINESS — WHALE / MICROORGANISMS

- **Icon:** signals resemble meanings
- **Symbol:** *arbitrary* relationship between signal and meaning
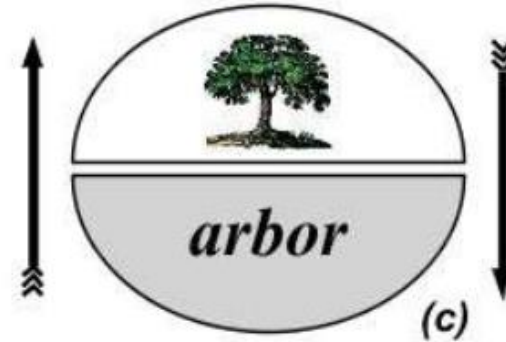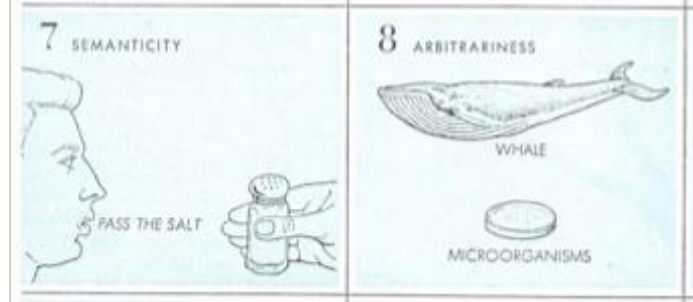
arbor (c)

Ritualization in the lab, with humans

Repeated interaction in a Pictionary-like communication task

Garrod, S. et al. (2007). Foundations of Representation: Where Might Graphical Symbol Systems Come From? *Cognitive Science, 31*, 961-987

Ritualization in the lab, with humans

Repeated interaction in a Pictionary-like communication task

Garrod, S. et al. (2007). Foundations of Representation: Where Might Graphical Symbol Systems Come From? *Cognitive Science, 31*, 961-987

Ritualization in the lab

Garrod, S. et al. (2007). Foundations of Representation: Where Might Graphical Symbol Systems Come From? *Cognitive Science, 31*, 961-987

Transmission in laboratory 'societies'

Caldwell, C. A., & Smith, K. (2012). Cultural evolution and the perpetuation of arbitrary communicative conventions in experimental microsocieties. *PLoS ONE, 7,* e43807.

Transmission in laboratory 'societies'

Caldwell, C. A., & Smith, K. (2012). Cultural evolution and the perpetuation of arbitrary communicative conventions in experimental microsocieties. *PLoS ONE, 7,* e43807.

Transmission in laboratory 'societies'

(Rou
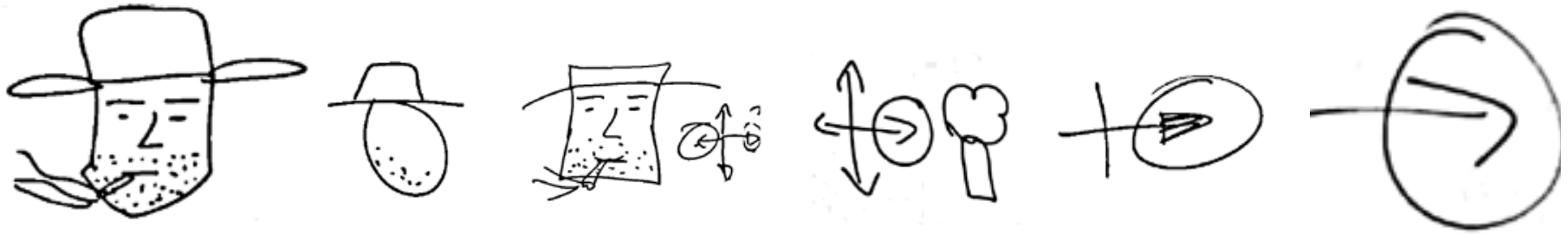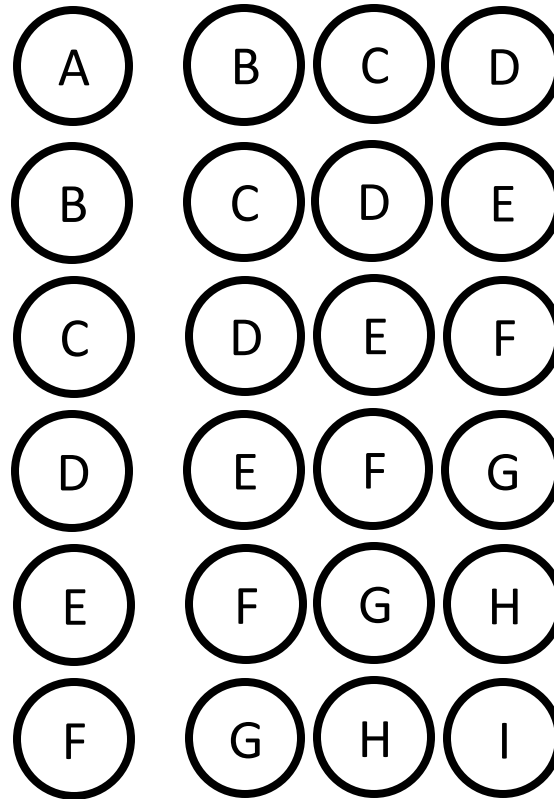
Caldwell, C. A., & Smith, K. (2012). Cultural evolution and the perpetuation of arbitrary communicative conventions in experimental microsocieties. *PLoS ONE, 7*, e43807.
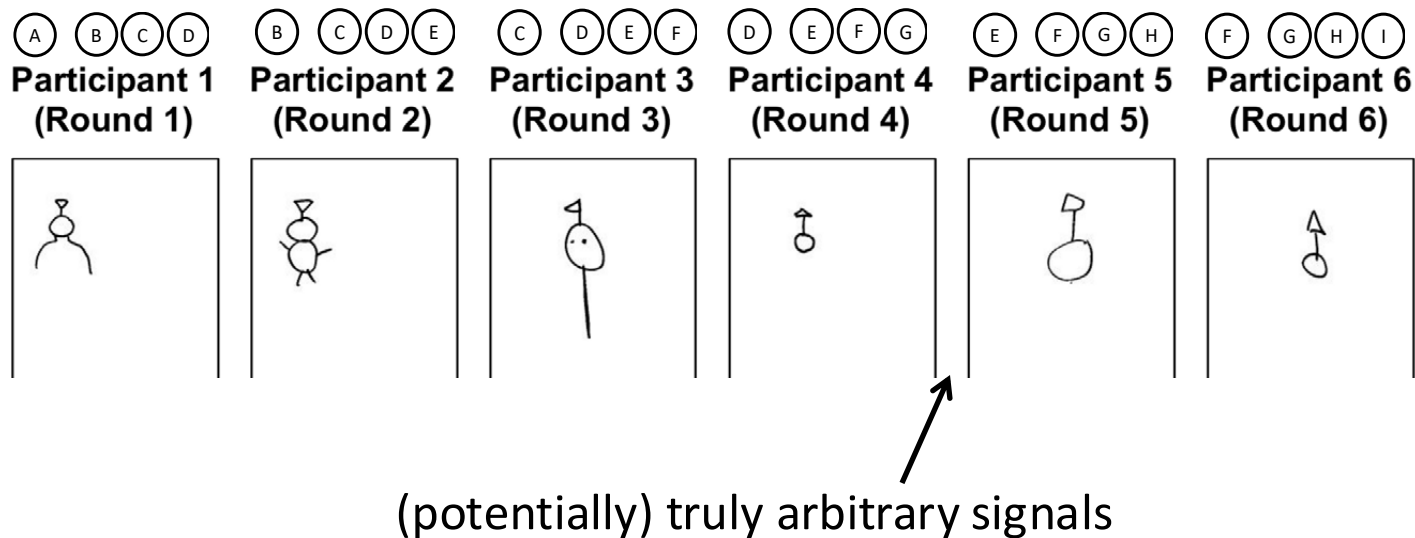
Transmission in laboratory 'societies'

(potentially) truly arbitrary signals

So much for symbols – how about structure?

11 PRODUCTIVITY

SHE HAS GREEN HAIR

13 DUALITY OF PATTERNING

T . . . . E A . . . . M

M . . . . E A . . . . T
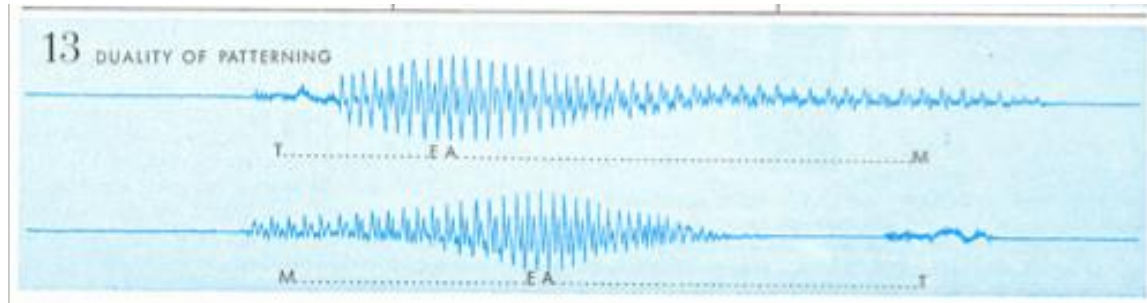
Language's communicative power comes (in part) from its **structure**

Inventory of meaningless units
(10s)

p t d s ð k g ɔ ə a   ...

Inventory of meaningful units
(1000s)

ə   ðə   -əd   dɔg   kat   ðat   spɔt
(a)   *(the)*   *(past tense)*   *(dog)*   *(cat)*   *(that)*   *(spot)*   ...

Inventory of meaningful sentences
(∞)

the cat spotted the dog   *a dog spotted the cat*

a cat spotted the dog   *the dog spotted the cat*

the cat spotted the cat that spotted a dog   ...

the dog spotted the cat that spotted the dog

Studying language transmission in the lab

From Kirby, S., Griffiths, T. L., & Smith, K. (2014). Iterated learning and the evolution of language. *Current Opinion in Neurobiology, 28,* 108-114.
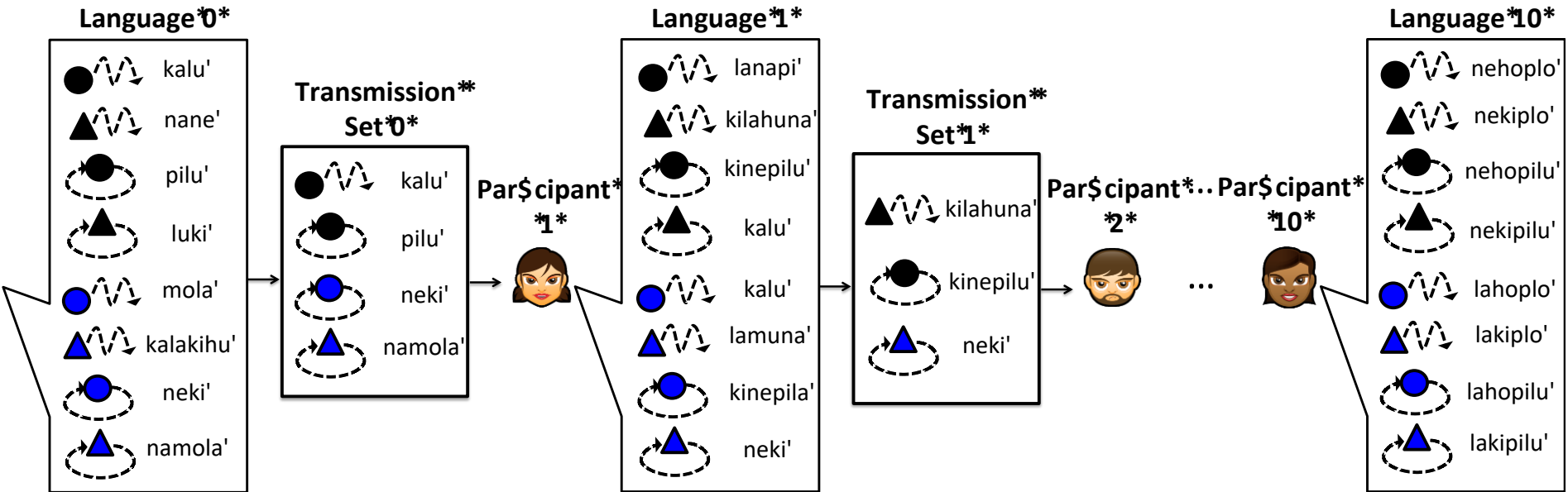
An initial **holistic** language

wimaku	miniki	gepinini	□
nihepi	wigemi	mahekuki	○
wikima	nipikuge	hema	△
miwiniku	pinipi	kihemiwi	□
kinimapi	wikuki	kikumi	○
miwimi	nipi	wige	△
gepihemi	kunige	miki	□
pikuhemi	kimaki	pimikihe	○
mihe	winige	kinimage	△

10 generations later…

ne-re-ki	le-re-ki	renana	□
ne-he-ki	la-ho-ki	re-ne-ki	○
ne-ke-ki	la-ke-ki	ra-he-ki	△
ne-ro-plo	la-ne-plo	re--plo	□
ne-ho-plo	la-ho-plo	re-ho-plo	○
ne-ki-plo	la-ki-plo	ra-ho-plo	△
ne--pilu	la-ne-pilu	re--pilu	□
ne-ho-pilu	la-ho-pilu	re-he-pilu	○
ne-ki-pilu	la-ki-pilu	ra-ho-pilu	△

If structure arises from social learning, why isn't it more common?

Claidière, N., Smith, K., Kirby, S., & Fagot, J. (2014). Cultural evolution of a systematically structured behaviour in a non-human primate. *Proceedings of the Royal Society B, 281,* 20141541.

∞ random trials

50 transmission trials

→ See / produce

⇢ Transmit

Transmission trials

Random trials

Baboon Generation n

Baboon Generation n+1
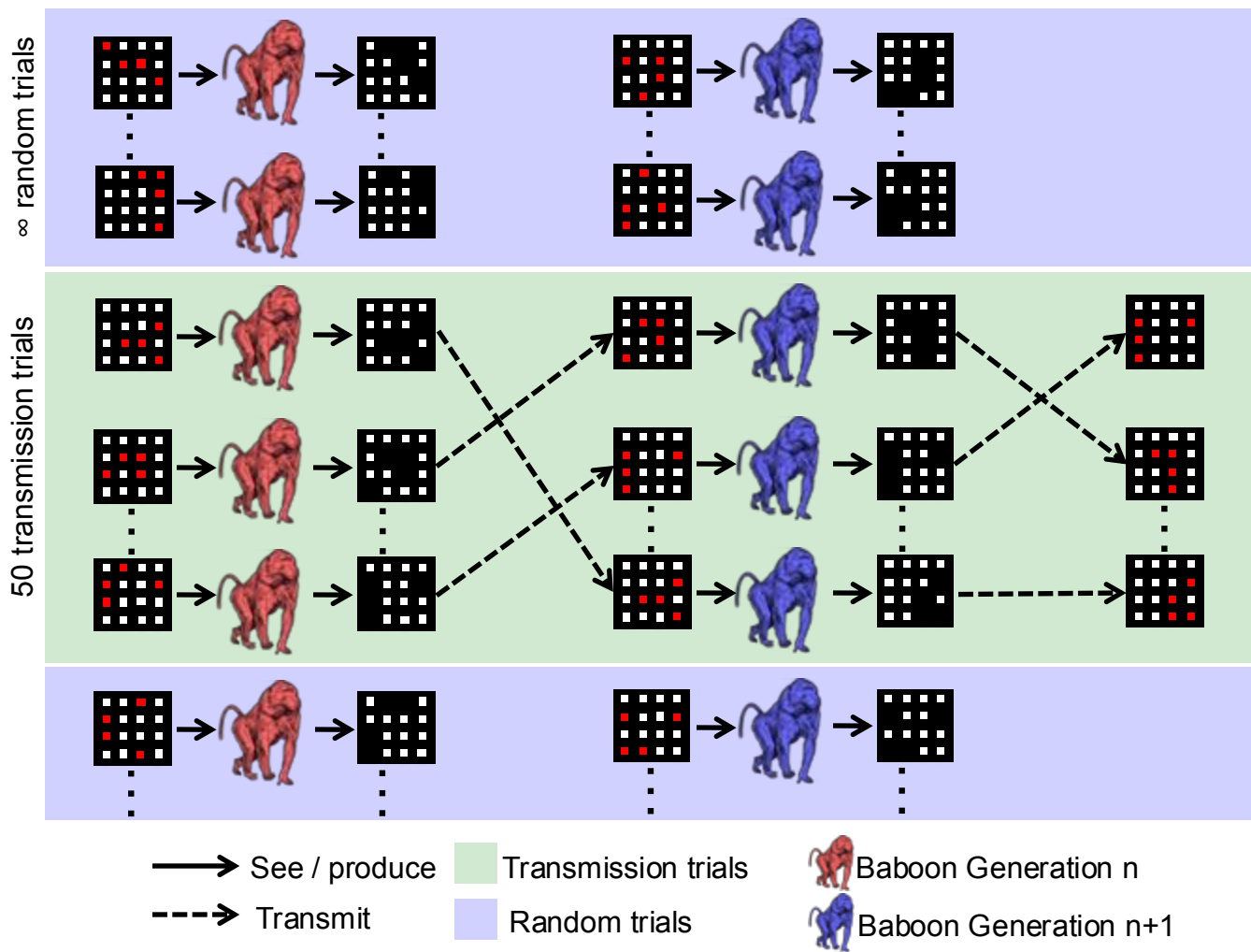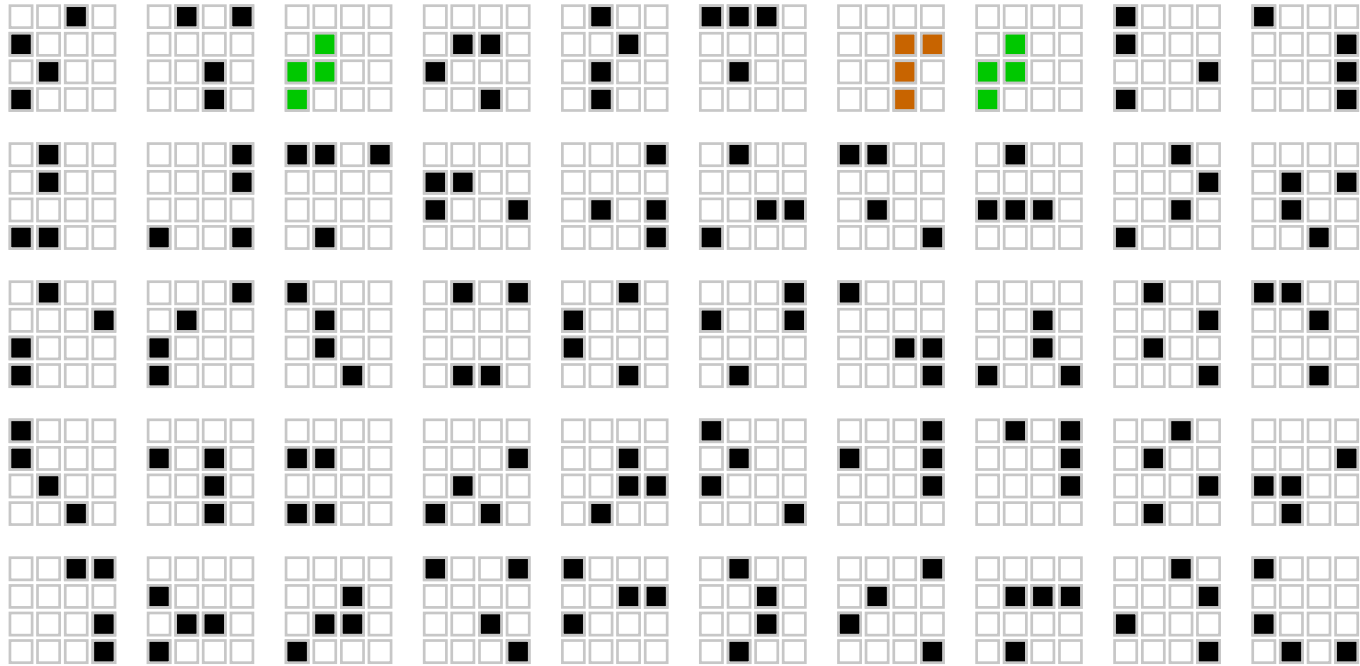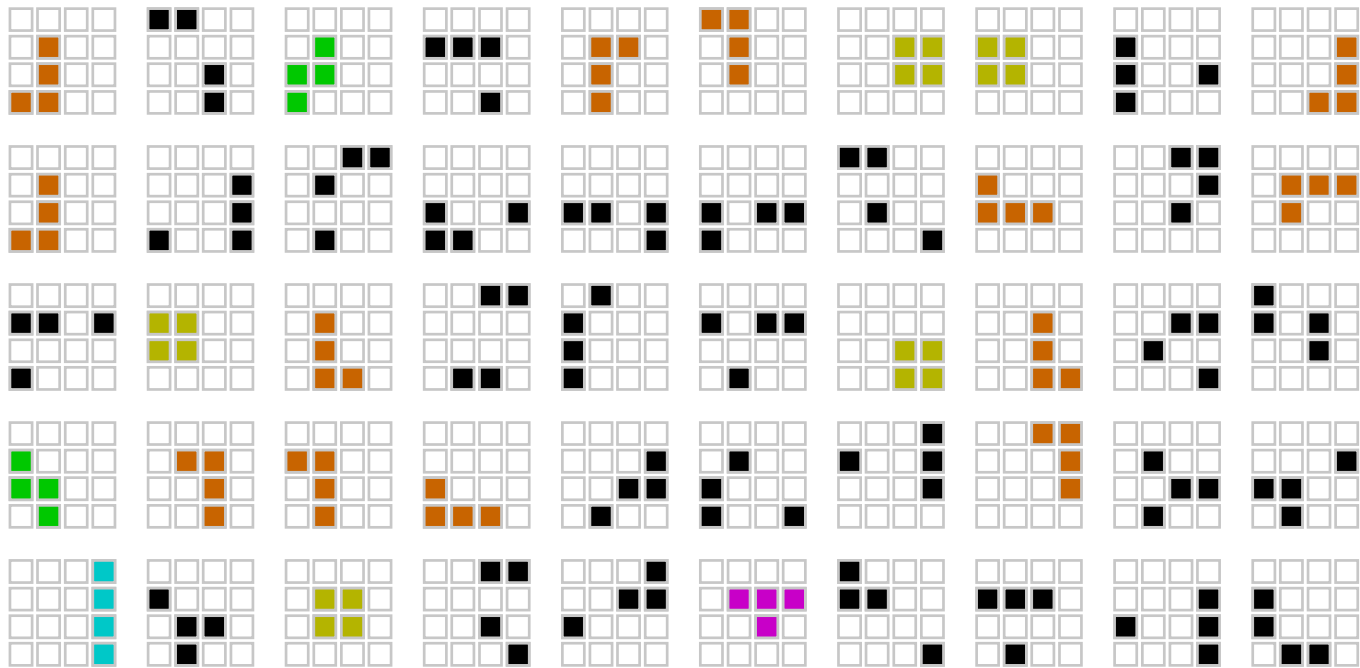
Random grids
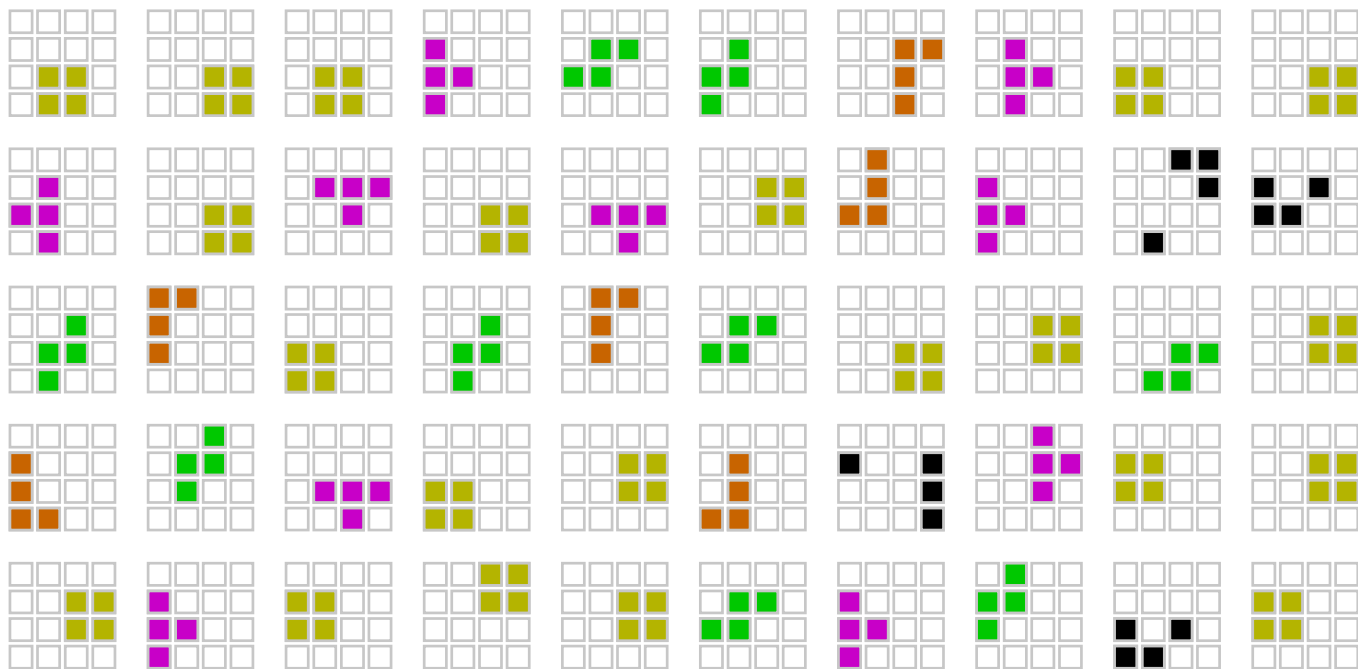
Generation 1
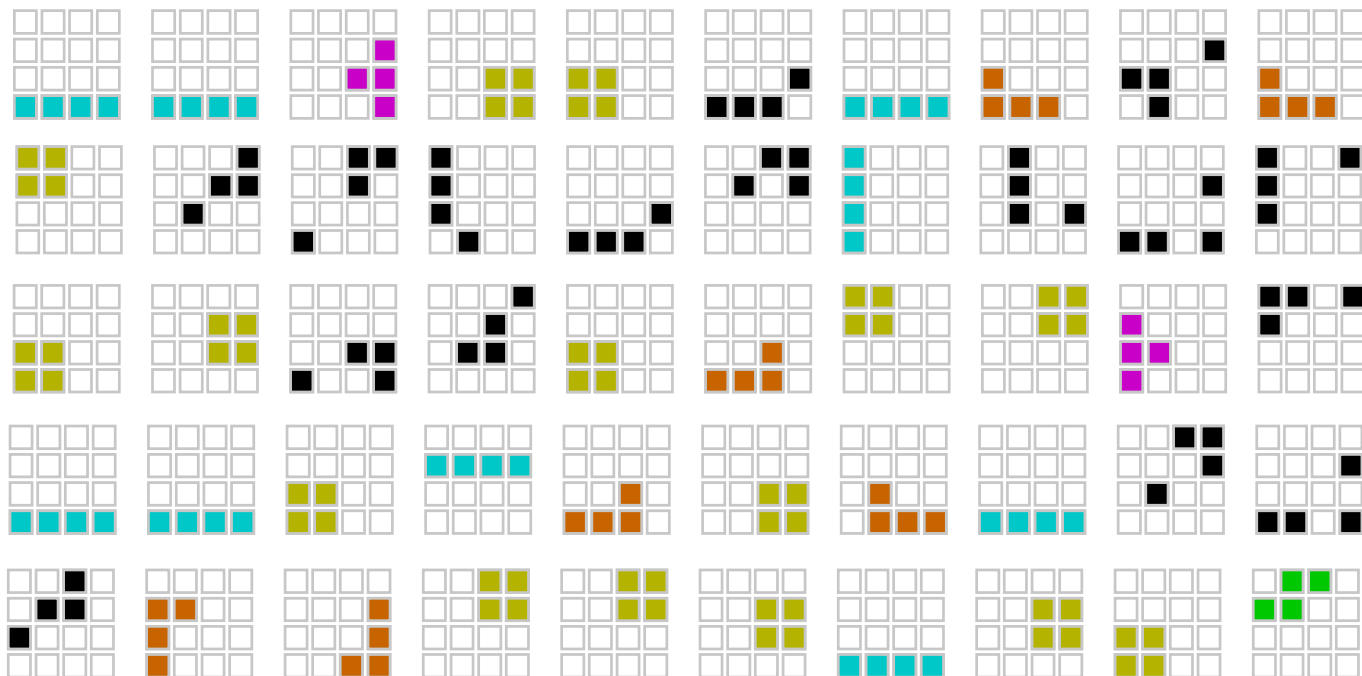
Generation 12

Emergence of a **system**

Emergence of a **system**

Chain 1, Generation 12

Systematic structure develops even in baboons (if you scaffold their environment in the right way)

The idea

- Humans ended up with an unusual combination of traits: ubiquitous social learning (including of vocal signalling) and mental interpenetration
- This set in place a cultural evolutionary process that shaped how language works

Schedule

Week	Topic
1	Introduction
2	Natural selection, adaptation and language
3	Intention and structure in animal communication
4	Social learning and cumulative culture
5	Vocal learning, grammar learning
6	Evolution of social cognition
7	Cultural evolution of language
8	Sign language and language origins
9	Gene-culture co-evolution

Readings and next lecture

- What is evolution? What is adaptation? How can we learn about humans by studying other animals?

- Language as a biological adaptation, evolved through natural selection under pressure for communication