

Origins and Evolution of Language

Week 3: Intention and structure in animal communication

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Assignment brief now on the course page

Note the **detailed** instructions, cover sheets, link to the FAQ, example essays from previous years, and deadlines for questions

Plan for today

- Brief summary of Fitch (2020)
- Spotlight on **intentional** communication in primates
- Spotlight on **structure** in primates and birds
- Spotlight on **learned communication** in primates and birds

But first - your questions

An excellent question by email (edited a little)

“In the pattern-grid experiment with the bonobos, the animals’ tendency was to replicate terominos. If the experiment was iterated for long enough, you suggested, this tendency would converge such that all the grids would become 2x2 squares ... would we not need to understand why it is that the languages of human beings do **not** converge to 2x2 squares, so to speak: why we develop systems that carry a far greater processing burden than if they were to collapse into basic (but more predictable) patterns?”

This may seem like a silly question: languages that were highly repetitive would not be at all **useful** when deployed in reference to the complex real world. But here I stumble across a problem that I’ve been coming up against a lot when thinking about Pinker ... We surely wouldn’t want to deny that all of the features associated with language - systematicity, temporal and spatial displacement, ability to abstract, speculate and fictionalise, etc. - are useful?”

The core of the argument (from Pinker & Bloom, 1990)



“We will suggest that language shows signs of design for the communication of propositional structures over a serial channel.

The propositions in [human thought] are relational structures whose symbols pertain to people, objects, and events, the categories they belong to, their distribution in space and time, and their causal relations to one another ... The causal relations governing the behavior of other people are understood as involving their beliefs and desires, which can be reconsidered as relations between an individual and the proposition that represents the content of that belief or desire”

Pinker, S., & Bloom, P. (1990). Natural language and natural selection. *Behavioural and Brain Sciences*, 13, 707-784.
Lengthy quote is from p. 712-713

The core of the argument (from Pinker & Bloom, 1990)



“We would want to be able to

- refer to individuals and classes,*
- to distinguish among basic ontological categories (things, events, places, times, manners, and so on),*
- to talk about events and states, distinguishing the participants in the event or state according to role (agents, patients, goals),*
- to talk about the intentional states of ourselves and others*
- to express distinctions of truth value, modality (necessity, possibility, probability, factivity)*

The core of the argument (from Pinker & Bloom, 1990)

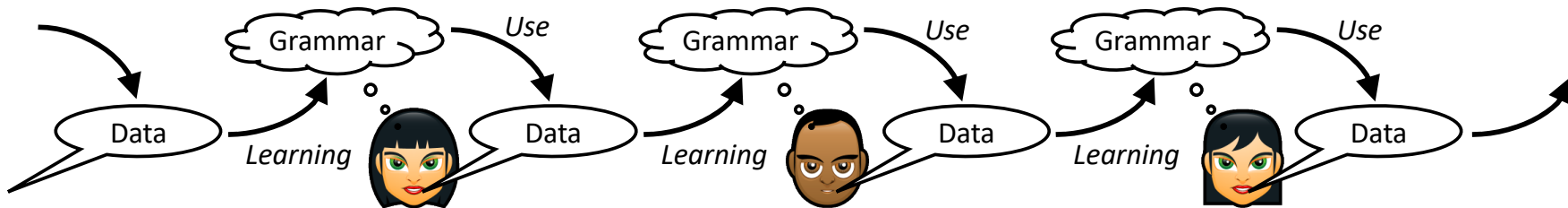


- *to comment on the time of an event or state, including both its distribution over time (continuous, iterative, punctate) and its overall time of occurrence*
- *to encode an unlimited number of predicates, arguments, and propositions*
- *to be able to use the same propositional content within different speech acts; for instance, as a question, a statement, or a command.*
- *to focus or to put into the background different parts of a proposition, so as to tie the speech act into its context of previously conveyed information and patterns of knowledge of the listener. ”*

The core of the argument (from Pinker & Bloom, 1990)



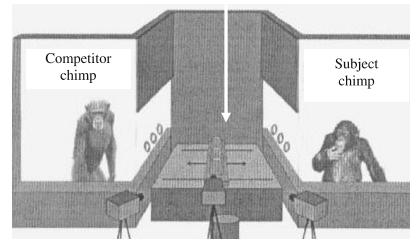
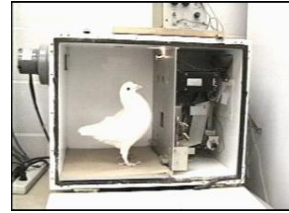
“All we have argued is that human language, like other specialized biological systems, evolved by natural selection. Our conclusion is based on two facts that we would think would be entirely uncontroversial: Language shows signs of complex design for the communication of propositional structures, and the only explanation for the origin of organs with complex design is the process of natural selection.” (p. 726)



Summary of Fitch (2019)

Non-humans have rich mental lives...

- Concepts and categories
- Memory and planning
- Hierarchically-structured behaviours
- Tool use
- Knowing what others know
- ...



Alex the parrot

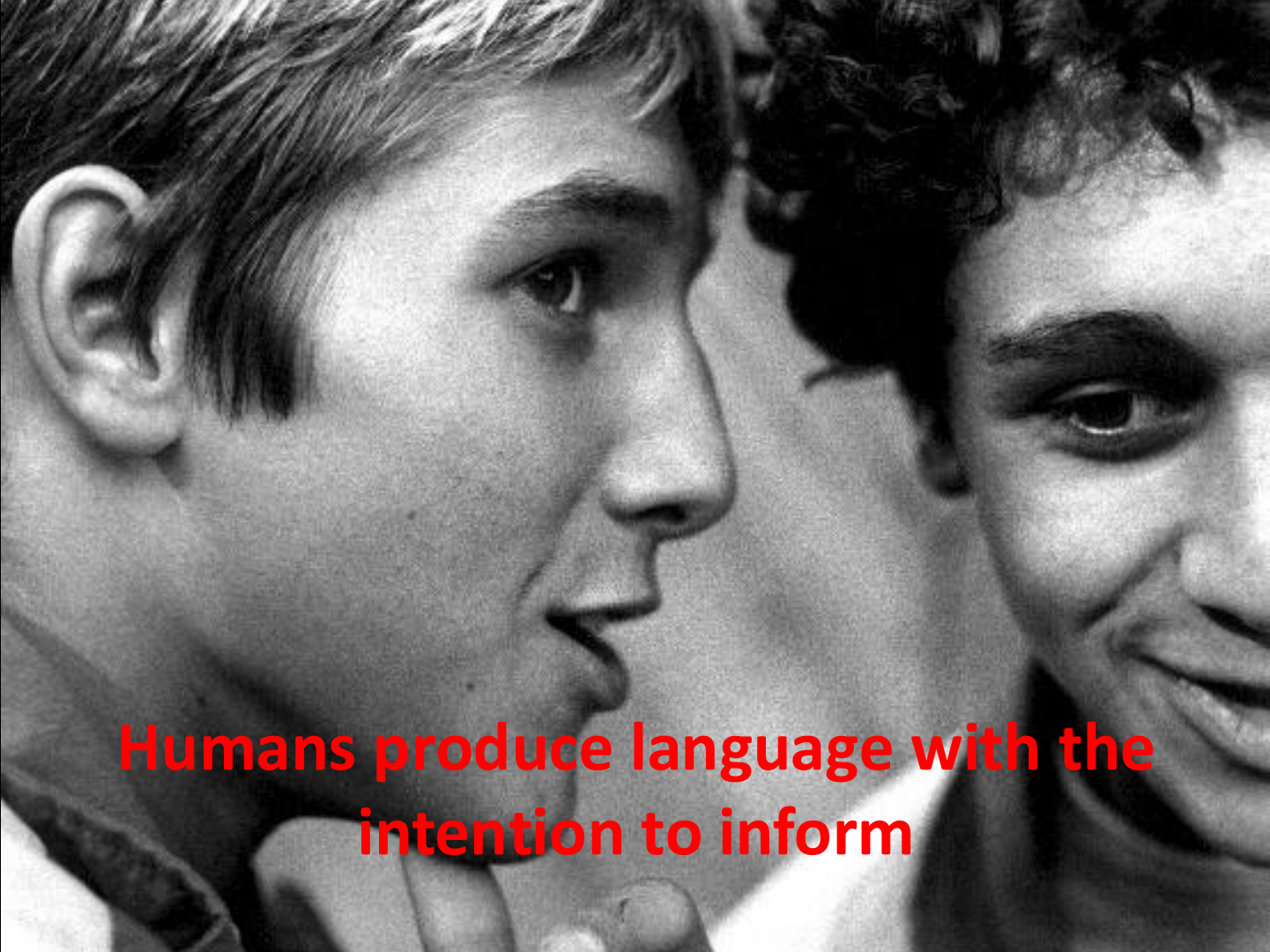


...but their communication systems seem *relatively* restricted

- In the things they communicate about
- ‘Innate’ signal repertoires
 - Particularly among primates
 - But see later today
- “Functionally referential”
 - But not intentional (?)
- Complex vocalisations
 - But less obviously in primates (?)
 - And complexity not subserving meaning



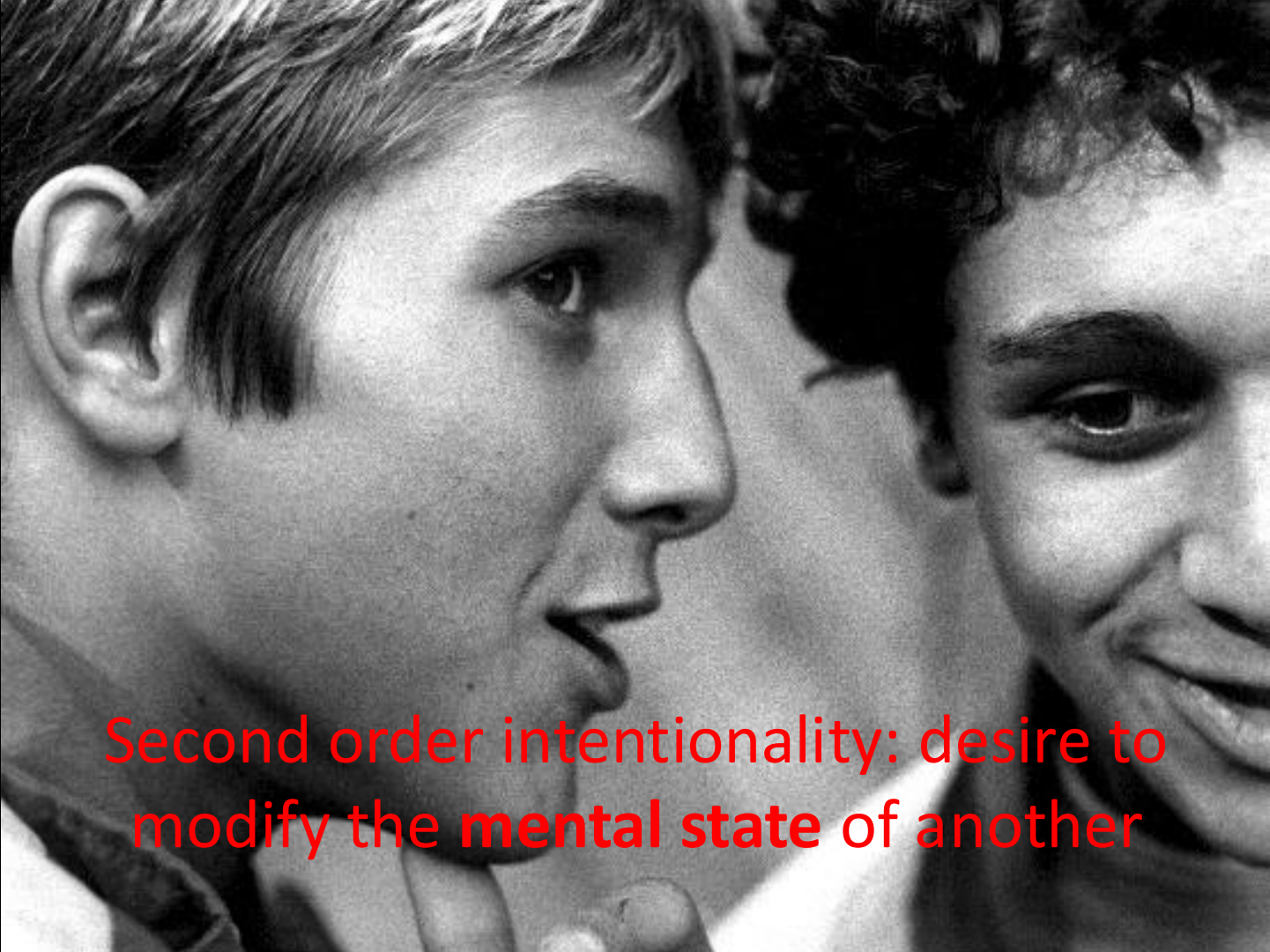
Intentional communication in primates



**Humans produce language with the
intention to inform**



First order intentionality: desire to modify the **behaviour** of another



Second order intentionality: desire to modify the **mental state** of another

Functionally referential communication in primates

Can Monkeys Talk?

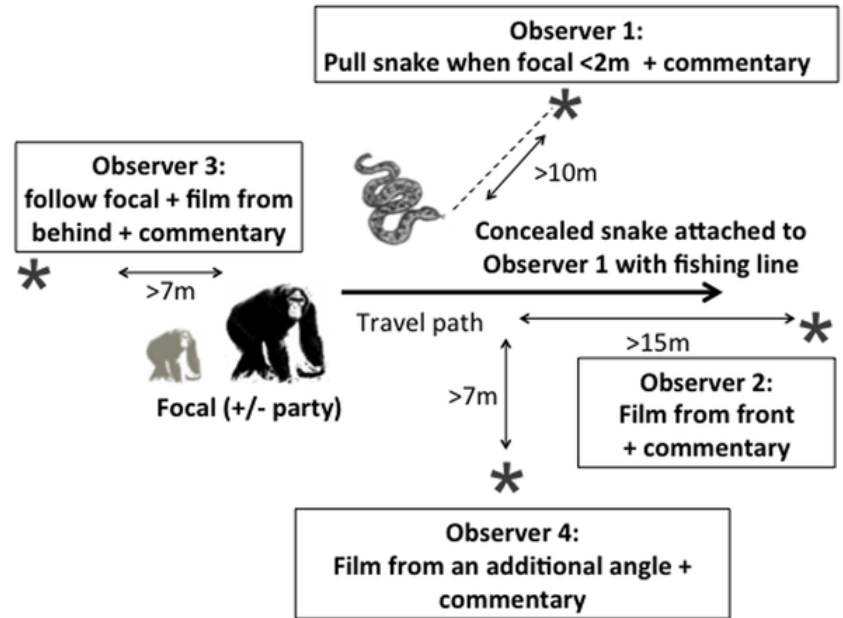
Absence of intentional communication in macaques?

- Mothers and infants
- **Ignorance condition:** Mother knows something, infant doesn't
 - Presence of food, predator
- **Knowledge condition:** They both know it
- **Mothers' vocalizations didn't differ between conditions**



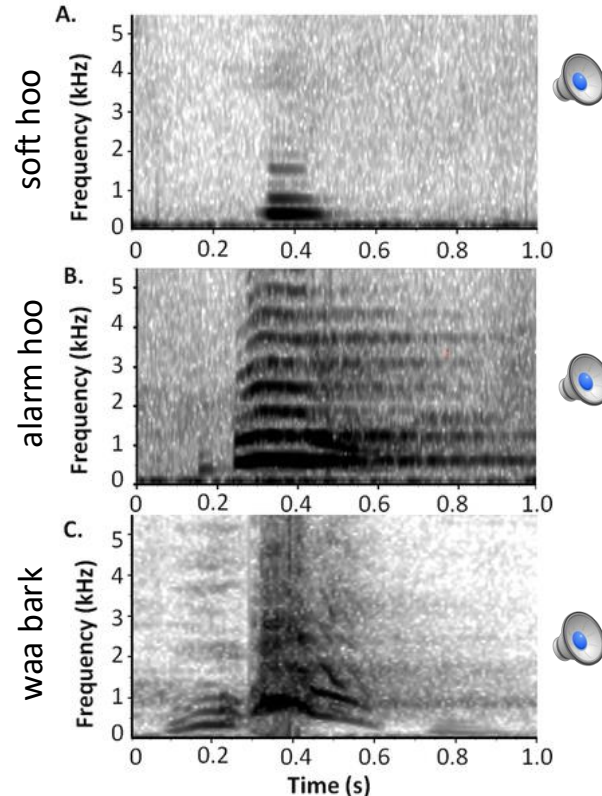
Intentional communication in chimpanzees?

- Wild chimps
- Surprised with snake model, either alone or in part of group
 - Presence of others matters?
 - Gaze-alternation?
 - Persist until others safe?



Intentional communication in chimpanzees?

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Structure in primate and avian
communication

Learning in primate and avian
communication

Reminder: structure in language

Inventory of meaningless units
(10s)



Inventory of meaningful units
(1000s)



Inventory of meaningful sentences
(∞)

p t d s ð k g ɔ ə a ...

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

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

Song in gibbons



Putty-nosed monkey

Pyow = leopard

Hack = eagle

Pyow-hack = move

wooclap.com, code INMRBS

What does this system share with language?

1. Not enough to make a comparison
2. Combinatorial phonology
3. Compositional syntax



Campbell's monkey

Leopard alarm



Eagle alarm

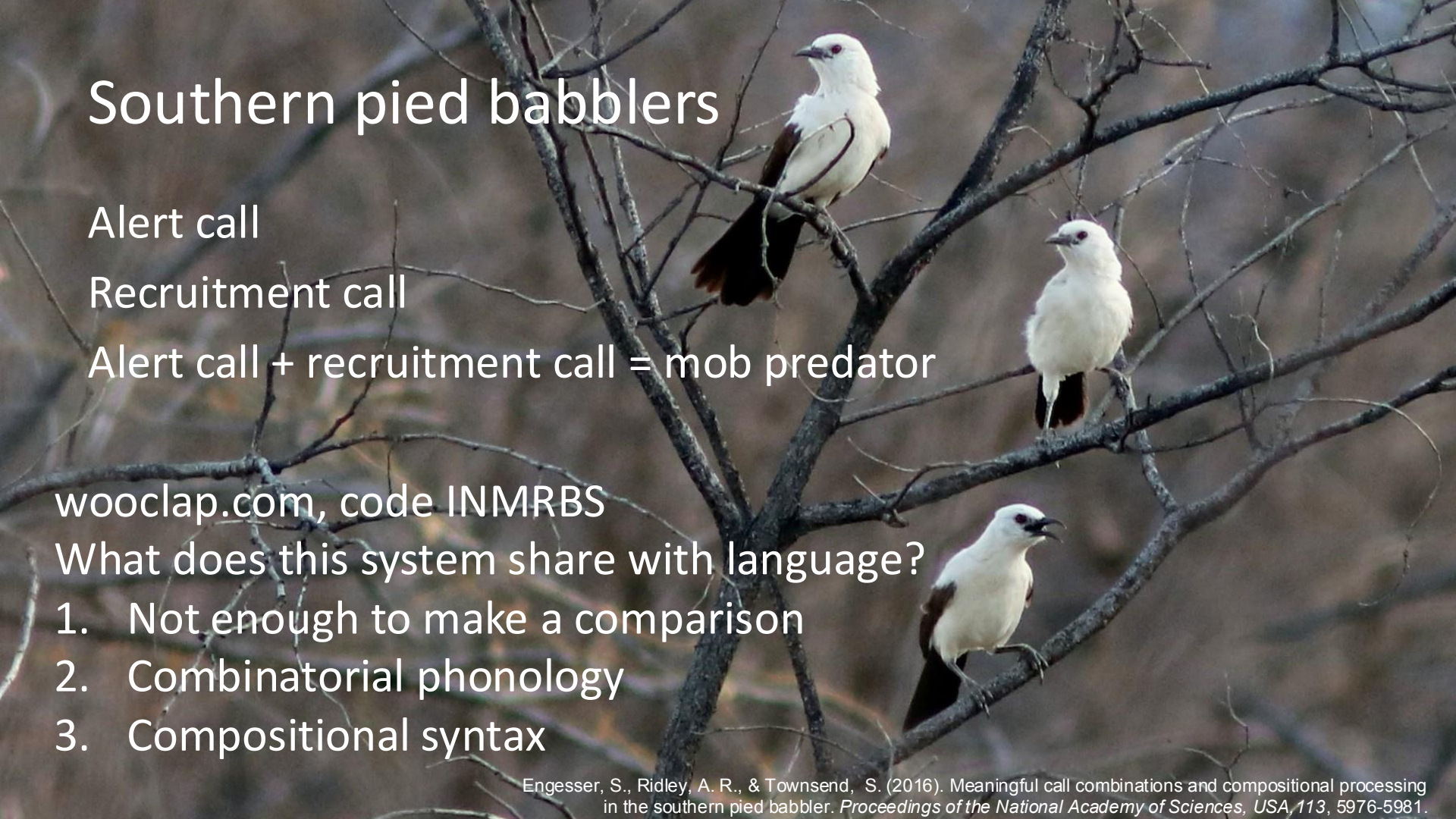
Boom = not urgent

wooclap.com, code INMRBS

What does this system share with language?

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3. Compositional syntax

Southern pied babblers

The background of the slide is a photograph of three Southern pied babblers perched on a dark, leafless tree branch. The birds have white plumage with dark brown or black wings and tails. They are positioned at different heights on the branch, looking in various directions.

Alert call

Recruitment call

Alert call + recruitment call = mob predator

wooclap.com, code INMRBS

What does this system share with language?

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Chimpanzees

Alarm huus: alarm or threat

Waa bark: recruitment call (?)

Alarm huu + waa bark = recruitment signal in a dangerous situation (?)

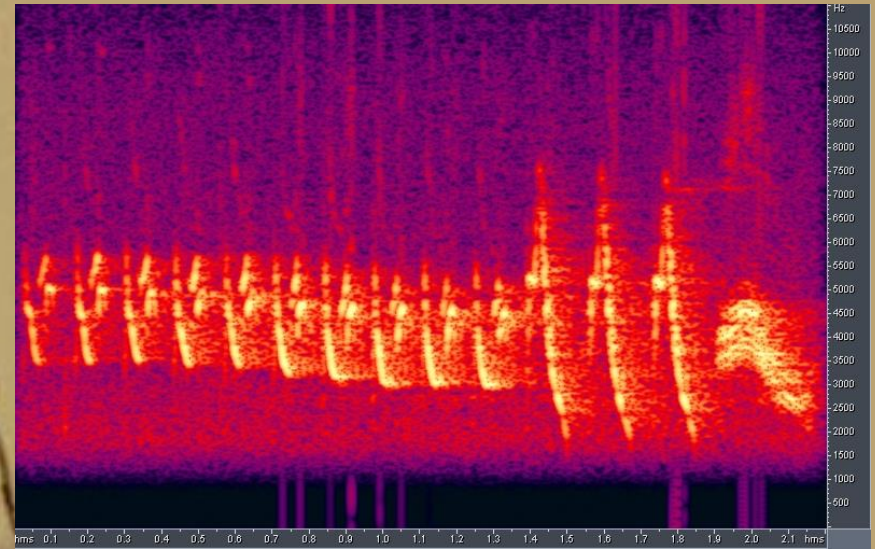
Video illustrating the reaction to the
playback of an “*alarm-hoo+waa-bark*”
combination.

Abundant evidence of structure in **bird song**

- Songs consist of sequences of notes
- Constraints on the order of combination
- Structure in the signal doesn't subserve meaning
- **Vocal learning**
 - Absent in primate vocal behaviour (?)
- Ultimate functions
 - Territorial defense
 - Courtship
 - Pair/group bonding (duetting)



Chaffinch song



Structure of chaffinch song (British)

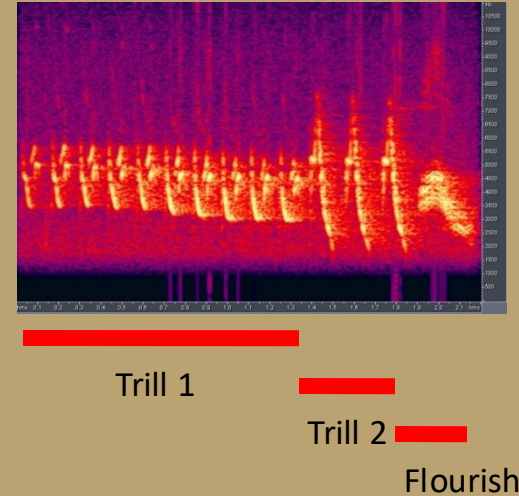
Each bird has 1-6 song types

- Mean 2-3

Order of notes in each song fixed

2-5 trill phrases, followed by a flourish

- Trill: sequence of 2 or more near-identical units
 - Number of repetitions can vary
- Flourish: no repetition
- Transitional notes: single notes between trill phrases
- Re-use of notes
 - Different songs may share, e.g., a flourish



Willow warbler song

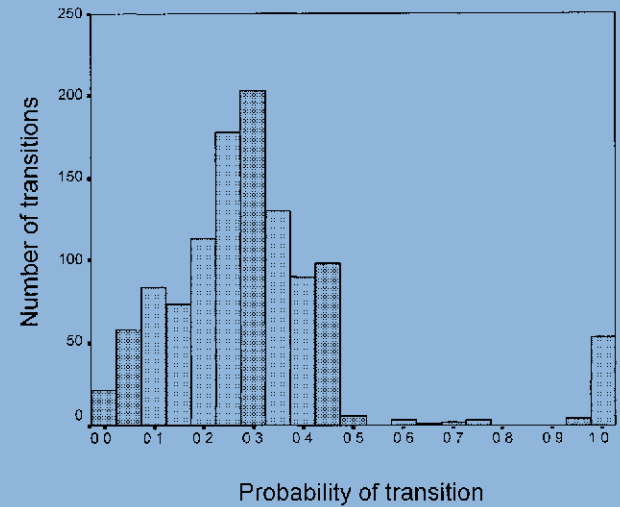


> 100 songs for some birds

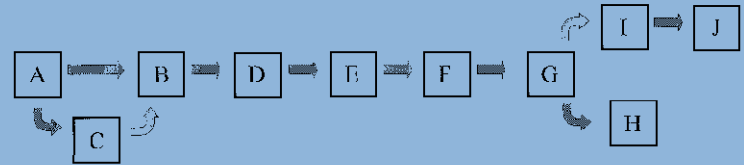
- Repertoire size varies

Mix of predictable and less predictable transitions

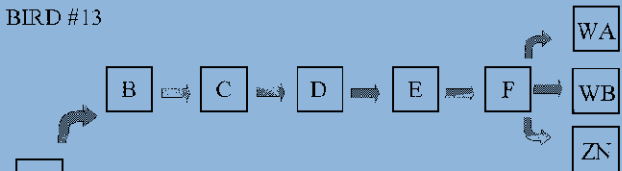
- A simple grammar



BIRD #117



BIRD #13





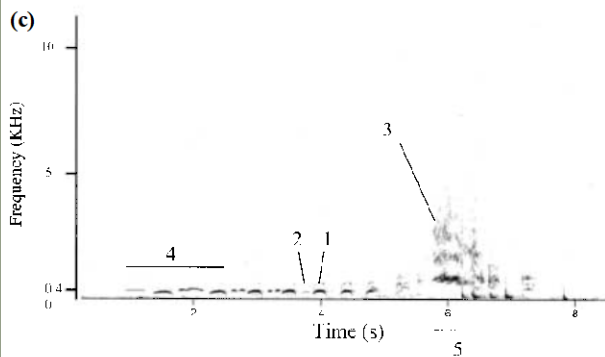
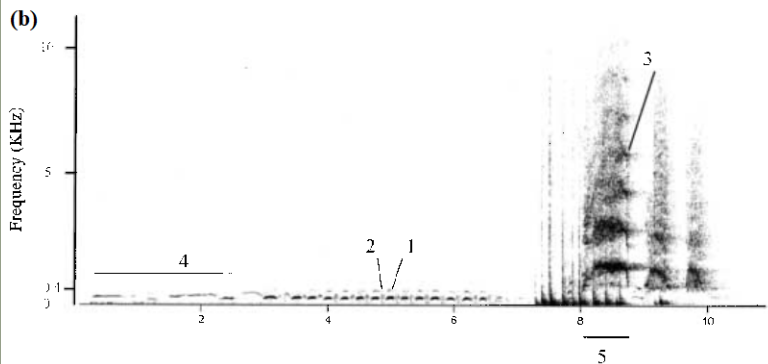
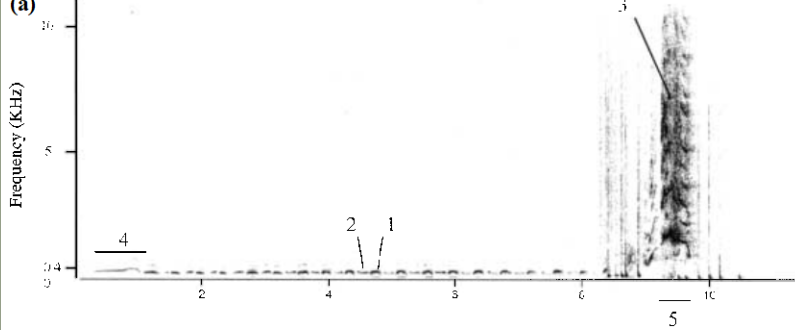
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Suggestive evidence for learned vocalizations in chimpanzees?



Pant hoots of chimpanzees vary between neighbouring groups

Crockford, C., Herbinger, I., Vigilant, L. & Boesch, C. (2004). Wild Chimpanzees Produce Group-Specific Calls: a Case for Vocal Learning? *Ethology*, 110, 221—243.



Crockford et al. (2004): pant hoots of neighbouring groups differ in (e.g.):

- Length of intro (4)
- Peak frequency of screams (3)
- Duration of climax (5)

But Desai et al. (2022) fail to replicate in Gombe National Park

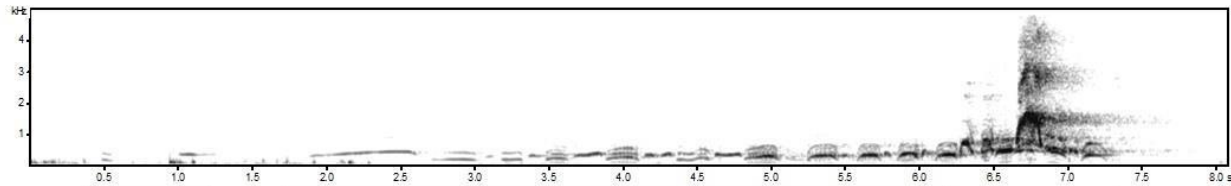
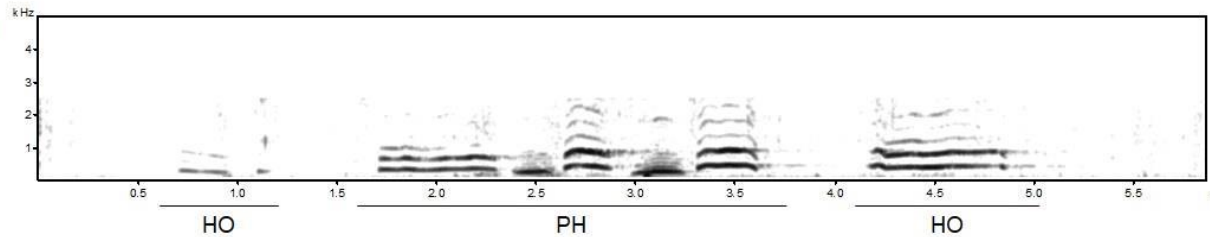
- Substantial inter-individual differences, small sample sizes

Crockford, C., Herbinger, I., Vigilant, L. & Boesch, C. (2004). Wild Chimpanzees Produce Group-Specific Calls: a Case for Vocal Learning? *Ethology*, 110, 221–243.

Desai, N. P., Fedurek, P., Slocombe, K. E., & Wilson, M. L. (2022). Chimpanzee pant-hoots encode individual information more reliably than group differences. *American Journal of Primatology*, 84, e23430.



A lot is not known about call combinations in chimpanzees!



Girard-Buttoz, C., Zaccarella, E., Bortolato, T., Friederici, A. D., Wittig, R. M., & Crockford, C. (2022). Chimpanzees produce diverse vocal sequences with ordered and recombinatorial properties. *Communications Biology*, 5, 410.

Summary of today

- Intentional communication
 - Rare in primates, perhaps present in chimpanzees?
- Structured communication
 - Rare and limited in most primates, common in songbirds
 - Generally structure not subserving meaning
- Learned communication
 - Rare in primates (but perhaps present in chimpanzees?), common in songbirds
 - Relationship between vocal learning and structure?

Communication in the Last Common Ancestor of chimps and humans?

- Not 2nd order intentional?
- No/minimal use of structure subserving meaning?
- Probably not learned?

But remember Fitch's point: their communication system may underrepresent their cognitive capacities!



Next up

- Tutorial on chimpanzee gesture comprehension by humans
 - Do we have access to an ancestral ape gestural communication system?
 - **Be prepared, be involved**
- Week 4: human evolution, cumulative non-linguistic culture in humans and other animals, inferring language from the archaeological record