Biology and Compositionality: Empirical Considerations for Emergent-Communication Protocols

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Plausible Claims

- AI research can benefit from biological research (and vice-versa).

- Communication is ubiquitous in nature, but language is unique to humans.

Question

How can simple communication systems become more like systems of natural language?

Method

Since language is complicated, we abstract away many features of language to find key *explanatory targets*.

Sociological Fact

Most researchers take compositionality (compositional syntax, hierarchical syntax, openness, generativity, etc.) to be a key feature unique to language.

Definitions

Gradualism: /ˈɡrad͡ʒ(əw)ə.lizəm/
The view that language arose gradually, from simpler precursors, and is continuous with animal communication systems.

Compositionality: /ˌkɒmpəˈzɪʃənælɪtɪ/
A principle that holds that the meaning of a complex expression is a function of the meanings of its parts and how they are combined.

Problem

Compositional signals are rare, or nonexistent, in nature. (Fig. 1)

Where they do exist, they cannot be precursors to human language. (Fig. 2)

Consequence

It is a mistake to assume (from a gradualist perspective) that *since* compositionality provides a crucial difference between language and communication, research on language origins *must* centre on the evolution of compositional syntax.
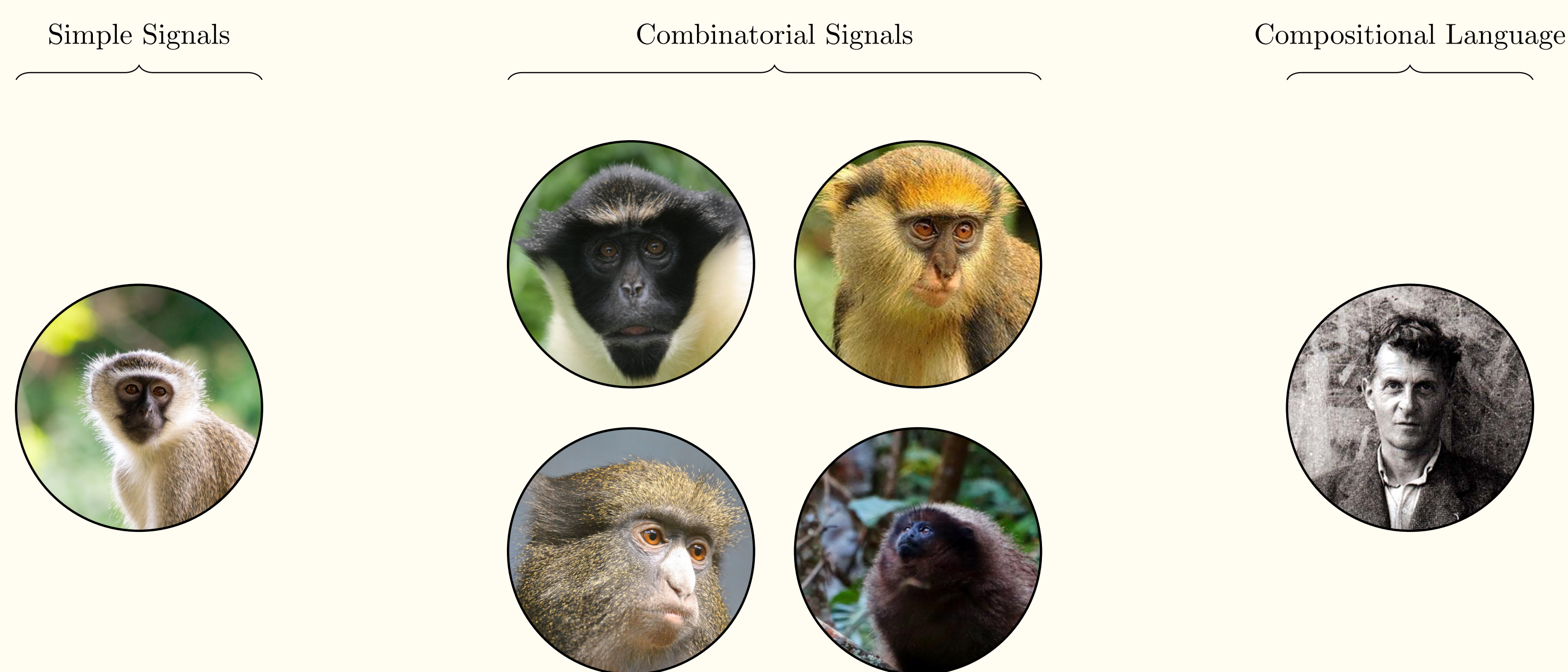

Simple Signals — Combinatorial Signals — Compositional Language

Fig. 1: Some instances of simple, combinatorial, and compositional communication in nature

> If gradualism is the correct approach to language origins, then compositionality is not a plausible explanatory target.
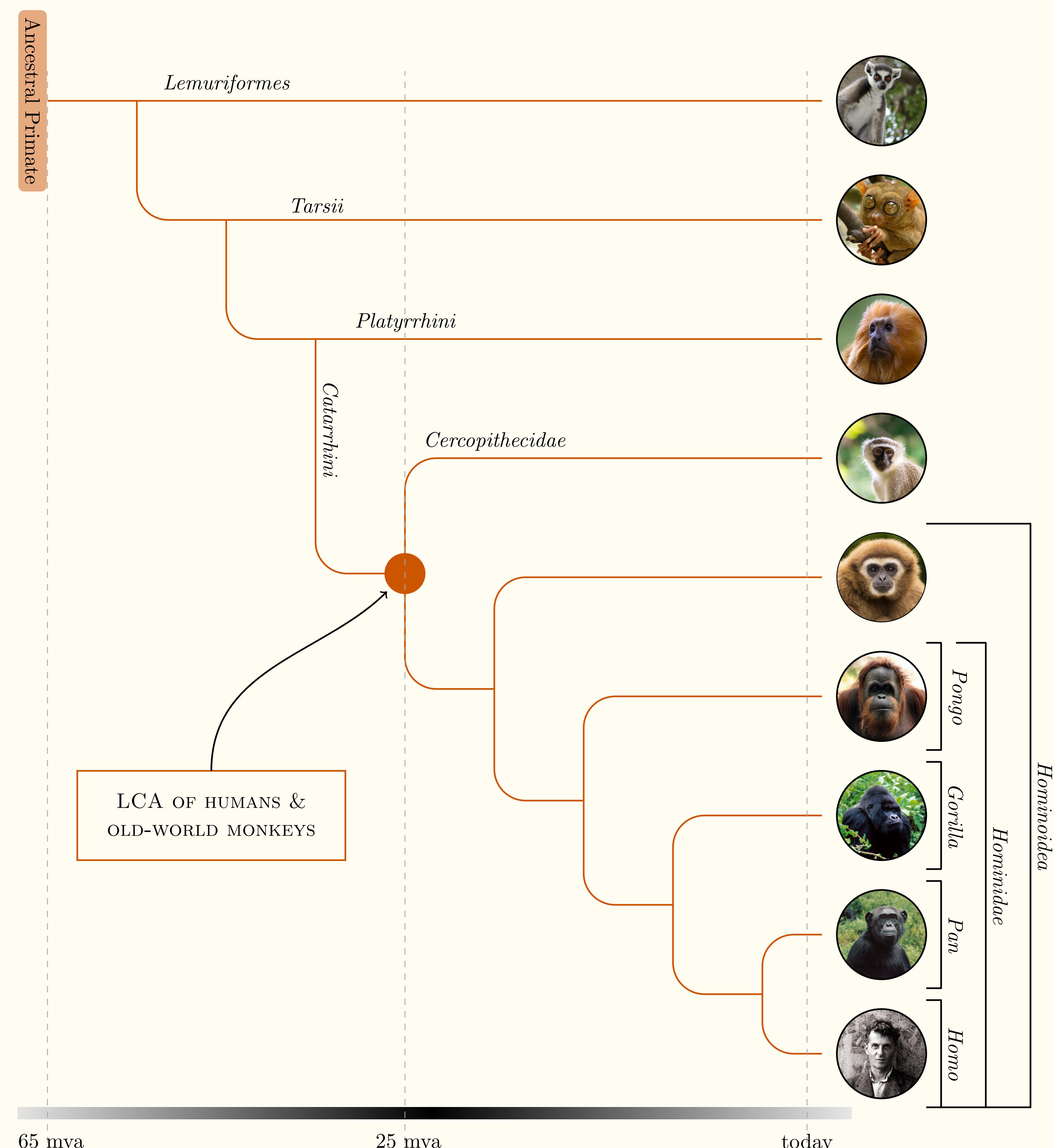

Fig. 2: Phylogenetic tree of the primates

Moving Forward

- Once a group of individuals has learned some set of simple communication conventions, those learned behaviours may be used to influence future communicative behaviours, giving rise to a feedback loop.

- Agents may learn to take advantage of previously evolved dispositions.

- Agents may learn to take advantage of pre-evolved *communicative* dispositions to influence the evolution of future communicative dispositions.

- This is a notion of *reflexivity*.

- Reflexivity, unlike compositionality, is consistent with a gradualist approach to language origins.

Conclusion

Insofar as reflexivity is an apt target for the biological evolution of linguistic communication, it may too provide some insights for modelling emergent communication in an artificial system.

Additional Information

See the full paper and references here:

Acknowledgements

More Information

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