

# 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:** /'graj(əw)əlizəm/  
The view that language arose gradually, from simpler precursors, and is continuous with animal communication systems.

**Compositionality:** /'kɒmpəzɪʃənəlɪti/  
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.

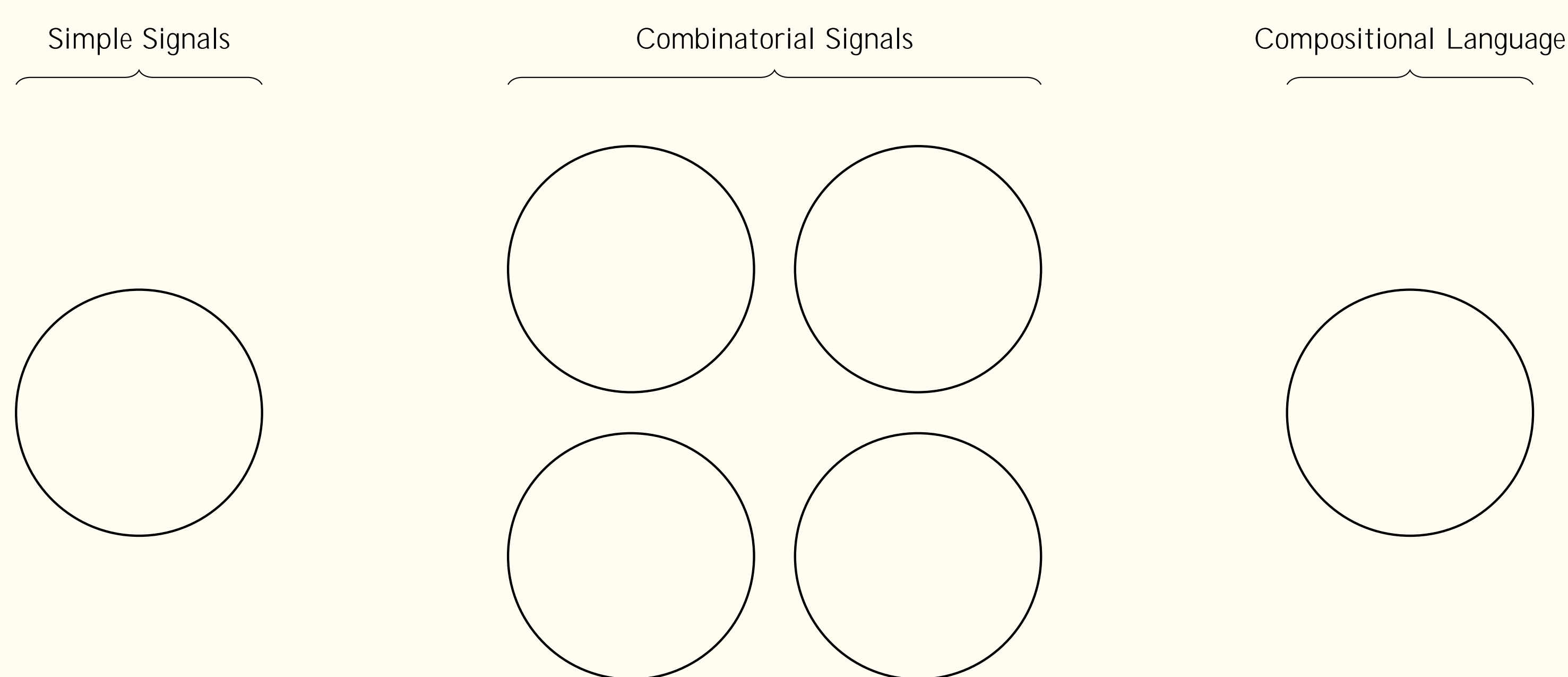


Fig. 1: Some instances of simple, combinatorial, and compositional communication in nature

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

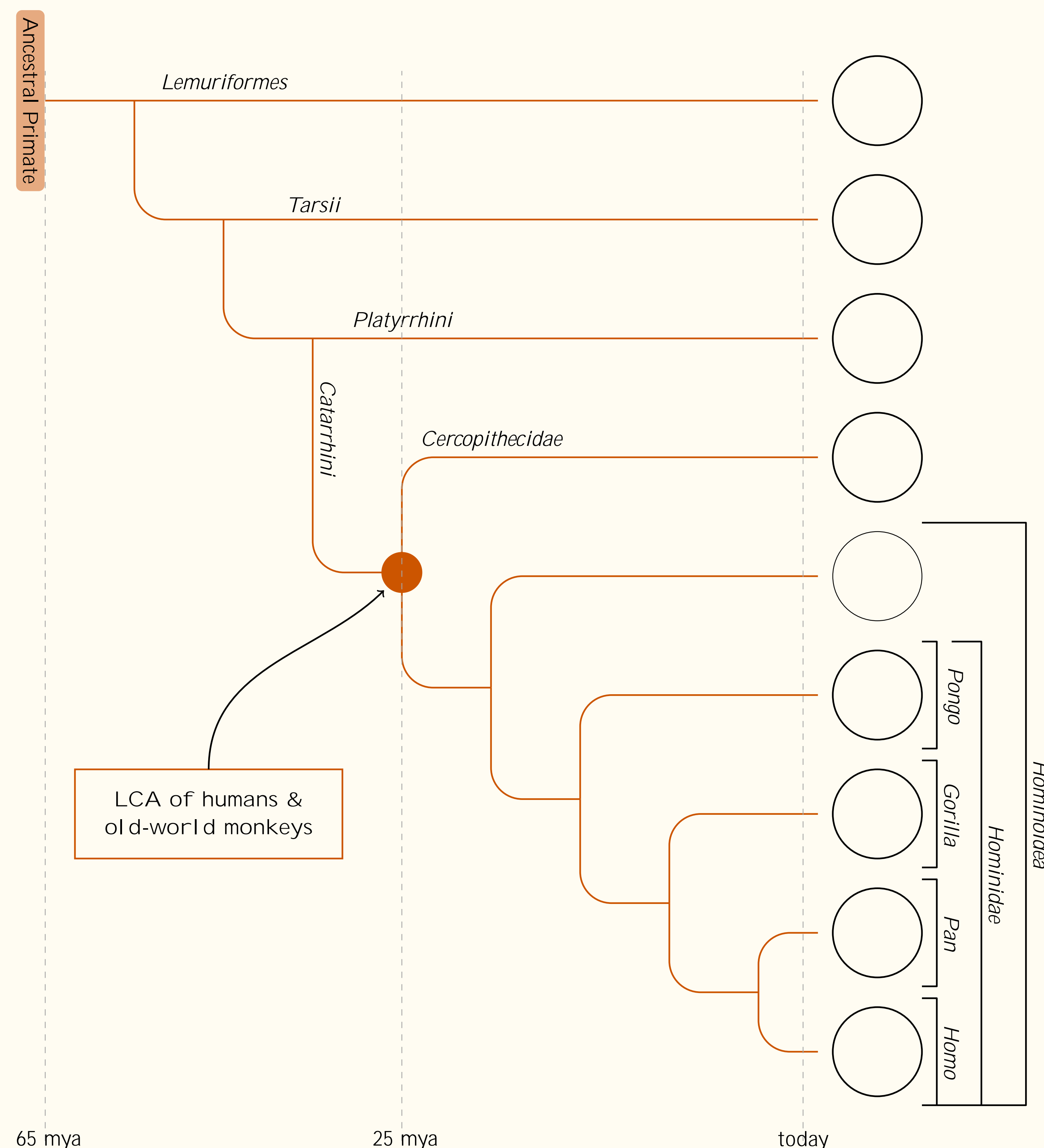


Fig. 2: Phylogenetic tree of the primates

## 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:



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## More Information

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