The Language Organism
Lecture 4: When will optimal signalling evolve?

Simon Kirby

simon@ling.ed.ac.uk

Lab 3 worksheet

1. The two ways of scoring an agent's success depend on being understood (the first number), and understanding (the third number). What are the ecological interpretations of these scores? Which do you think are evolutionarily significant, and why?

Lab 3 worksheet

2. Can you construct a population where every agent gets approximately the same score for being understood, but different scores for understanding? What about the other way round?

Lab 3 worksheet

4. Who communicates with who in a population? What other ways could you model this, and how would you start adjusting the code to implement your model? Hint: what if people only talked to people who were ‘near’ them?

Optimal communication

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m2	0	1	0
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m1 ⟷ s1

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- Natural selection does not necessarily create optimal solutions!
- Optimal, Saussurean signalling is not the inevitable result of evolution
- Oliphant aims to show that it can only emerge given specific conditions

Oliphant's simulation 1

- Simplified variant of our model, with two signals, two meanings, and deterministic mappings between the two

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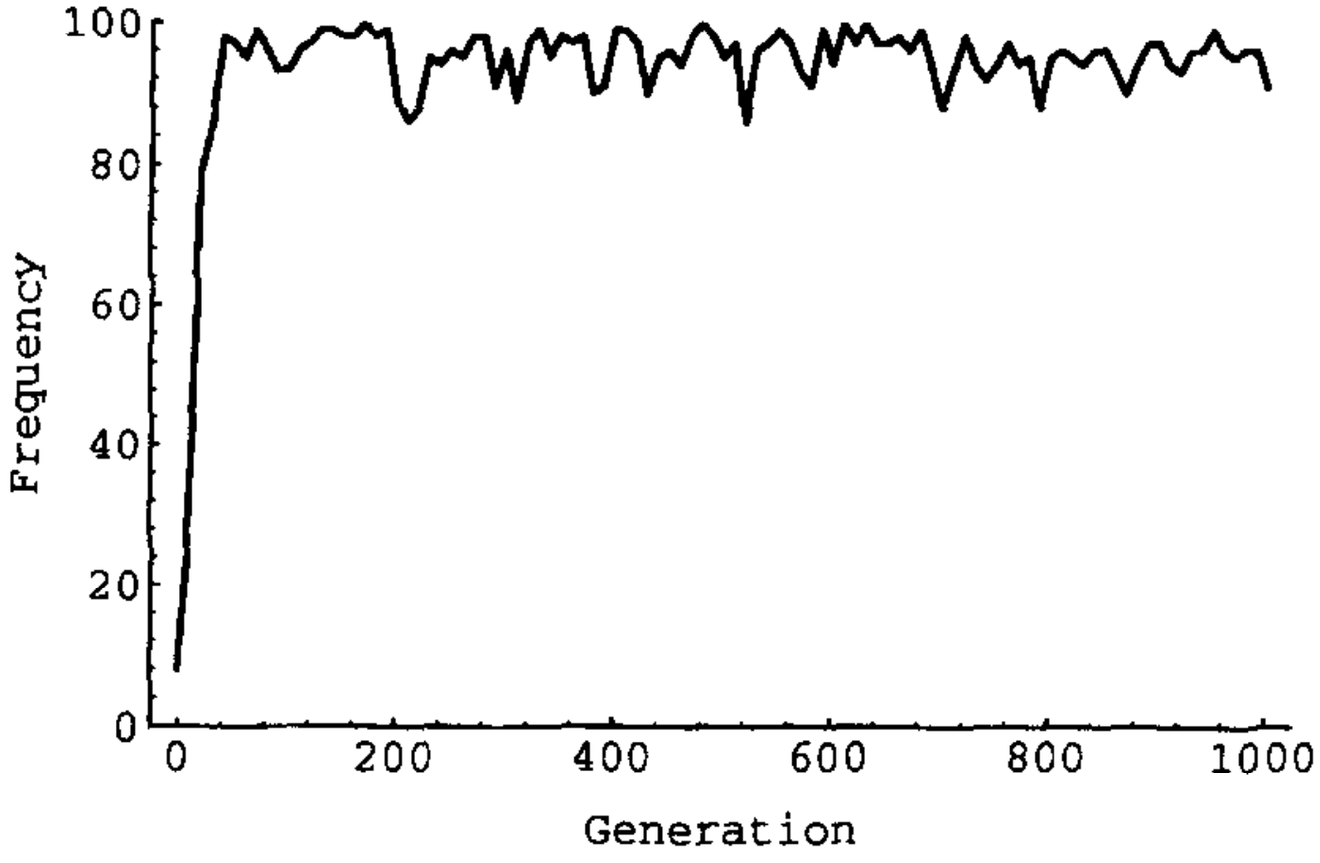

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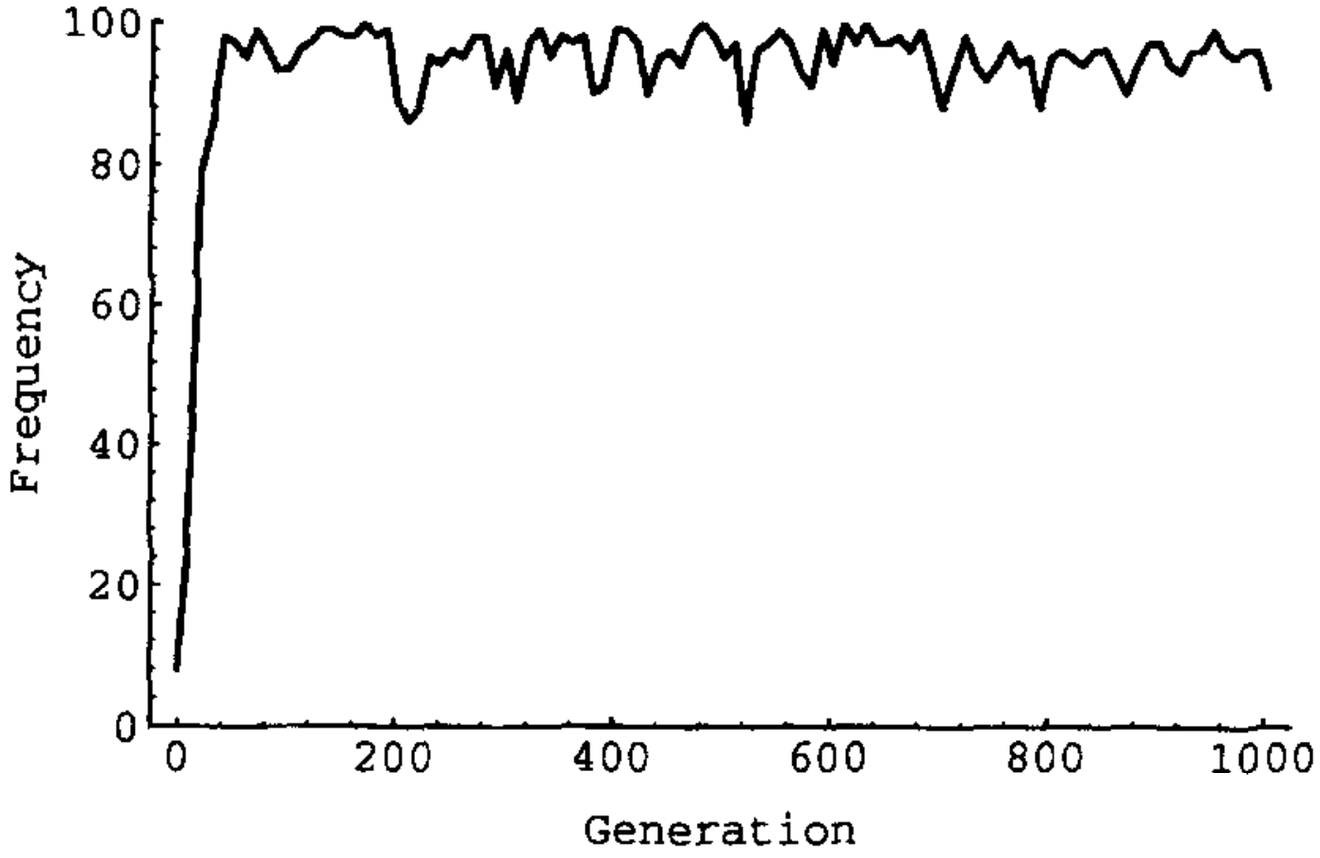

Note: not a fitness graph. Measures frequency of one of two optimal systems

m1 ⟷ s2

m2 ⟷ s1

How to get communication, solution 1:

mutual benefit

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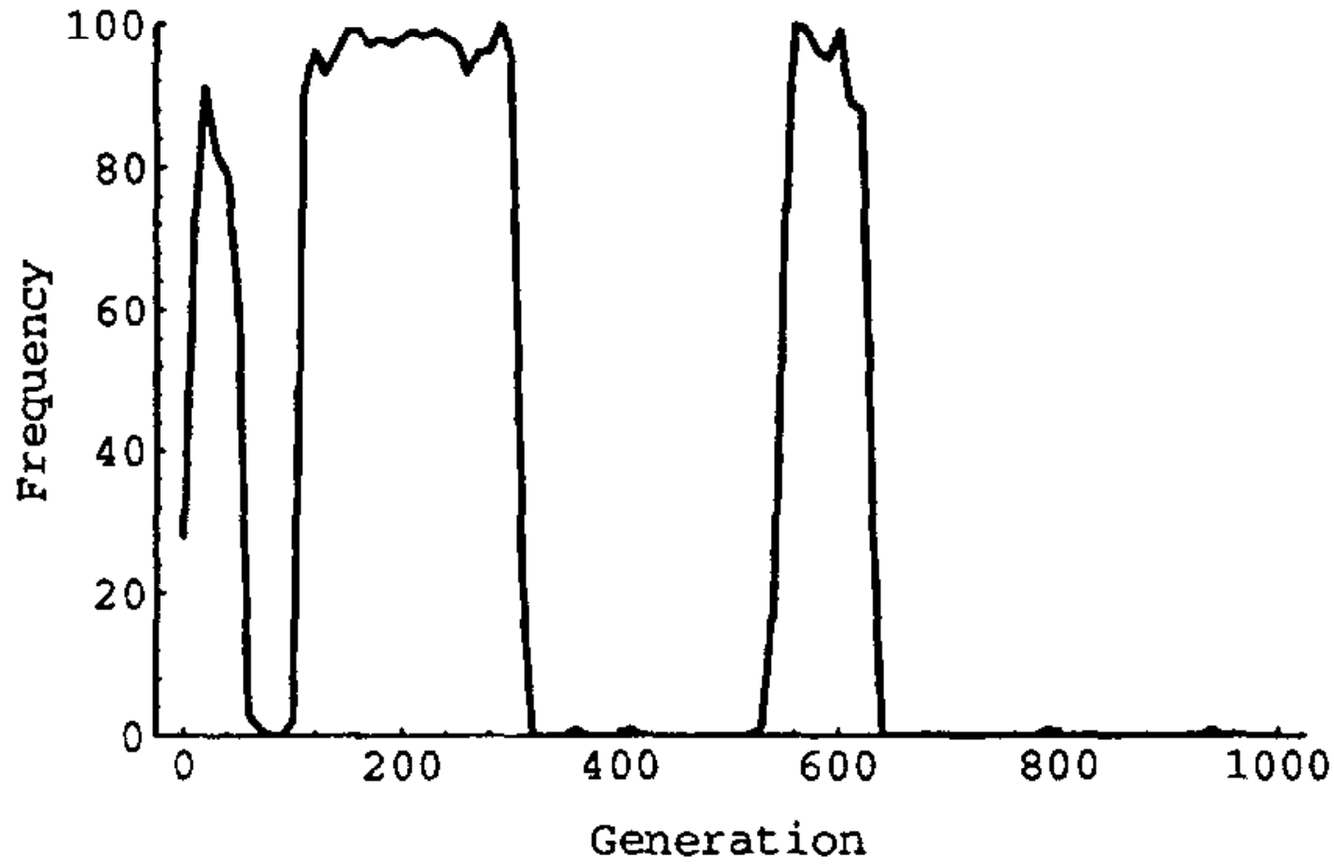
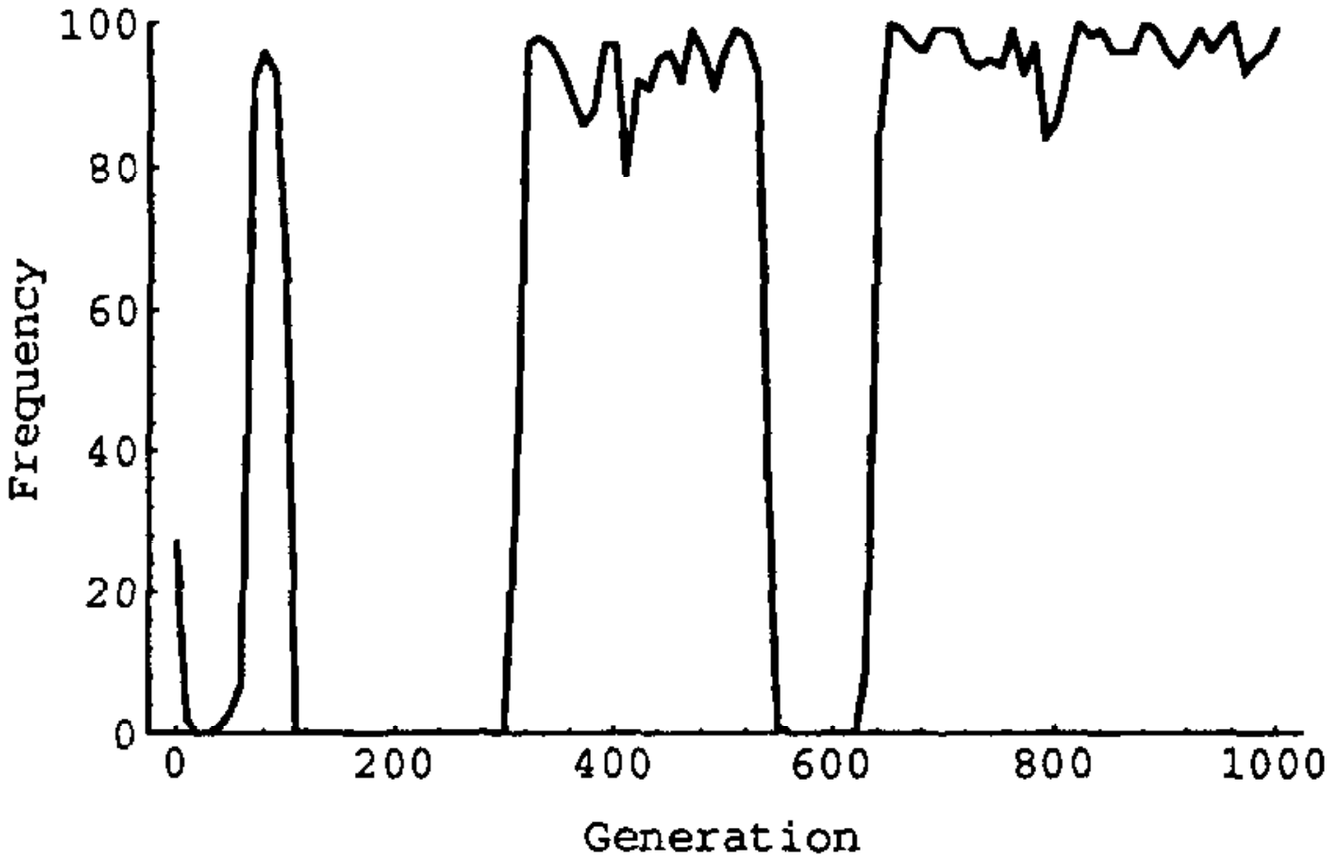
- Oliphant reruns the simulation with only receivers benefiting from successful signalling

- Population does not converge on optimal signalling
  - Reception behaviour looks optimal (but unstable)
  - Transmission behaviour wanders about at random
    - And these random fluctuations drive switches between reception systems



s1 ⟶ m1

s2 ⟶ m2



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- Optimal signalling evolves (initially along with a deliberately unhelpful "punishment" system).

How to get communication, solution 2:

reciprocity

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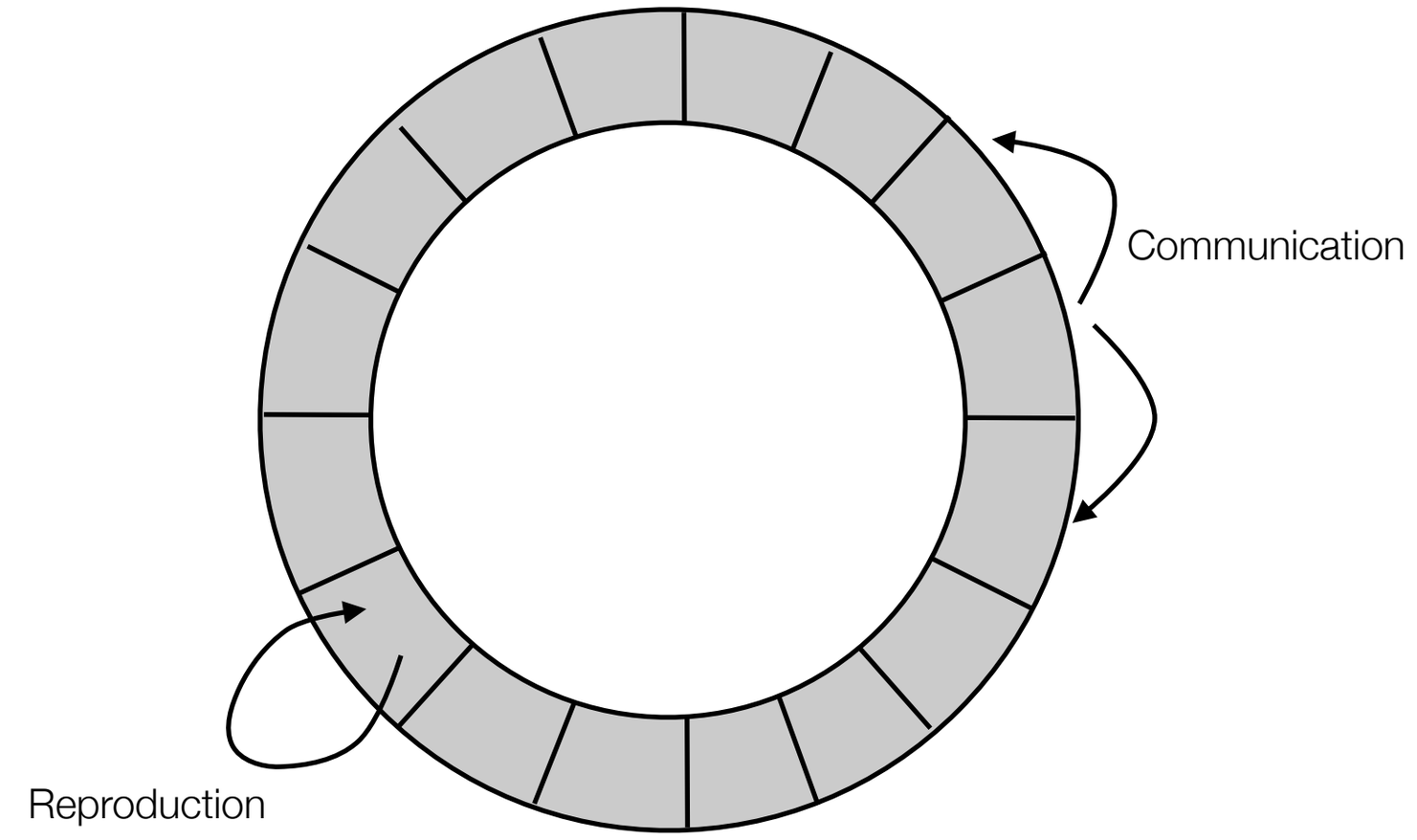

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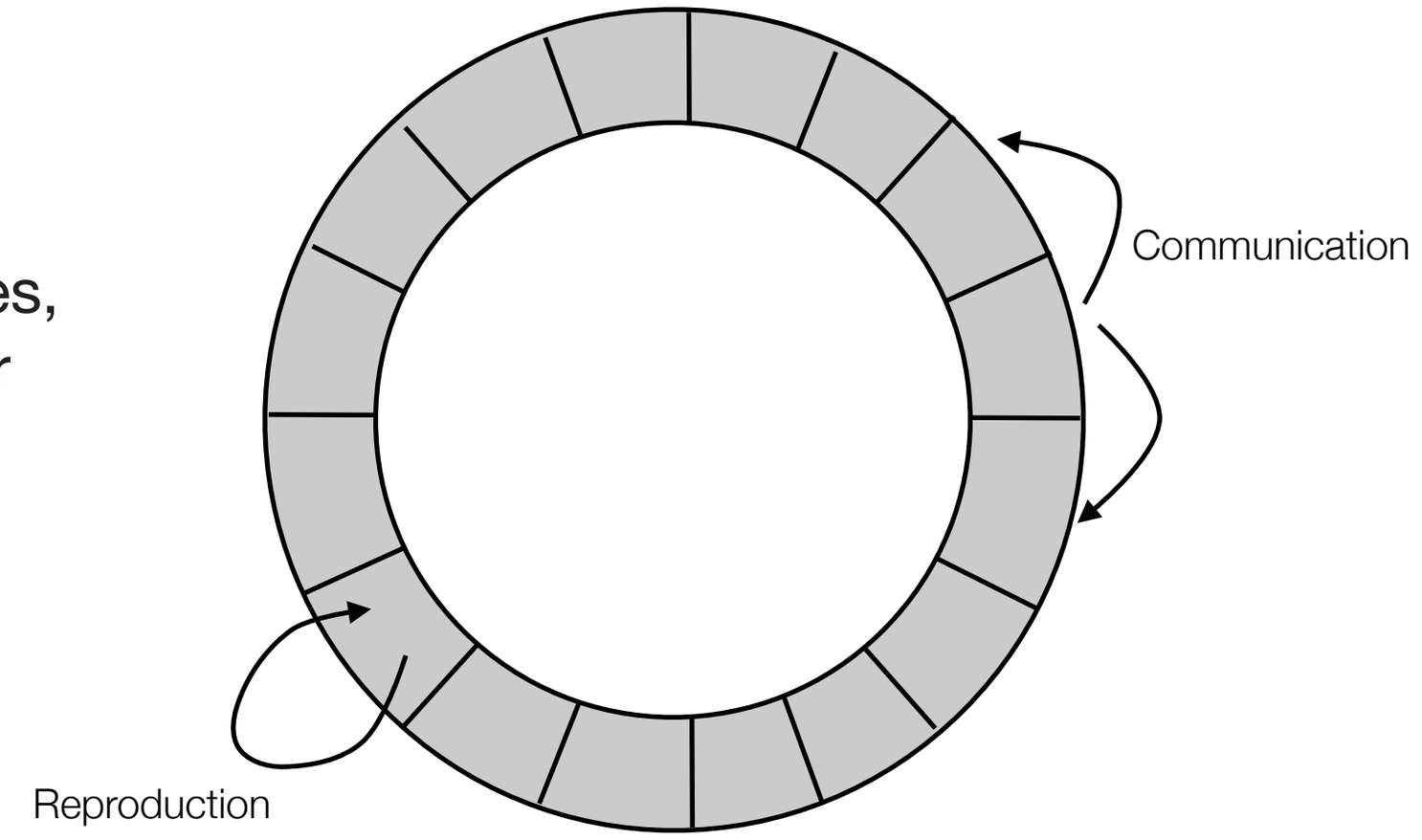

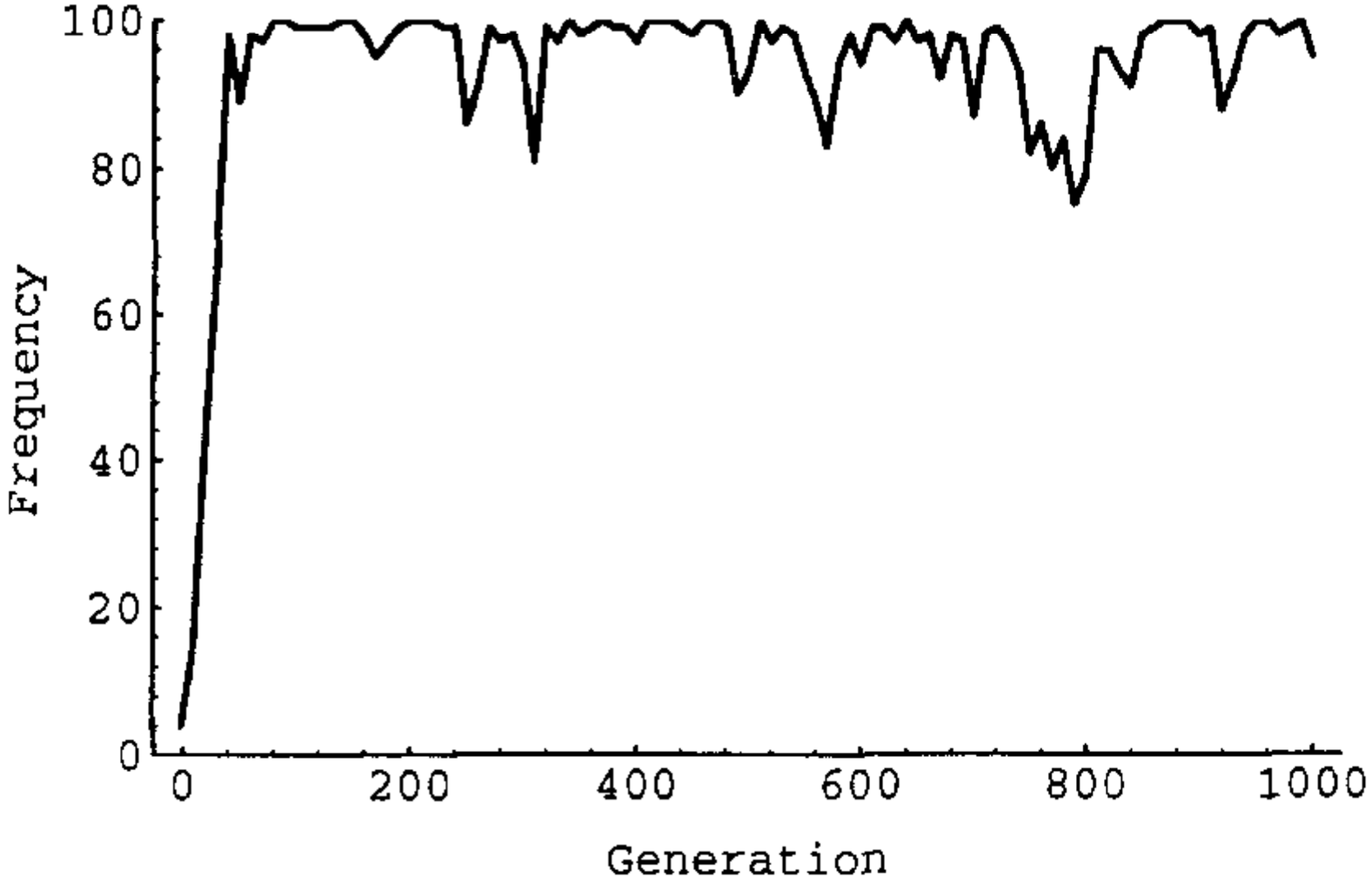
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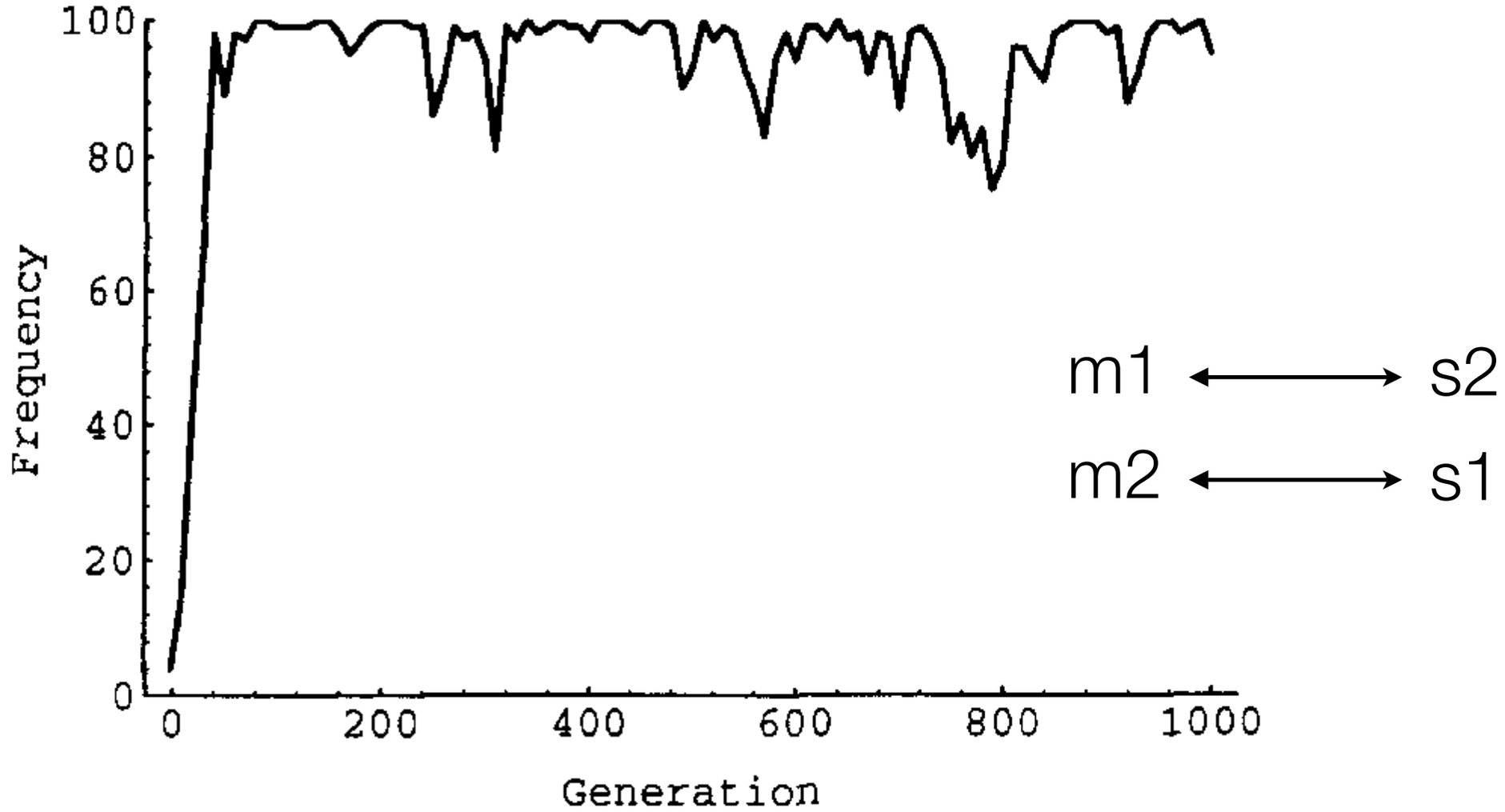
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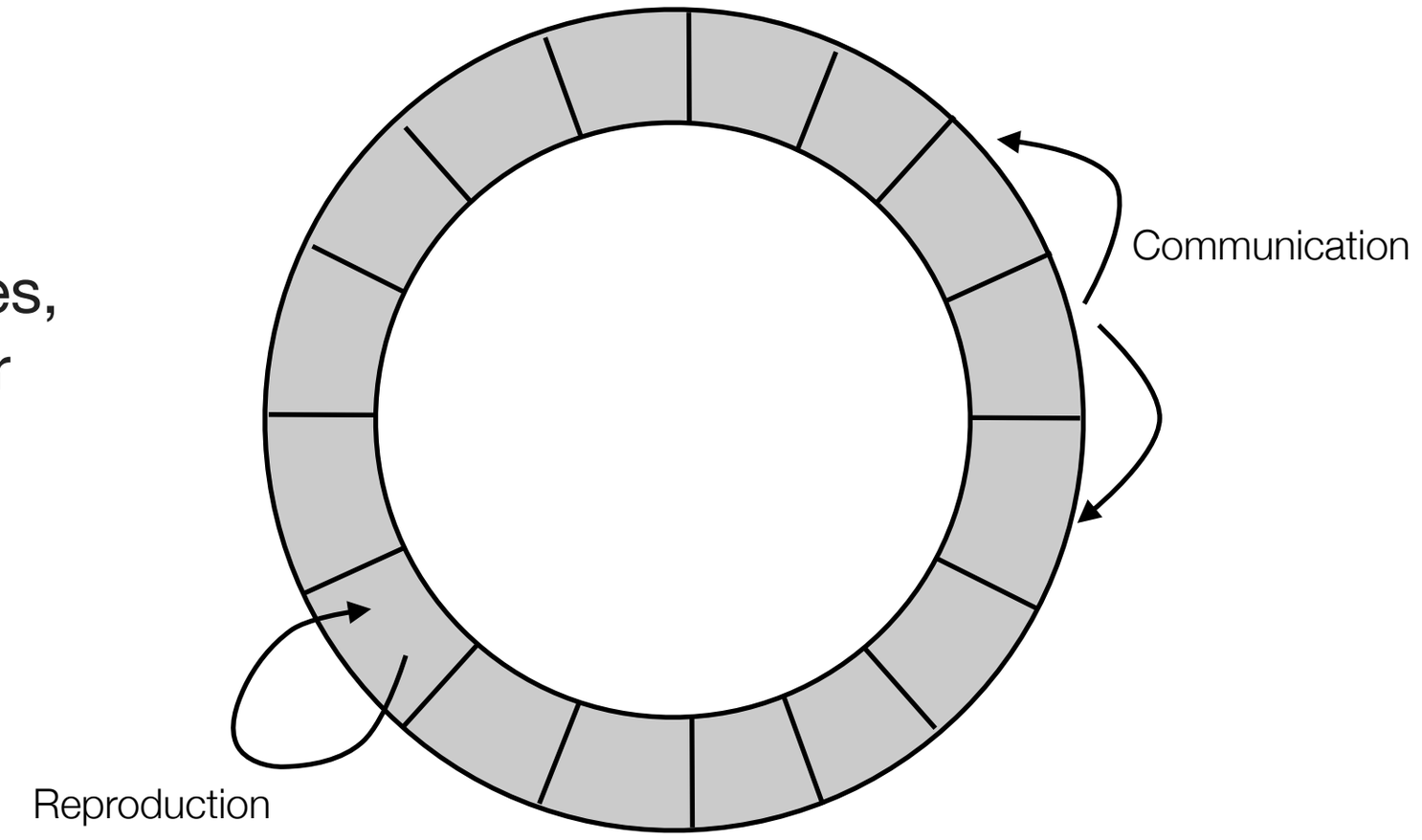

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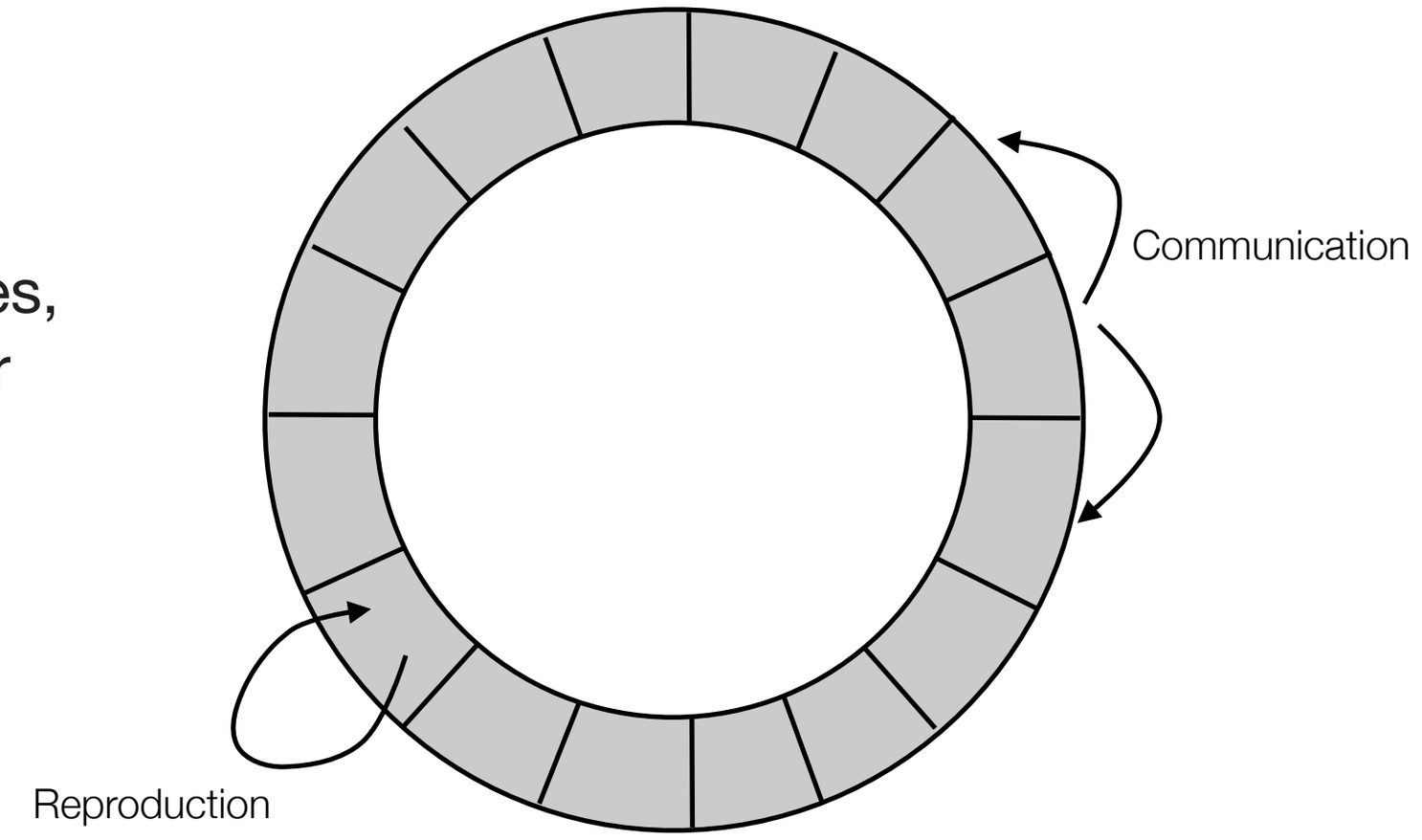
- Optimal communication evolves, even without mutual benefit, or reciprocal altruism!
- Why?



How to get communication, solution 3:
spatial organisation

Summary

- Optimal “Saussurean” signalling does not automatically evolve by natural selection

- Needs either:

  - mutual benefit

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  - spatial organisation

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- Can we replicate the first of these results in our simulation model?

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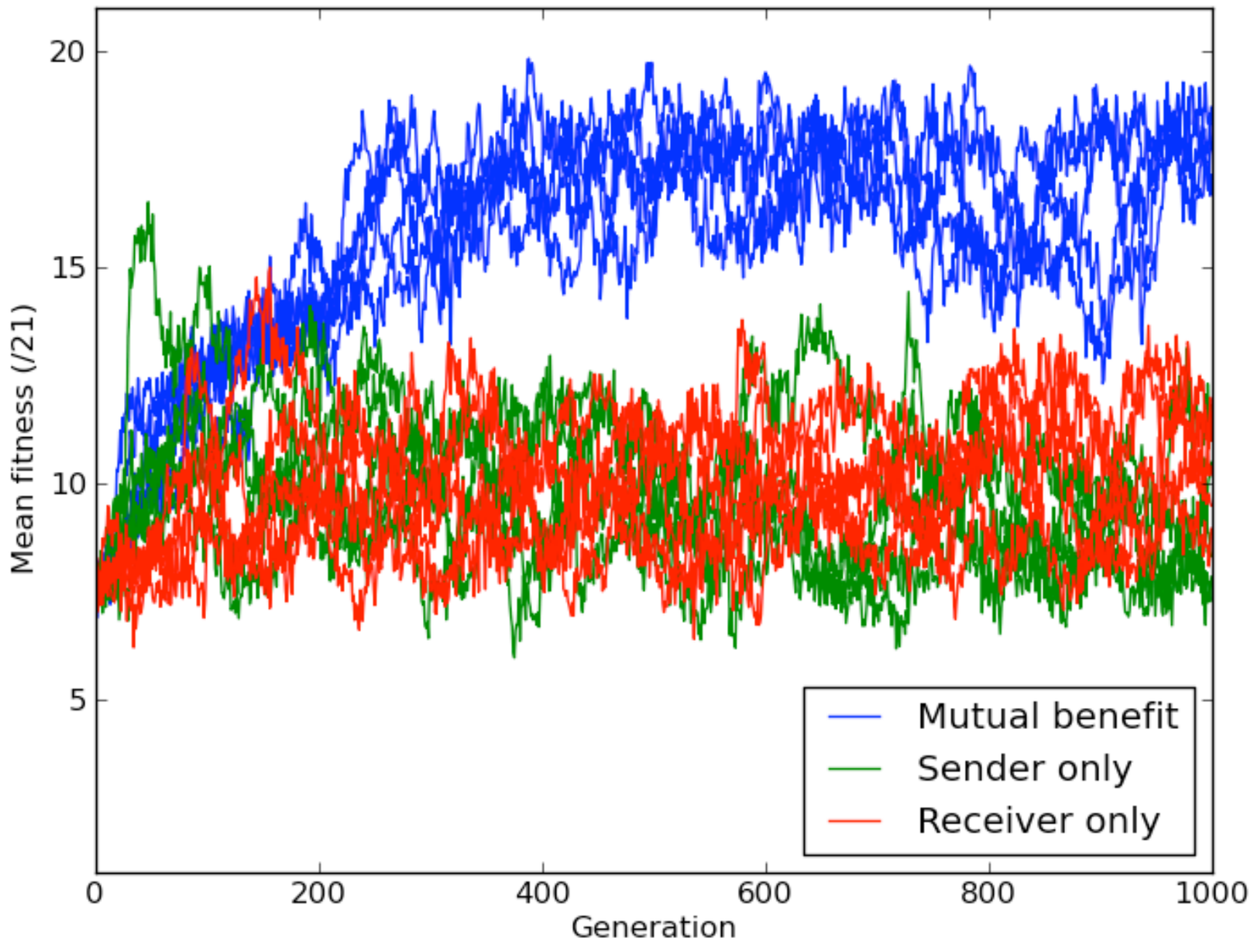

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2. Can you speed up evolution (or slow it down)? How? Is there a limit to how fast evolution can happen in the model?

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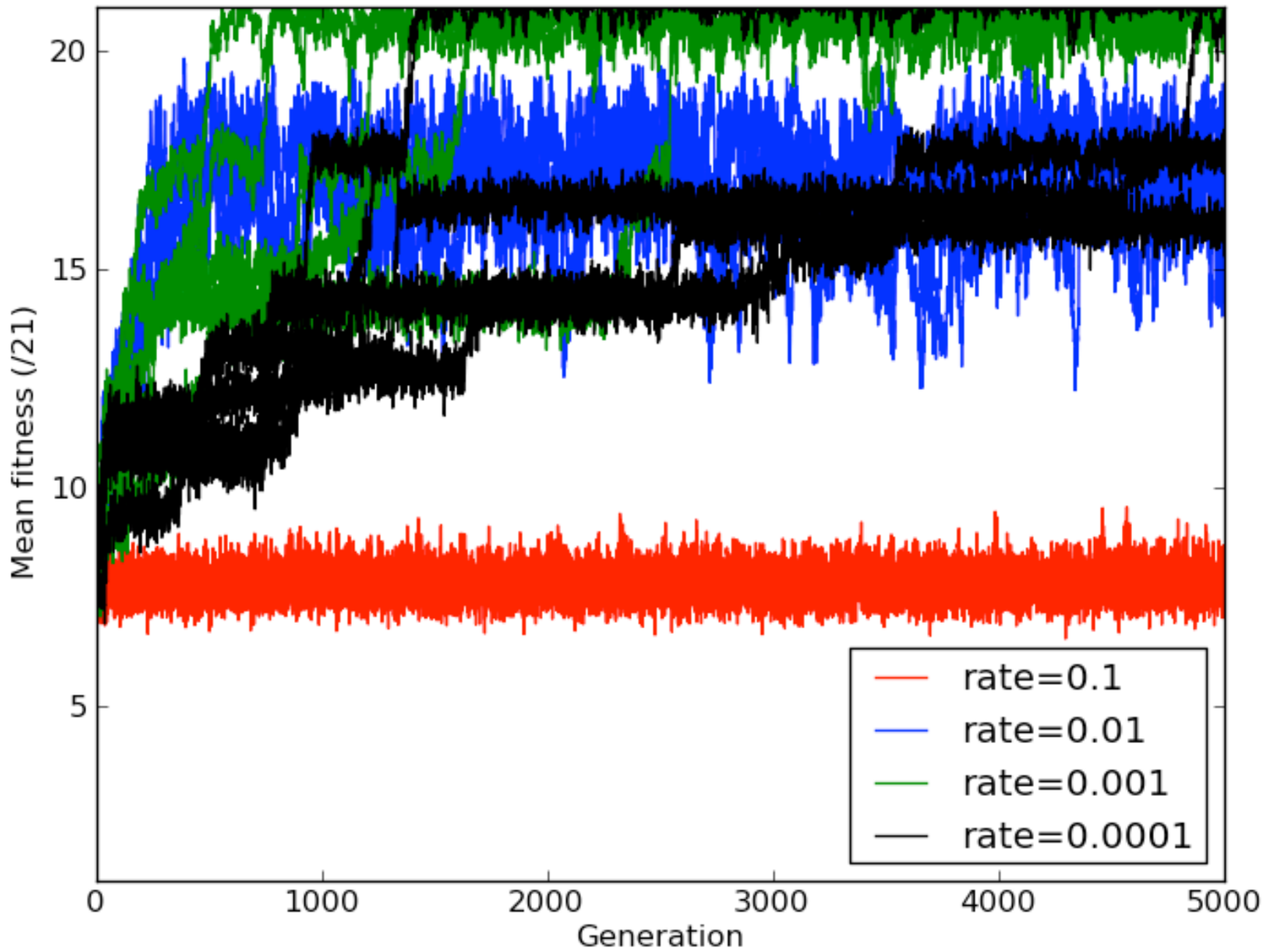

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3. In earlier worksheets we gave you the option of modelling production and reception using a single matrix of weights, or of modelling populations in a more structured way (e.g. where each individual communicated with their neighbours). What difference do you think these factors will make to the evolution of communication? Make the necessary adjustments to the code and find out.

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4. In this model a parent's signalling system is transmitted directly to their offspring - this is our model of the genetic transmission of an innate signalling system. How else might a signalling system be transmitted from parent to offspring, and how might you model that process?

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We'll explore this next.