

# Simulating social norms in gene-culture coevolution multi-agent model.

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# Social norms

## Definition

*“Norms are rules that prescribe or proscribe a behavior or set of behaviors.*

*Norms are enforced by external sanctions.*

*Norms are consensual, group-level phenomena.*

*Group members recognize the existence of norms and feel entitled to enforce them.”*

# Master's thesis

## Structure

1. Theoretical part – survey of relevant research (evolutionary anthropology, social science, social neuroscience, economics / game theory, AI)
2. Model / Simulation – agent model building up on surveyed theory, simulation of the model in MAS.

## Motivation

Emergence of social norms within a group of interacting individuals  
Using gene-culture coevolution theories

# Social dimensions

## Social / Vygotskian intelligence hypothesis

*Tomasello et al:* significant differences between human infants and higher apes social cognition. Species equal in terms of physical/practical cognition. Proposed some evolutionary trait making humans much more social.

## Evolutionary models

- Group selection theories
- Gene-culture coevolution theories

*“At some point during the evolution of the human species a type of social learning leading to cumulative cultural evolution was evolutionary advantageous.”*

## Computer models

Classical PD/IPD modelling – cooperation

Norms – some research involving IPD, some incorporating emotion models



# Agent model

## Genetic traits

- *genSight* (how far an agent sees)
- *genSocialLearner* (how good an agent can learn)
- *genCooperator* (if agent of selfish or non-selfish type)

Binary encoded numbers

Passed to children after crossover & mutation (GA)

## Social traits

- *socGiving* (how much food the agent donates)
- *socRaising* (how fast can the agent procreate and “shut up” the parents)

Numbers between zero and one

Initialized randomly, **but** subject to social learning

# Social learning in the simulation

## 1. Reproduction.

- Agent sends requests to reproduce
- Agent that received a request decides according to similarities of social traits
- Until child reaches age given by *socRaising* it learns from parents.

## 2. Food donations.

- Agent having a critically low energy level sends requests for help.
- Agent that received such a request decides according to similarities of social traits
- When receiving food the agent learns the social traits of the donor.

# Social learning in the simulation

## Learning rule

$$a[i]_{t+1} = a[i]_t + (b[i]_t - a[i]_t) * \text{sgm}(\hat{\alpha})$$

$a[i]_{t+1}$  – new value of social trait

$a[i]_t$  – old value of social trait

$b[i]_t$  – the donor value of social trait

alpha – speed of learning, given by *genSocialLearner*



# Multi-agent modelling of social norms

## Simulation setup

- 6 variants (a, b, c, d, e, f) have been run
- Each variant run 5 times, each 150 000 cycles
- Two populations compete for resources (selfish / non-selfish)

## Variants

*a* – no learning, no donations

*b* – no learning, donations

*c* – learning, donations

*d* – no learning, donations to all

*e* – learning, donations to all

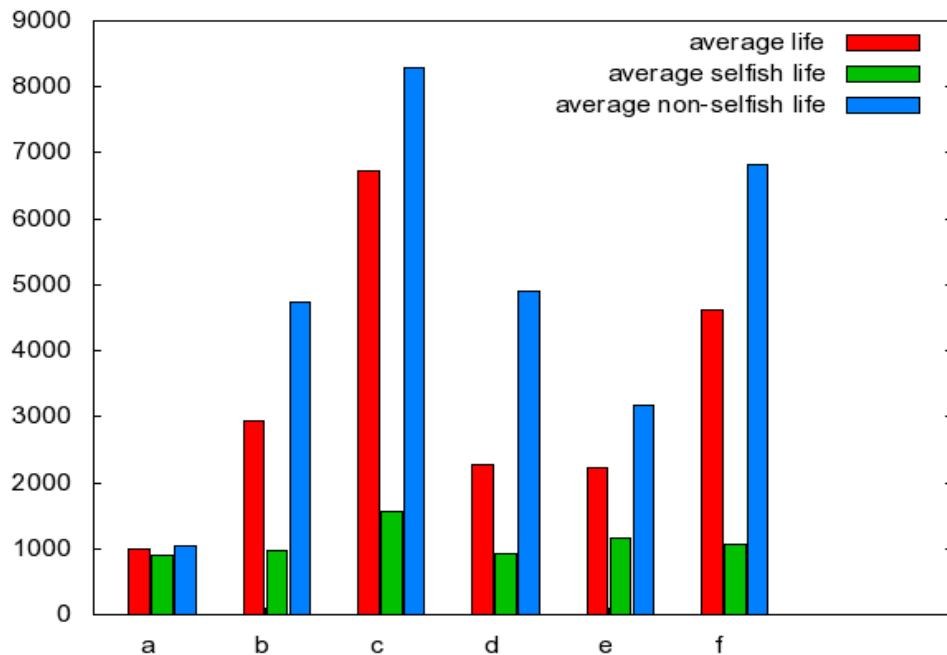
*f* – learning, donations, all initial agents are non-selfish

# Multi-agent modelling of social norms

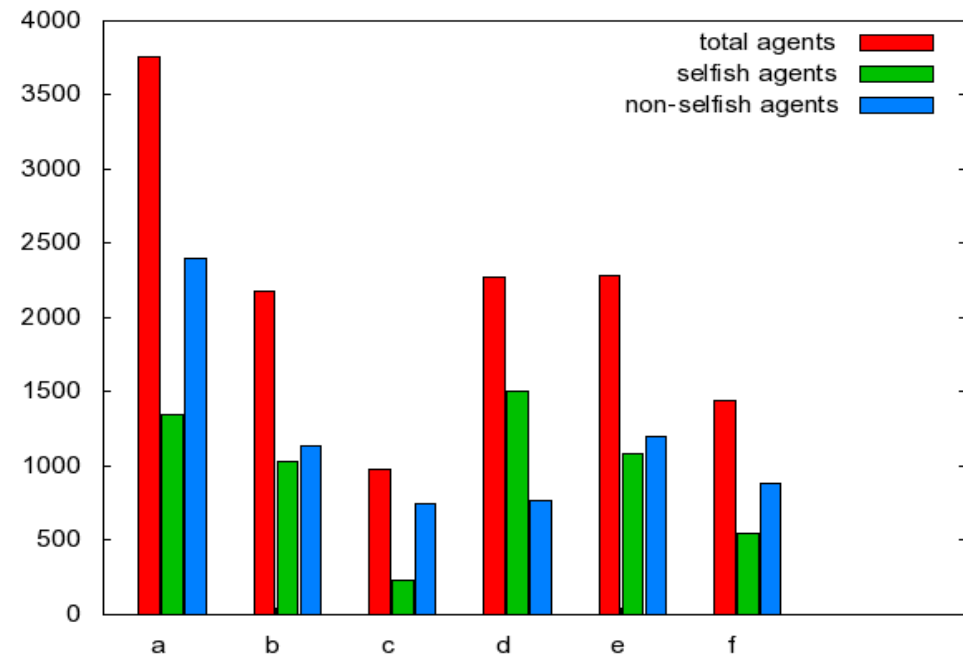
## Results

- Effects of altruistic behaviour: 300% increase in life-span longer
- Effects of social learning: 700% increase in life-span
- **But** there's less of them

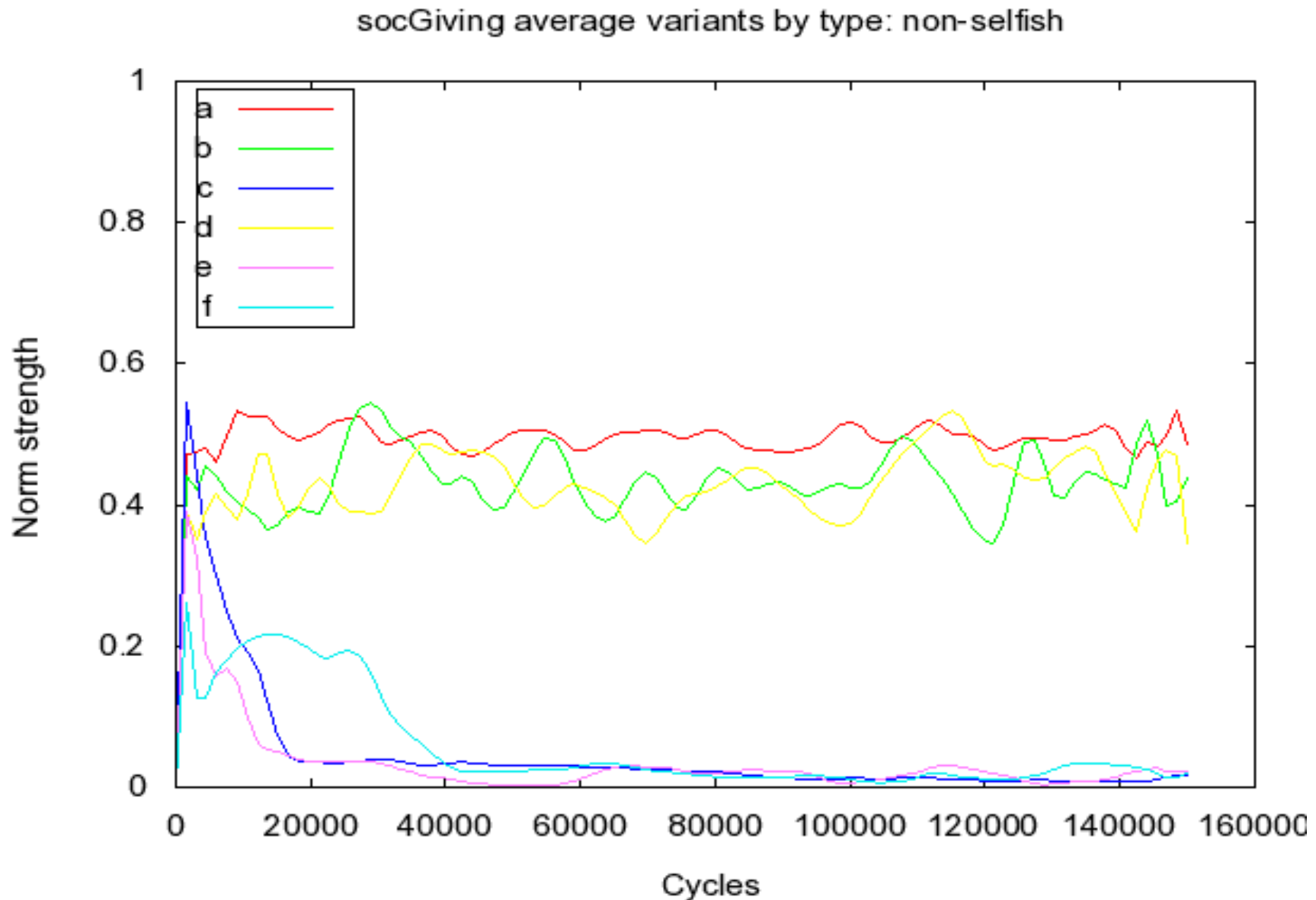
Agent life by variants



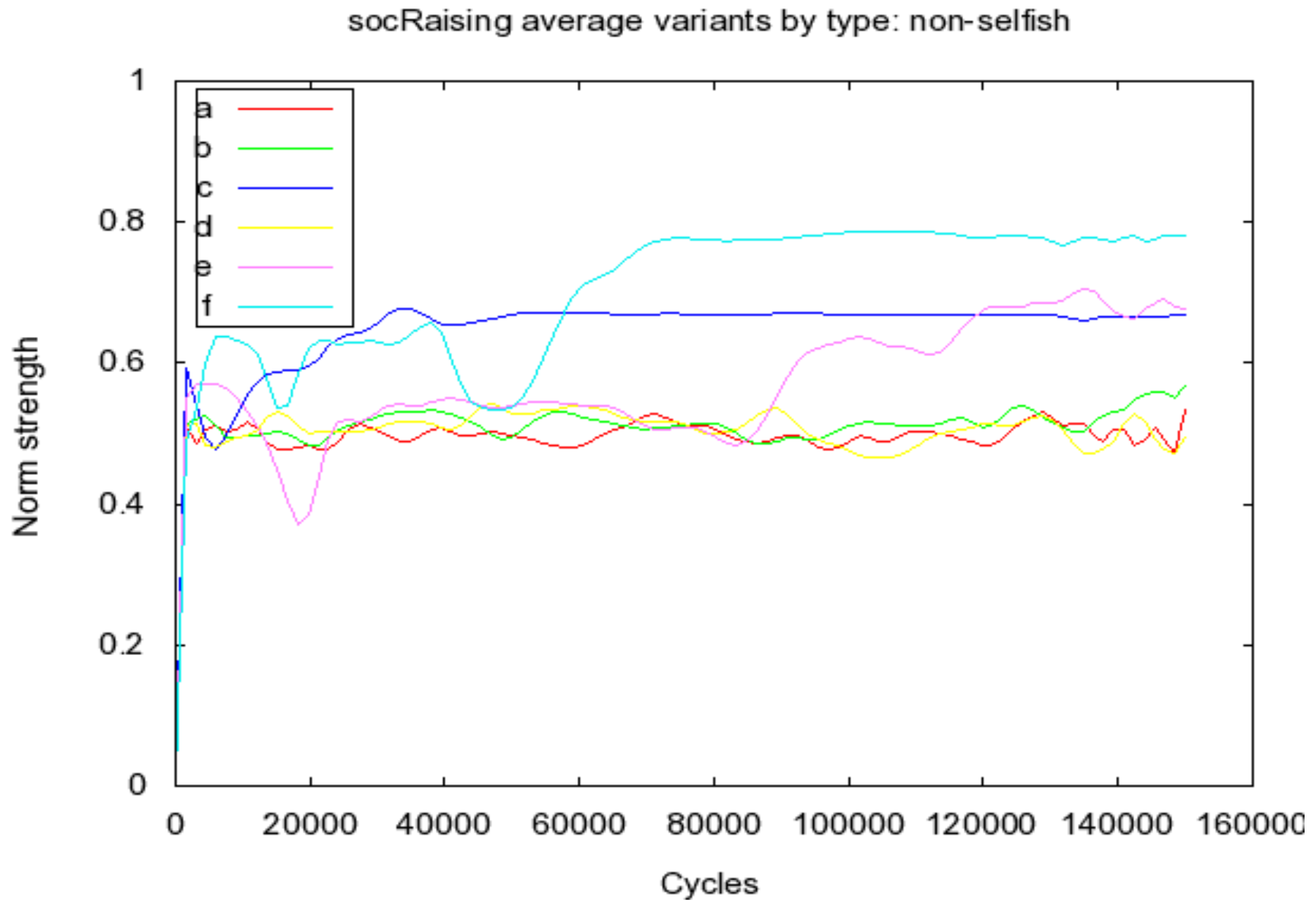
Agent count by variants



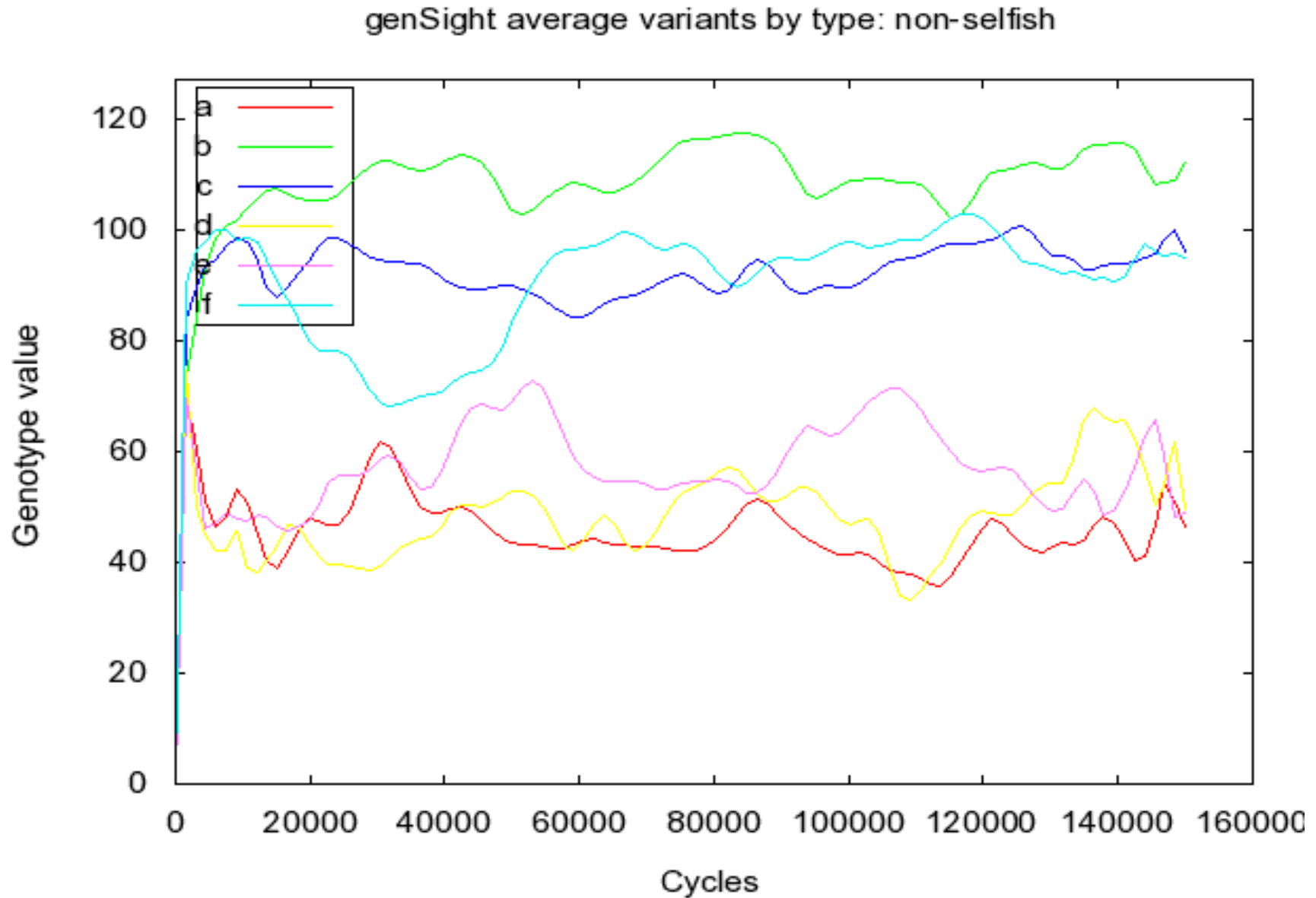
# Multi-agent modelling of social norms



# Multi-agent modelling of social norms



# Multi-agent modelling of social norms



# Multi-agent modelling of social norms

## Wrap up

- Altruism promotes longevity
- Altruism + social learning even more
- *socGiving* and *SocRaising* have converged similarly across variants
- Genetic adaptation for non-selfish agents was observed ( *genSight* increase)

Thanks for attention

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