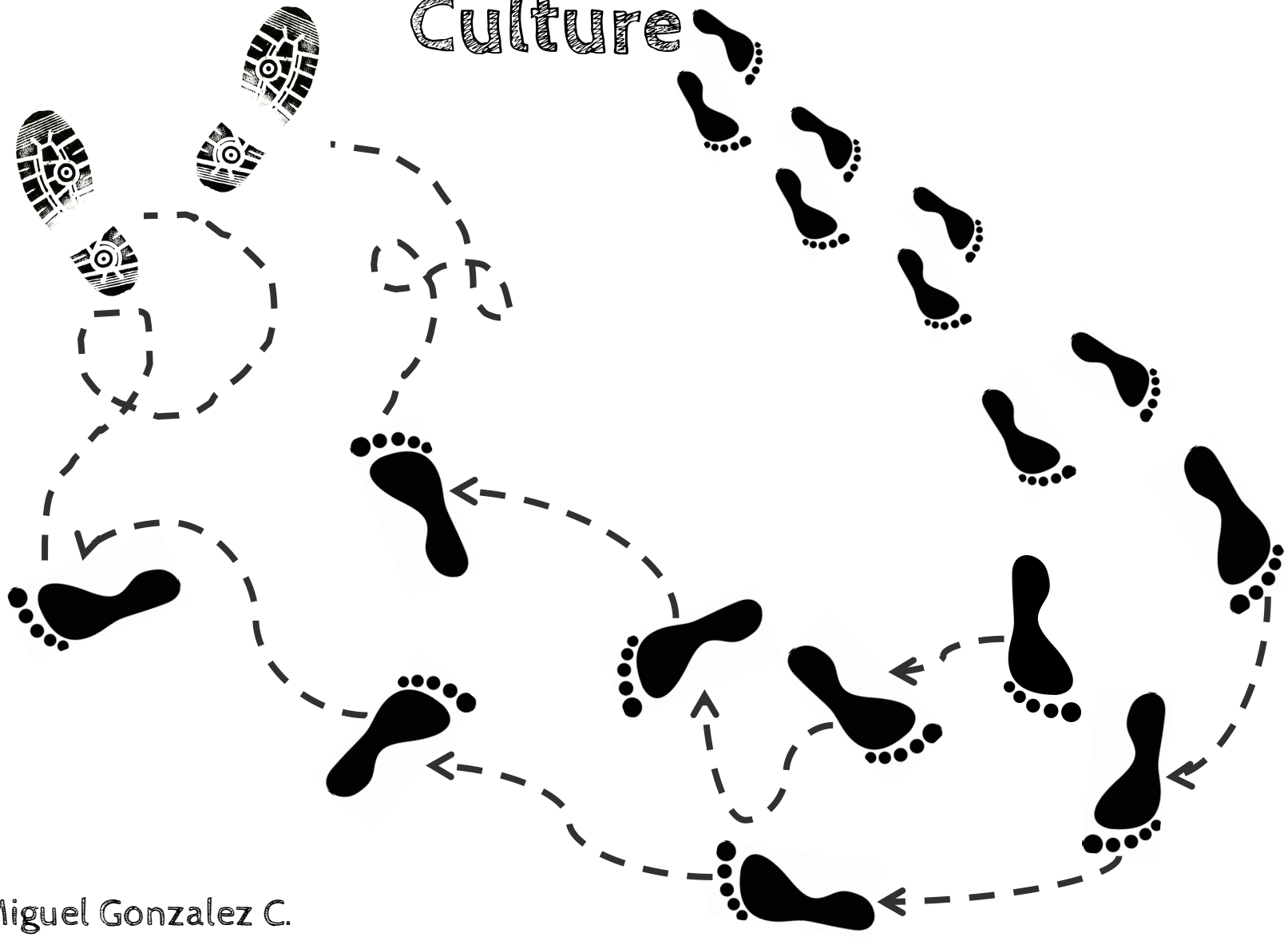
The Origin and Evolution of Culture



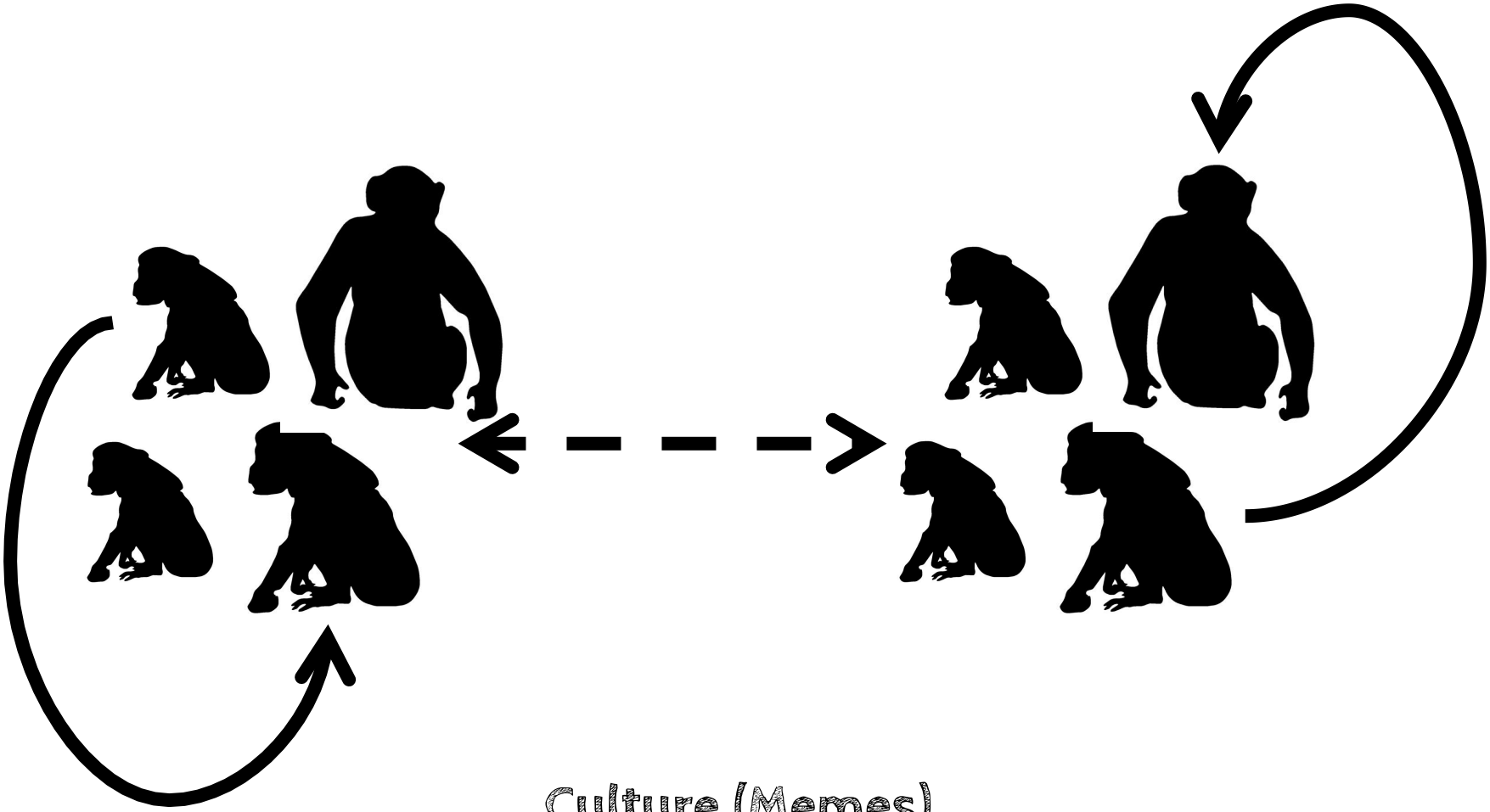
By Miguel Gonzalez C.

The set of behaviours that cannot be attributed to genetic inheritance and that are stored and transmitted by means of social learning

How do we Know Culture Exists?

Genes

Within-Group Variation > Between-Group Variation[1]



Culture (Memes)

Between-Group Variation > Within-Group Variation[2]

Twin and Sibling Studies

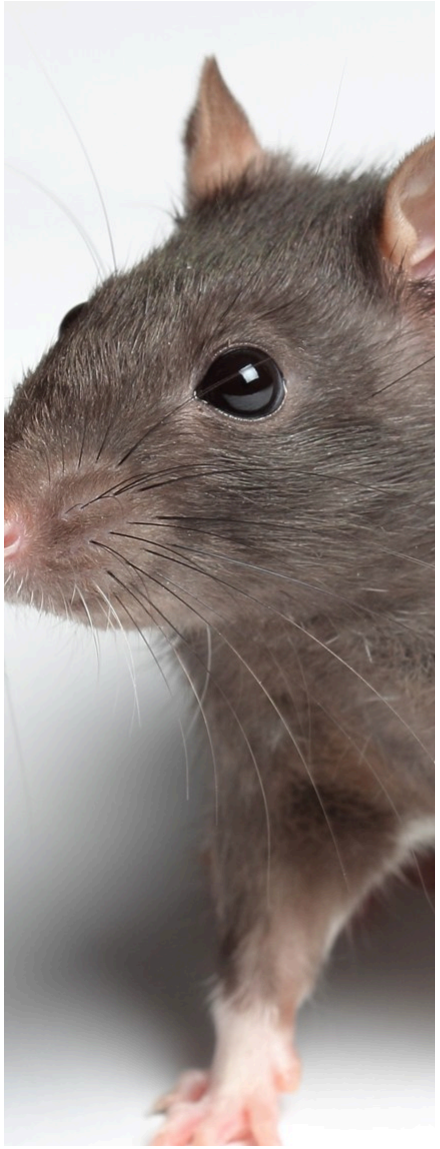
50% of Variation is not Genetic[3]

Different Environments
Contingent Cultures[4]

Others…

Our Behavioral Repertoire is not only the Result of Genes. Memes also play a big role.

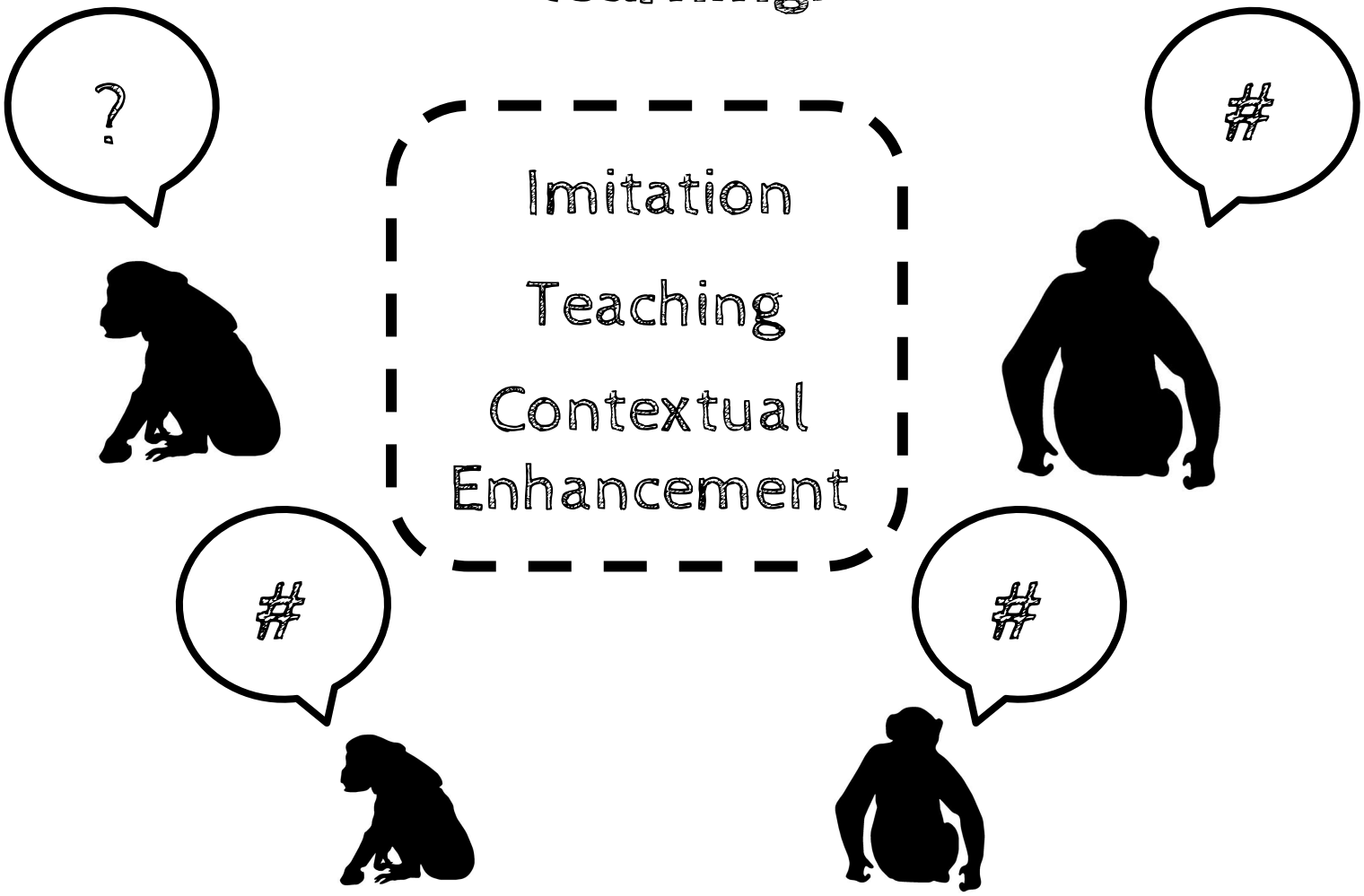
Animals with Culture



Culture (as defined here) is present in several species.

The Origin of Culture

Culture is a population-level product of the evolution of social learning.



Is Social Learning Enough for Culture to Evolve?

In a population where each individual is defined by:

Phenotype:

10001010001010011110

Genotype:

100010100010100111100

. . . there are two types of individuals.

Instinctive Actuator

Follows its Instincts

Phenotype is Mapped From the Genotype

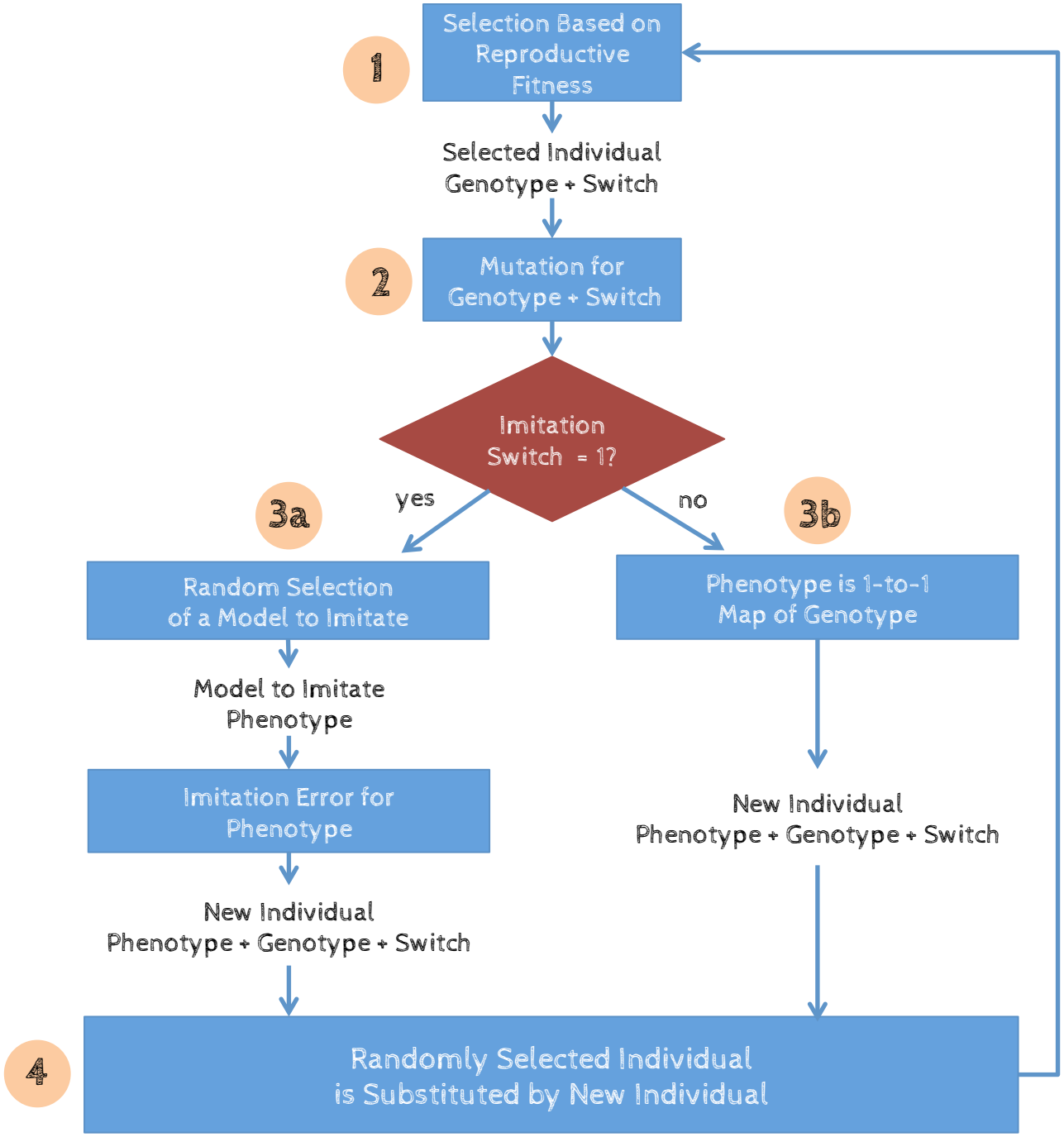
Phenotype:
1000101000101001110
Genotype:
10001010001010011100

Social Learner

Imitates at Random

Phenotype can be Different from Genotype

Phenotype:
1010101110101011110
Genotype:
10001010001010011101


1
Selection Based on Reproductive Fitness
Selected Individual Genotype + Switch
2
Mutation for Genotype + Switch
Imitation Switch = 1?
yes
no
3a
3b
Random Selection of a Model to Imitate
Model to Imitate Phenotype
Imitation Error for Phenotype
New Individual Phenotype + Genotype + Switch
Phenotype is 1-to-1 Map of Genotype
New Individual Phenotype + Genotype + Switch
4
Randomly Selected Individual is Substituted by New Individual

Model Assumption

Imitation Error ›› Genetic Mutation

Initial Conditions

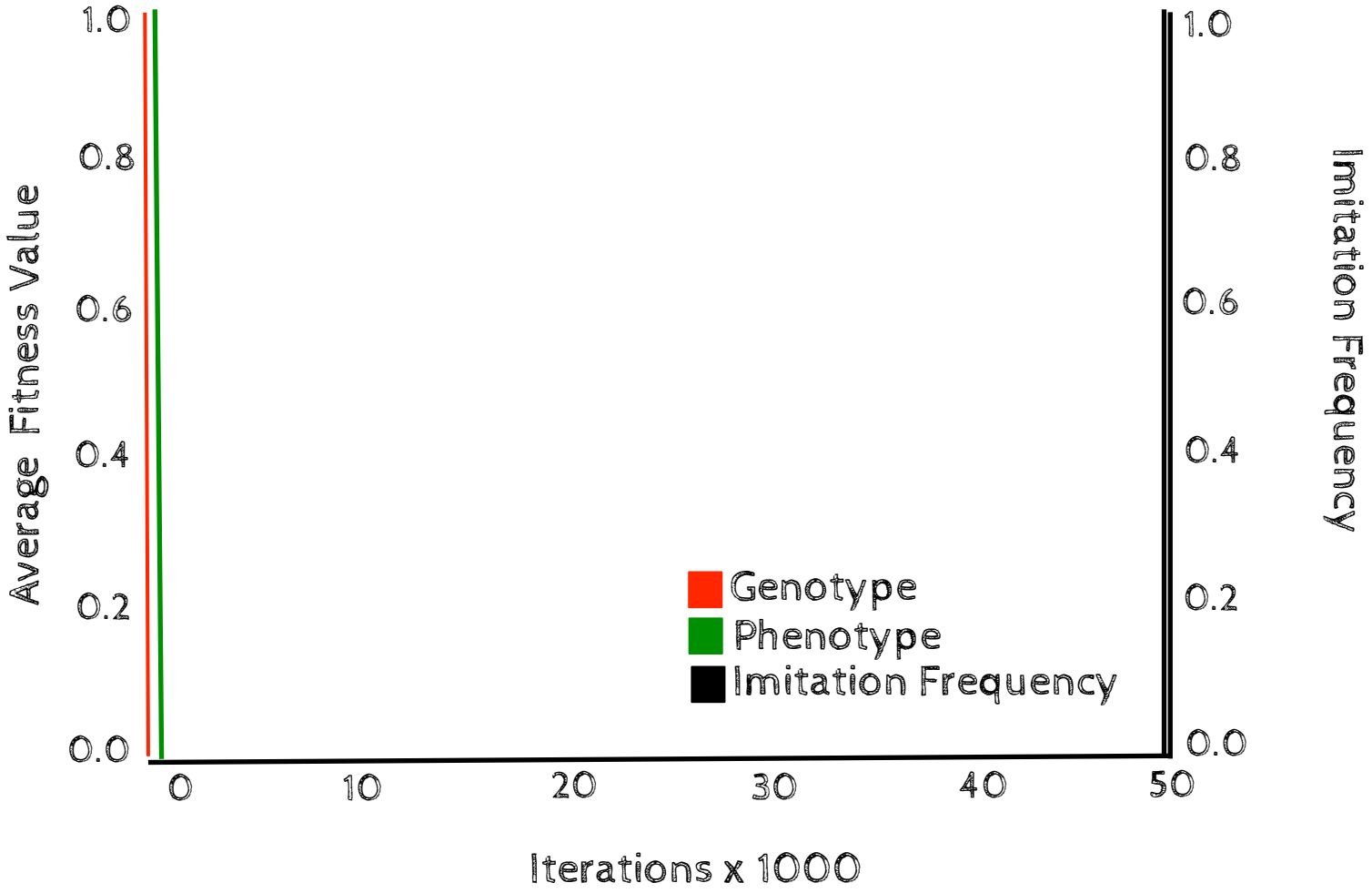
New Environmental Challenge

111111111111111111111

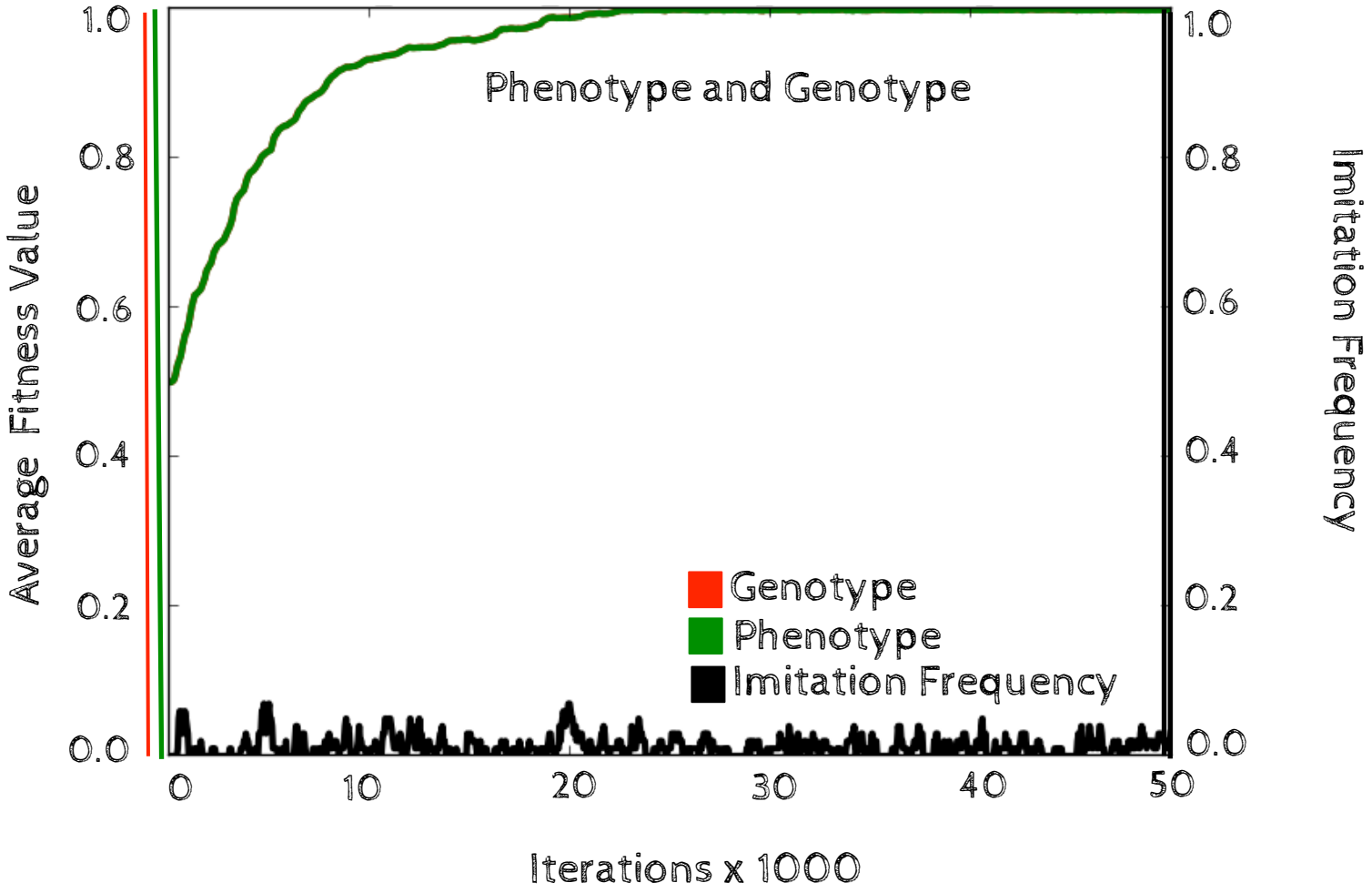
100% Instinctive Actuators

50% of String Solved

Predictions?

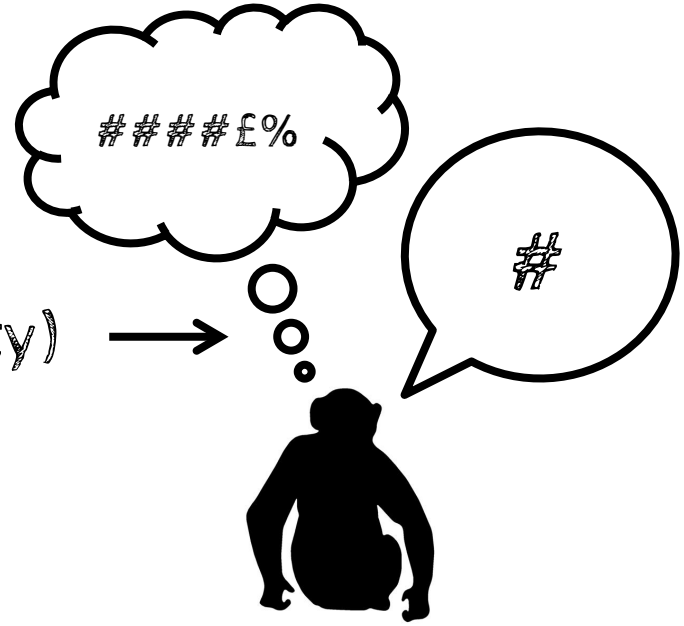


Social Learning is not Enough to Evolve Culture . . .

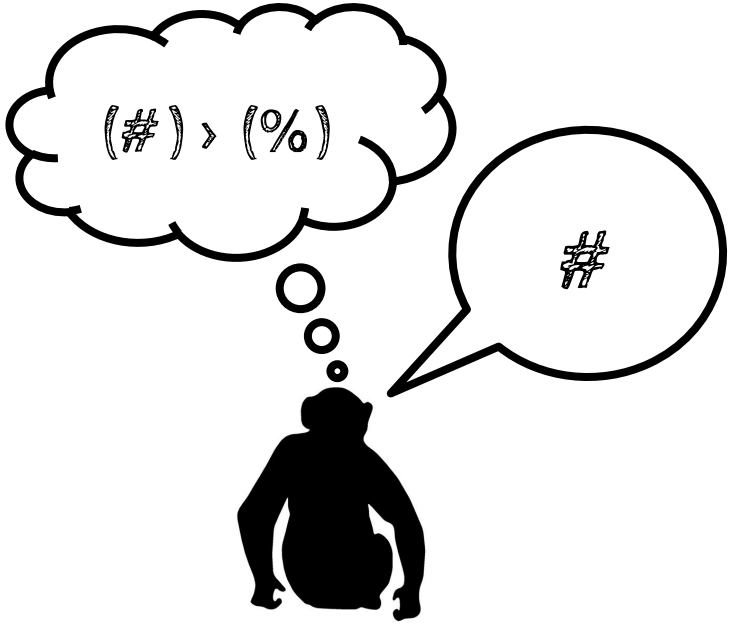


. . . Unless:

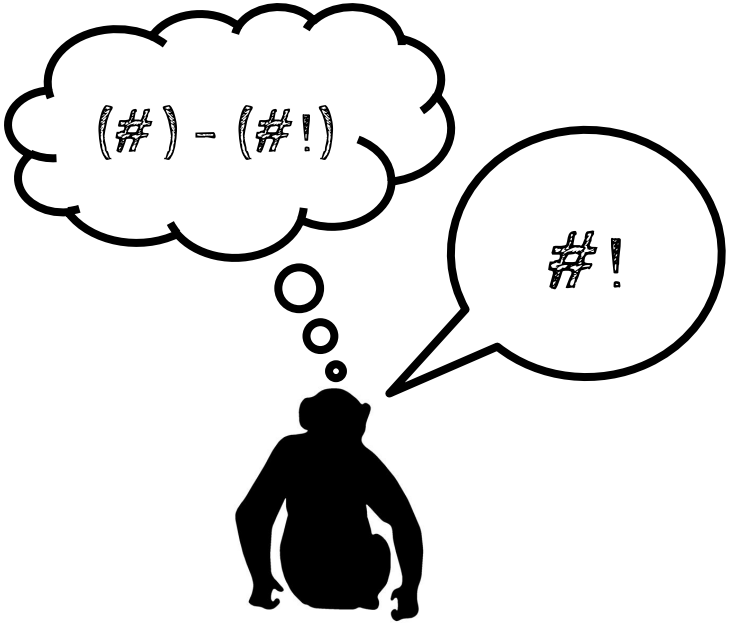
Conformity (Hypercomformity) →



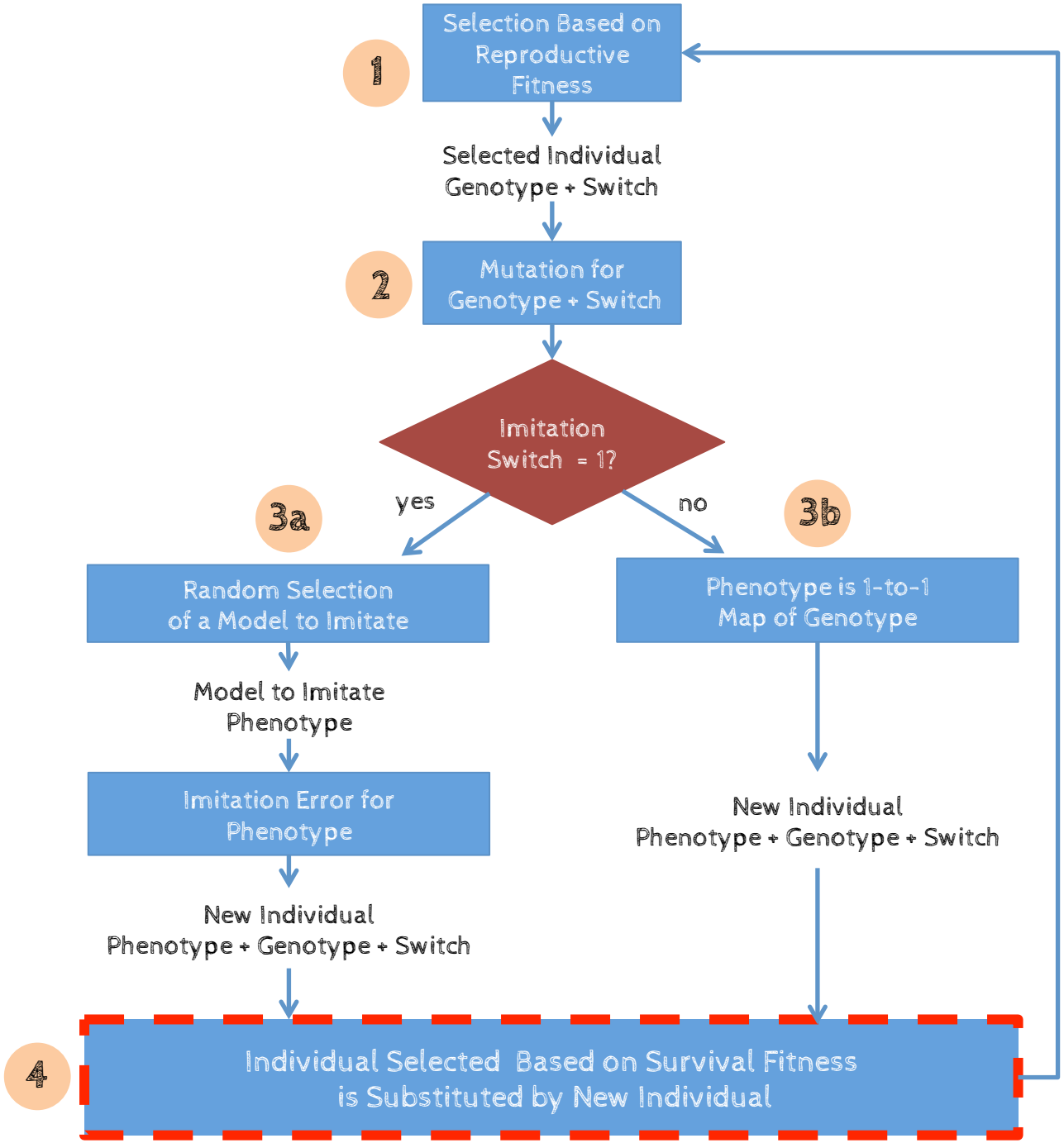
← Critical Social Learning



Guided Variation →



Unbiased imitation does not explain the evolution of culture . . . Or does it?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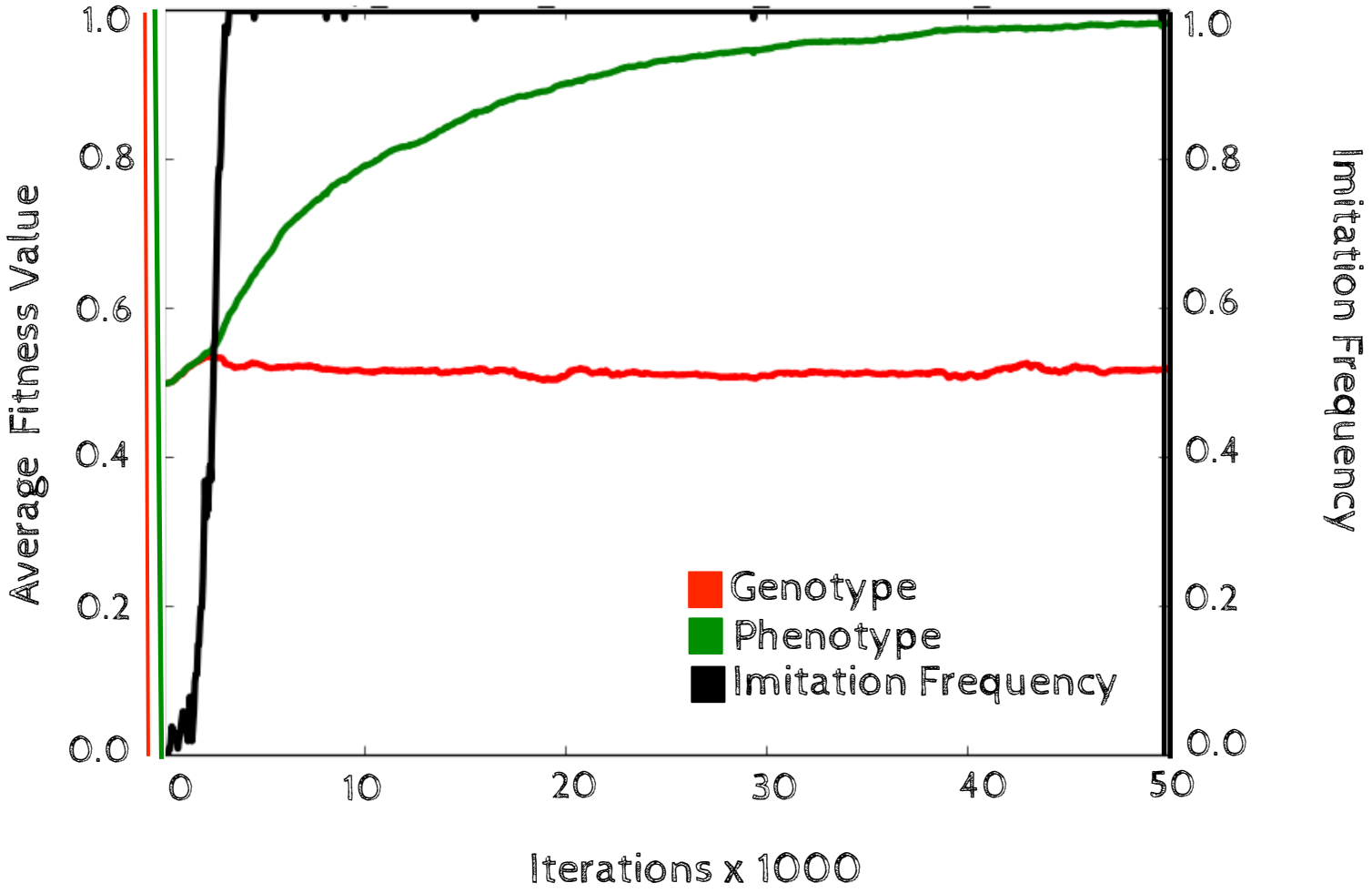
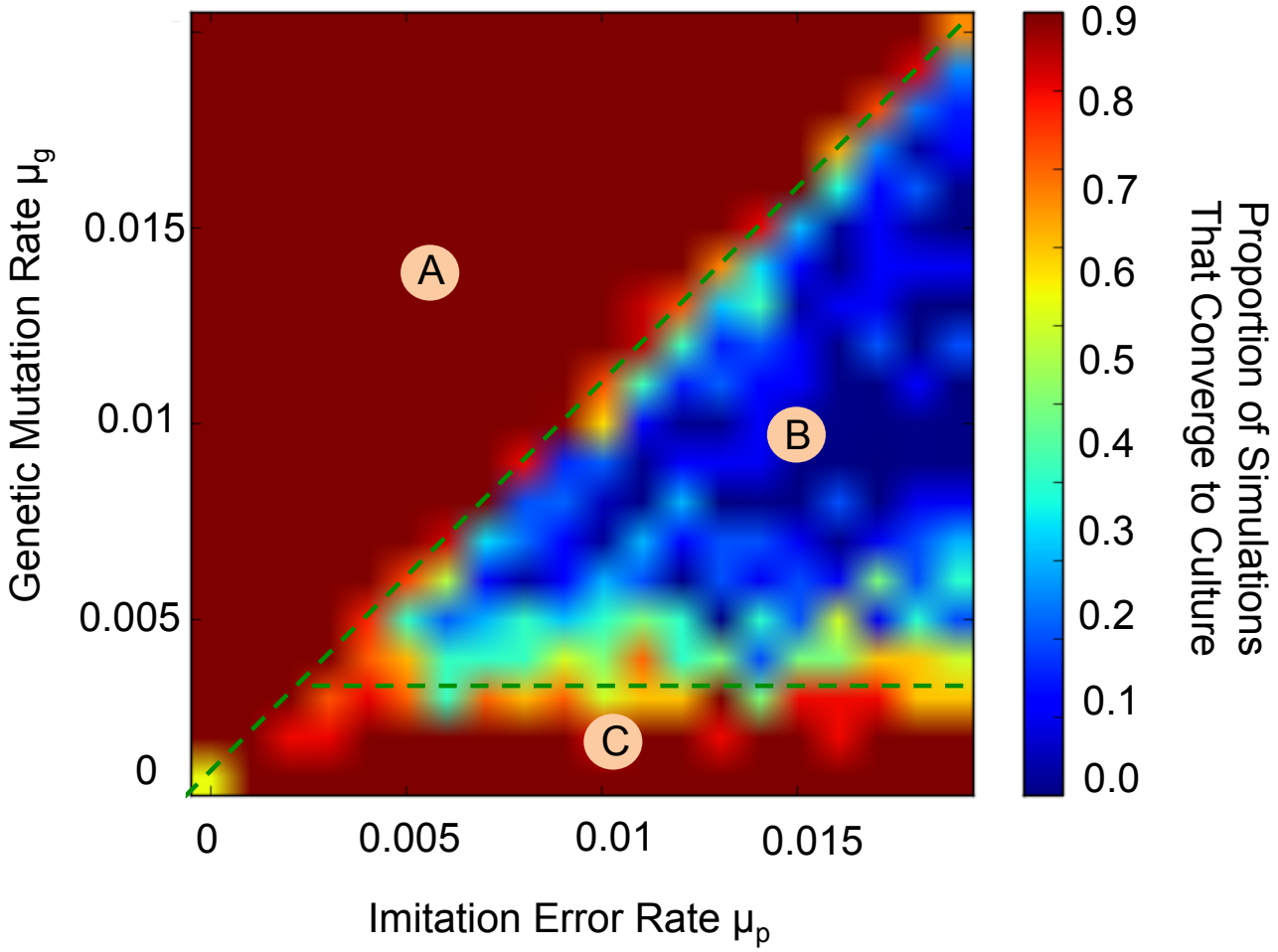
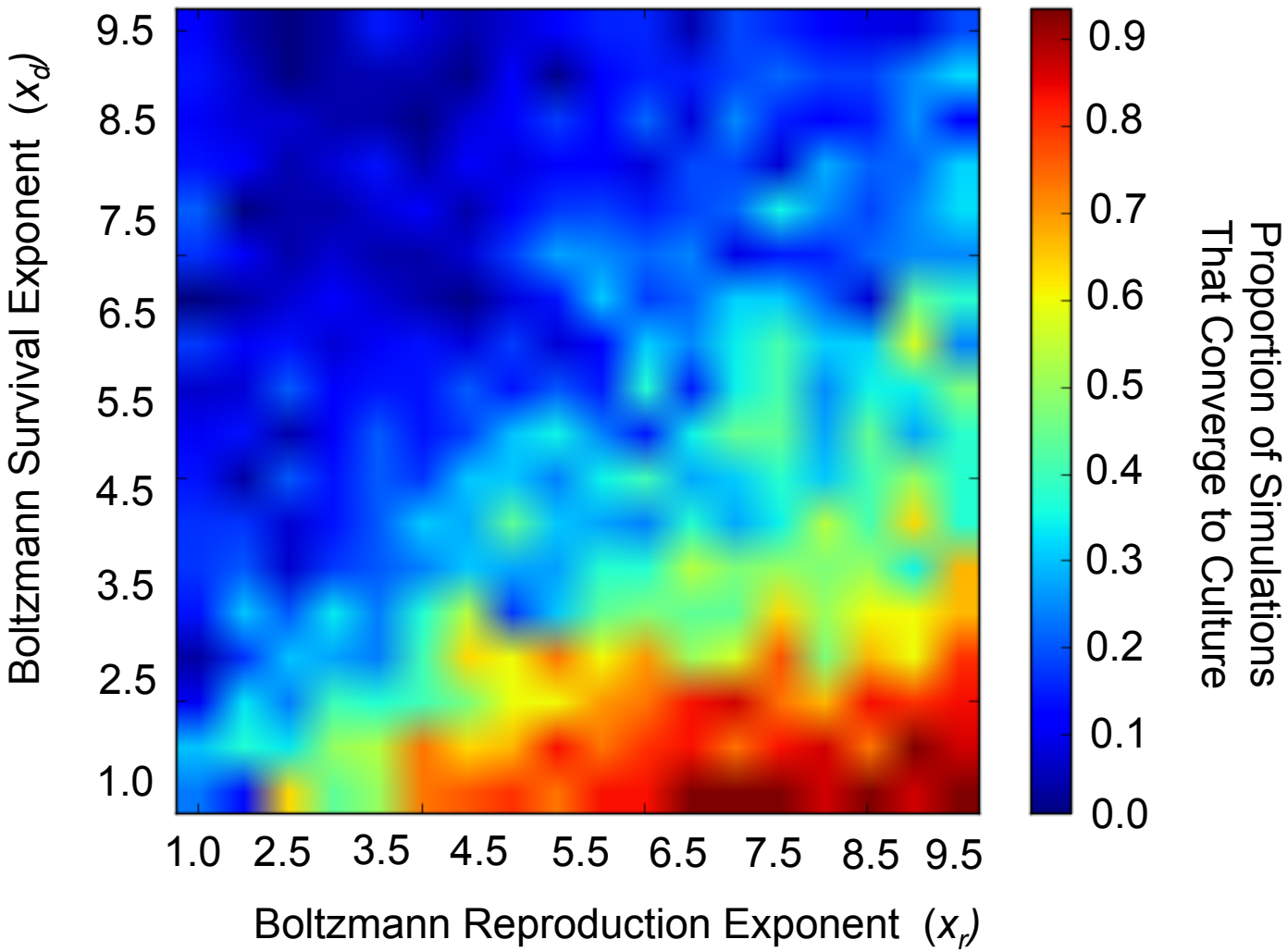
4
Individual Selected Based on Survival Fitness is Substituted by New Individual

Decomposing Selection into Survival and Reproduction[5]




Genetic Mutation Rate μ_g
0.015
0.01
0.005
0
A
B
C
0
0.005
0.01
0.015
Imitation Error Rate μ_p
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Proportion of Simulations
That Converge to Culture


Boltzmann Survival Exponent (x_d)
9.5
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.0
1.0
2.5
3.5
4.5
5.5
6.5
7.5
8.5
9.5
Boltzmann Reproduction Exponent (x_r)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Proportion of Simulations
That Converge to Culture

What are the Minimal Conditions for the Evolution of Culture?

Are Traits like Conformity, Critical Social Learning and Guided Variation Necessary?

Culture Evolve Because it is a "Better" Evolutionary System than its Genetic Counterpart?

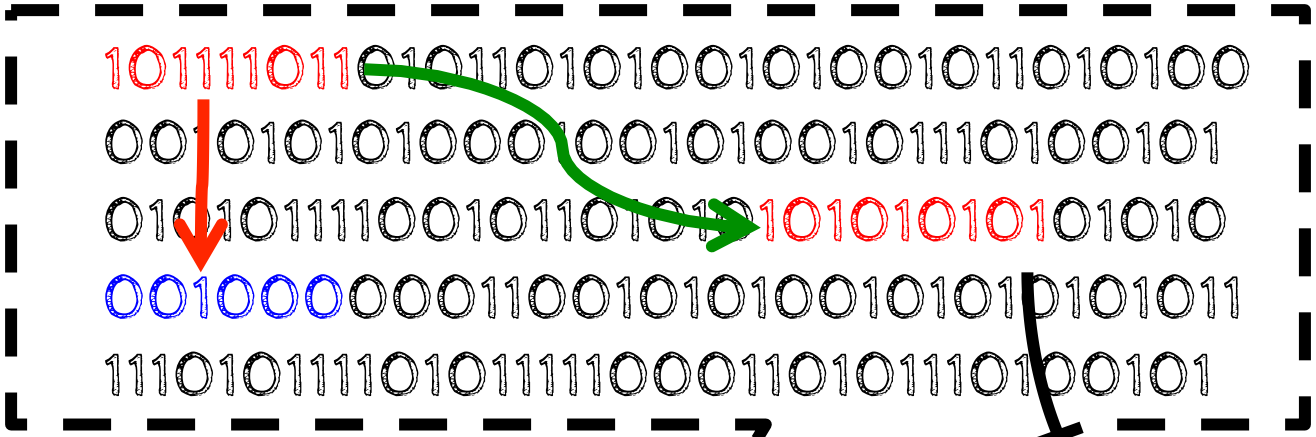
Its Culture More Likely to Evolve in Changing Environments?

Once Culture Evolves . . .

. . . Cultural Evolution Starts.

Epistatic

"Exploits" Genes



Co-evolves with Genes

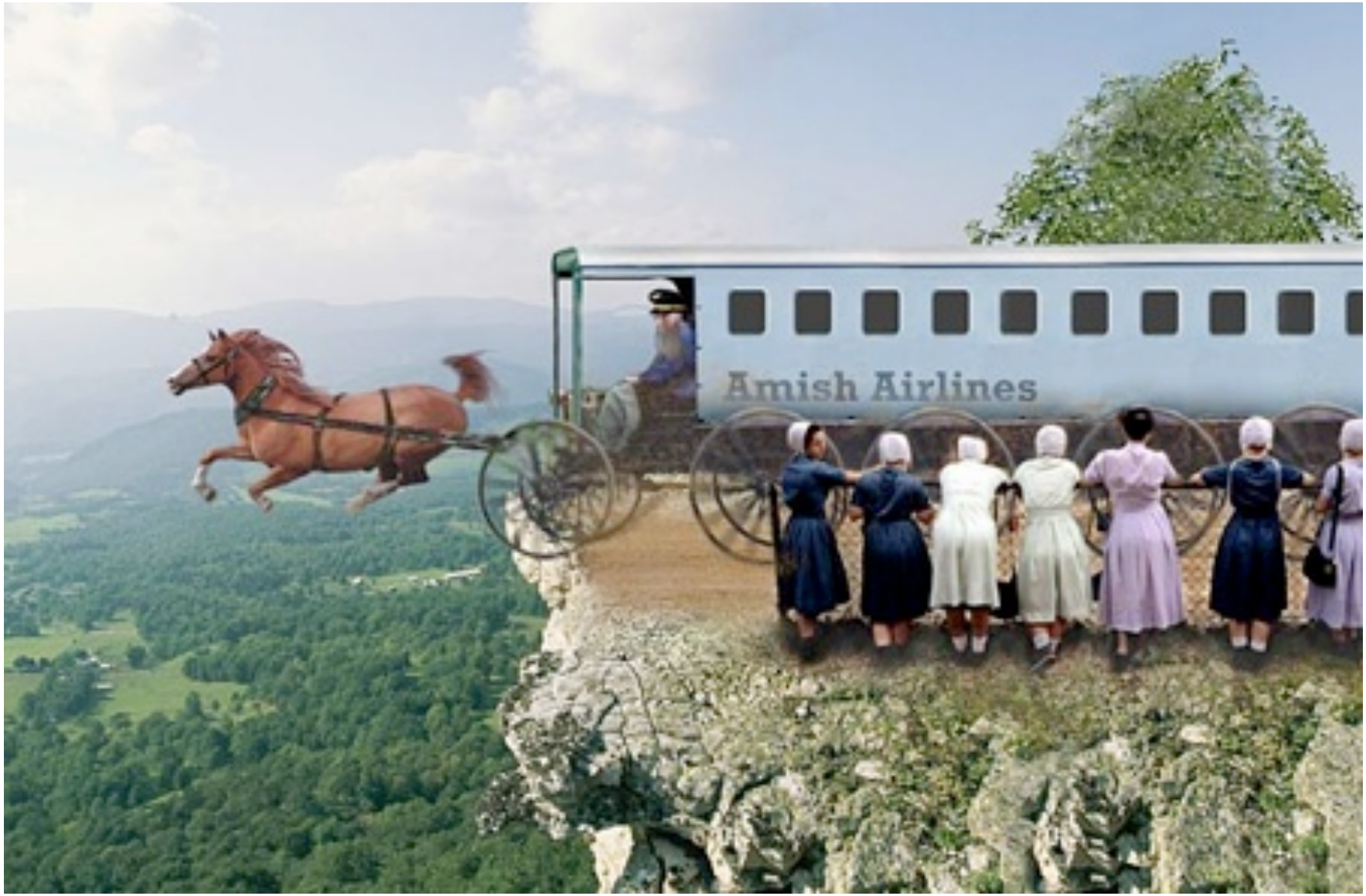
AGTTTGCCTAGCAT
GGATACGTAGATCA
TATGGCGAAAGATA

Can Produce "Dead Ends"

Can be Maladaptive

NOKIA

"Shakers"


Amish Airlines

Culture is a Parallel Evolutionary
System Co-evolving with Genes in “Complex” ways.

Thanks

References

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3. Plomin, R., DeFries, J., Craig, I., and McGuffin, P. (2003). Behavioral Genetics in the post-genomic era. American Psychological Association.

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