

APPEARANCES CAN BE DECEIVING: Lessons Learned Re-implementing Axelrod's “Evolutionary Approach to Norms”

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PRESENTATION OUTLINE

- **Axelrod's models**
- **Method**
- **Results and discussion**
- **Conclusions**



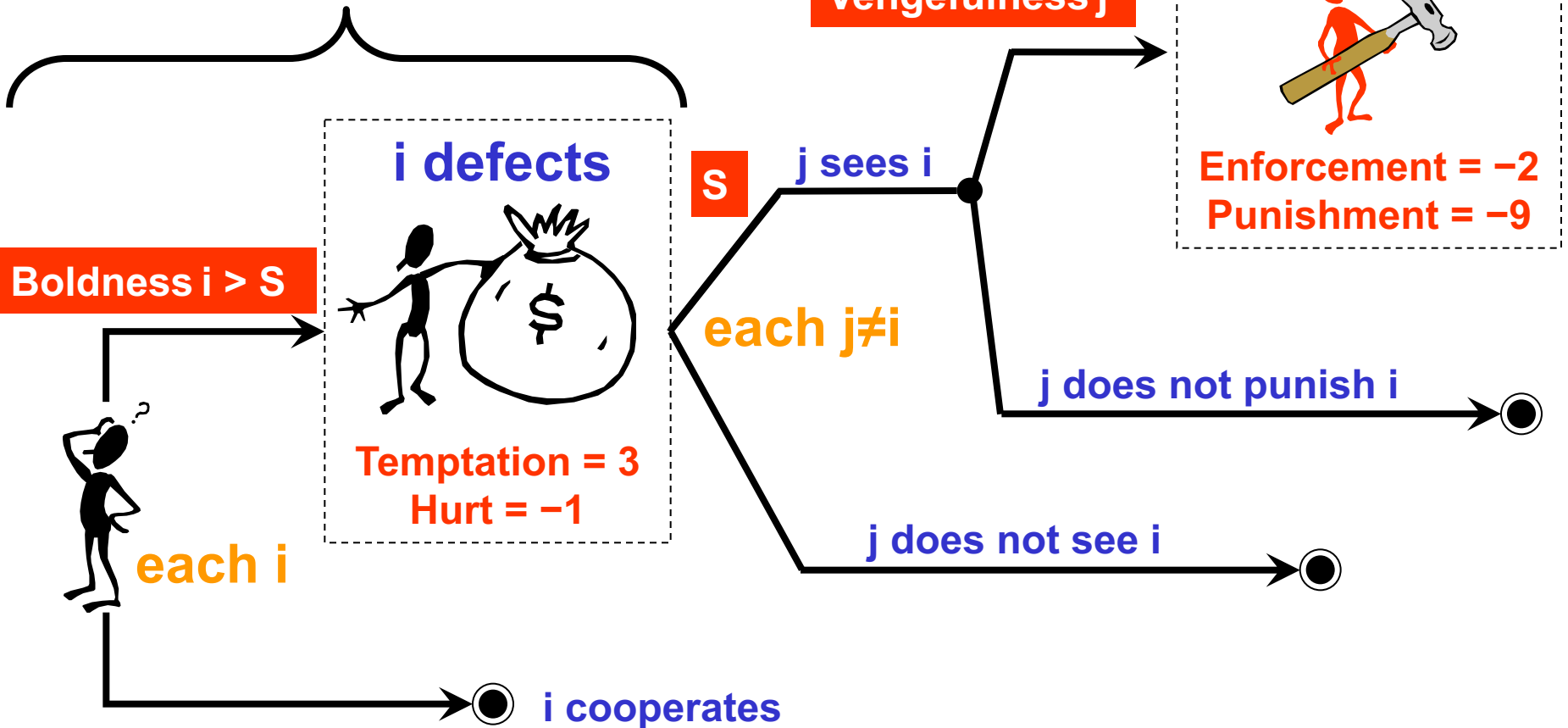
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AXELROD'S MODELS: The Norms model

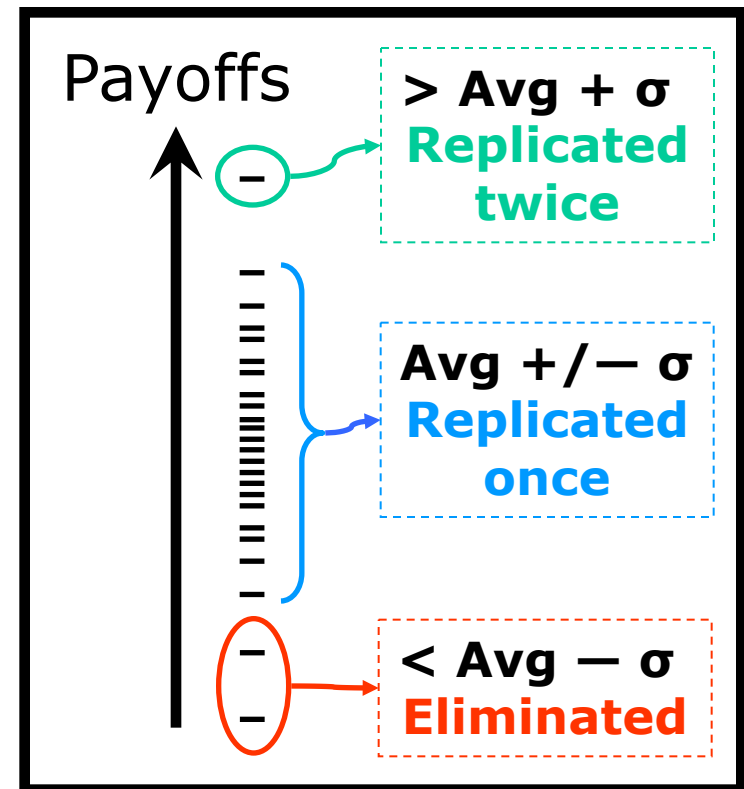
20-player PD



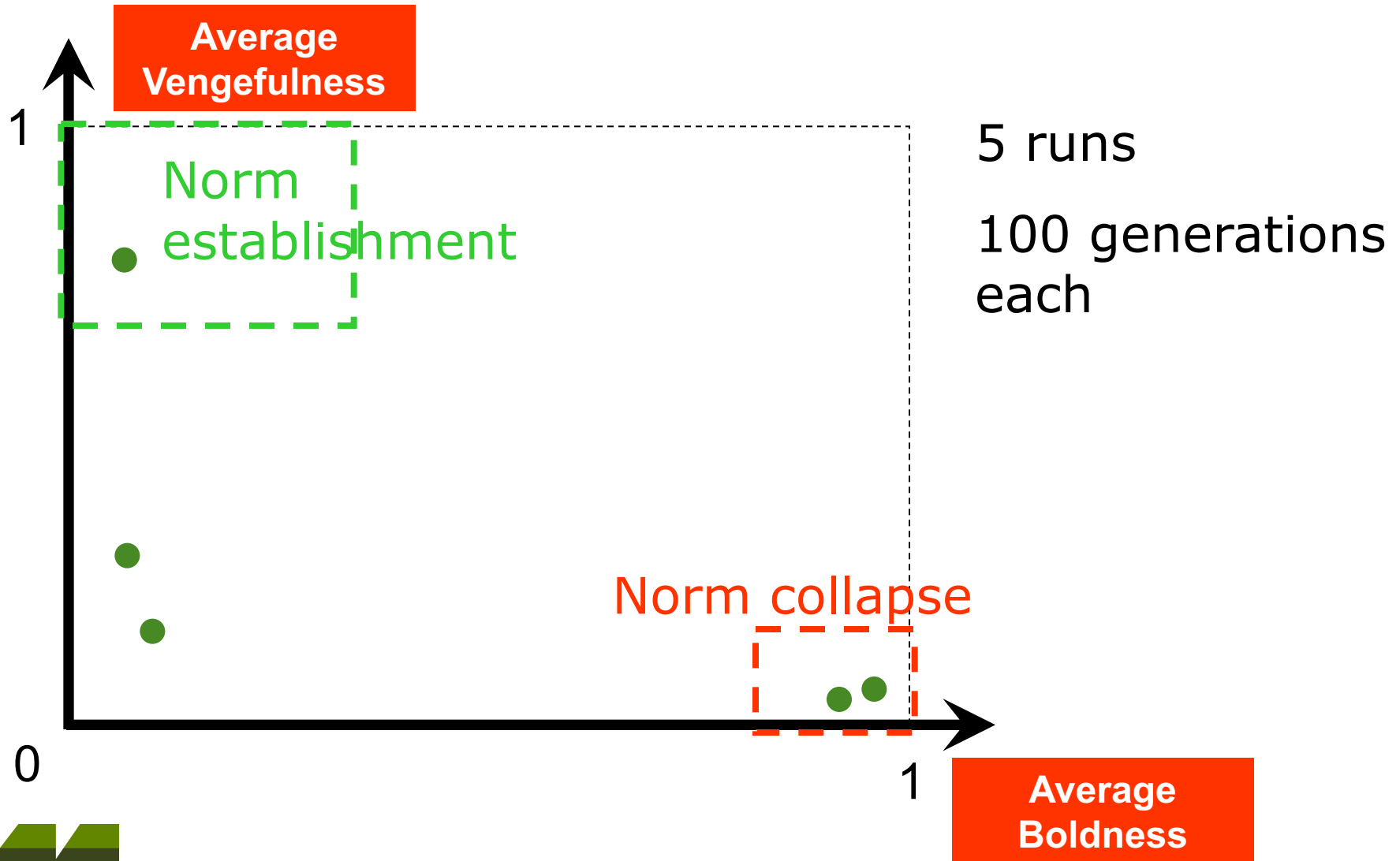
AXELROD'S MODELS: The Norms model

- 20 agents; Random initial strategies
- 1 round = 1 opp. to defect for everyone
- 4 rounds = 1 generation
- **Evolutionary pressures**
 - Selection mechanism
 - MutationRate = 0.01

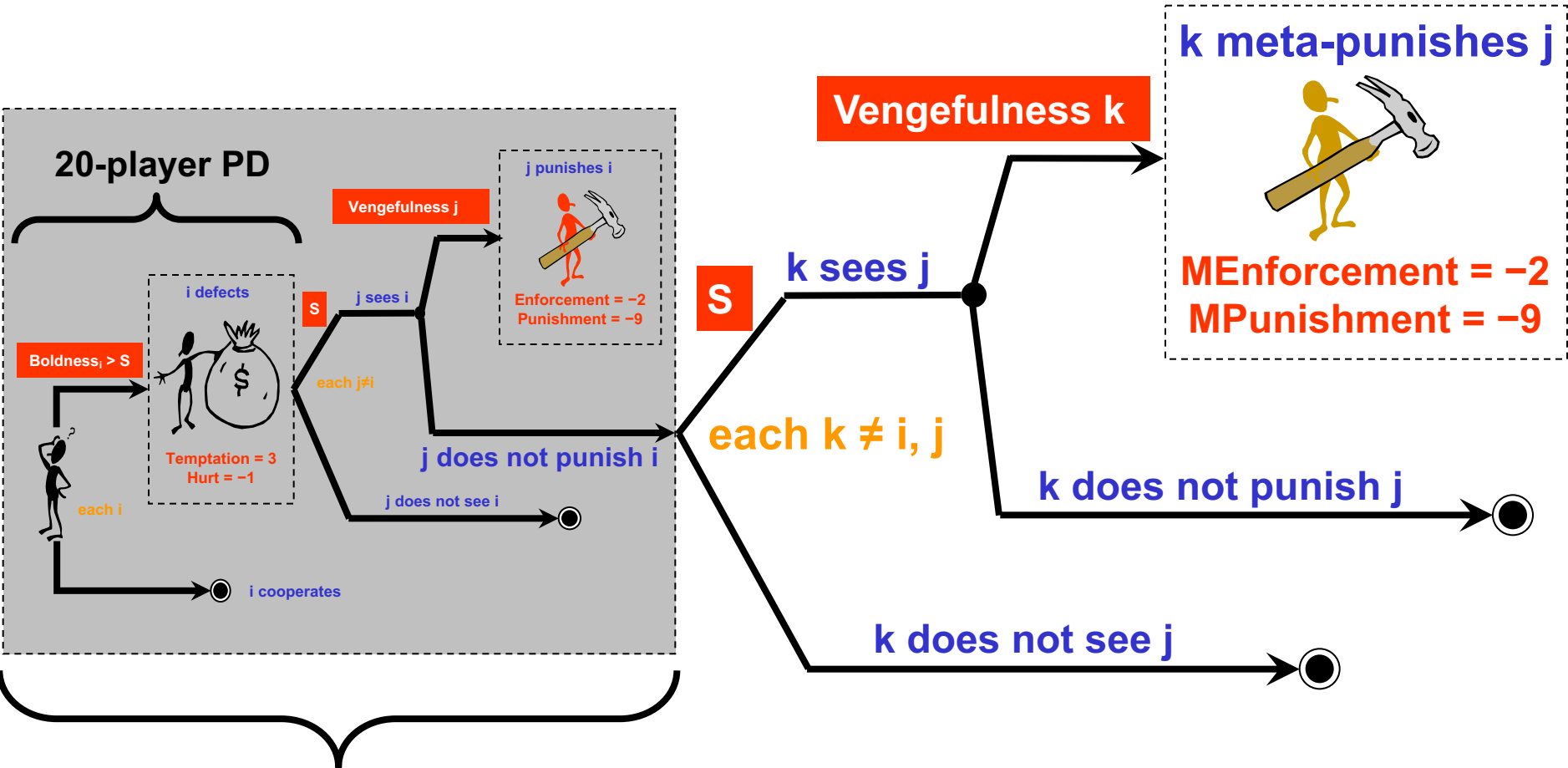
$$\begin{array}{|c|c|c|} \hline 0 & 1 & 1 \\ \hline \end{array} = 3 / 7$$



AXELROD'S MODELS: The Norms model



AXELROD'S MODELS: The MetaNorms model



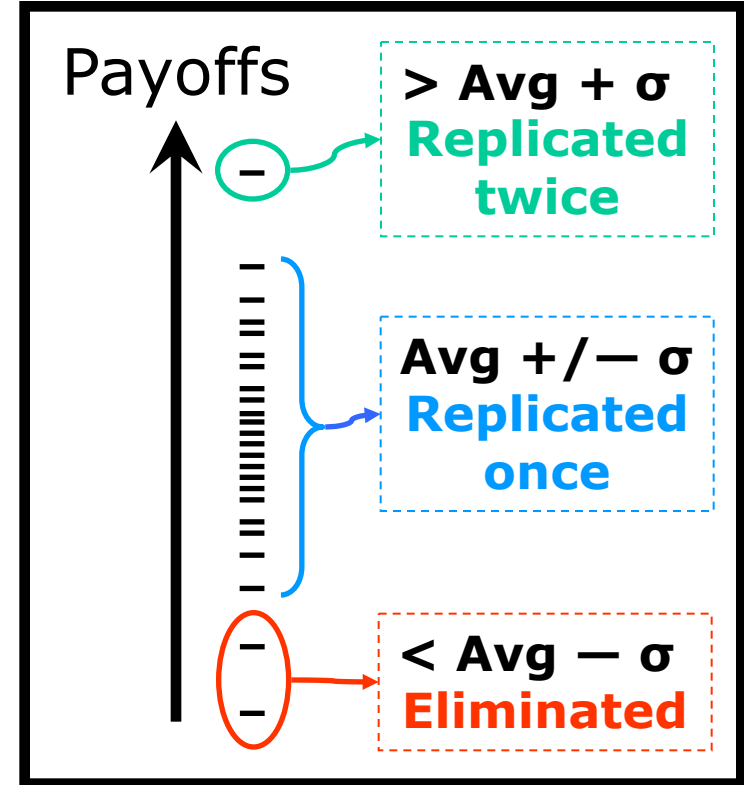
The Norms model



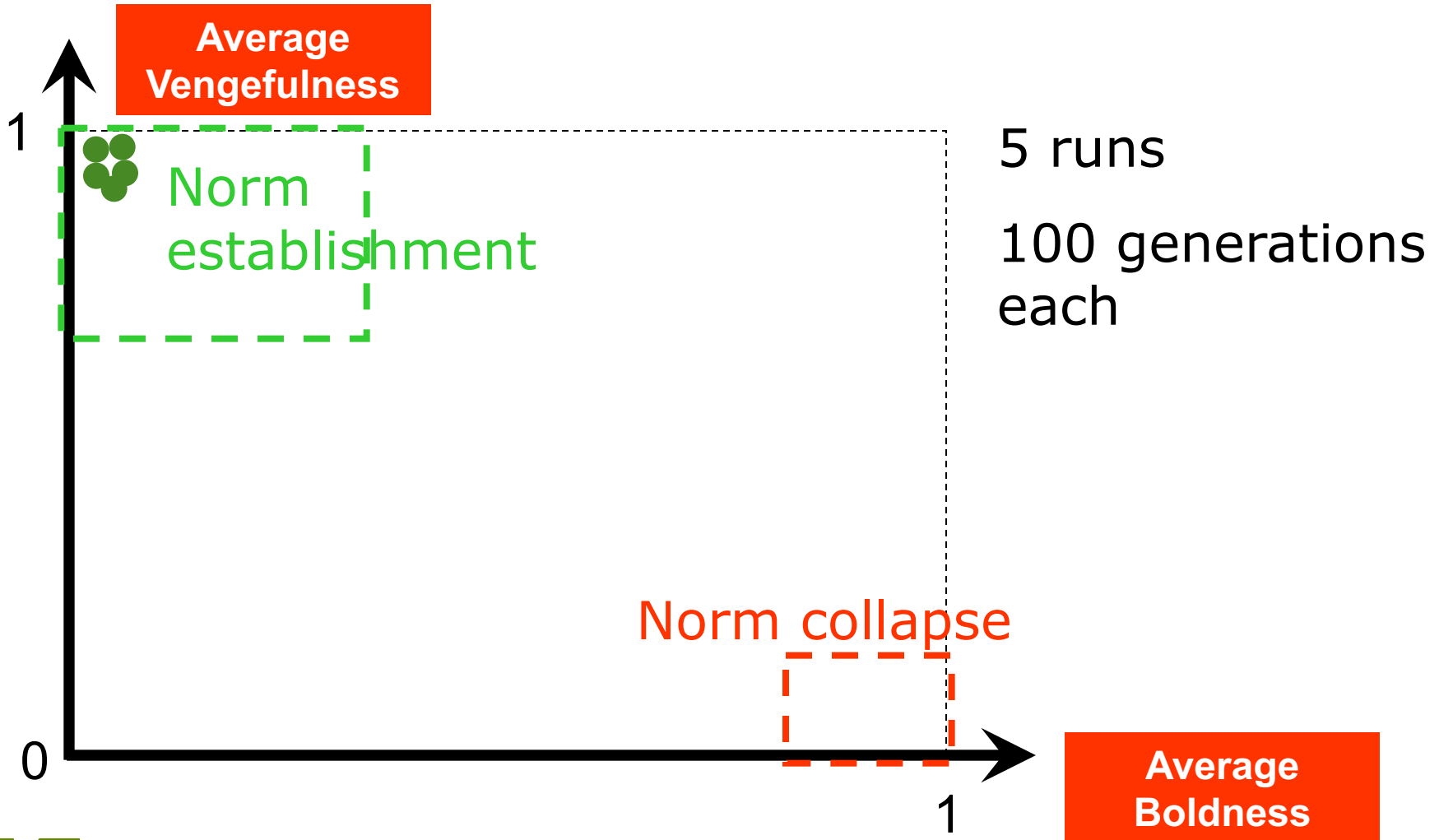
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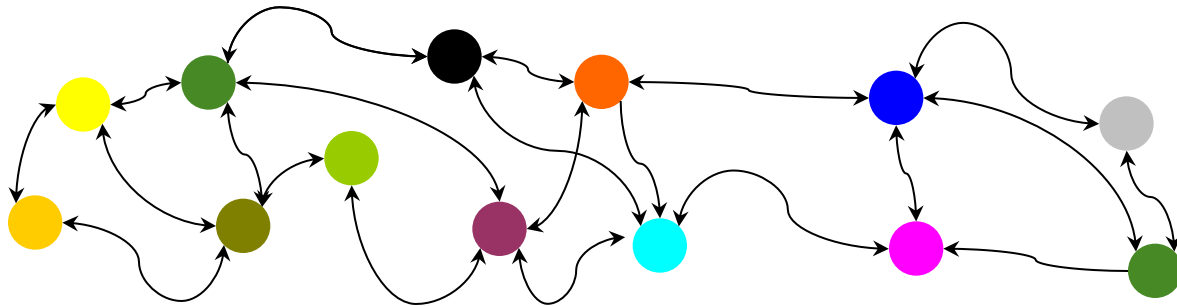
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METHOD

- **Computer models (Java & RePast)**
- **Mathematical analysis – Markov chain**



- **Mathematical Abstractions**



METHOD

- **Mathematical Abstractions**

$$\mathbf{Exp}(\text{Payoff}_i) = T \cdot b_i + H \cdot \sum_{\substack{j=1 \\ j \neq i}}^n b_j + E \frac{v_i}{2} \sum_{\substack{j=1 \\ j \neq i}}^n b_j^2 + P \frac{b_i^2}{2} \sum_{\substack{j=1 \\ j \neq i}}^n v_j$$

+ Continuity

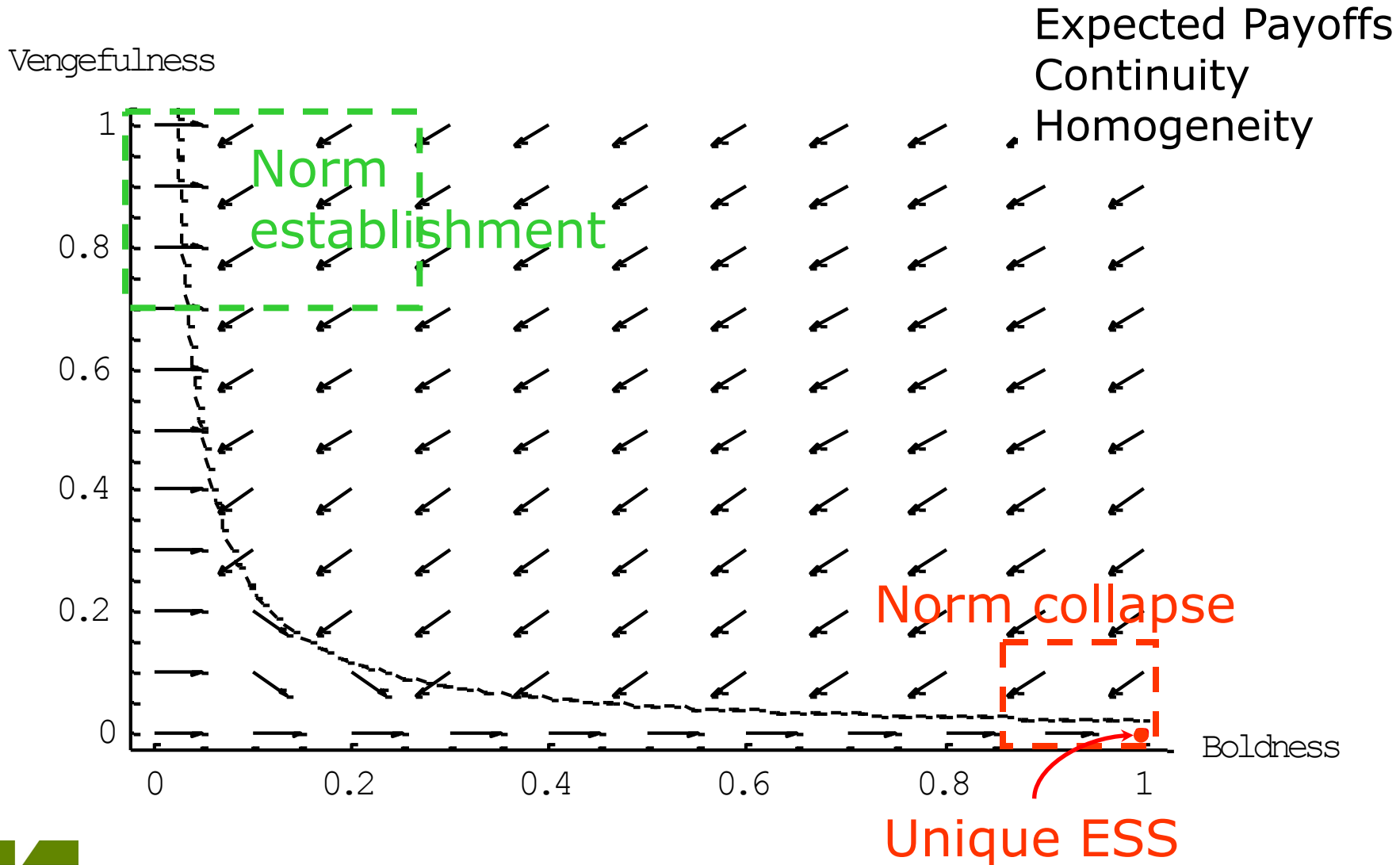
**Definition of
Evolutionary Stable
States**

+ Homogeneity

**Maps of the
dynamics**

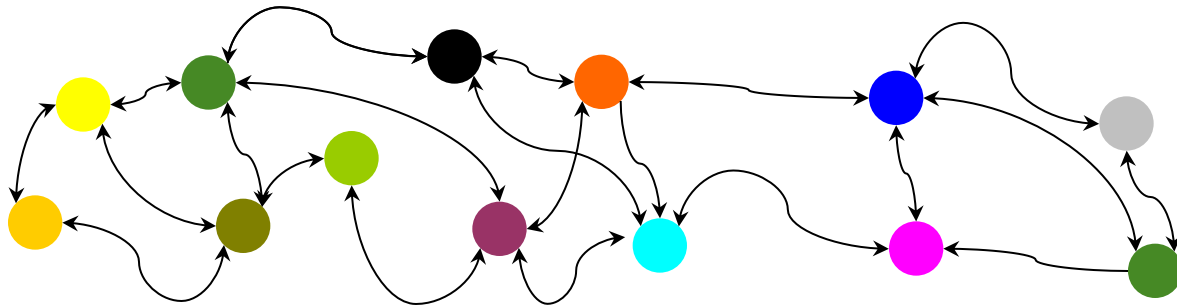


MAPS OF THE DYNAMICS



METHOD

- **Computer models (Java & RePast)**
- **Mathematical analysis – Markov chain**



- **Mathematical Abstractions**



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RESULTS AND DISCUSSION

- **The Norms model**
- **The MetaNorms model**
 - **Replication of the original experiments**
 - **Exploration of parameter space**
 - **Other instantiations of the same conceptual model**

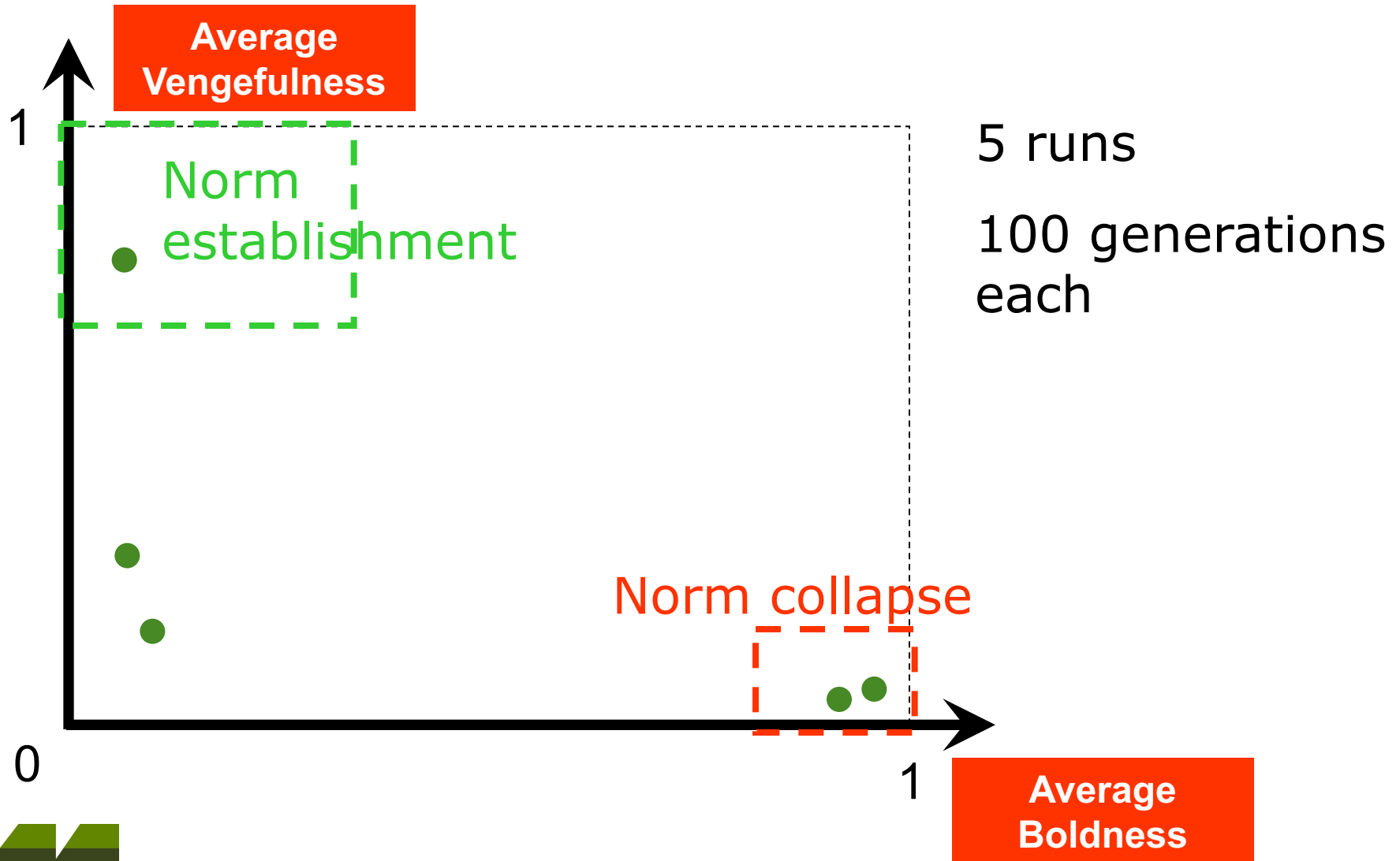


RESULTS AND DISCUSSION

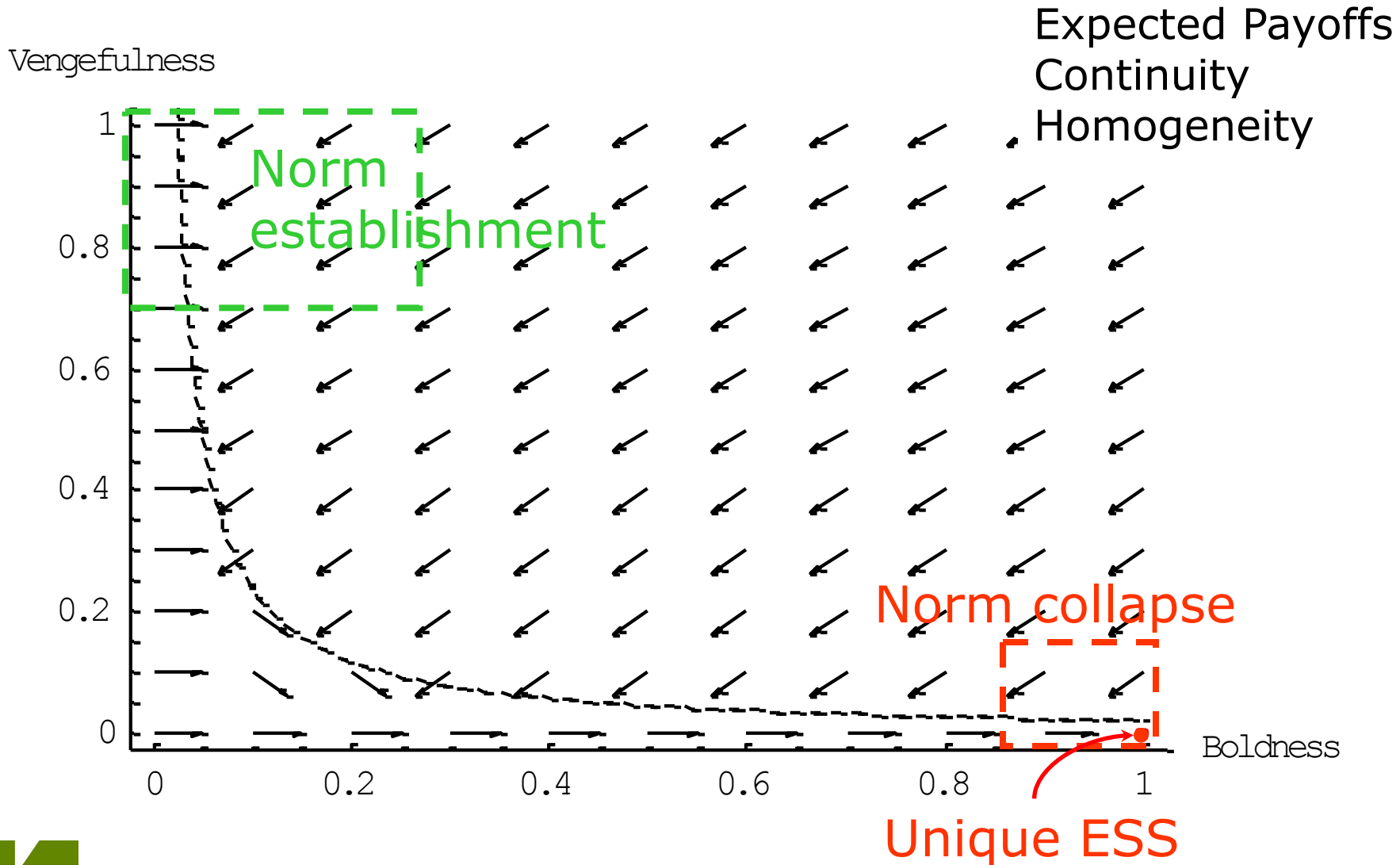
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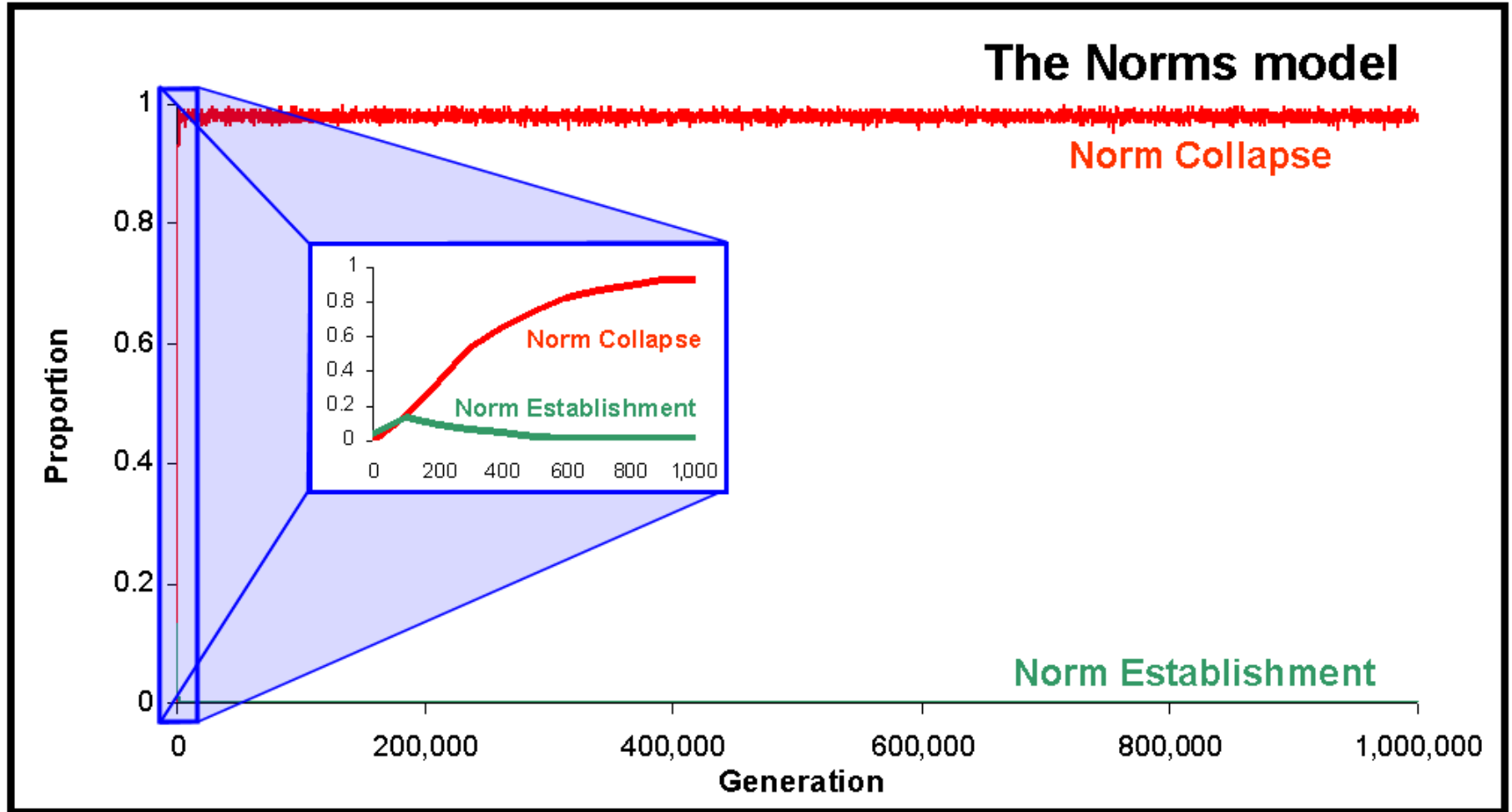
THE NORMS MODEL: Axelrod's results



THE NORMS MODEL: Dynamics



THE NORMS MODEL: Our results



500 runs; 1,000,000 generations each



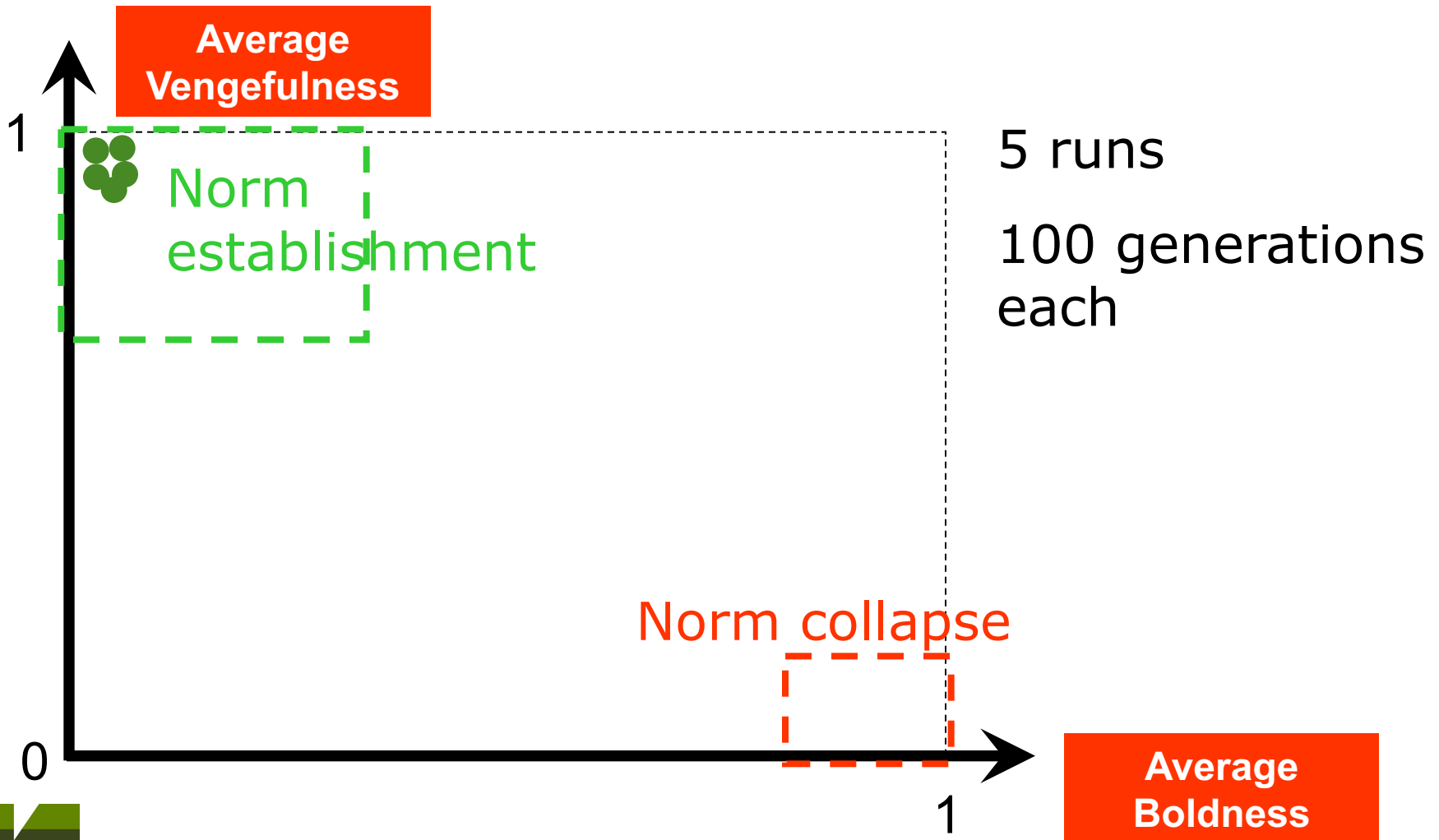
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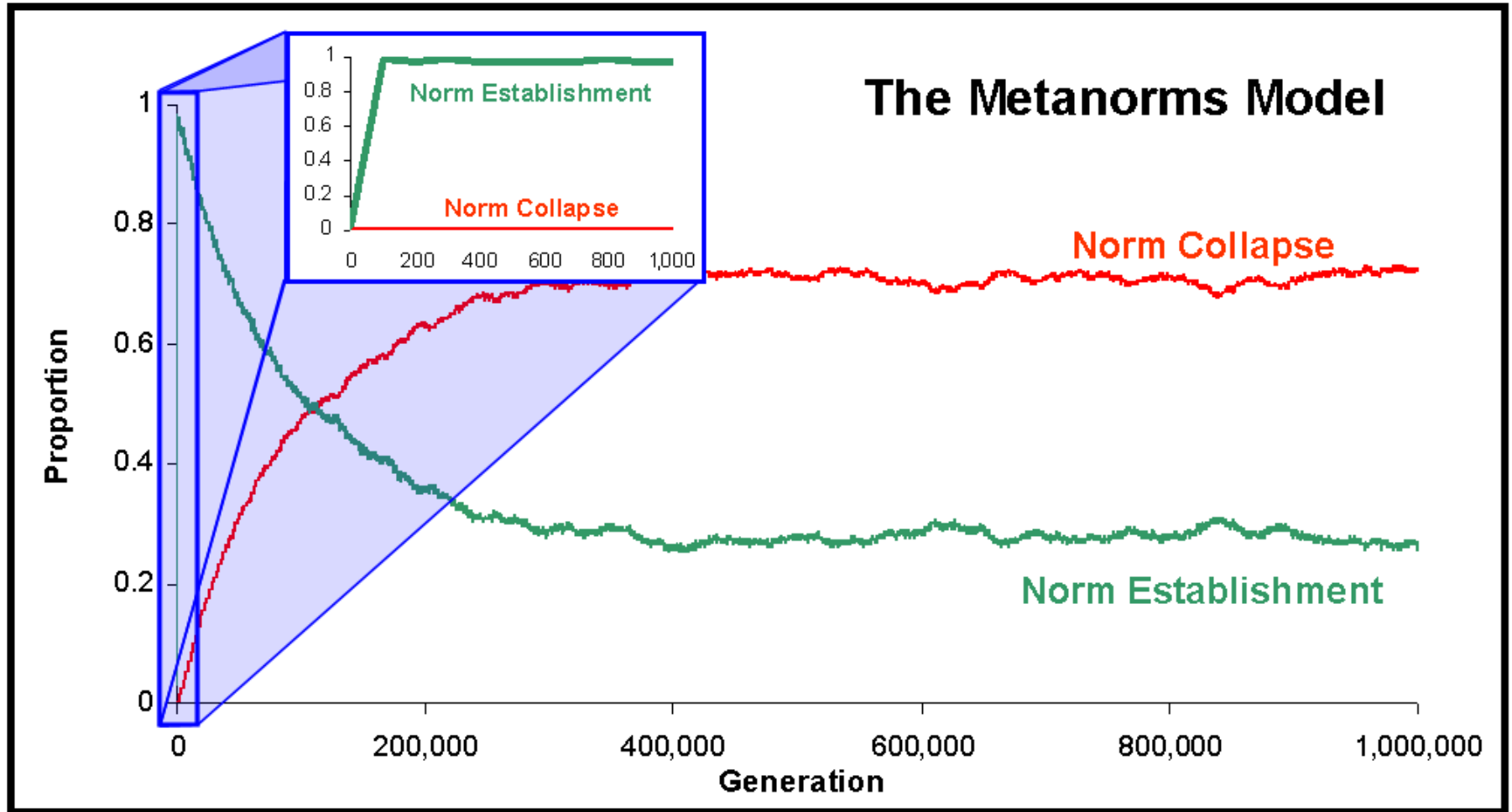


THE METANORMS MODEL

Axelrod's results



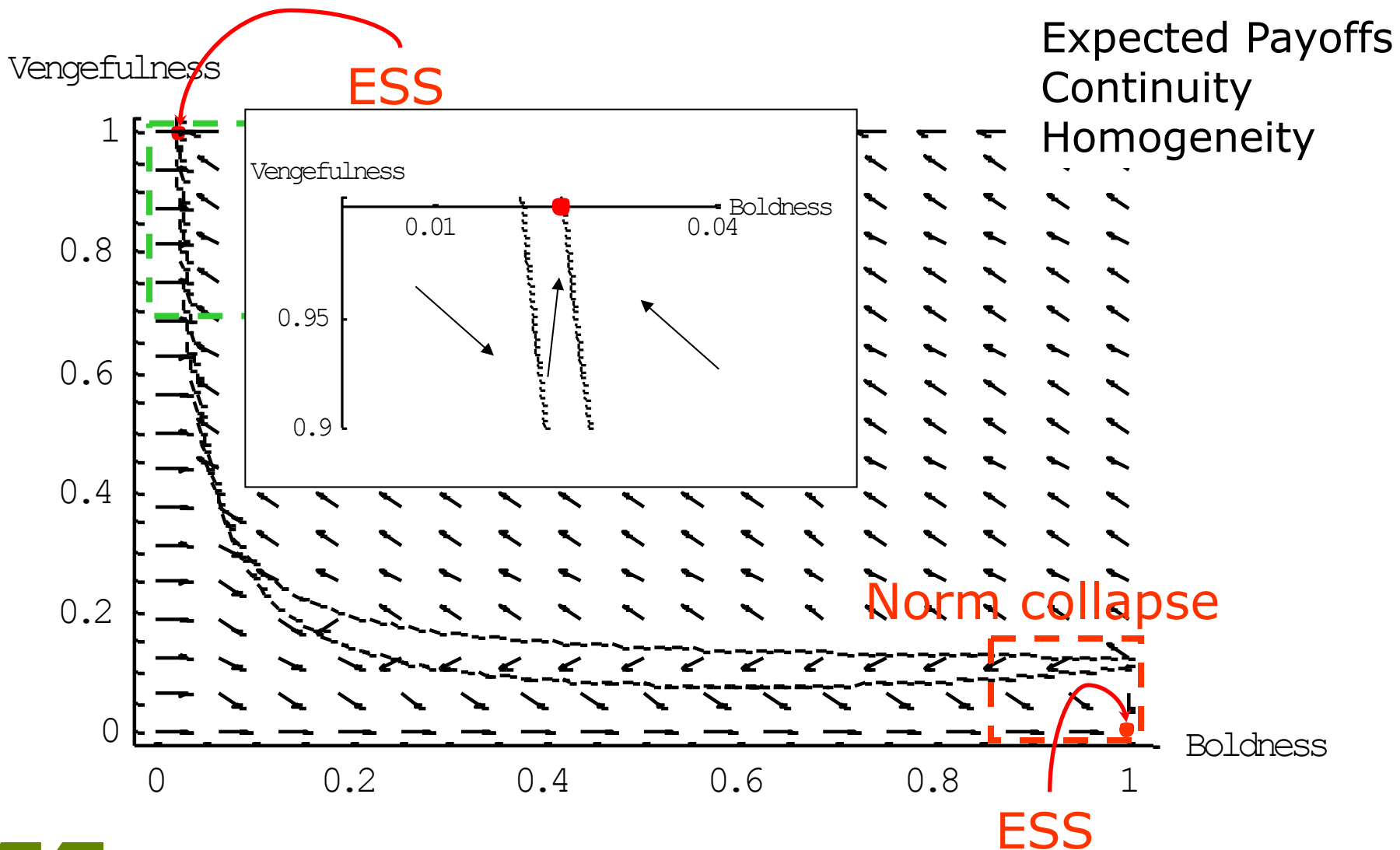
THE METANORMS MODEL: Our results



1,000 runs; 1,000,000 generations each



THE METANORMS MODEL: Dynamics



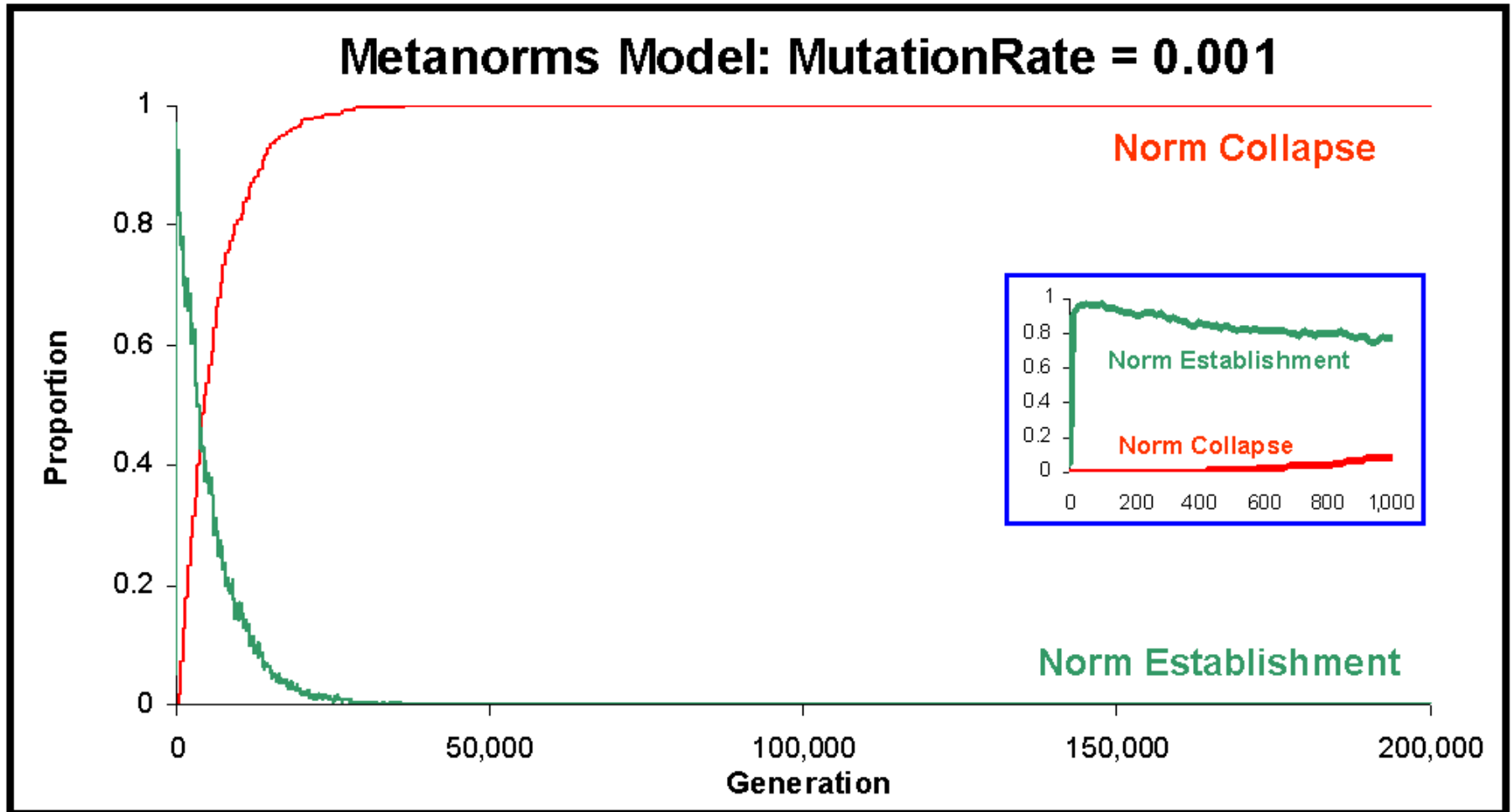
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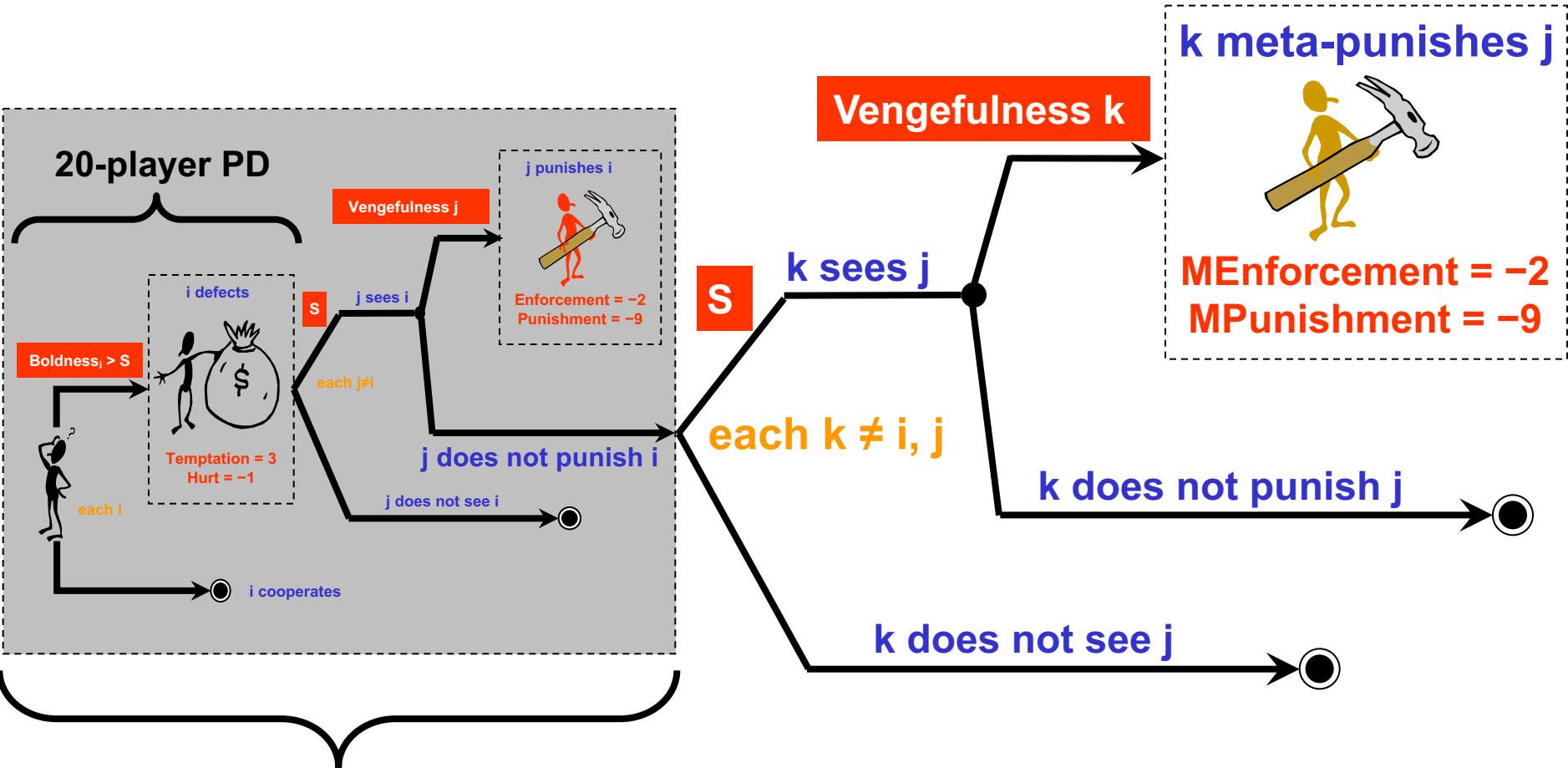
MutationRate = 0.001 (as opposed to 0.01)



300 runs; 200,000 generations each



AXELROD'S MODELS: The MetaNorms model

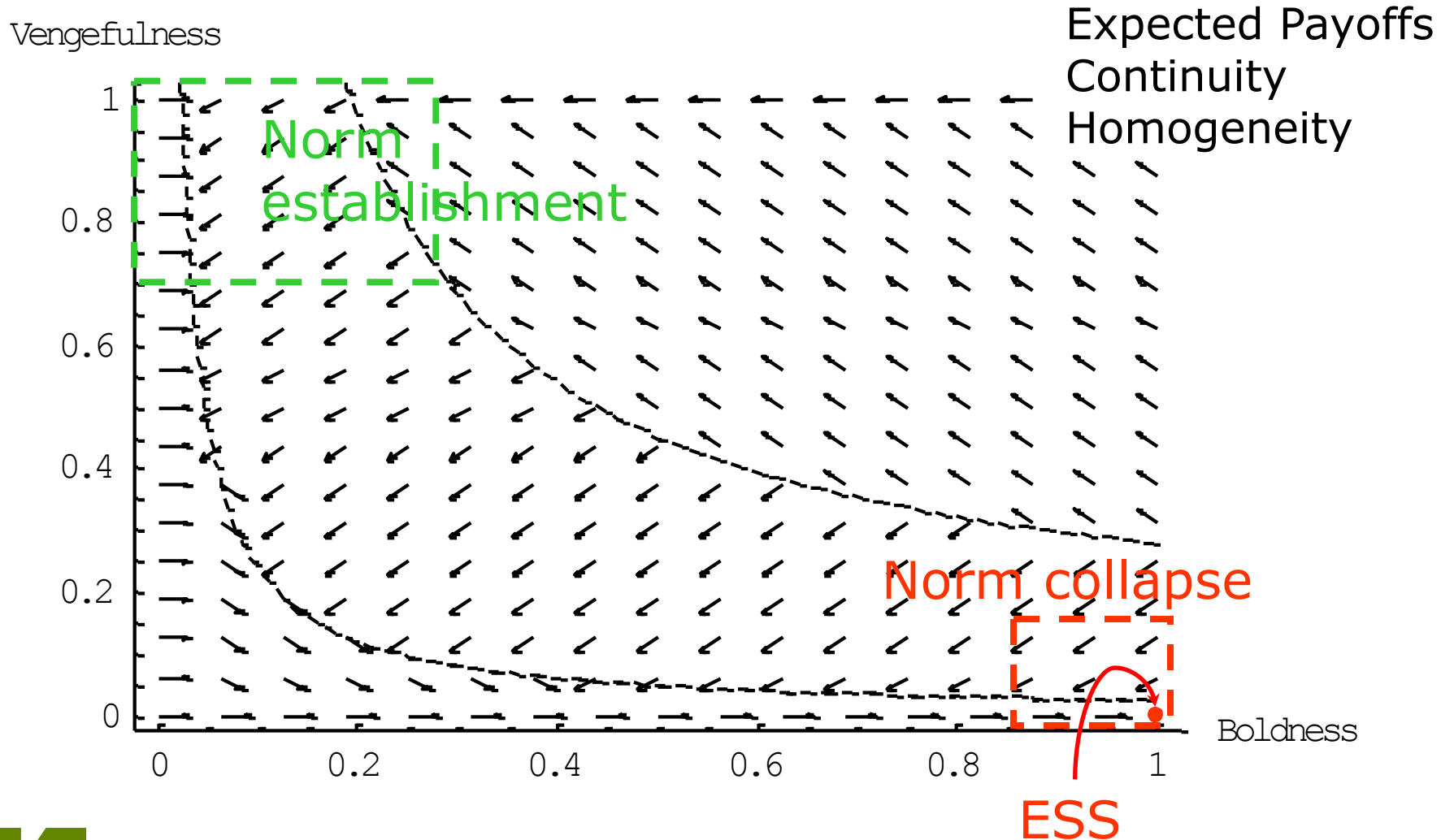


The Norms model



THE METANORMS MODEL

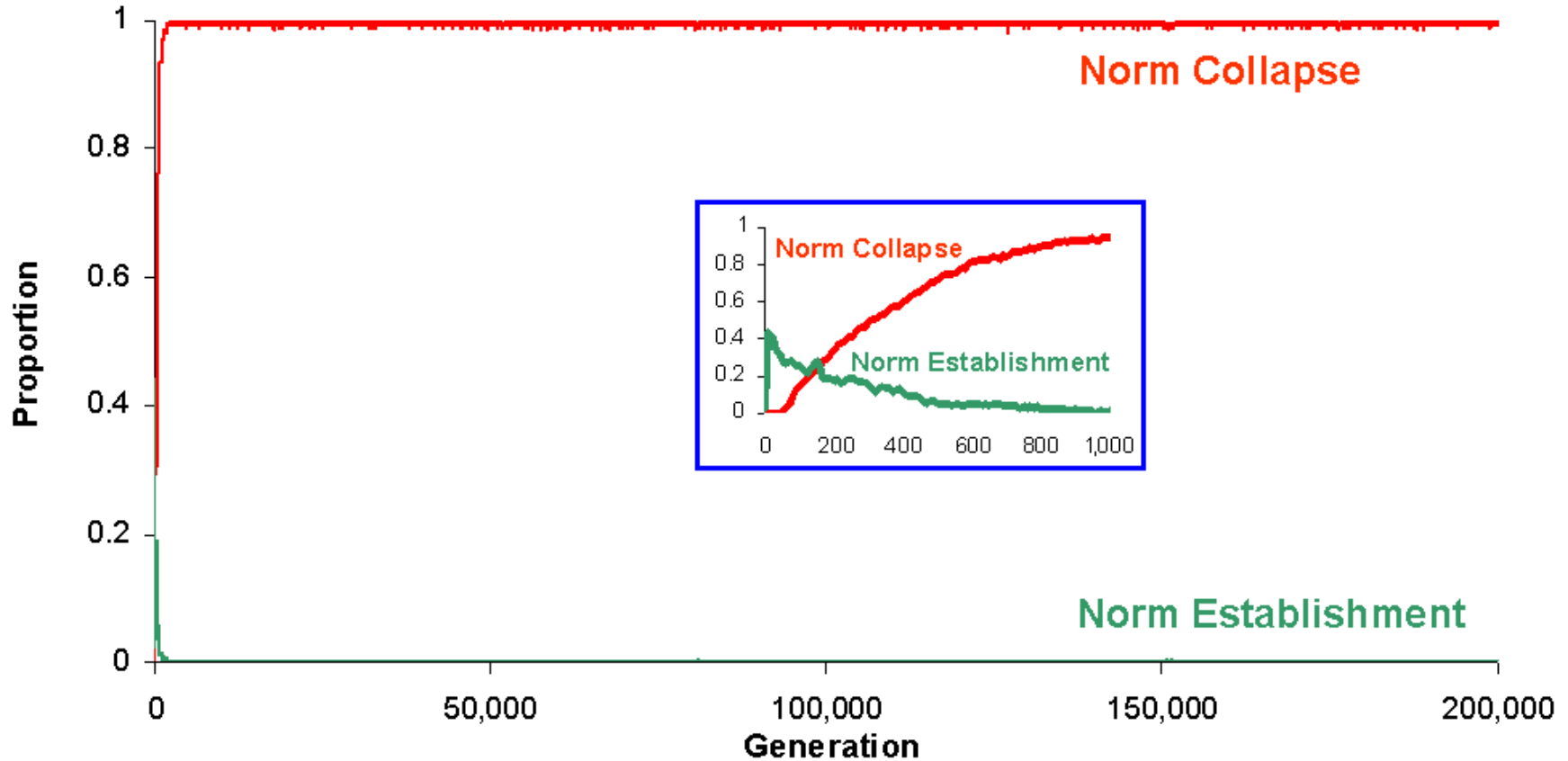
$$ME = -0.2 ; MP = -0.9$$



THE METANORMS MODEL

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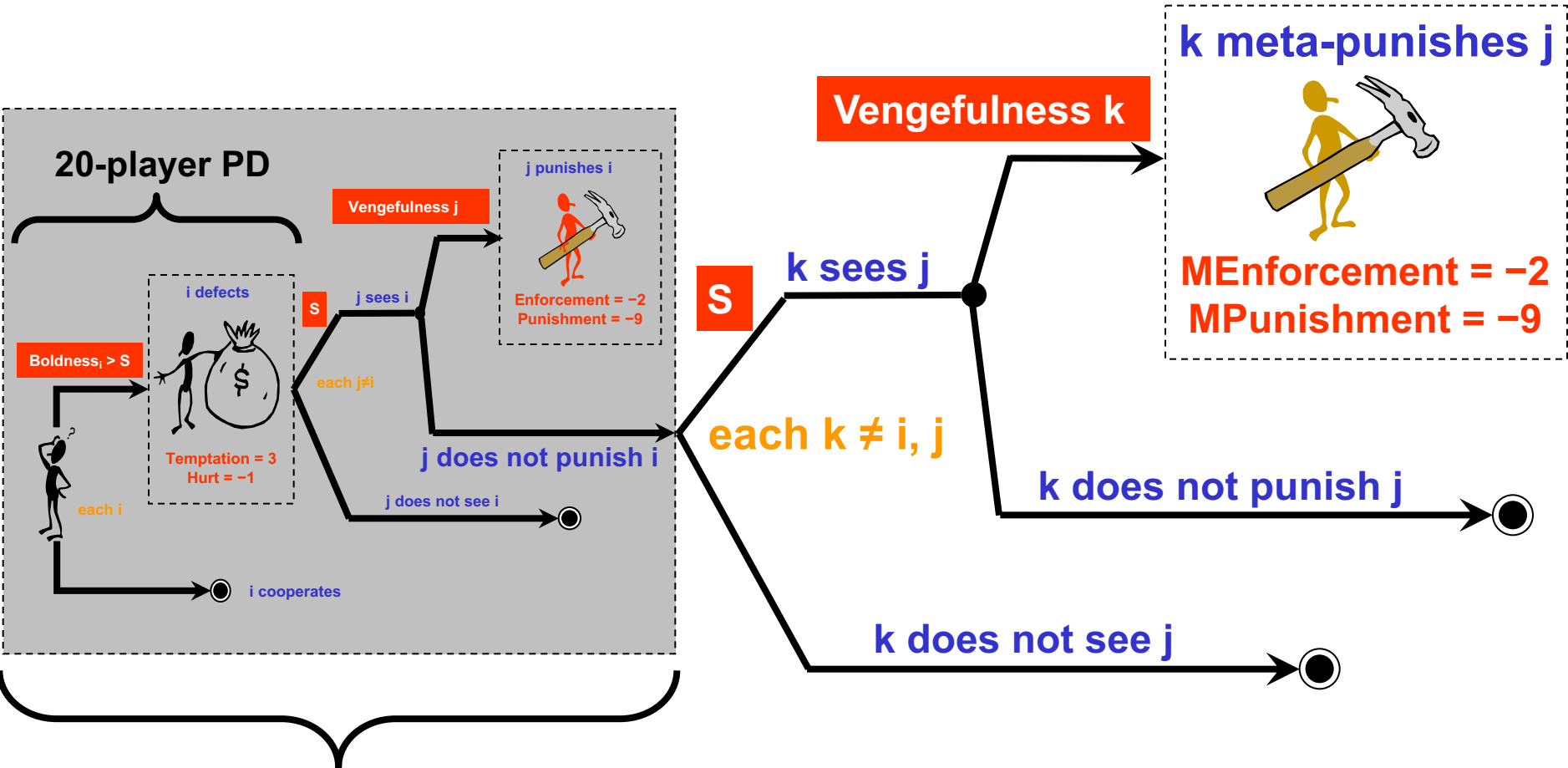
Metanorms Model: ME=- 0.2; MP=- 0.9



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AXELROD'S MODELS: The MetaNorms model



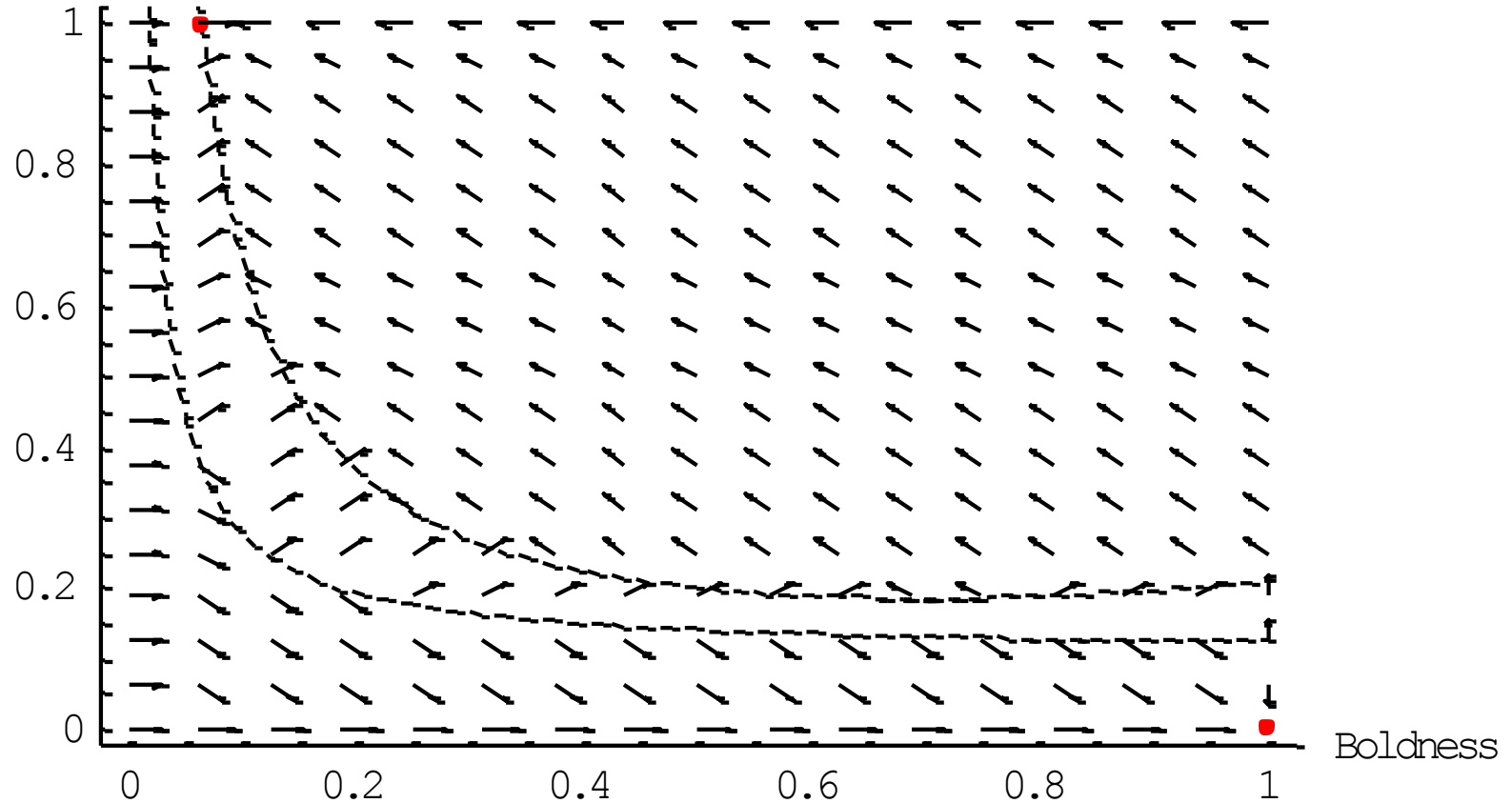
The Norms model



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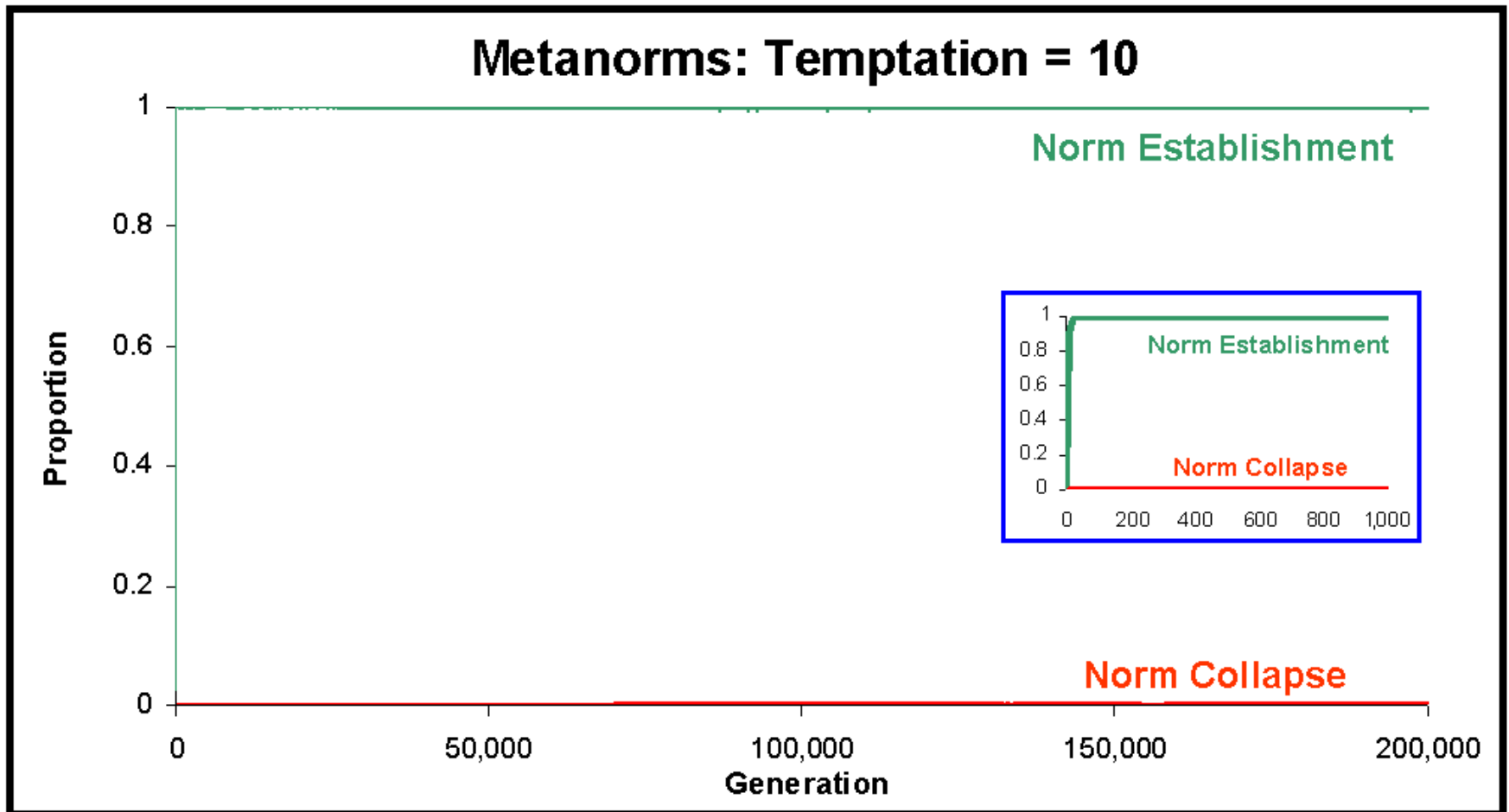
Temptation = 10 (as opposed to $T = 3$)

Vengefulness



THE METANORMS MODEL

Temptation = 10 (as opposed to $T = 3$)



1,000 runs; 200,000 generations each



RESULTS AND DISCUSSION

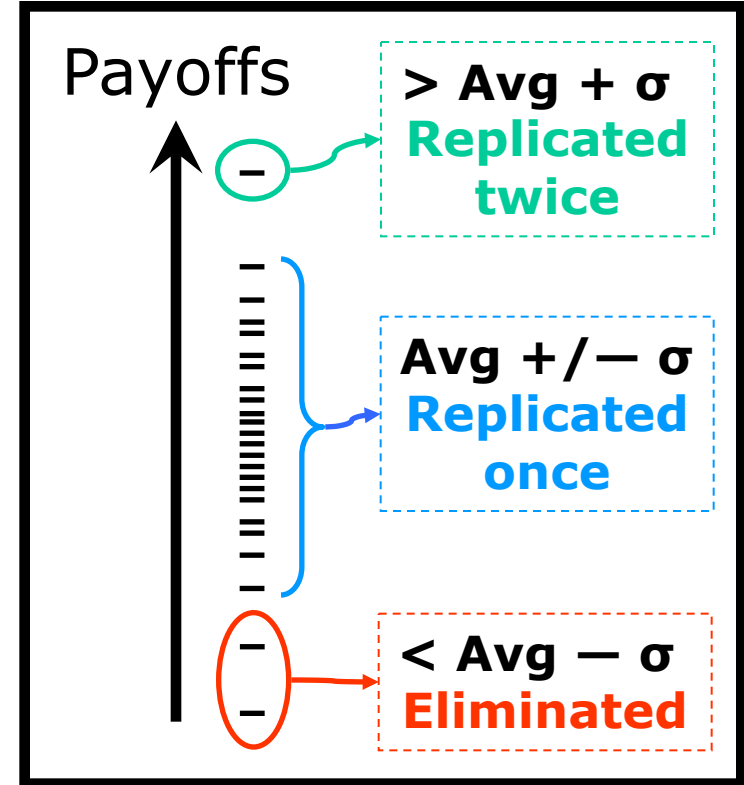
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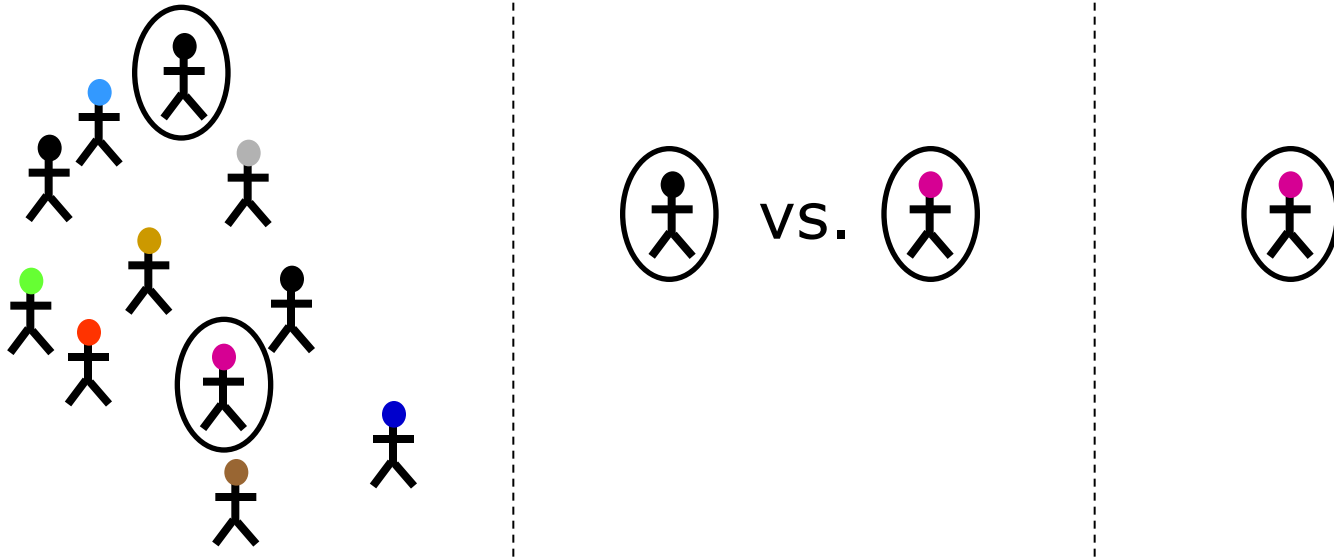
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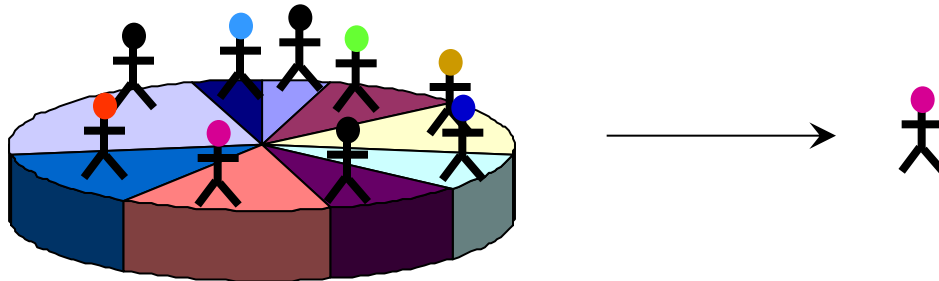
OTHER SELECTION MECHANISMS

- **Random Tournament**



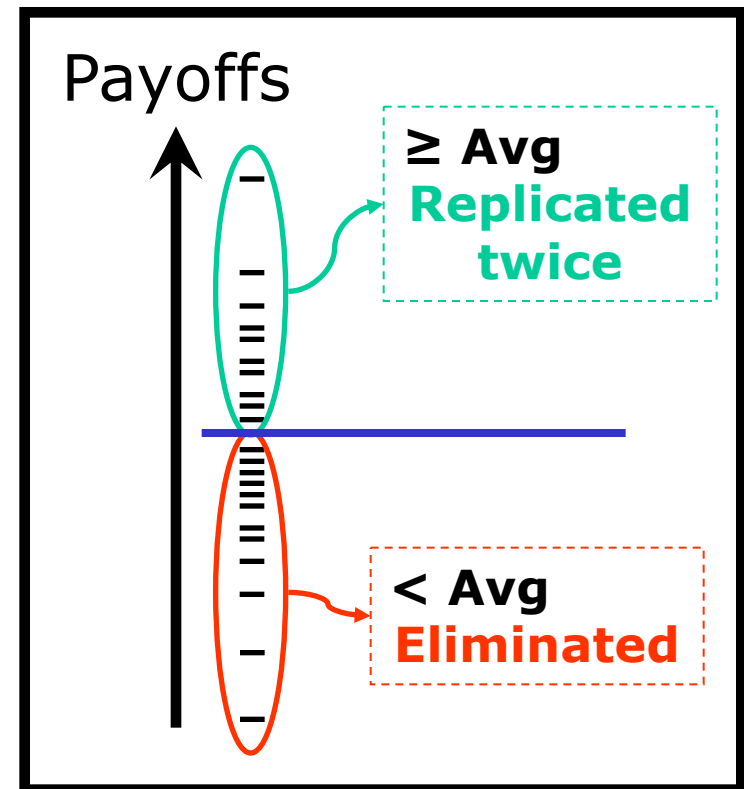
OTHER SELECTION MECHANISMS

- **Random Tournament**
- **Roulette wheel**



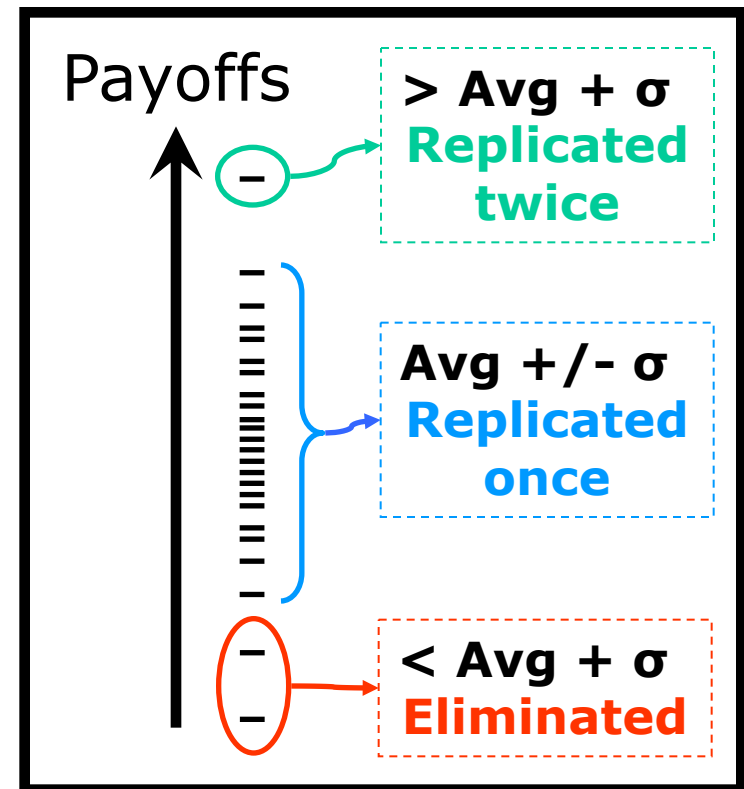
OTHER SELECTION MECHANISMS

- Random Tournament
- Roulette wheel
- Average selection

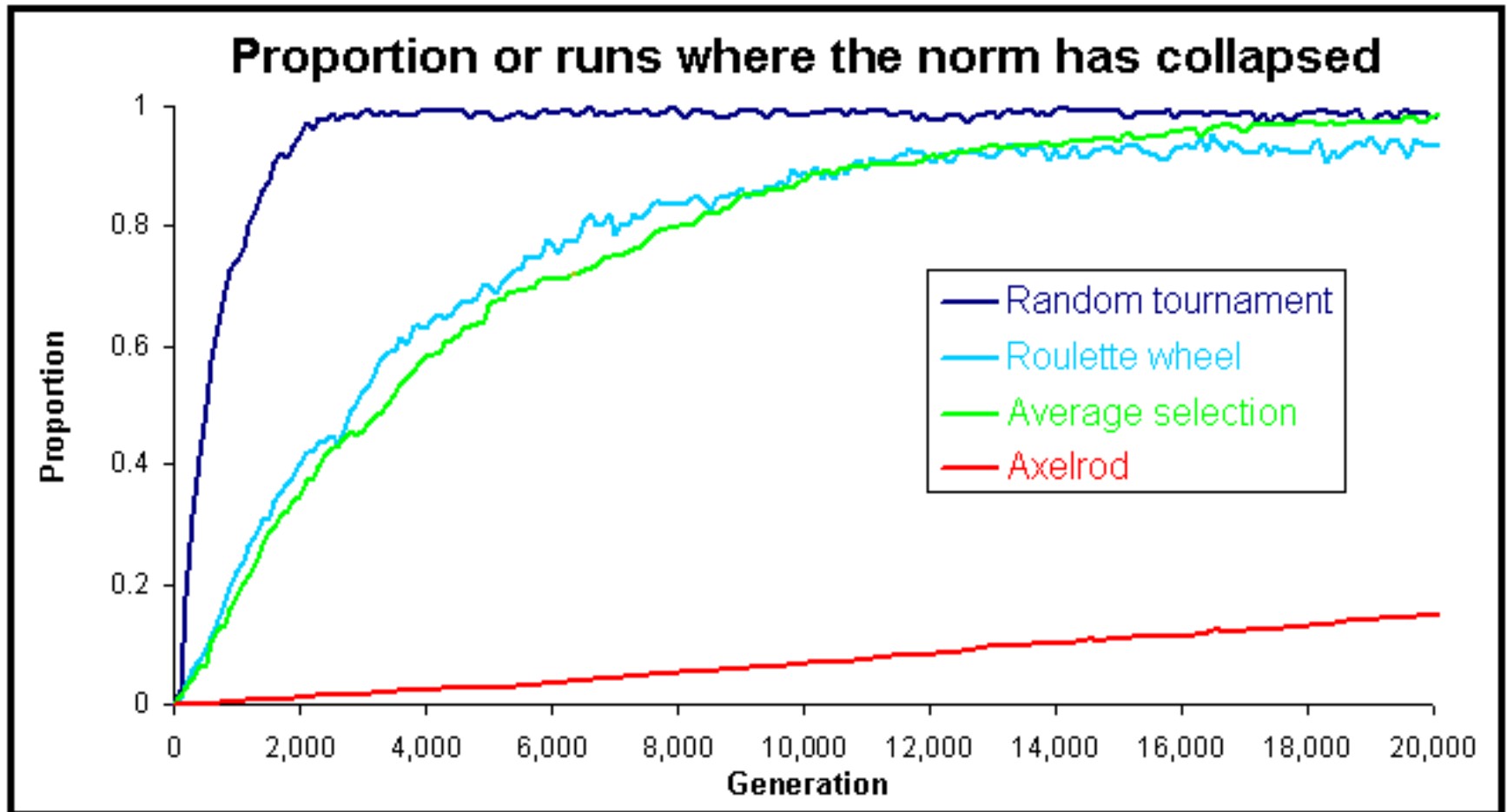


OTHER SELECTION MECHANISMS

- Random Tournament
- Roulette wheel
- Average selection
- Axelrod



OTHER SELECTION MECHANISMS



300 runs; 20,000 generations each



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CONCLUSIONS

- **Run our models several times for many periods**
- **Exploration of the parameter space**
- **Usefulness of complementary analytical work**
- **We should try not to conclude anything beyond the scope of our models**



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