Evolution Of Co-operation and defection when the strategies are hidden: The human mating game.

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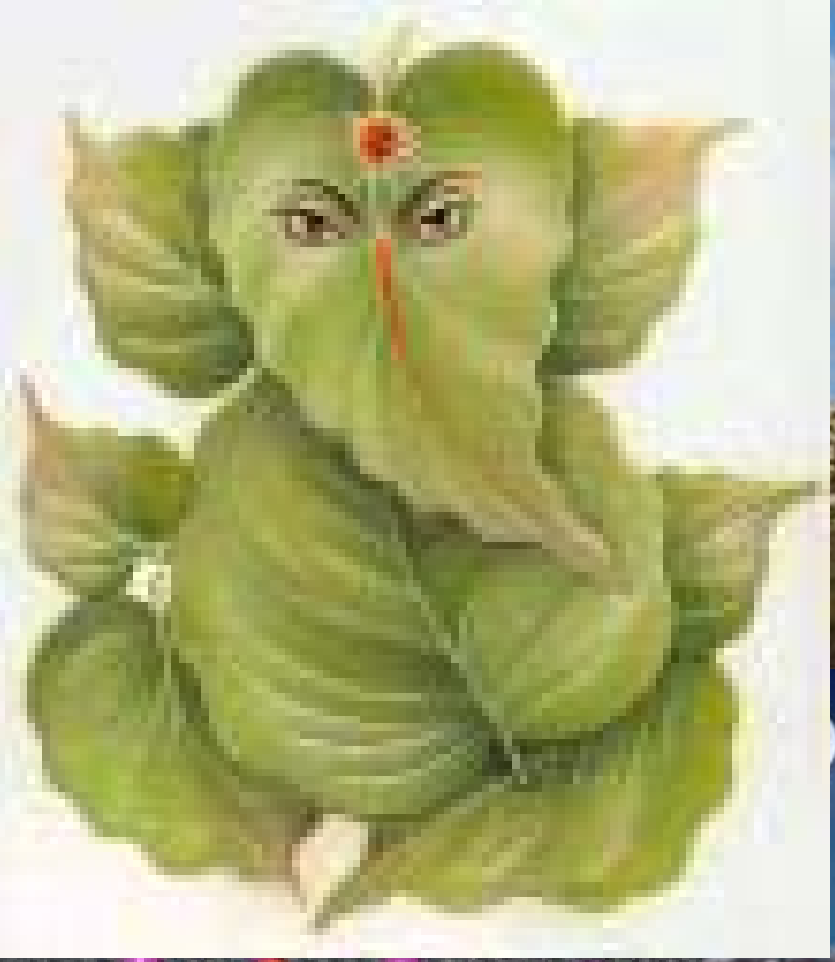
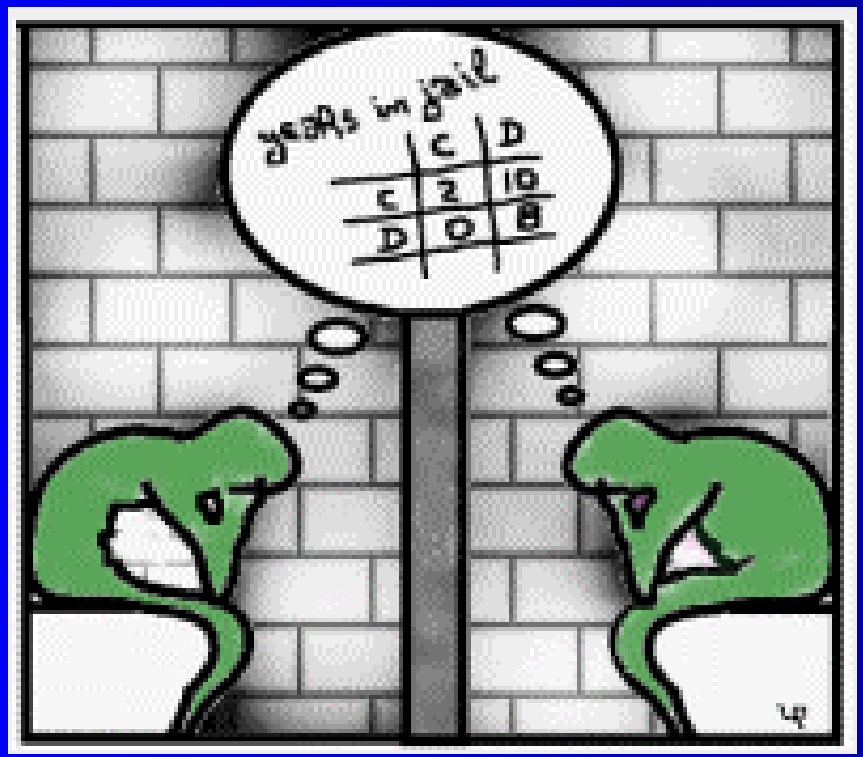


Recombination: The origin of creativity

Co-Operation in Prisoners' Dilemma



- non-iterated games - Classical Prisoner's dilemma

Defection alone is the Evolutionary Stable Strategy (ESS)

Stability of co-operation in Iterated PD

- Tit-for-Tat and reciprocity
- 2nd order free riders – A major problem in reciprocity
- Solutions depend upon strategies and payoffs of previous games

What if strategies and payoffs remain hidden?

The hidden strategy games. Example: Mating in species with biparental care.

- In such species, fidelity is co-operation
- Cuckoldry or opportunistic extra pair mating is defection

• Cuckoldry and its genetic effects remain hidden most often from the partner and from the society.

• Even the player may not be completely aware of the payoffs

Different types of benefits for males and females.

- Both have some benefit in defecting
- Males gain quantitatively- increased no. of offspring
- Females gain qualitatively- better quality offspring, sexy son?

Would cuckoldry be an ESS?

Intra-gender Variability

- Not all are involved in Extra Pair Mating – data from birds and humans
- Sources of intra-gender variability:

  Intrinsic – all are not equally interested in EPM

  Extrinsic – all don't get opportunity to EPM
- Evolutionary psychology hasn't explained intra-gender variability adequately – particularly if it is intrinsic

Counterstrategies against cuckoldry

- Mate guarding as a counterstrategy to reduce EPM – data from birds and humans
- Can mate guarding stabilize monogamy in the population ?
- No: says data and the model results below

Language and social policing

- In humans too: opportunistic EPM tendency seen in both sexes.
- Language and gossip play major role – unique to humans.
- Co-operative mate guarding and social policing enabled by gossip.
- Cost of social policing lower than individual mate guarding.

Problem of 2nd order free riders in social policing.

BLACKMAILING !
A Wonder Strategy

- An opportunistic act
- Low probability but high gain
- Direct returns to policing individual
- Makes policing a non-altruistic act

Probabilistic Non- Altruistic Punishment:

On a rare occasion of "caught red-handed"

- Deserting adulterous partner with advertisement
- Accept defection and continue partnership

(Probability of getting a 2nd partner) X (higher expected genetic gain) > (Suckers payoff: Reduced reproductive success)

Deserted individual gets a bad reputation: Social sanctions with no altruistic element

The Model

All players socially monogamous genetically Mono/Poly

- Player 1: Mono, Non-guarding, Non-policing
- Player 2: Mono, Non-guarding, Policing, Blackmailing
- Player 3: Mono, Guarding, Non-policing
- Player 4: Mono, Guarding, Policing, Blackmailing
- Player 5: Poly, Non-guarding, Non-policing
- Player 6: Poly, Non-guarding, Policing, Blackmailing
- Player 7: Poly, Guarding, Non-policing
- Player 8: Poly, Guarding, Policing, Blackmailing

Assumptions of the model

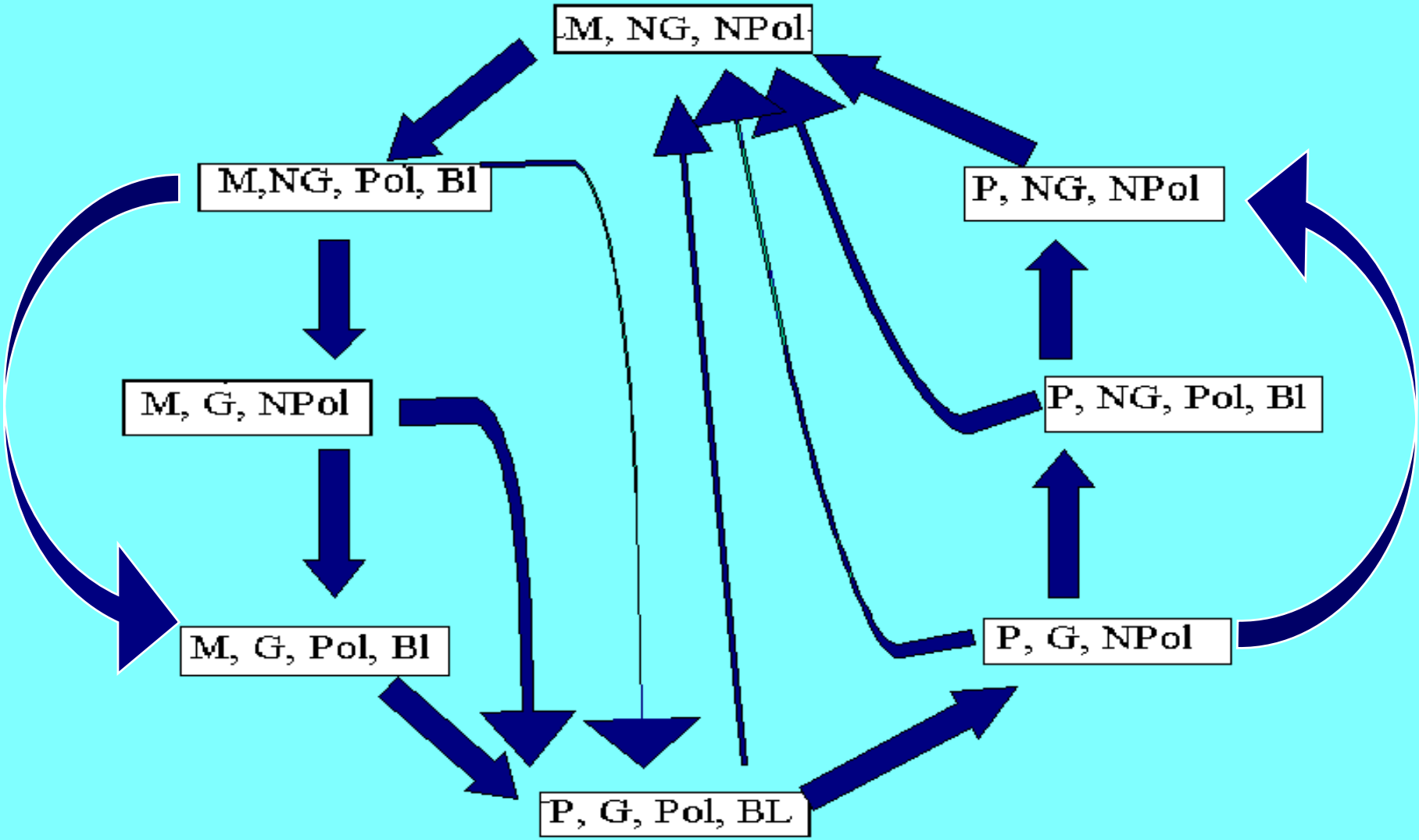
The baseline fitness of a strictly monogamous pair is 1

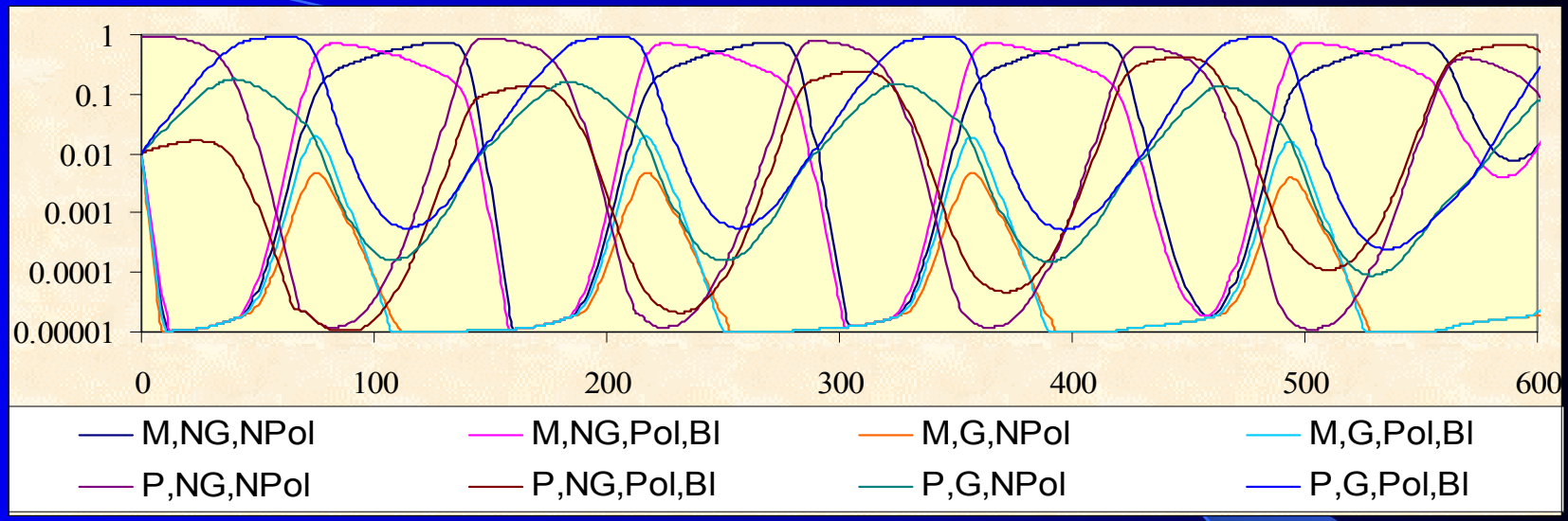
- **pc= cost of policing**
- **gc= cost of guarding** **(pc<gc)**
- **α= common benefit of policing in terms of reduction in loss due to cuckoldry**
- **β= reduction in benefit of cuckoldry due to policing**
- **Z= advantage of EPM**
- **L= genetic loss due to cuckoldry by partner**
- **S= benefit of guarding** **(S>gc)**
- **BP= average probabilistic benefit to blackmailer** **(BP>pc)**
- **BB= average probabilistic loss due to blackmailing/punishment** **(BB>BP)**

The payoff matrix

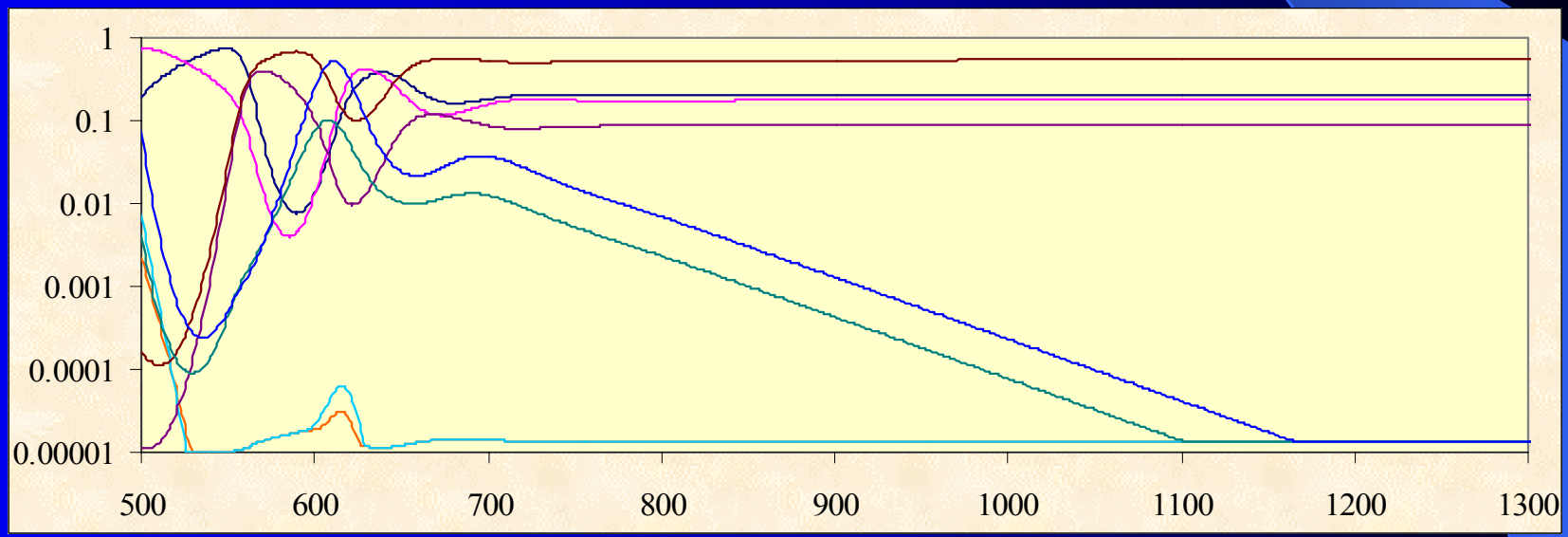
	M,NG,Npol	M,NG,Pol, Bl	M, G, NPol	M,G,Pol,Bl	P, NG, Npol	P,NG, Pol, Bl	P, G, Npol	P, G, Pol, Bl
M,NG,Npol	1	1	1	1	1-(L*(1–α*pol))	1-(L*(1–α*pol))	1-(L*(1–α*pol))	1-(L*(1–α*pol))
M,NG,Pol, Bl	1-pc+BP*Poly	1-pc +BP*Poly	1-pc +BP*Poly	1-pc +BP*Poly	1-(L*(1–α*pol))-pc +BP*Poly	1-(L*(1–α*pol))-pc +BP*Poly	1-(L*(1–α*pol))-pc +BP*Poly	1-(L*(1–α*pol))-pc +BP*Poly
M, G, NPol	1-gc	1-gc	1-gc	1-gc	1-(L*(1–α*pol-S))-gc	1-(L*(1–α*pol-S))-gc	1-(L*(1–α*pol-S))-gc	1-(L*(1–α*pol-S))-gc
M,G,Pol,Bl	1-gc-pc +BP*Poly	1-gc-pc +BP*Poly	1-gc-pc +BP*Poly	1-gc-pc +BP*Poly	1-(L*(1–α*pol-S))-gc-pc +BP*Poly	1-(L*(1–α*pol-S))-gc-pc +BP*Poly	1-(L*(1–α*pol-S))-gc-pc +BP*Poly	1-(L*(1–α*pol-S))-gc-pc +BP*Poly
P, NG, Npol	1+(Z*(1-β*pol))	1+(Z*(1-β*pol)) -BB	1+(Z*(1-β*pol-S))	1+(Z*(1-β*pol-S)) -BB	1+(Z*(1-β*pol))-(L*(1-α*pol))	1+(Z*(1-β*pol))-(L*(1-α*pol))-BB	1+(Z*(1-β*pol-S))-(L*(1-α*pol))	1+(Z*(1-β*pol-S))-(L*(1-α*pol))-BB
P,NG, Pol, Bl	1+(Z*(1-β*pol))-pc +BP*Poly	1+(Z*(1-β*pol))-pc-BB +BP*Poly	1+(Z*(1-β*pol-S))-pc +BP*Poly	1+(Z*(1-β*pol-S))-pc-BB +BP*Poly	1+(Z*(1-β*pol))-(L*(1-α*pol))-pc +BP*Poly	1+(Z*(1-β*pol))-(L*(1-α*pol))-pc-BB +BP*Poly	1+(Z*(1-β*pol))-(L*(1-α*pol-S))-pc +BP*Poly	1+(Z*(1-β*pol))-(L*(1-α*pol-S))-pc-BB +BP*Poly
P, G, Npol	1+(Z*(1-β*pol))-gc	1+(Z*(1-β*pol))-gc-BB	1+(Z*(1-β*pol-S))-gc	1+(Z*(1-β*pol-S))-gc-BB	1+(Z*(1-β*pol))-(L*(1-α*pol))+S-gc	1+(Z*(1-β*pol))-(L*(1-α*pol))+S-gc-BB	1+(Z*(1-β*pol))-(L*(1-α*pol-S))+S-gc	1+(Z*(1-β*pol))-(L*(1-α*pol-S))+S-gc-BB
P, G, Pol, Bl	1+(Z*(1-β*pol))-gc-pc +BP*Poly	1+(Z*(1-β*pol))-gc-pc-BB +BP*Poly	1+(Z*(1-β*pol-S))-gc-pc +BP*Poly	1+(Z*(1-β*pol-S))-gc-pc-BB +BP*Poly	1+(Z*(1-β*pol))-(L*(1-α*pol))+S-gc-pc +BP*Poly	1+(Z*(1-β*pol))-(L*(1-α*pol))+S-gc-pc-BB +BP*Poly	1+(Z*(1-β*pol))-(L*(1-α*pol-S))+S-gc-pc +BP*Poly	1+(Z*(1-β*pol))-(L*(1-α*pol-S))+S-gc-pc-BB +BP*Poly

Rock-Paper-Scissor relationship with eight players



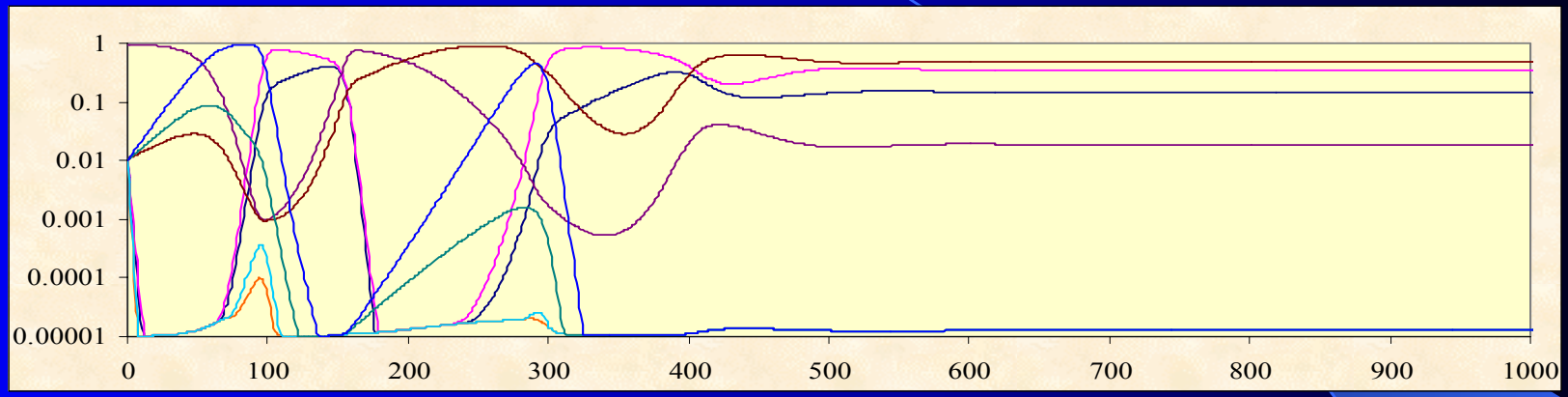


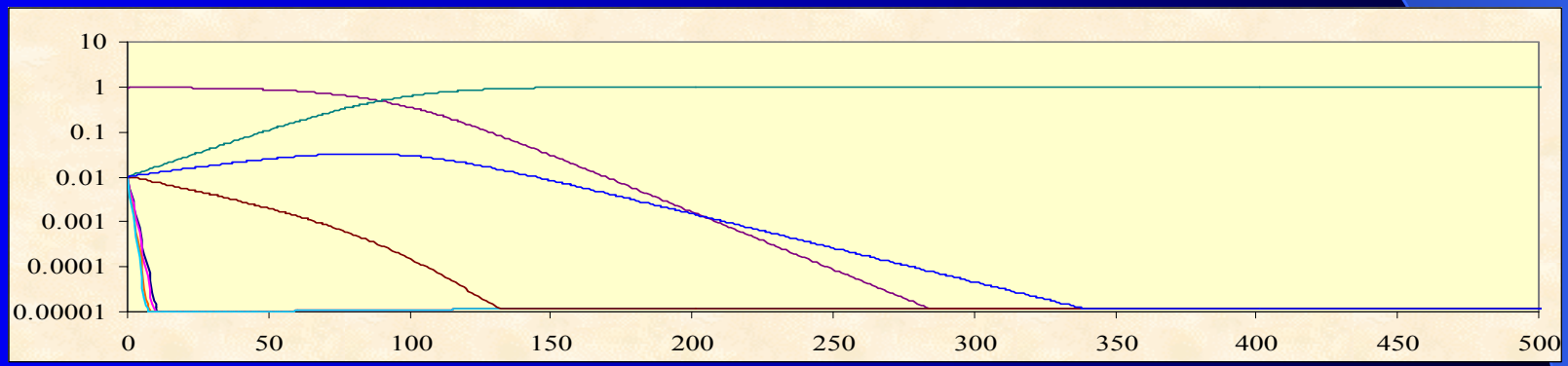
- A) Succession of all 8 players



- B) Steady state co-existence

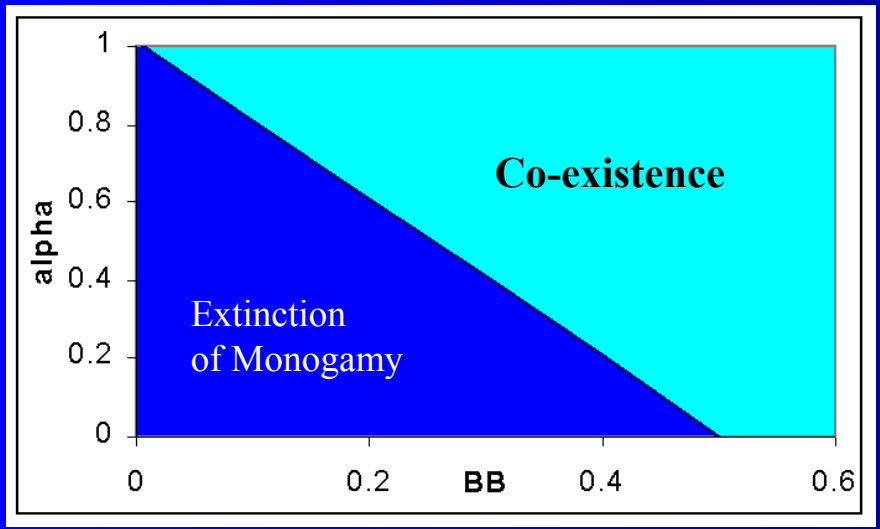
Blackmailing: the keystone strategy

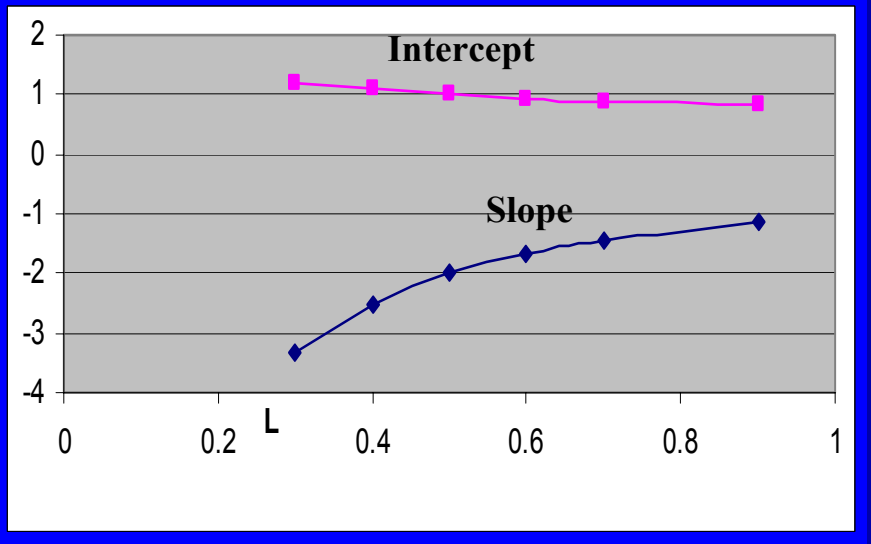




If blackmailing gains are zero, polygamy with mate guarding is the only ESS

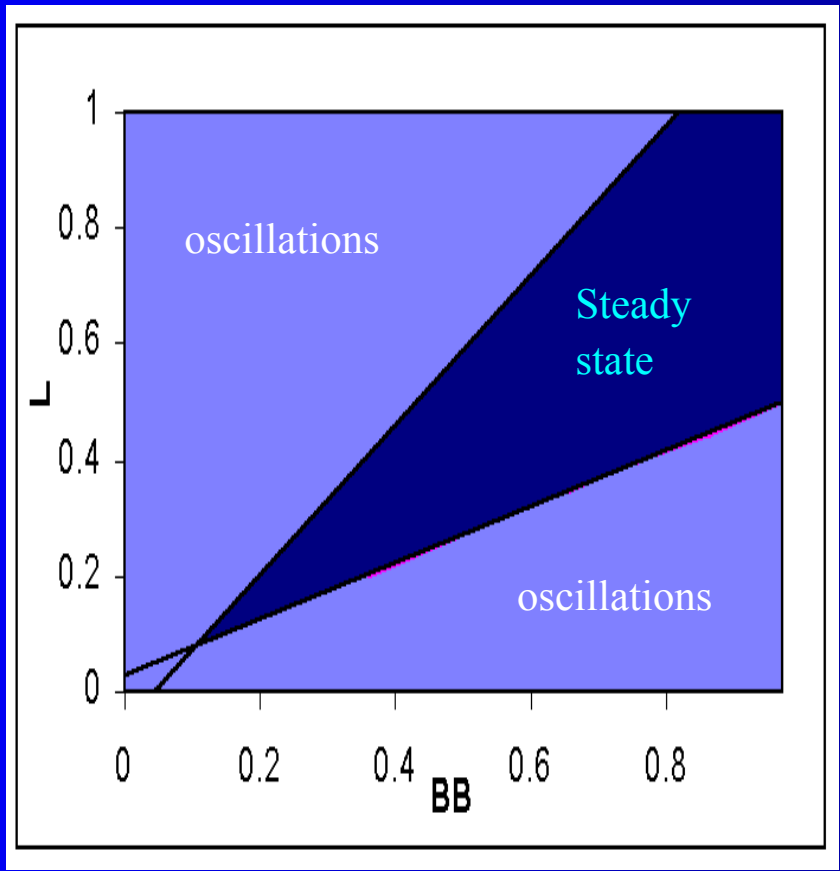
Parameter areas for co-existence





- Both co-operative mate guarding and punishment contribute to coexistence
- Punishment more effective than mate guarding
- If benefits and losses of polygamy are small, punishment is the only effective strategy. Mate guarding doesn't help

Parameter area for steady state co-existence



- Greater benefit of polygamy helps stabilize the system, needs greater punishment
- Optimum level of punishment for stability

Gender Difference Model

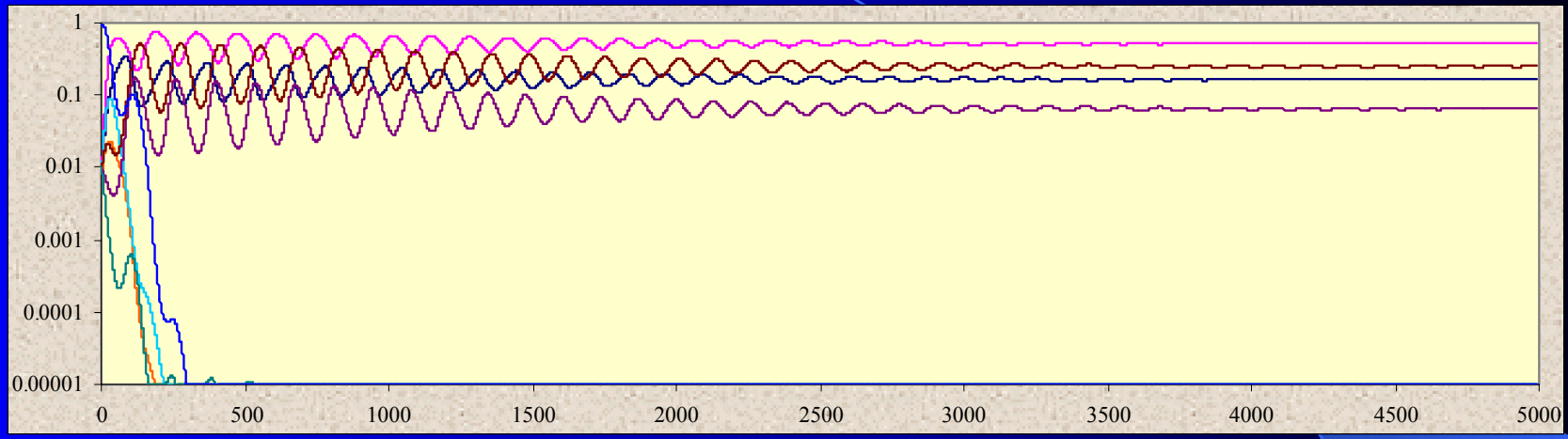
- Assumptions:

1. Benefit of EPM greater for males
2. Loss due to cuckoldry greater for males
3. Social punishment costlier for females

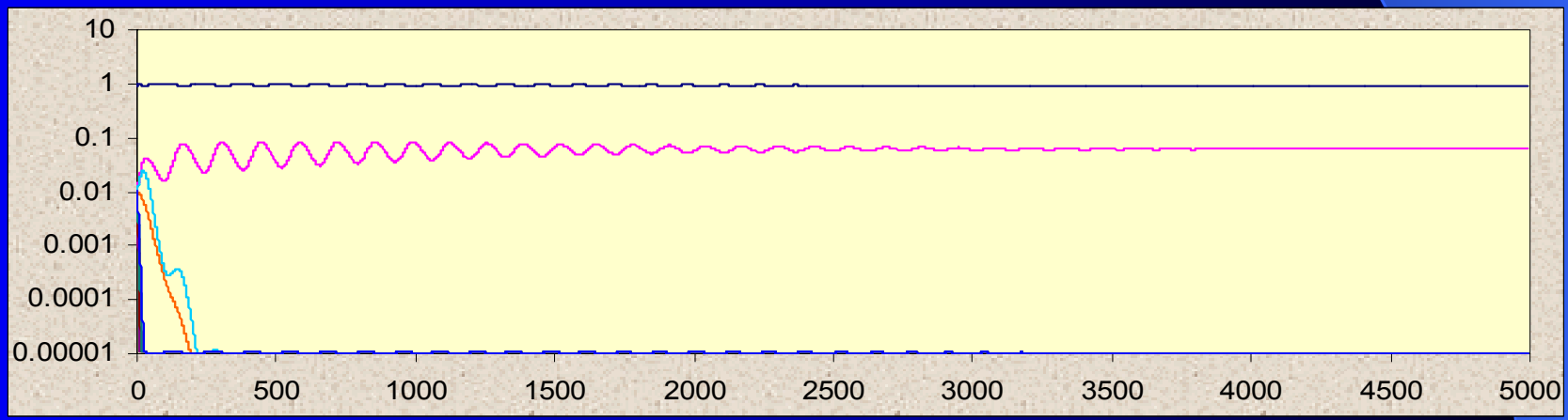
- Results:

1. Polymorphism in both genders
2. Dominant strategies different

Stable polymorphism in both genders

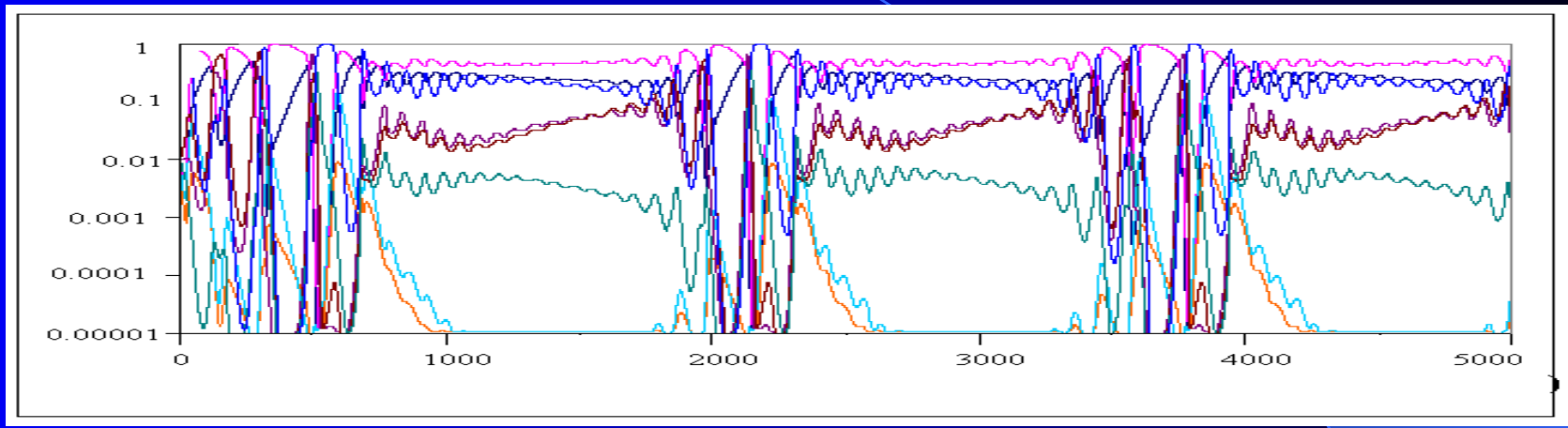


- Male

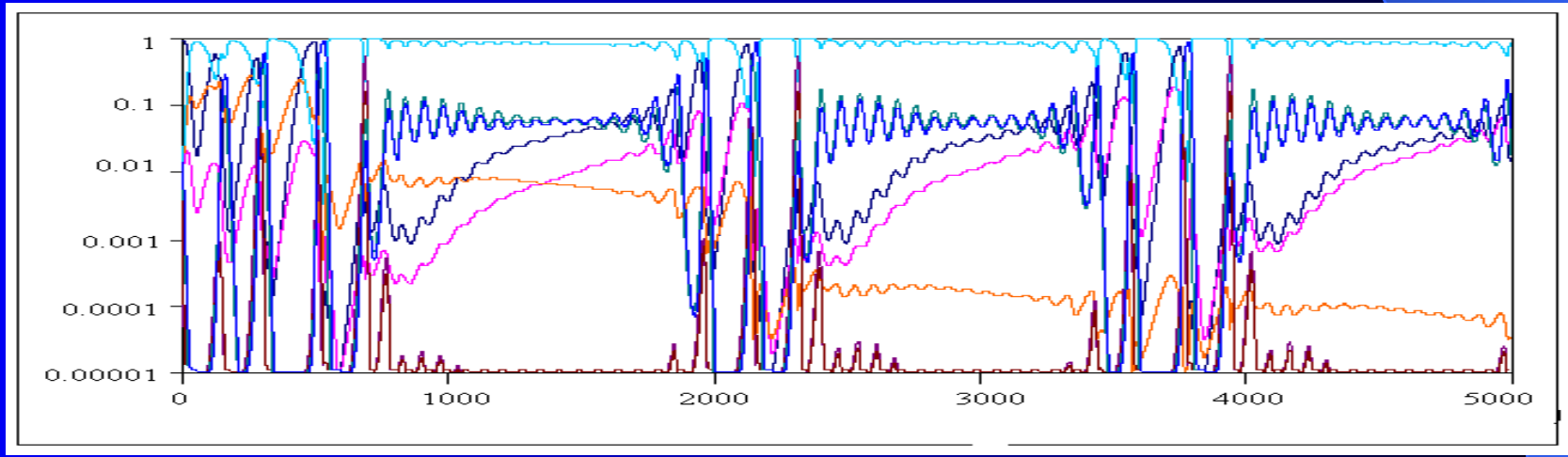


- Female

Complex patterns seen as model complexity grows



- Male



- Female

No gender specific stereotypes

- By Darwinian forces alone, there will be behavioral variance in both genders
- And yet there will be gender differences

Explaining both intra and inter-gender variability

Acknowledgements

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THANK YOU !