Cooperating with Trusted Parties Would Make Life Easier

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Promoting cooperation in the iterated Prisoner Dilemma

- Costly prior commitment
- Penalty for defection

- Trust and reputation
- Probabilistic strategies

The Prisoner Dilemma

A

- Payout matrix B

  T>P>R>S

	C	D
C	P/P	S/T
D	T/S	R/R

- Nash Equilibrium

  A plays D ... B plays D

- Problem: How to promote a more rewarding situation?

  A plays C ... B plays C

Committed Iterated Prisoner Dilemma

- A population of agents iteratively playing PD with random opponents
- Before playing their move players may make commitments
- Commitment has a cost ε
- There is a penalty δ if commitments are not respected

Agent	propose	accept	play C with commit	play C without commit
C	always	always	always	always
D	never	never	N/A	never
COMP	always	always	always	never
FAKE	never	always	never	never
FREE	never	always	always	never
BASTARD	always	always	never	never
SCHIZO	always	always	never	always
SILLY	never	never	N/A	always
RANDOM	P=1/2	P=1/2	P=1/2	P=1/2

Latest literature deals by and large on analysis and simulations about relative performance of the agents C,D,COMP,FAKE,FREE depending on values of ε and δ.

Trust and Reputation

- When playing the agent knows the index of *trustworthyness* θ and *reputation* ρ of the opponent
- *trust* measures the agent willingness to comply with commitments (plays C when a commitment is established)
- *reputation* measures the agent willingness to play C
- δ and ρ are globally maintained during game iterations. They start at 0 for every agents and are uptated with the reinforcement rule

$$x(t+1) := x(t) + \Delta x$$

Update rules

$$\Delta\theta = \begin{cases} +\alpha(1-\theta) & \text{if commit and play C} \\ -\alpha\theta & \text{if commit and play D} \\ 0 & \text{if no commit} \end{cases}$$

$$\Delta\rho = \begin{cases} +\alpha(1-\rho) & \text{if play C} \\ -\alpha\rho & \text{if play D} \end{cases}$$

where $0 < \alpha < 1$ and drives the rate of change of θ and ρ during subsequent rounds.

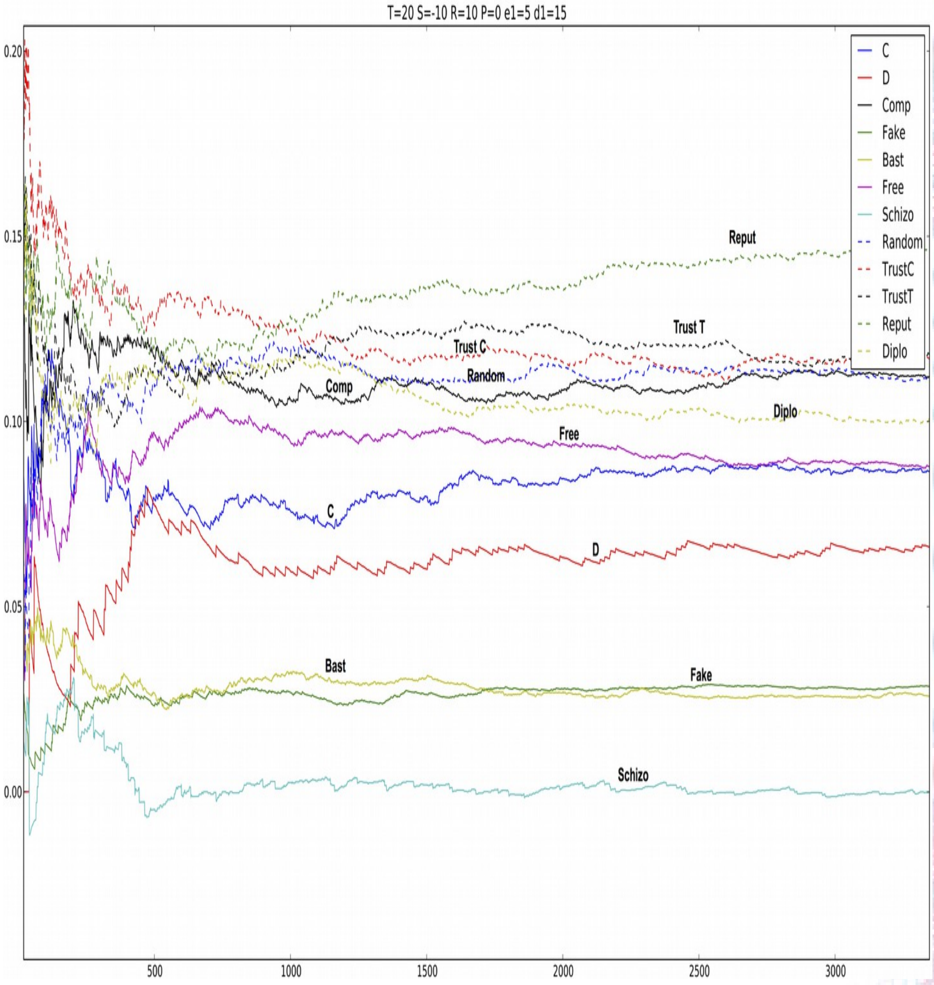
Probabilistic Agents Strategies

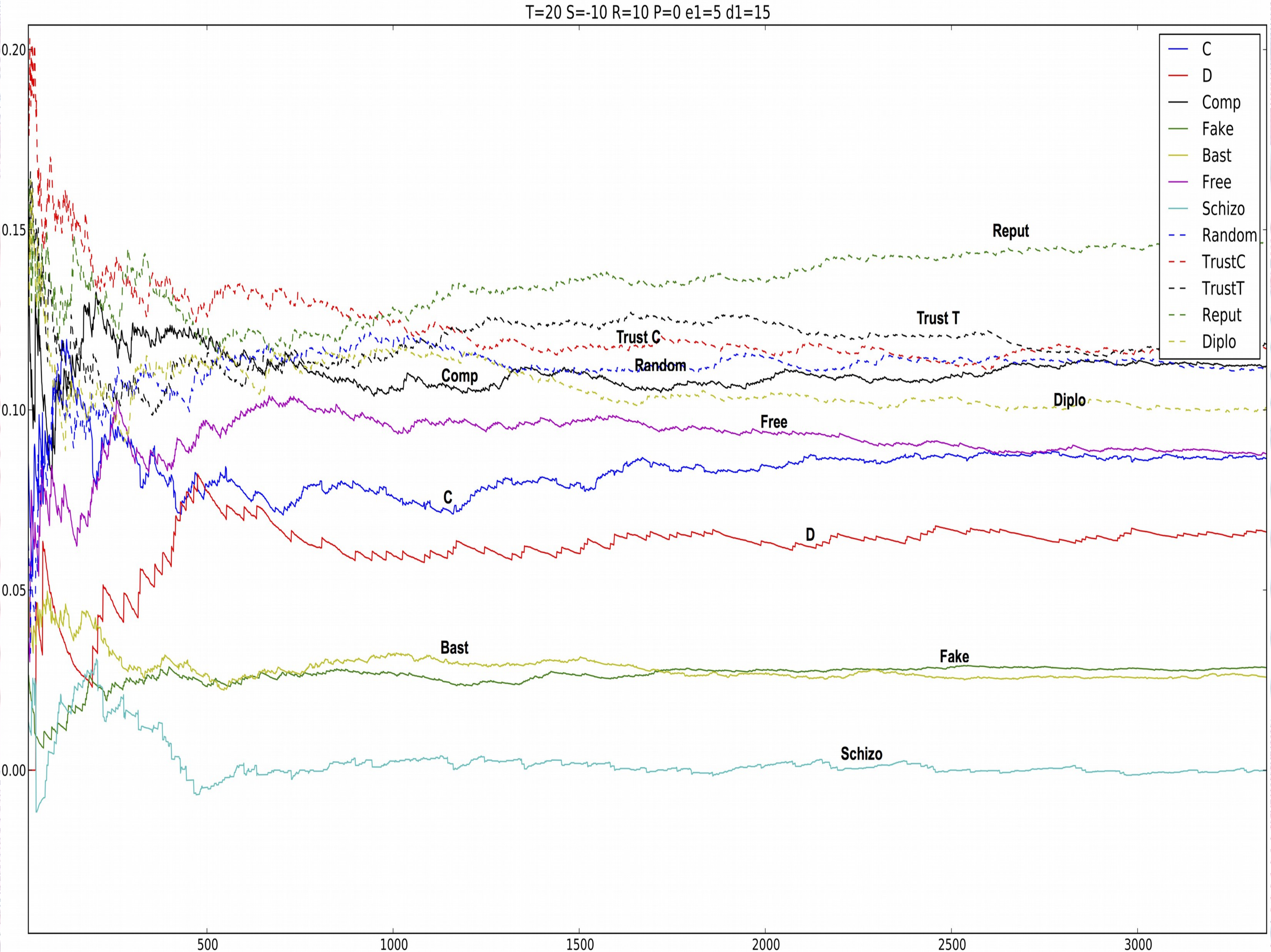
- By using θ and ρ we can define new agents whose playing choices are probabilistic

Agent	propose	accept	play C on commit	play C on no commit
TRUST	$P=\theta$	always	$P=\theta$	$P=\rho$
TRUST C	$P=\theta$	$P=\theta$	always	$P=\rho$
REP	never	never	$P=\rho$	$P=\rho$
DIPLOMAT	always	always	$P=\rho*\theta$	$P=\rho$

SIMULATIONS

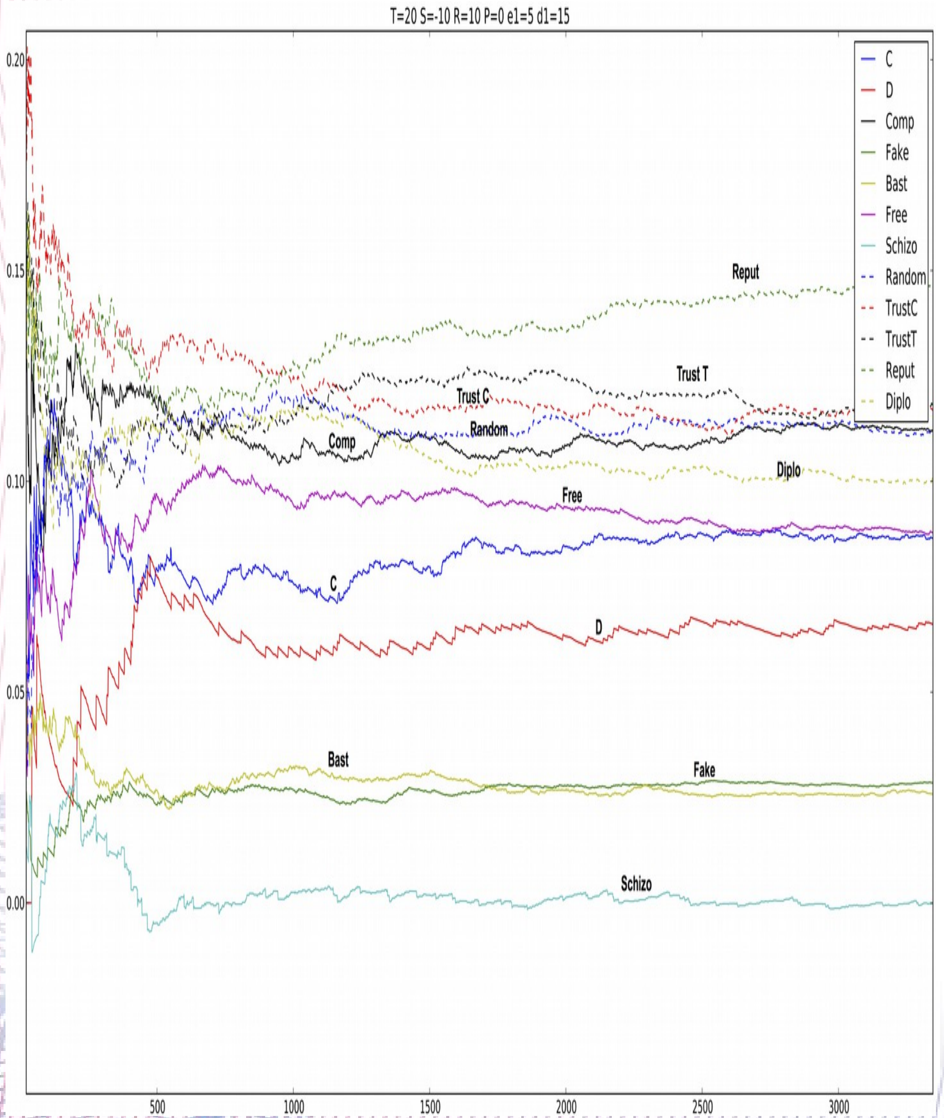
- A population of 100 agents randomly chosen with uniform probability among the 12 different agent types, for 10.000 rounds
- At each iteration two players are chosen at random
- Trust and reputation are updated at every iteration

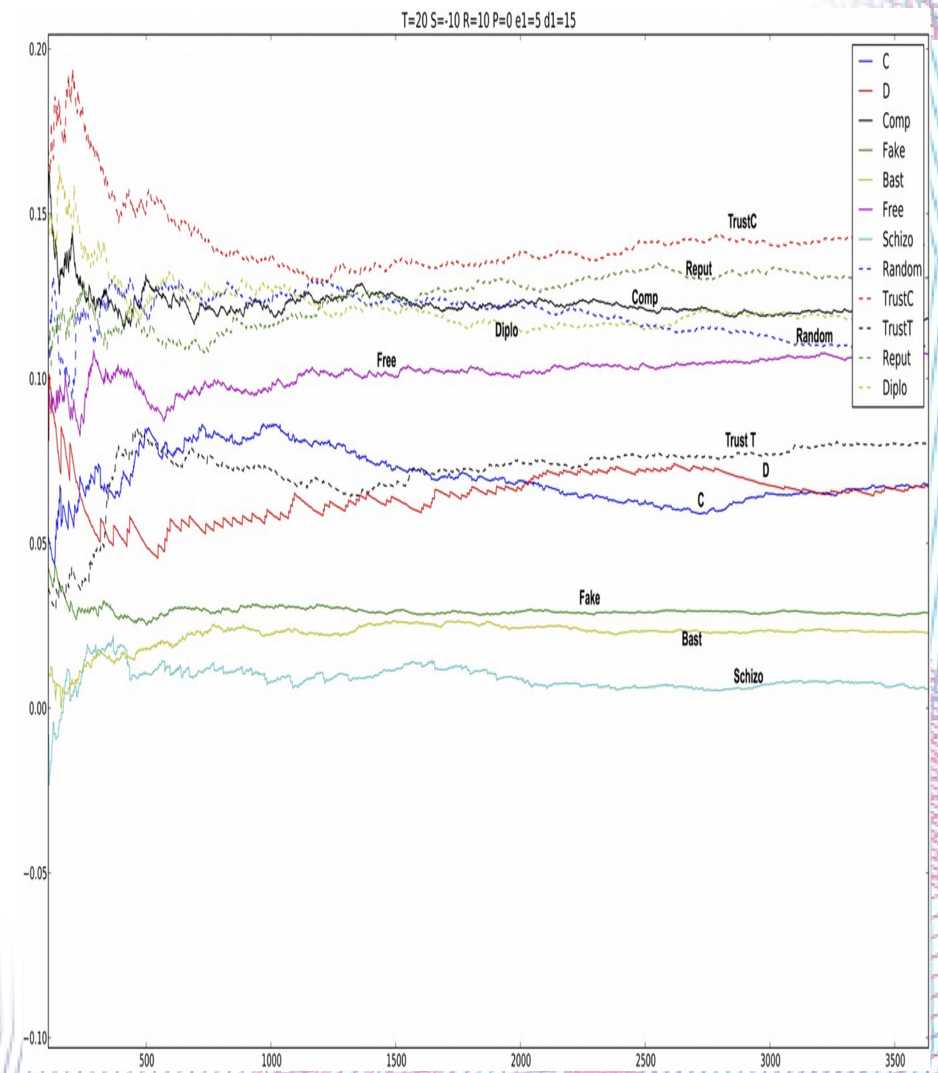


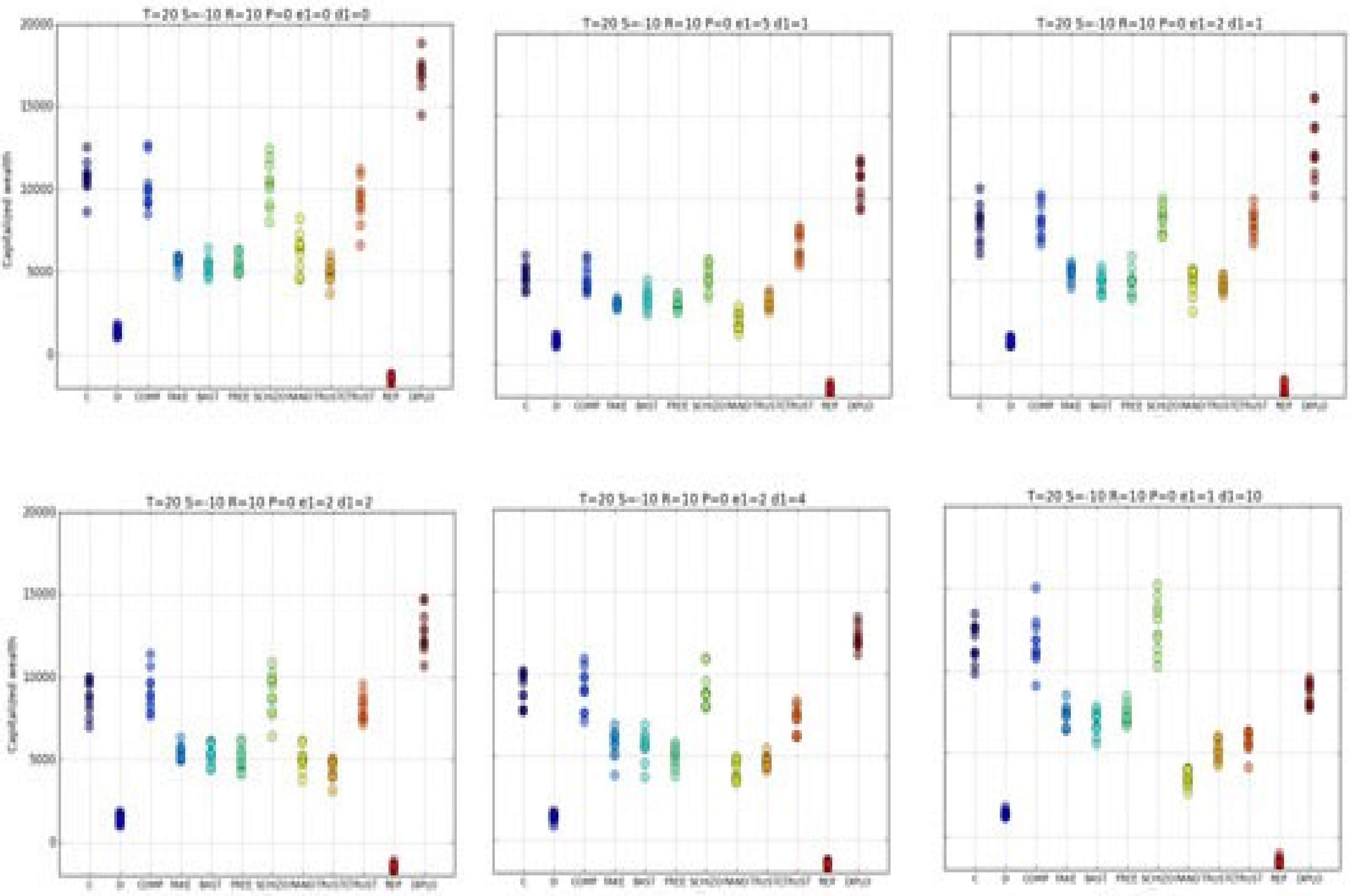


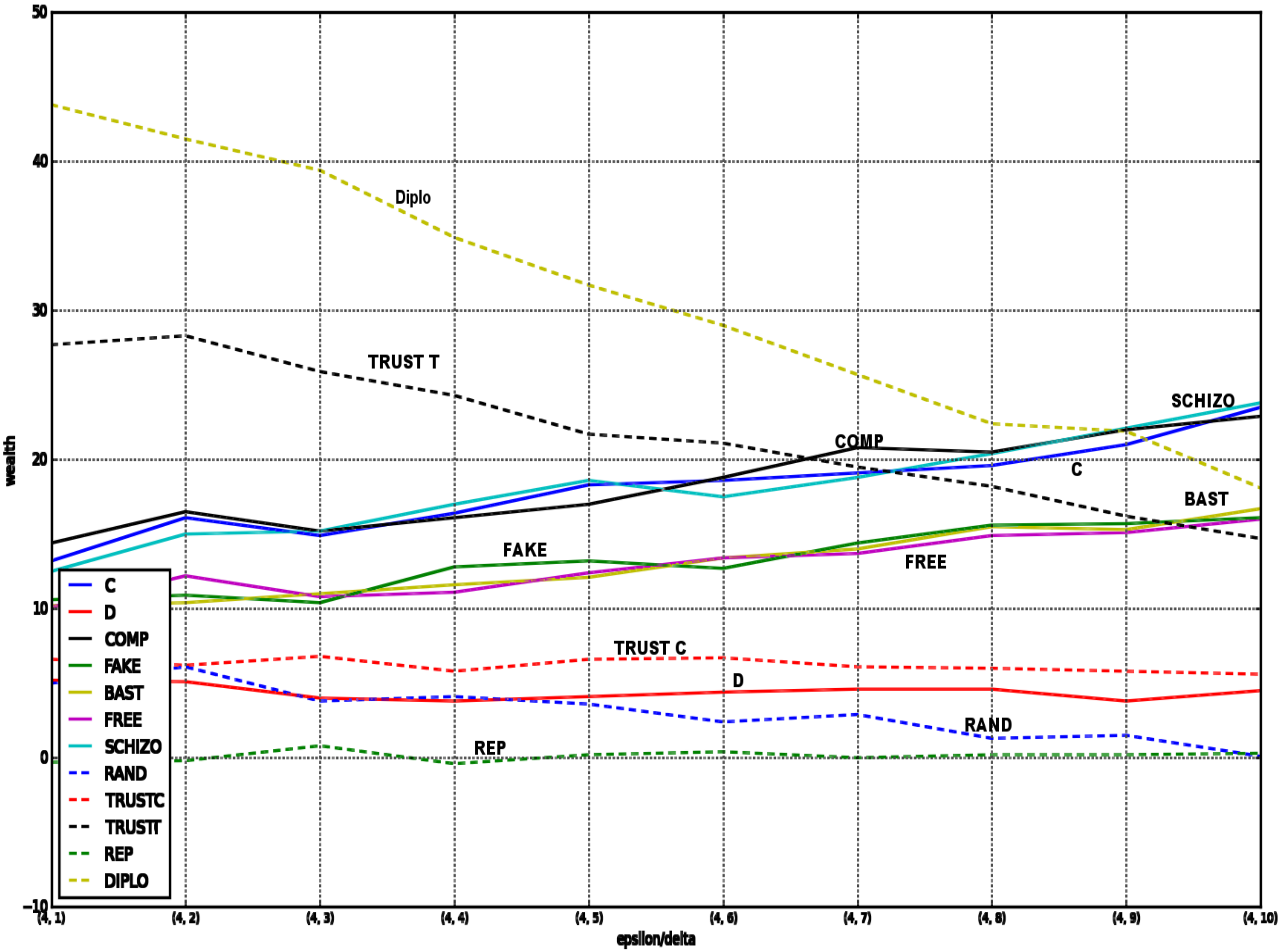
T=20 S=-10 R=10 P=0 e1=5 d1=15
C
D
Comp
Fake
Bast
Free
Schizo
Random
TrustC
TrustT
Reput
Diplo
Reput
Trust T
Trust C
Random
Comp
Diplo
Free
C
D
Bast
Fake
Schizo
0.20
0.15
0.10
0.05
0.00
500
1000
1500
2000
2500
3000

Chance and luck do play a role in the Iterated Prisoner Dilemma






T=20 S=-10 R=10 P=0 e1=0 d1=0
T=20 S=-10 R=10 P=0 e1=5 d1=1
T=20 S=-10 R=10 P=0 e1=2 d1=1
T=20 S=-10 R=10 P=0 e1=2 d1=2
T=20 S=-10 R=10 P=0 e1=2 d1=4
T=20 S=-10 R=10 P=0 e1=1 d1=10
20000
15000
10000
5000
0



50
40
30
20
10
0
−10
wealth
(4, 1)
(4, 2)
(4, 3)
(4, 4)
(4, 5)
(4, 6)
(4, 7)
(4, 8)
(4, 9)
(4, 10)
epsilon/delta
Diplo
TRUST T
SCHIZO
COMP
C
BAST
FAKE
FREE
TRUST C
D
RAND
REP
C
D
COMP
FAKE
BAST
FREE
SCHIZO
RAND
TRUSTC
TRUSTT
REP
DIPLO

Conclusion

Today

- Profiling agents with trust and reputation provides a means for promoting cooperation
- Simple probabilistic strategies based on trust and reputation improve performance in cooperation games

Maybe tomorrow

- Better, more complex profiling
- Improve performance with better informed, more complex, and *adaptive* strategies