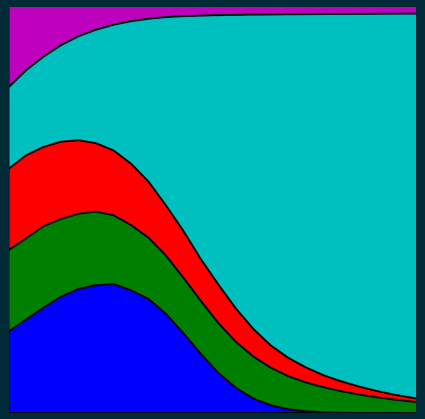
Stability of defection, optimisation of strategies and testing for extortion in the Prisoner's Dilemma

Nikoleta E. Glynatsi

Dr Vincent Knight Dr Jonathan Gillard Dr Marc Harper



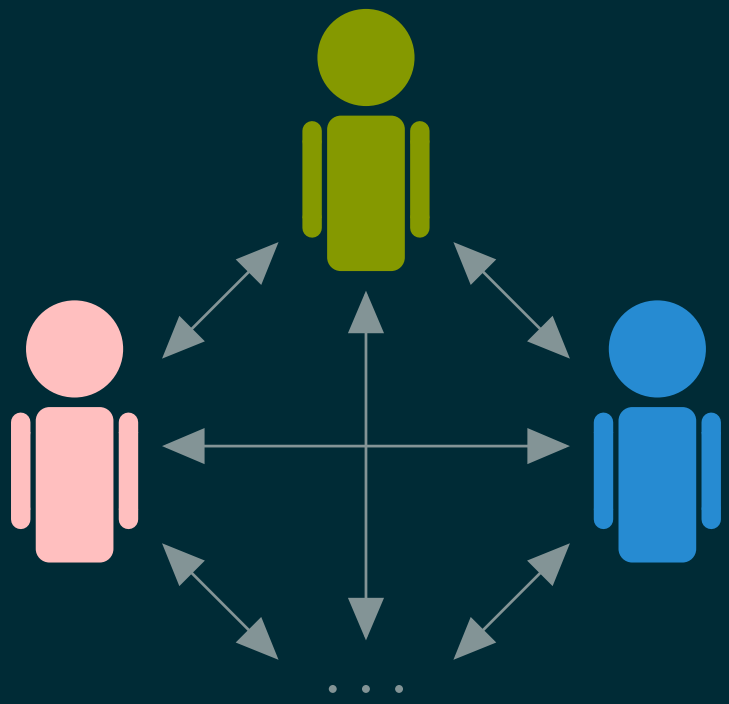
Software
Sustainability
Institute

NICE? NOT NICE?

$$S_p = \begin{pmatrix} 3 & 0 \\ 5 & 1 \end{pmatrix} \quad S_q = \begin{pmatrix} 3 & 5 \\ 0 & 1 \end{pmatrix}$$

Effective Choice in the Prisoner's Dilemma - Robert Axelrod, 1980

Tit For Tat

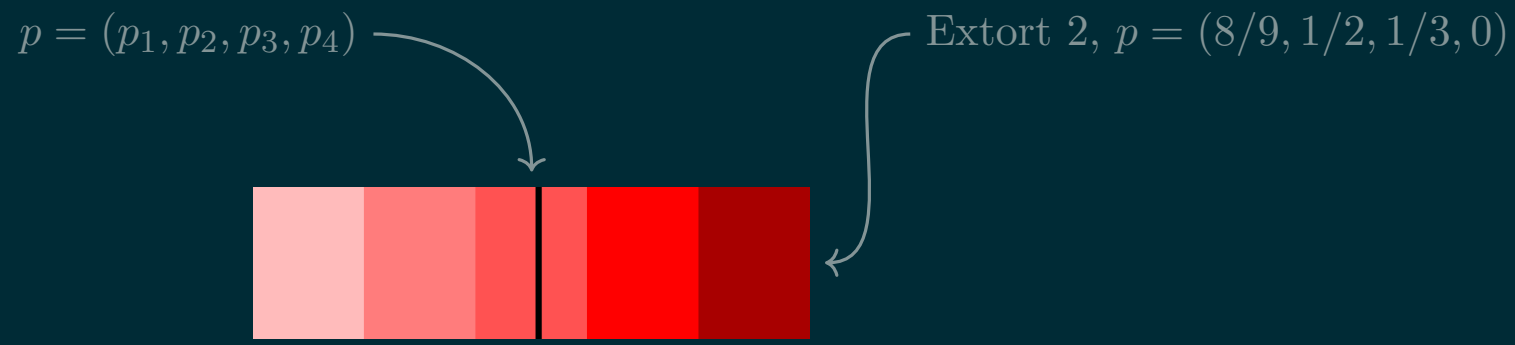


Iterated Prisoner's Dilemma contains strategies that dominate any evolutionary opponent - William H. Press and Freeman J. Dyson, 2012

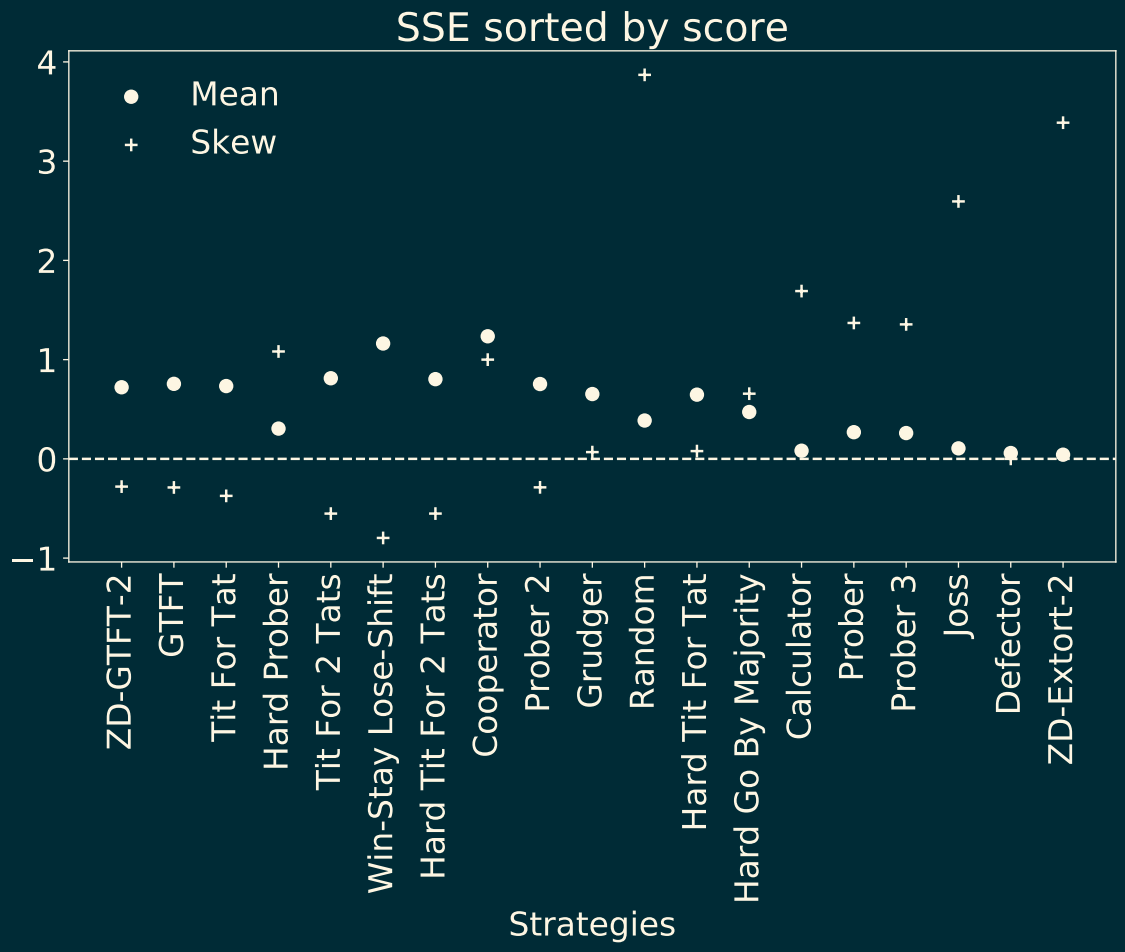
$$p = (p_1, p_2, p_3, p_4)$$

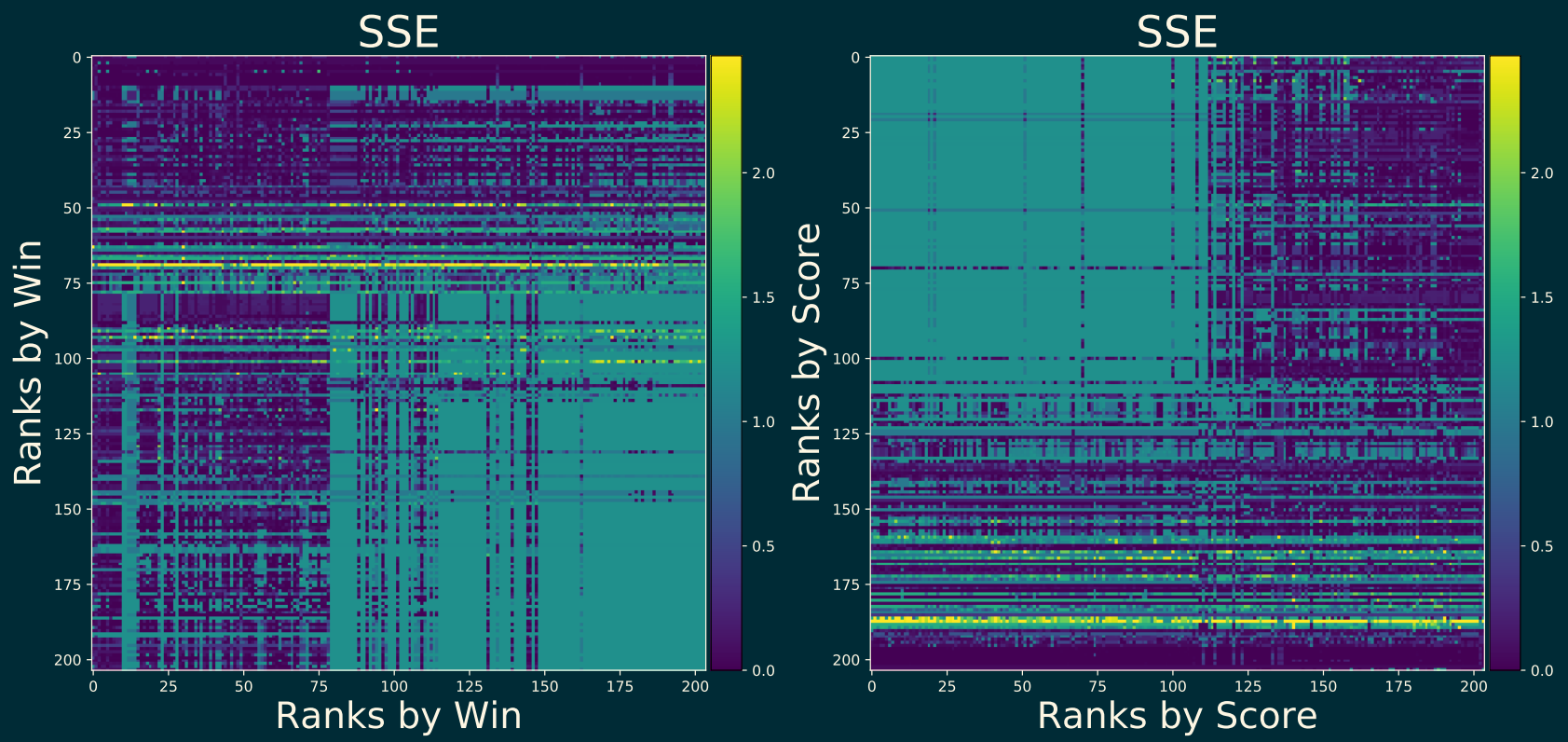
$$(S_P - P) = \chi(S_Q - P)$$

Recognising and evaluating the effectiveness of extortion in the Iterated Prisoner's Dilemma - Vincent A. Knight, Marc Harper, Nikoleta E. Glynatsi and Jonathan Gillard, 2019

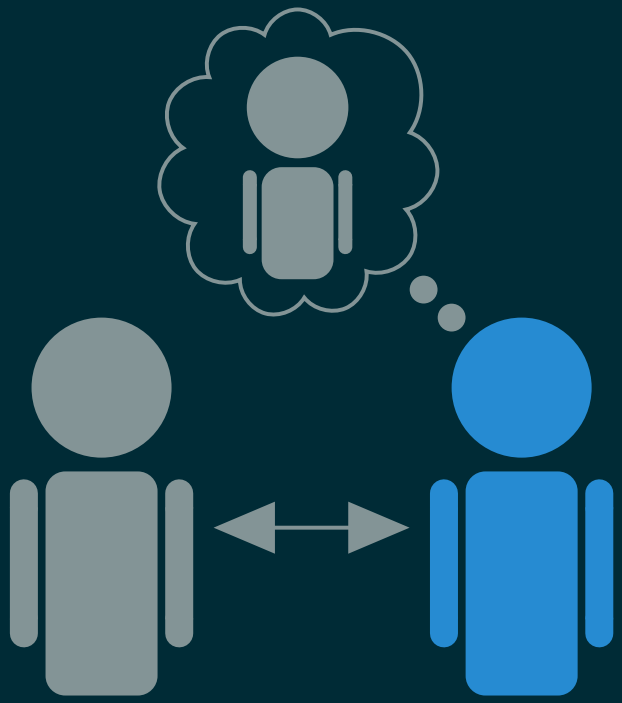


Extortion and cooperation in the Prisoner's Dilemma - A. J. Stewart and J. B. Plotkin., 2012



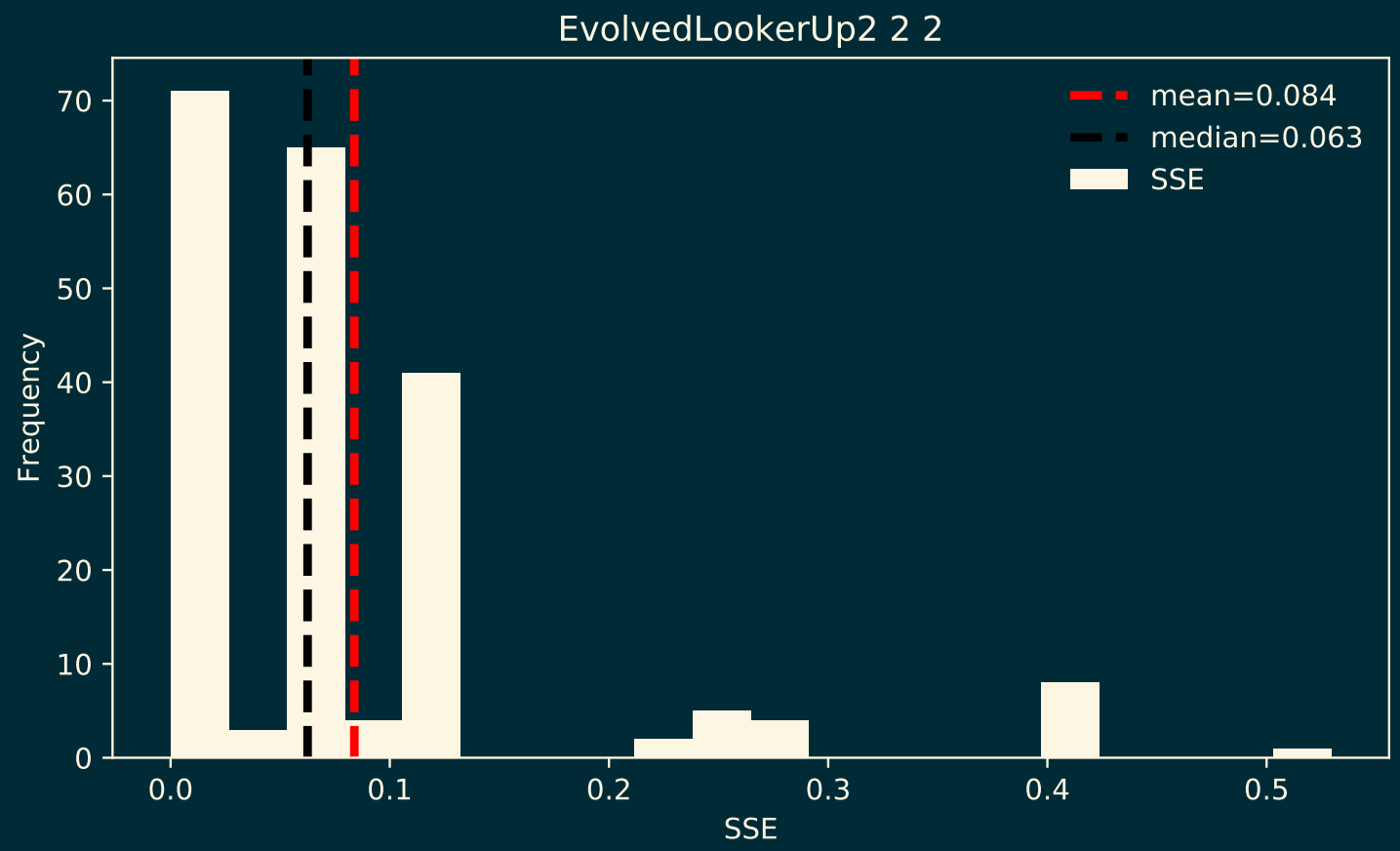

SSE
Ranks by Win
Ranks by Win
SSE
Ranks by Score
Ranks by Score

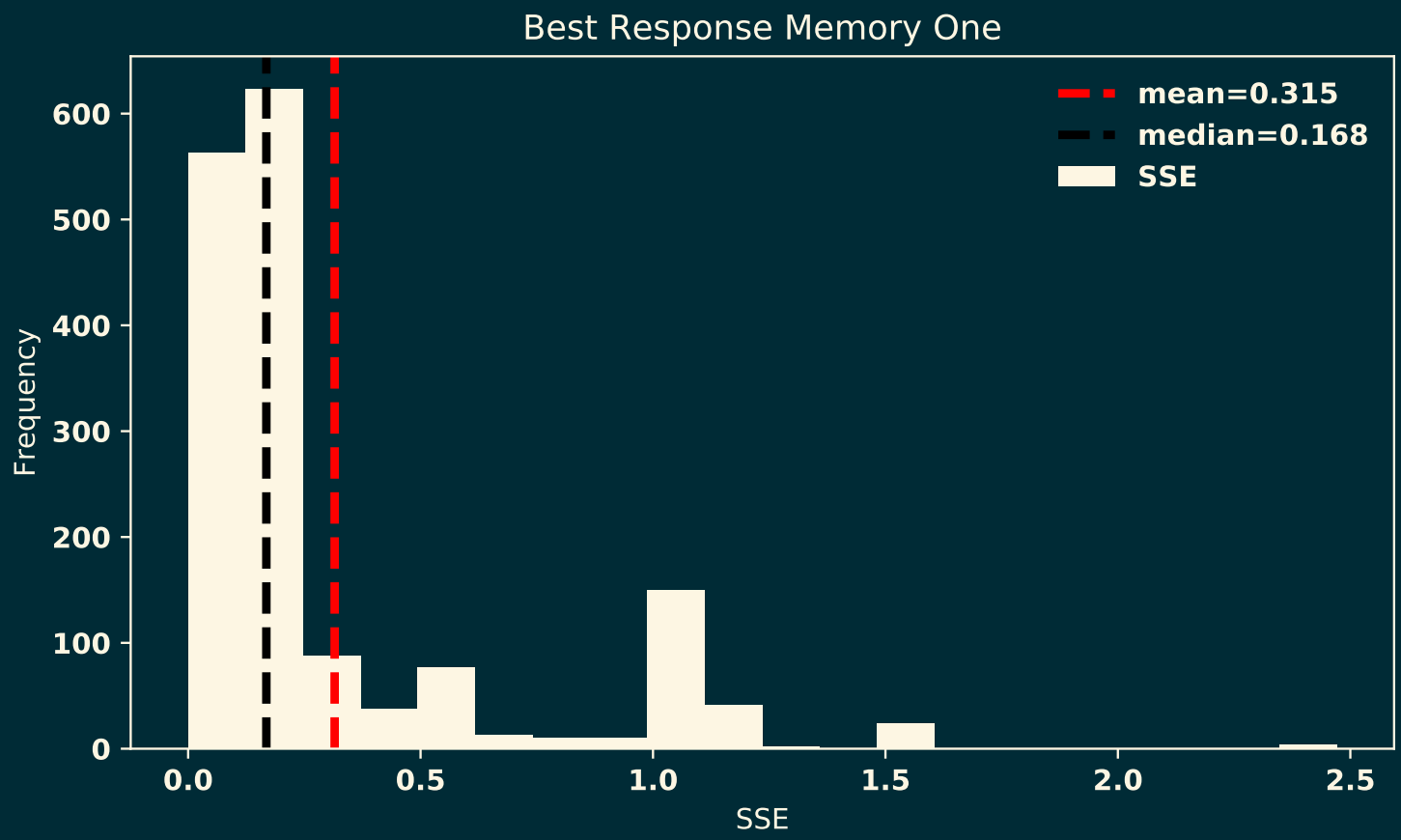
Stability of defection, optimisation of strategies and th limits of memory in the Prisoner's Dilemma - Nikoleta E. Glynatsi and Dr Vincent Knight

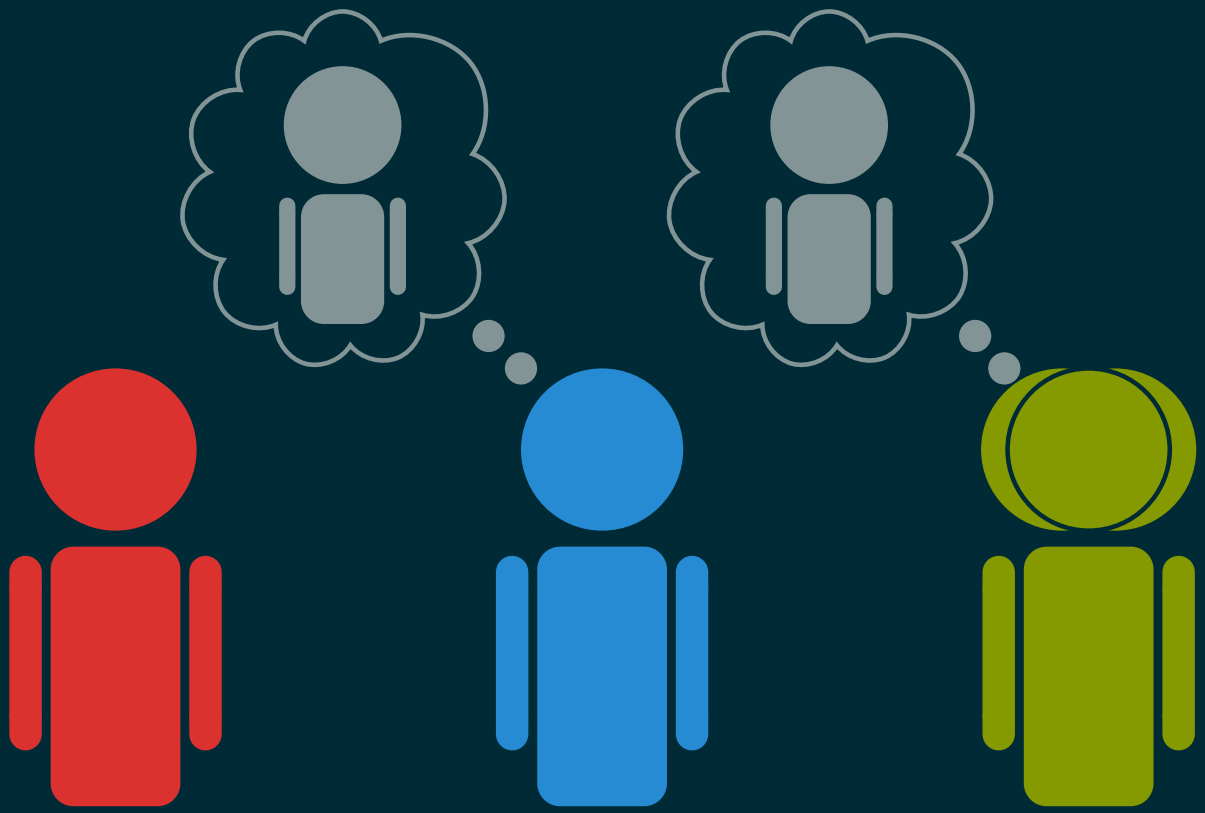


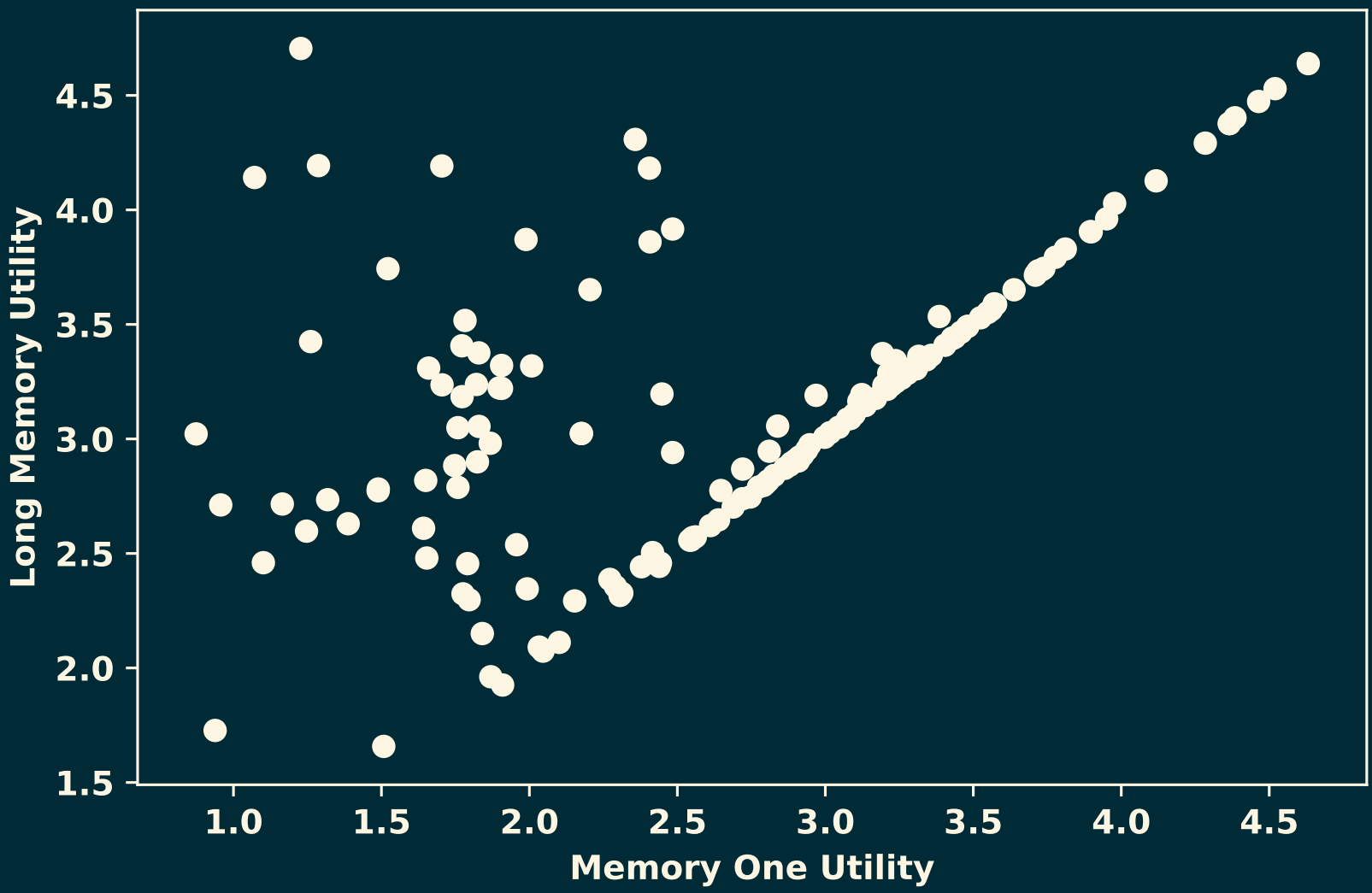
$$u_q(p) = \frac{\frac{1}{2} p Q p^T + cp + a}{\frac{1}{2} p \bar{Q} p^T + \bar{c} p + \bar{a}}$$

$$p^* = \text{argmax}_p \, u_q(p)$$


EvolvedLookerUp2 2 2
mean=0.084
median=0.063
SSE
Frequency
SSE
0
10
20
30
40
50
60
70
0.0
0.1
0.2
0.3
0.4
0.5


Best Response Memory One
mean=0.315
median=0.168
SSE
Frequency
600
500
400
300
200
100
0
0.0
0.5
1.0
1.5
2.0
2.5
SSE




Long Memory Utility
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Memory One Utility

- ZD strategies are not adaptable.
- Extortion is not optimal.
- Longer memory is beneficial.

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https://arxiv.org/abs/1904.00973

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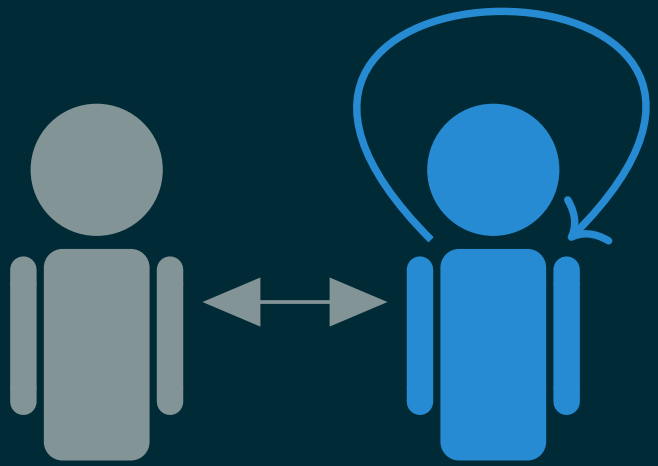
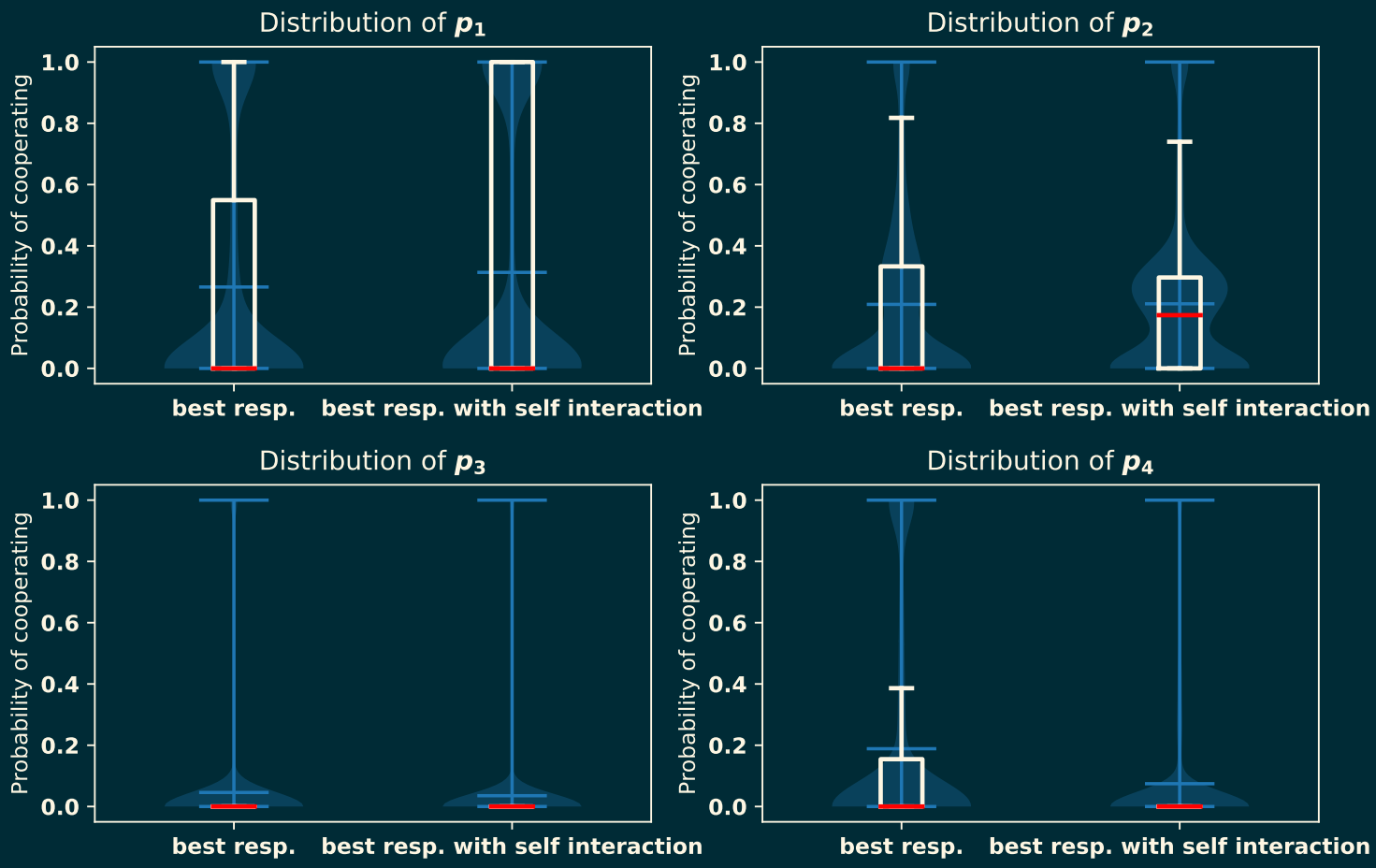
"Recognising and evaluating the.." is the #1 paper on Arxiv today in computer science and game theory. Github code (testing...) supports their results. Congrats @joelvincent @NikoletaGlyn. See it at assert.pub/arxiv/cs/cs.gt + assert.pub/papers/1904.00…. Please retweet.

11:21 PM - 1 Apr 2019

Stability of defection, optimisation of strategies and th limits of memory in the Prisoner's Dilemma - Nikoleta E. Glynatsi and Dr Vincent Knight



$$p^* = \text{argmax}_p \, u_q(p) + u_{p*}(p^*)$$


Distribution of p_1
Distribution of p_2
Distribution of p_3
Distribution of p_4
Probability of cooperating
1.0
0.8
0.6
0.4
0.2
0.0
best resp.
best resp. with self interaction