Cooperation

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Introduction

Readings

Kydd, chapter 8, (7)

What to remember from previous weeks

- solving normal form games $\rightarrow$ NE
- solving extensive form games $\rightarrow$ backward induction, SPNE
- finite horizon games $\rightarrow$ now extending to infinite horizon

How to model cooperation?

How to model cooperation?

- when wars too costly or ineffective $\rightarrow$ cooperation
- 2x2 normal form games told us how nuclear deterrence works, why we are in a security dilemma
- but: cooperation frequent! $\rightarrow$ repeated interactions sustain cooperation without *centralized enforcement*

How to model cooperation?

- consider cooperation problem
  - as in prisoner's dilemma where $T > R > P > S$ and unique NE is (P, P)
  - R, R pareto-dominates P, P

		Player 2	
		Cooperate	Defect
Player 1	Cooperate	R, R	S, T
	Defect	T, S	P, P

Think about international relations, why might this not be a sufficiently complex model of the world?

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- preferences model phenomenon well but not one-shot interaction

Time discounting

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- starting assumption: δ constant over time, so we can write

$$V_\infty = \delta u(x) + \delta^2 u(x) + \delta^3 u(x) \dots$$

or

$$V_\infty = \frac{1}{1 - \delta} u(x)$$

Time discounting

For finitely repeated interaction

$$V_\infty = \frac{1-\delta^n}{1-\delta} u(x)$$

Time discounting

TABLE 1 (*Cont.*)

Study	Time Range	Annual Discount Rate(s)	Annual Discount Factor(s)
Maital & Maital 1978	1 year	70%	0.59
Hausman 1979	undefined	5% to 89%	0.95 to 0.53
Gateley 1980	undefined	45% to 300%	0.69 to 0.25
Thaler 1981	3 mos. to 10 yrs.	7% to 345%	0.93 to 0.22
Ainslie & Haendel 1983	undefined	96000% to ∞	0.00
Houston 1983	1 yr. to 20 yrs.	23%	0.81
Loewenstein 1987	immediately to 10 yrs.	–6% to 212%	1.06 to 0.32
Moore and Viscusi 1988	undefined	10% to 12%	0.91 to 0.89
Benzion et al. 1989	6 mos. to 4 yrs.	9% to 60%	0.92 to 0.63
Viscusi & Moore 1989	undefined	11%	0.90
Moore & Viscusi 1990a	undefined	2%	0.98
Moore & Viscusi 1990b	undefined	1% to 14%	0.99 to 0.88
Shelley 1993	6 mos. to 4 yrs.	8% to 27%	0.93 to 0.79
Redelmeier & Heller 1993	1 day to 10 yrs.	0%	1.00
Cairns 1994	5 yrs. to 20 yrs.	14% to 25%	0.88 to 0.80
Shelley 1994	6 mos. to 2 yrs.	4% to 22%	0.96 to 0.82
Chapman & Elstein 1995	6 mos. to 12 yrs.	11% to 263%	0.90 to 0.28
Dolan & Gudex 1995	1 month to 10 yrs.	0%	1.00
Dreyfus and Viscusi 1995	undefined	11% to 17%	0.90 to 0.85
Kirby & Marakovic 1995	3 days to 29 days	3678% to ∞	0.03 to 0.00
Chapman 1996	1 yr. to 12 yrs.	negative to 300%	1.01 to 0.25
Kirby & Marakovic 1996	6 hours to 70 days	500% to 1500%	0.17 to 0.06
Pender 1996	7 mos. to 2 yrs.	26% to 69%	0.79 to 0.59
Wahlund & Gunnarson 1996	1 month to 1 yr.	18% to 158%	0.85 to 0.39
Cairns & van der Pol 1997	2 yrs. to 19 yrs.	13% to 31%	0.88 to 0.76
Green, Myerson & McFadden 1997	3 mos. to 20 yrs.	6% to 111%	0.94 to 0.47
Johanneson & Johansson 1997	6 yrs. to 57 yrs.	0% to 3%	0.97
Kirby 1997	1 day to 1 month	159% to 5747%	0.39 to 0.02
Madden et al. 1997	1 week to 25 yrs.	8% to ∞	0.93 to 0.00
Chapman & Winquist 1998	3 months	426% to 2189%	0.19 to 0.04
Holden, Shiferaw & Wik 1998	1 yr.	28% to 147%	0.78 to 0.40
Cairns & van der Pol 1999	4 yrs. to 16 yrs.	6%	0.94
Chapman, Nelson & Hier 1999	1 month to 6 mos.	13% to 19000%	0.88 to 0.01
Coller & Williams 1999	1 month to 3 mos.	15% to 25%	0.87 to 0.80
Kirby, Petry & Bickel 1999	7 days to 186 days	50% to 55700%	0.67 to 0.00
van der Pol & Cairns 1999	5 yrs. to 13 yrs.	7%	0.93
Chesson & Viscusi 2000	1 year to 25 yrs.	11%	0.90
Ganiats et al. 2000	6 mos. to 20 yrs.	negative to 116%	1.01 to 0.46
Hesketh 2000	6 mos. to 4 yrs.	4% to 36%	0.96 to 0.74
van der Pol & Cairns 2001	2 yrs. to 15 yrs.	6% to 9%	0.94 to 0.92
Warner & Pleeter 2001	immediately to 22 yrs.	0% to 71%	0 to 0.58
Harrison, Lau & Williams 2002	1 month to 37 mos.	28%	0.78

Figure 1: Source: Frederick, Loewenstein, and O'Donoghue (2002), p.81

Time discounting

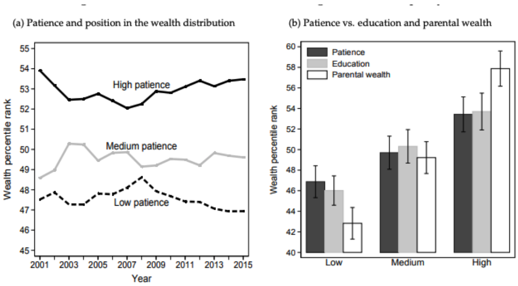

Figure 2: Source: Epper et al. (2020) , p.1189

Finitely repeated games

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- Consider this coordination game:

		Player 2	
		A	B
Player 1	A	2, 1	0, 0
	B	0, 0	1, 2

- repeated game: *stage game*

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$$\{A, A\}, \{A, B\}, \{B, A\}, \{B, B\}$$

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- payoffs
  - player 1 gets $(2) + \delta(1)$
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- NE?

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- NE? any incentive to deviate unilaterally?
  - in neither round, payoff 0 instead of 1 and 2 each

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- what if *unique NE* in stage game?

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- mutual defection in round n, therefore in round $n-1$ ...
- if unique NE in finitely repeated game: played in every stage game!
  - if unique NE is mutual defection we are screwed

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- complexity of game ask for starting with simple strategies **Can you think of any?**
  - *All defect*
  - *grim trigger*: cooperate until any other actor defects, then defect
  - *tit for tat*: cooperate first round, cooperate when other actors cooperate but defect when other actors defect in $t-1$

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- Note, value of future payoffs does not change that rationale

Grim trigger

Cooperate in the first round, cooperate if no one has ever defected, defect if anyone has ever defected

Grim trigger

- payoff when cooperating

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  - when future valued, cooperation possible!

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$\rightarrow$ cooperation wins when

$$\delta > \frac{T - R}{R - S}$$

which binds if $\frac{T+S}{2} < R$

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- But! Tit for tat is not subgame perfect $\rightarrow$ skipping punishment beats tit for tat when

$$\delta > \frac{T-R}{R-S}$$

Any better strategy?

- Contrite tit for tat (Signorino 1996)

Definition 8.5 *The strategy* CTFT

- *Good and bad standing are defined as follows:*

in round 1, both players are in good standing;

in any round $t > 1$, player i is in good standing if in round $t - 1$ it cooperated, or if it defected and player j was in bad standing. Otherwise, player i is in bad standing.

- *Cooperate, unless only the other side is in bad standing, in which case defect.*

- Effect of short-term exploitation diminished with repeated interaction and long time horizons

Any better strategy?

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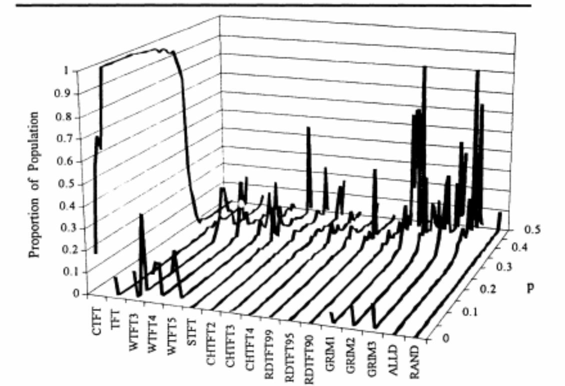

Any better strategy?

- Depending on context!

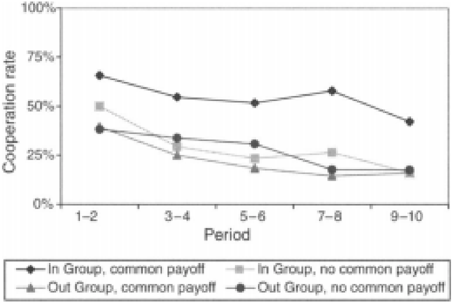

Figure 3: Source: Charness, Rigotti, and Rustichini (2007), p.1350

- Rationalize by introducing identity contingent strategies

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  - probabilistic detection of defection $\rightarrow$ avoids cost of detecting defection late
  - or, say CTFT is played but it take *two* periods to discover defect:

$$T + \delta T + \delta^2 S + \delta^3 S + \delta^4 R + \dots$$

  - CTFT with monitoring beats deviation if

$$\delta \geq \left(\frac{T-R}{R-S}\right)^{\frac{1}{2}}$$

Cheap talk

Modelling communication

- Interaction between a **sender** with more information and a **receiver**

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  - Building an army

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$\Rightarrow$ is information transmitted?

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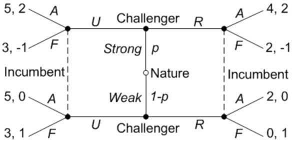
$\Rightarrow$ is information transmitted? $\Rightarrow$ Are there **separating equilibria**

Cheap talk


5, 2
A
U
Challenger
R
A
4, 2
3, -1
F
Strong
p
F
2, -1
Incumbent
Nature
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Weak
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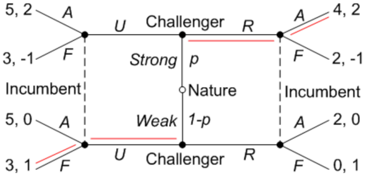
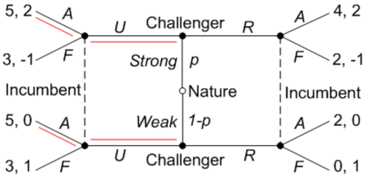
R
F
0, 1

Separating equilibrium



Pooling equilibrium



How to advance theory?

Of monkeys and children

- one option ...

Of monkeys and children

- one option . . . empirically

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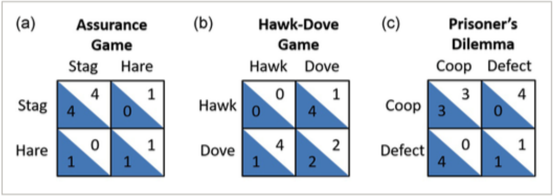

Figure 4: Source: Smith et al. (2019),p.3

Of monkeys and children

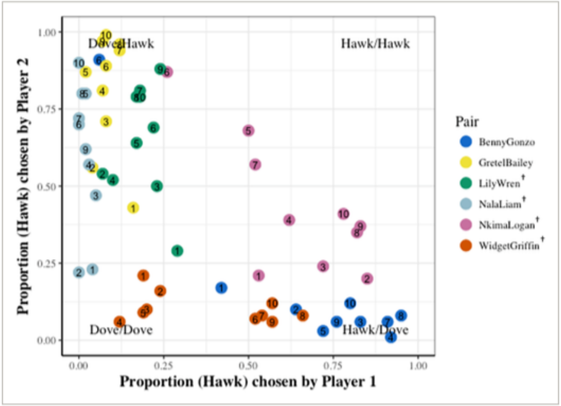

Figure 5: Source: Smith et al. (2019),p.3

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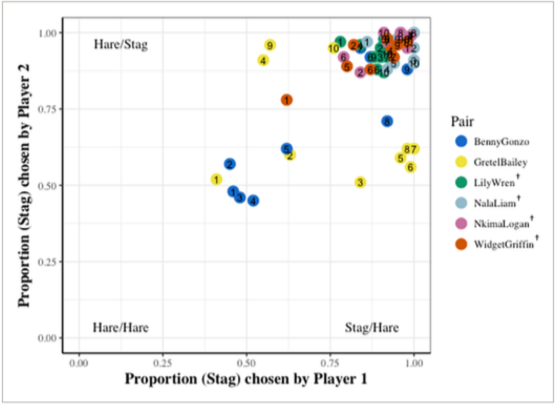

Figure 6: Source: Smith et al. (2019),p.3

Of monkeys and children

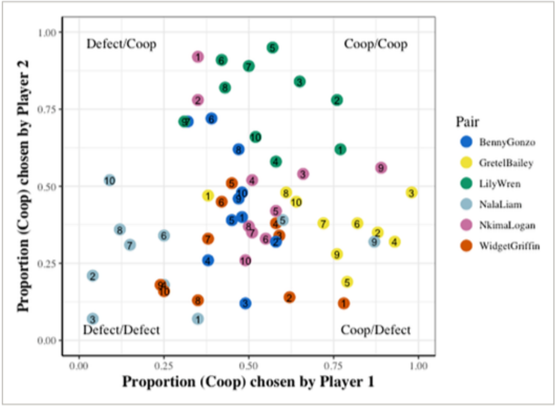

Figure 7: Source: Smith et al. (2019),p.3

Of monkeys and children

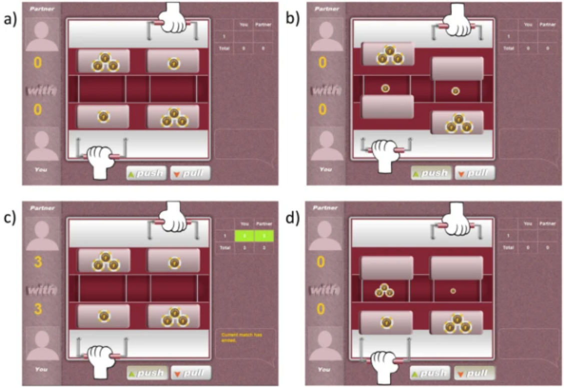

Figure 8: Source: Blake et al. (2015),p.2

Of monkeys and children

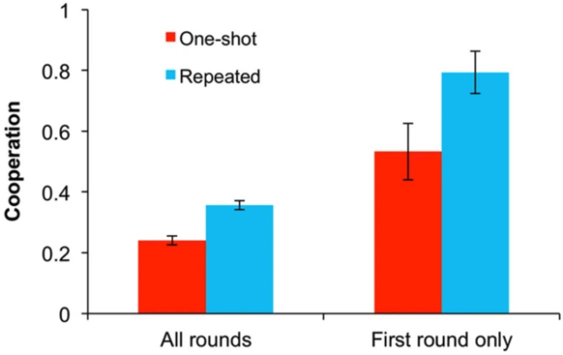

Figure 9: Source: Blake et al. (2015),p.3

Of monkeys and children

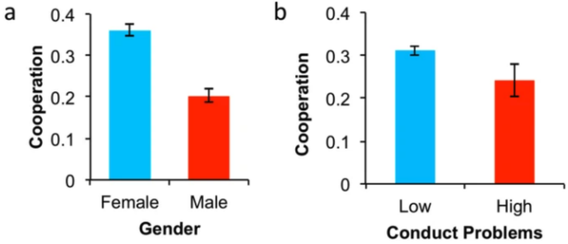

Figure 10: Source: Blake et al. (2015),p.3

Discussion

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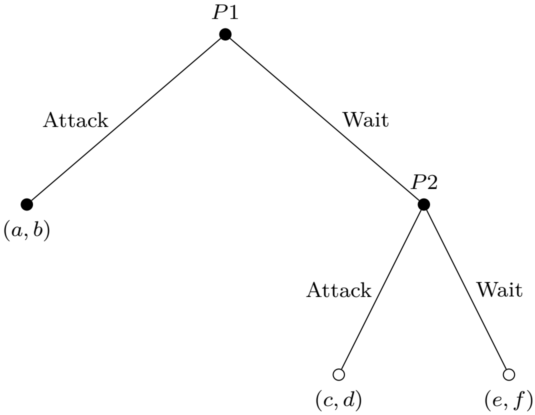
  - are the models presented today simple but not too simple?
- how to move between equilibria?
  - is the equilibrium analysis we do too static?
- who are the actors?
  - does *methodological individualism* mean we study individuals only? Surely not but what are we black-boxing?

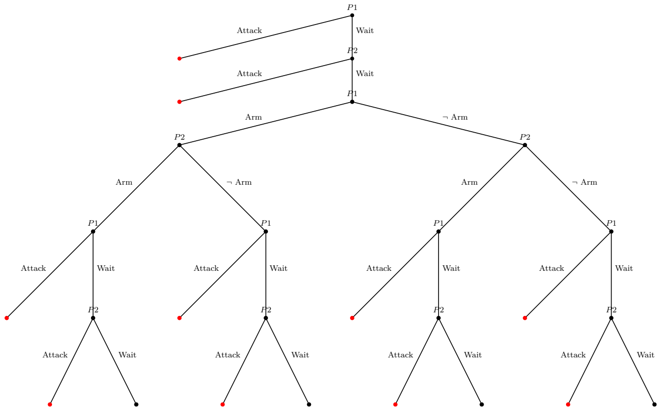
Mechanism linking arms and war

1. *Costly deterrence*: too costly to sustain military at the level necessary to deter, cheaper to go to war.
2. *Risk-return calculation*: too costly to sustain military to deter all attack, cheaper to allow for some conflict.

How to model?

- prisoners dilemma
  - extended to continuous strategy space
- simultaneous game
- peace is not free


P1
Attack
Wait
(a, b)
P2
Attack
Wait
(c, d)
(e, f)


P1
Attack
Wait
P2
Attack
Wait
P1
Arm
¬ Arm
P2
P2
Arm
¬ Arm
Arm
¬ Arm
P1
P1
P1
P1
Attack
Wait
Attack
Wait
Attack
Wait
Attack
Wait
P2
P2
P2
P2
Attack
Wait
Attack
Wait
Attack
Wait
Attack
Wait

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