MW24.2 Experimental Economics (SS2020) Coordination Games

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⇒ unlike in *cooperation* games (e.g., Prisoner's Dilemma), the interests of the players in *coordination* games are *not* conflicted by socially and privately optimal choices/outcomes

⇒ coordinating on the *same* action (∼ equilibrium strategy):

- [individual coordination] each player would prefer to choose an action that supports an equilibrium (i.e., best response)
- [collective coordination] all players would prefer to end up in a payoff dominant equilibrium

Coordination Games (2×2)

Pure Coordination Game

	L	R
L	$_*2, 2^*$	$-1, -1$
R	$-1, -1$	$_*1, 1^*$

- 2 N.E.: {L; L} and {R; R}
- {L; L} payoff dominates {R; R}

Traffic Game

∼ choice of a *new* technological standard

	L	R
L	$_*1, 1^*$	$-1, -1$
R	$-1, -1$	$_*1, 1^*$

- 2 N.E.: {L; L} and {R; R}
- neither equilibrium payoff dominates the other

Battle of Sexes

∼ coordination with a payoff (i.e., interest) conflict

∼ universal adoption of an *existing* standard

	O	F
O	$_*2, 1^*$	0, 0
F	0, 0	$_*1, 2^*$

* 2 N.E.: {O; O} and {F; F}
* The players *disagree* on which equilibrium is desirable

Stag Hunt

~ coordination with a tension between safe and risky outcomes

	S	H
S	$_*8, 8^*$	6, 7
H	7, 6	$_*7, 7^*$

* 2 N.E.: {S; S} and {H; H}
* {S; S} is payoff dominant while {H; H} is risk dominant

Minimum Effort Game

* more general than, e.g., Stag Hunt
* models processes subject to bottlenecking (i.e.,"weakest link")

⇒ $\pi(e_i, e_{-i}) = a \cdot min\{e_i, e_{-i}\} - b \cdot e_i + c$
s.t. $a > b > 0$ and $e_i \in [0, \bar{e}]$,
where π is own payoff, e_i is own effort level, e_{-i} are opponent effort levels, a is return to coordination, b is marginal cost of effort, and c is base payoff

⇒ any *common* effort level $e_i = e_{-i}$ is a N.E.

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exa) Stag Hunt $\leftarrow \pi = 20 \cdot min\{e_i, e_{-i}\} - 10 \cdot e_i + 60$ s.t. $e_i \in \{1, 2\}$

	(2)	(1)
(2)	80, 80	60, 70
(1)	70, 60	70, 70

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* two types of coordination failure:
  — incorrectly predict $min\{e_{-i}\}$ and choose $e_i \neq min\{e_{-i}\}$ (i.e., not b.r.)
  — coordinate on $e_i = e_{-i} \neq \bar{e}$ (i.e., not socially desirable)

⇒ according to Harsanyi and Selten [1988][1], *payoff dominance* should resolve both issues

[1] John C Harsanyi and Reinhard Selten. *A general theory of equilibrium selection in games.* The MIT Press, 1988

Huyck et al. [1990]

* testing payoff dominance as an equilibrium selection device
* repeated minimum effort game (treatment A: 10 repetitions) [Table A]
* minimum effort level revealed after each period; prediction about future play
* group size 14–16 or 2; partner or partner/stranger matching

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Treatments: [Table 1]

A) ∼ as above

B) ∼ $e_i = 7$ is (weakly) dominant ($b = 0$); no coordination problem [Table B]

A') ∼ A after B again

C) ∼ A played in pairs

A*) ∼ A with monitoring ⇔ entire distribution of effort levels known

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* payoff function:
  $\pi(e_i, e_{-i}) = 0.2 \cdot min\{e_i, e_{-i}\} - 0.1 \cdot e_i + 0.6$ s.t. $e_i \in \{1, 2, 3, 4, 5, 6, 7\}$
* predictors:
  — payoff (Pareto) dominance
  — risk dominance (i.e., maximin)
  — adaptive learning (i.e., b.r. to the minimum observed)
* major manipulations:
  (i) cost to benefit ratio of effort
  (ii) number of players

(i) Compare the previous Stag Hunt parametrization to one with the following payoff function:
$\pi' = 20 \cdot min\{e_i, e_{-i}\} - 19 \cdot e_i + 60$ s.t. $e_i \in \{1, 2\}$

	(2)	(1)
(2)	62, 62	42, 61
(1)	61, 42	61, 61

(ii) $E(\pi|e_i = 1) = 0.2 \cdot E[min\{1, e_{-i}\}] - 0.1 + 0.6 = 0.2 - 0.1 + 0.6$ (i.e., no risk)[2]

$E(\pi|e_i = 7) = 0.2 \cdot E[min\{7, e_{-i}\}] - 0.7 + 0.6$,
where $E[min\{7, e_{-i}\}]$ is *negatively* related to the number of players

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Results:

⇒ Subject predictions:

— heterogeneous expectations

— match actual behavior better than payoff or risk dominance

— relatively reasonable fit between beliefs and actions albeit most choose $e_i > E_i[min\{\cdot\}] \mid E_i[min\{\cdot\}] < 7$

⇒ Period one: [Table 2]

— (7) ∼ 31%; (1) ∼ 2%; (4) ∼ 17%; (5) ∼ 32%;

— $max[min\{\cdot\}] \leq 4$

— if $e_i > min\{\cdot\}$ → lower effort in period 2 (some *'overshoot'* $min\{\cdot\}$!)

— if $e_i = min\{\cdot\}$ → adjust upward or repeat same effort level

— only 14 out 107 subjects b.r. in period 2, some go below the $min\{\cdot\}$

⇒ Repeated: [Table 2]

— convergence to the "secure" inefficient equilibrium

— convergence to the payoff dominant equilibrium in B, which does *not* persist through A' [Table 3]

⇒ Paired: [Tables 4–5]

— partner matching → most pairs coordinate on (7)

— random matching → most are above (1) but below (7)

⇒ Monitoring: [Table 6]

— initial distribution of actions and time dynamics quite similar (albeit faster)

— *individual* coordination (b.r.) appears easier to achieve

[2] All expectations are conditional on the probability distributions over effort choice of the individual opponents, e.g., $E(\pi|e_i) \equiv E(\pi|e_i; e_{-i}) \equiv E(\pi|e_i; f_{e_a}(\cdot), ..., f_{e_h}(\cdot), f_{e_j}(\cdot), ..., f_{e_n}(\cdot))$, where $f_e(\cdot)$ is a probability density function over said effort.

Suggested Literature

- Charles A Holt. *Markets, games, & strategic behavior*. Boston Pearson Addison Wesley, 2007 [Chapters 3.3, 12]

- John B. Van Huyck, Raymond C. Battalio, and Richard O. Beil. Tacit coordination games, strategic uncertainty, and coordination failure. *The American Economic Review*, 80(1):234–248, 1990

* Russell W. Cooper, Douglas V. DeJong, Robert Forsythe, and Thomas W. Ross. Selection criteria in coordination games: Some experimental results. *The American Economic Review*, 80(1):218–233, 1990