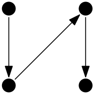
Egalitarian Networks from Asymmetric Relations: Coordination on Reciprocity in a Social Game of Hawk-Dove

Milena Tsvetkova, Cornell University
Vincent Buskens, Utrecht University

Third Annual Meeting and Conference of the COST Action MP0801
May 18, 2011

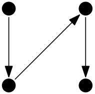
ICS
RUG/UU/RU

Background



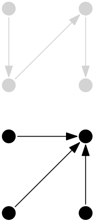
- Asymmetric relations
  - ubiquitous (e.g., specialization in social exchange)

Background



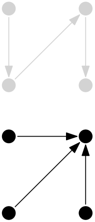
- Asymmetric relations
    - ubiquitous (e.g., specialization in social exchange)
    - essential for collective efficiency

Background



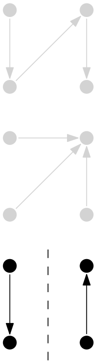
- Asymmetric relations
  - ubiquitous (e.g., specialization in social exchange)
  - essential for collective efficiency
  - conductive to aggregate inequality and hierarchy

Background

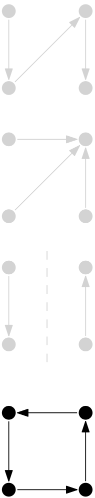


- Asymmetric relations
  - ubiquitous (e.g., specialization in social exchange)
  - essential for collective efficiency
  - conductive to aggregate inequality and hierarchy
- Egalitarian outcomes through norms of reciprocity

Background

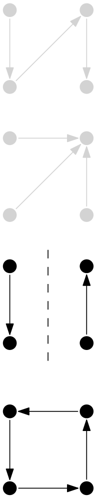


- Asymmetric relations
  - ubiquitous (e.g., specialization in social exchange)
  - essential for collective efficiency
  - conductive to aggregate inequality and hierarchy
- Egalitarian outcomes through norms of reciprocity
  - Direct reciprocity



- Asymmetric relations
  - ubiquitous (e.g., specialization in social exchange)
  - essential for collective efficiency
  - conductive to aggregate inequality and hierarchy
- Egalitarian outcomes through norms of reciprocity
  - Direct reciprocity
  - Indirect (generalized) reciprocity

Background



- Asymmetric relations
  - ubiquitous (e.g., specialization in social exchange)
  - essential for collective efficiency
  - conductive to aggregate inequality and hierarchy
- Egalitarian outcomes through norms of reciprocity
  - Direct reciprocity
  - Indirect (generalized) reciprocity
- Requirements for establishment of social norms
  - Monitoring
  - Punishment

Question

- What are the conditions under which groups of individuals are more likely to coordinate on efficient and egalitarian structures from asymmetric dyadic relations?

Question

- What are the conditions under which groups of individuals are more likely to coordinate on efficient and egalitarian structures from asymmetric dyadic relations?
  - Group size
    - hinders monitoring
    - encourages violations

Question

- What are the conditions under which groups of individuals are more likely to coordinate on efficient and egalitarian structures from asymmetric dyadic relations?
  - Group size
    - hinders monitoring
    - encourages violations
  - Link costs
    - makes punishment through exclusion individually rational

Model

	(0,*G*) (0,*T*)	(1,*G*)	(1,*T*)
(0,*G*) (0,*T*)	**0**, **0**	0, 0	0, 0
(1,*G*)	0, 0	4, 4	**3**, **9**
(1,*T*)	0, 0	**9**, **3**	1, 1

- Social game
  - Network game: $l_{ij} = \{0, 1\}$
  - Hawk-Dove Game: $a_{ij} = \{Give, Take\}$

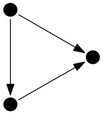
Model

	(0, G) (0, T)	(1, G)	(1, T)
(0, G) (0, T)	**0**, **0**	0, 0	0, 0
(1, G)	0, 0	4, 4	**3**, **9**
(1, T)	0, 0	**9**, **3**	1, 1

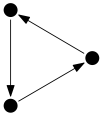
- Social game
  - Network game: $l_{ij} = \{0, 1\}$
  - Hawk-Dove Game: $a_{ij} = \{Give, Take\}$
- Strict Nash equilibria

Model

s.d.	score	probability stat.	probability alt.
4.9	(0, 1, 2)	.75	.75

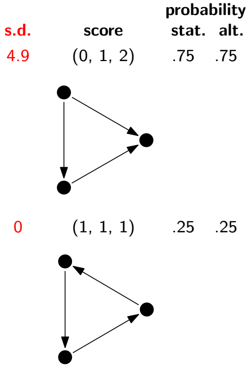


s.d.	score	probability stat.	probability alt.
0	(1, 1, 1)	.25	.25



- Social game
  - Network game: $l_{ij} = \{0, 1\}$
  - Hawk-Dove Game: $a_{ij} = \{Give, Take\}$
- Strict Nash equilibria
  - combination of equilibria in two-person version

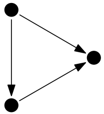
Model



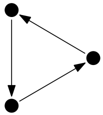
- Social game
    - Network game: $l_{ij} = \{0, 1\}$
    - Hawk-Dove Game: $a_{ij} = \{Give, Take\}$
- Strict Nash equilibria
    - combination of equilibria in two-person version
    - efficient but not necessarily egalitarian

Model

s.d.	score	probability stat.	probability alt.
4.9	(0, 1, 2)	.75	.75

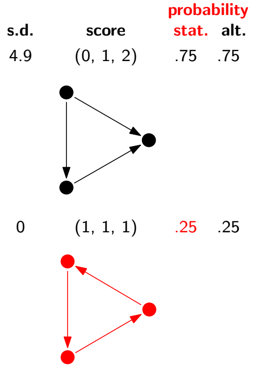


s.d.	score	probability stat.	probability alt.
0	(1, 1, 1)	.25	.25



- Social game
  - Network game: $l_{ij} = \{0, 1\}$
  - Hawk-Dove Game: $a_{ij} = \{Give, Take\}$
- Strict Nash equilibria
  - combination of equilibria in two-person version
  - efficient but not necessarily egalitarian
- Egalitarian equilibria

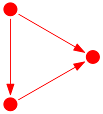
Model



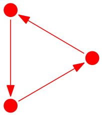
- Social game
  - Network game: $l_{ij} = \{0, 1\}$
  - Hawk-Dove Game: $a_{ij} = \{Give, Take\}$
- Strict Nash equilibria
  - combination of equilibria in two-person version
  - efficient but not necessarily egalitarian
- Egalitarian equilibria
  - Sometimes: Static — indirect reciprocity

Model

s.d.	score	probability stat.	probability alt.
4.9	(0, 1, 2)	.75	.75



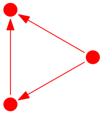
s.d.	score	probability stat.	probability alt.
0	(1, 1, 1)	.25	.25

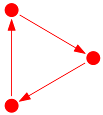


- Social game
  - Network game: $l_{ij} = \{0, 1\}$
  - Hawk-Dove Game: $a_{ij} = \{Give, Take\}$
- Strict Nash equilibria
  - combination of equilibria in two-person version
  - efficient but not necessarily egalitarian
- Egalitarian equilibria
  - Sometimes: Static — indirect reciprocity
  - Always: Alternating — direct reciprocity

Model

s.d.	score	probability stat.	probability alt.
4.9	(0, 1, 2)	.75	.75
0	(1, 1, 1)	.25	.25

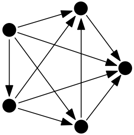




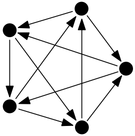
- Social game
  - Network game: $l_{ij} = \{0, 1\}$
  - Hawk-Dove Game: $a_{ij} = \{Give, Take\}$
- Strict Nash equilibria
  - combination of equilibria in two-person version
  - efficient but not necessarily egalitarian
- Egalitarian equilibria
  - Sometimes: Static — indirect reciprocity
  - Always: Alternating — direct reciprocity

Model

		probability	
s.d.	**score**	**stat.**	**alt.**
8.5	(0, 1, 2, 3, 4)	.117	.117



s.d.	score	stat.	alt.
7.6	(0, 1, 3, 3, 3)	.039	.078
7.6	(1, 1, 1, 3, 4)	.039	
7.6	(0, 2, 2, 2, 4)	.039	.039
6.6	(0, 2, 2, 3, 3)	.117	.234
6.6	(1, 1, 2, 2, 4)	.117	
5.4	(1, 1, 2, 3, 3)	.234	.234
3.8	(1, 2, 2, 2, 3)	.273	.273
0	(2, 2, 2, 2, 2)	.023	.023



- Social game
  - Network game: $l_{ij} = \{0, 1\}$
  - Hawk-Dove Game: $a_{ij} = \{Give, Take\}$
- Strict Nash equilibria
  - combination of equilibria in two-person version
  - efficient but not necessarily egalitarian
- Egalitarian equilibria
  - Sometimes: Static — indirect reciprocity
  - Always: Alternating — direct reciprocity

Hypotheses

- Assumption: Only egalitarian equilibria are stable.

Hypotheses

- Assumption: Only egalitarian equilibria are stable.
- Egalitarian equilibria
  - more likely in smaller groups
  - more likely when maintaining links is more costly

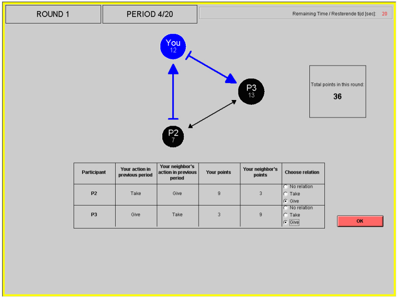
Hypotheses

- Assumption: Only egalitarian equilibria are stable.
- Egalitarian equilibria
  - more likely in smaller groups
  - more likely when maintaining links is more costly
- Egalitarian static equilibria
  - more likely in smaller groups

Hypotheses

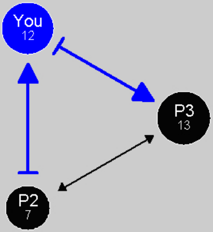
- Assumption: Only egalitarian equilibria are stable.
- Egalitarian equilibria
  - more likely in smaller groups
  - more likely when maintaining links is more costly
- Egalitarian static equilibria
  - more likely in smaller groups
- Egalitarian alternating equilibria
  - given group size: occurrence relative to their baseline probabilities

Experiment



- 11 sessions x 15 subjects
- each subject obtains 4 treatments
  - Group size of 3 and 5
  - Link costs of 0 and 2
  - Order is balanced over sessions
- 2 rounds x 20 periods
- Action choices
  - No relation, Give, Take
- Network visualization
  - after first period

ROUND 1 | PERIOD 4/20 | Remaining Time / Resterende tijd [sec]: 20



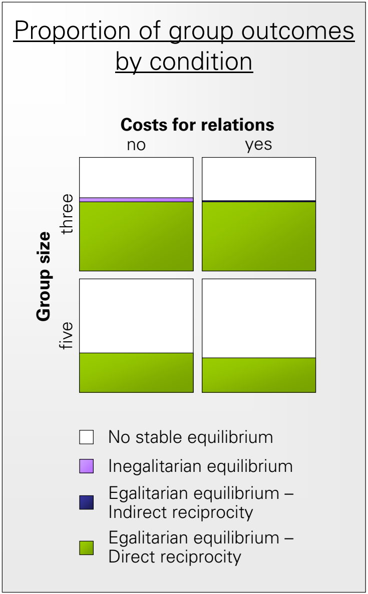
Total points in this round:

36

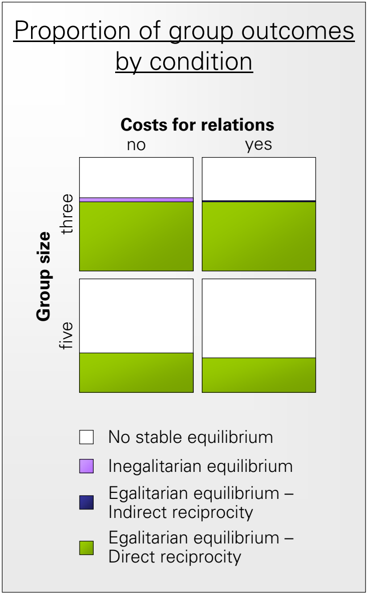
Participant	Your action in previous period	Your neighbor's action in previous period	Your points	Your neighbor's points	Choose relation
P2	Take	Give	9	3	○ No relation ○ Take ◉ Give
P3	Give	Take	3	9	○ No relation ○ Take ◉ Give

OK

Results

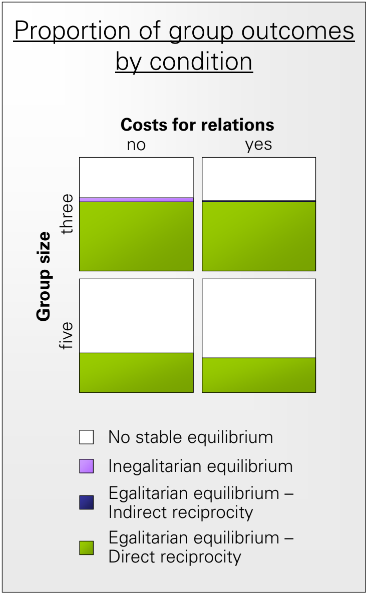


- Equilibria
  - nearly all egalitarian



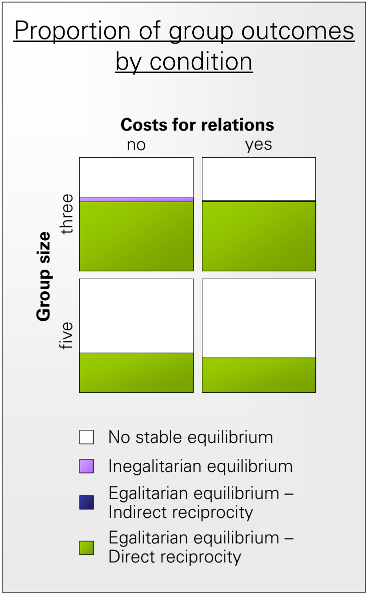
- Equilibria
  - nearly all egalitarian
- Egalitarian equilibria
  - nearly all alternating

Results



- Equilibria
  - nearly all egalitarian
- Egalitarian equilibria
  - nearly all alternating
  - more common in three-person groups

Results



- Equilibria
  - nearly all egalitarian
- Egalitarian equilibria
  - nearly all alternating
  - more common in three-person groups
  - equally common in both cost conditions

Table: Logistic regression on whether a group converges to an egalitarian equilibrium. Models without (Model 1a) and with (Model 1b) correction for composition effect due to group size.

	Model 1a			Model 1b		
	Coeff.	s.e.	p	Coeff.	s.e.	p
Composition effect					(offset)	
Five-person group	−1.496	.229	.000	−.673	.229	.003
Link costs	−.102	.187	.583	−.136	.193	.481
Rounds played	.329	.066	.000	.353	.066	.000
Group-size ordering [a]	.262	.407	.519	.555	.302	.066
Link-costs ordering [b]	.694	.426	.103	.444	.305	.147
Constant	−.921	.358	.010	−.466	.341	.172
Number of obs.		352			352	
Log likelihood		−205.328			−159.952	
X^2 [c]		81.00 ($p = .000$)			41.66 ($p = .000$)	
Df		5			5	

Note: Two-sided p-values for coefficients.
Note: Standard errors adjusted for multi-way clustering.
[a] Reference: interacting in three-person groups first
[b] Reference: interacting in the no-cost condition first
[c] Wald test

Results

Table: Logistic regression on whether a group converges to an egalitarian equilibrium. Models without (Model 1a) and with (Model 1b) correction for composition effect due to group size.

	Model 1a			Model 1b		
	Coeff.	s.e.	p	Coeff.	s.e.	p
Composition effect					(offset)	
Five-person group	−1.496	.229	.000	−.673	.229	.003
Link costs	−.102	.187	.583	−.136	.193	.481
Rounds played	.329	.066	.000	.353	.066	.000
Group-size ordering [a]	.262	.407	.519	.555	.302	.066
Link-costs ordering [b]	.694	.426	.103	.444	.305	.147
Constant	−.921	.358	.010	−.466	.341	.172
Number of obs.	352			352		
Log likelihood	−205.328			−159.952		
X^2 [c]	81.00 (p = .000)			41.66 (p = .000)		
Df	5			5		

Note: Two-sided p-values for coefficients.
Note: Standard errors adjusted for multi-way clustering.
[a] Reference: interacting in three-person groups first
[b] Reference: interacting in the no-cost condition first
[c] Wald test

Results

Table: Logistic regression on whether a group converges to an egalitarian equilibrium. Models without (Model 1a) and with (Model 1b) correction for composition effect due to group size.

	Model 1a			Model 1b		
	Coeff.	s.e.	p	Coeff.	s.e.	p
Composition effect					(offset)	
Five-person group	−1.496	.229	.000	−.673	.229	.003
Link costs	−.102	.187	.583	−.136	.193	.481
Rounds played	.329	.066	.000	.353	.066	.000
Group-size ordering [a]	.262	.407	.519	.555	.302	.066
Link-costs ordering [b]	.694	.426	.103	.444	.305	.147
Constant	−.921	.358	.010	−.466	.341	.172
Number of obs.		352			352	
Log likelihood		−205.328			−159.952	
X^2 [c]		81.00 (p = .000)			41.66 (p = .000)	
Df		5			5	

Note: Two-sided p-values for coefficients.
Note: Standard errors adjusted for multi-way clustering.
[a] Reference: interacting in three-person groups first
[b] Reference: interacting in the no-cost condition first
[c] Wald test

Table: Logistic regression on whether a group converges to an egalitarian equilibrium. Models without (Model 1a) and with (Model 1b) correction for composition effect due to group size.

	Model 1a			Model 1b		
	Coeff.	s.e.	p	Coeff.	s.e.	p
Composition effect					(offset)	
Five-person group	−1.496	.229	.000	−.673	.229	.003
Link costs	−.102	.187	.583	−.136	.193	.481
Rounds played	.329	.066	.000	.353	.066	.000
Group-size ordering [a]	.262	.407	.519	.555	.302	.066
Link-costs ordering [b]	.694	.426	.103	.444	.305	.147
Constant	−.921	.358	.010	−.466	.341	.172
Number of obs.	352			352		
Log likelihood	−205.328			−159.952		
X^2 [c]	81.00 (p = .000)			41.66 (p = .000)		
Df	5			5		

Note: Two-sided p-values for coefficients.
Note: Standard errors adjusted for multi-way clustering.
[a] Reference: interacting in three-person groups first
[b] Reference: interacting in the no-cost condition first
[c] Wald test

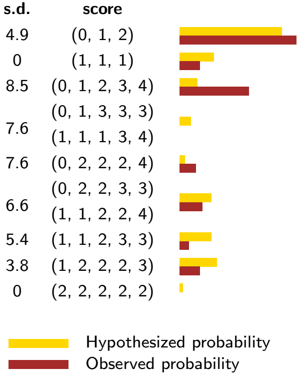
Results

Table: Logistic regression on whether a group converges to an egalitarian equilibrium. Models without (Model 1a) and with (Model 1b) correction for composition effect due to group size.

	Model 1a			Model 1b		
	Coeff.	s.e.	p	Coeff.	s.e.	p
Composition effect					(offset)	
Five-person group	−1.496	.229	.000	−.673	.229	.003
Link costs	−.102	.187	.583	−.136	.193	.481
Rounds played	.329	.066	.000	.353	.066	.000
Group-size ordering [a]	.262	.407	.519	.555	.302	.066
Link-costs ordering [b]	.694	.426	.103	.444	.305	.147
Constant	−.921	.358	.010	−.466	.341	.172
Number of obs.	352			352		
Log likelihood	−205.328			−159.952		
X^2 [c]	81.00 ($p = .000$)			41.66 ($p = .000$)		
Df	5			5		

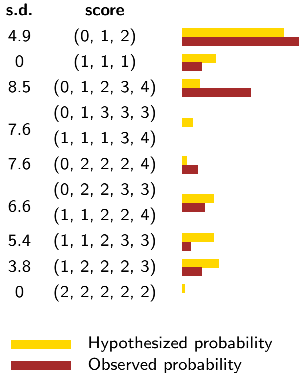
Note: Two-sided p-values for coefficients.
Note: Standard errors adjusted for multi-way clustering.
[a] Reference: interacting in three-person groups first
[b] Reference: interacting in the no-cost condition first
[c] Wald test

Results



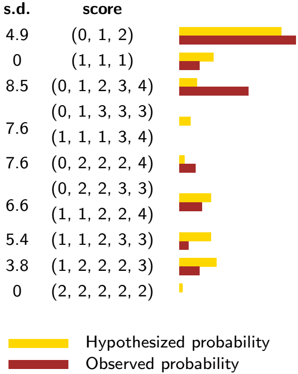
- Egalitarian alternating equilibria

Results



- Egalitarian alternating equilibria
  - Occurred more often than expected
    - (0, 1, 2) — .858 versus .75
    - (0, 1, 2, 3, 4) — .512 versus .117
    - (0, 2, 2, 2, 4) — .116 versus .039

Results



- Egalitarian alternating equilibria
  - Occurred more often than expected
    - (0, 1, 2) — .858 versus .75
    - (0, 1, 2, 3, 4) — .512 versus .117
    - (0, 2, 2, 2, 4) — .116 versus .039
  - Did not occur
    - (0, 1, 3, 3, 3)/(1, 1, 1, 3, 4)
    - (2, 2, 2, 2, 2)

Results

Table: Conditional logistic regressions on whether particular alternating equilibrium confgurations are more likely to occur than others after accounting for their hypothesized probability.

	Model 2			Model 3		
	Coeff.	s.e.	*p*	Coeff.	s.e.	*p*
Baseline probability	(offset)			(offset)		
(0, 1, 2)	.702	.315	.026			
(1, 1, 1)	(ref.)					
(0, 1, 2, 3, 4)				1.838	.451	.000
(0, 1, 3, 3, 3)/(1, 1, 1, 3, 4) [a]				–		
(0, 2, 2, 2, 4)				1.455	.779	.062
(0, 2, 2, 3, 3)/(1, 1, 2, 2, 4)				(ref.)		
(1, 1, 2, 3, 3)				−.847	.747	.257
(1, 2, 2, 2, 3)				−.308	.632	.626
(2, 2, 2, 2, 2) [a]				–		
Number of obs.	268			215		
Log likelihood	−54.699			−58.014		
X^2 [b]	4.96 (p=.026)			33.82 (p=.000)		
Df	1			4		

Note: Two-sided *p*-values for coefficients.
Note: Standard errors adjusted for multi-way clustering.
[a] Removed due to estimation problems caused by near-perfect prediction
[b] Wald test

Results

Table: Conditional logistic regressions on whether particular alternating equilibrium confgurations are more likely to occur than others after accounting for their hypothesized probability.

	Model 2			Model 3		
	Coeff.	s.e.	*p*	Coeff.	s.e.	*p*
Baseline probability		(offset)			(offset)	
(0, 1, 2)	.702	.315	.026			
(1, 1, 1)	(ref.)					
(0, 1, 2, 3, 4)				1.838	.451	.000
(0, 1, 3, 3, 3)/(1, 1, 1, 3, 4) [a]				–		
(0, 2, 2, 2, 4)				1.455	.779	.062
(0, 2, 2, 3, 3)/(1, 1, 2, 2, 4)				(ref.)		
(1, 1, 2, 3, 3)				−.847	.747	.257
(1, 2, 2, 2, 3)				−.308	.632	.626
(2, 2, 2, 2, 2) [a]				–		
Number of obs.		268			215	
Log likelihood		−54.699			−58.014	
X^2 [b]		4.96 (p=.026)			33.82 (p=.000)	
Df		1			4	

Note: Two-sided *p*-values for coefficients.
Note: Standard errors adjusted for multi-way clustering.
[a] Removed due to estimation problems caused by near-perfect prediction
[b] Wald test

Results

Table: Conditional logistic regressions on whether particular alternating equilibrium confgurations are more likely to occur than others after accounting for their hypothesized probability.

	Model 2			Model 3		
	Coeff.	s.e.	p	Coeff.	s.e.	p
Baseline probability		(offset)			(offset)	
(0, 1, 2)	.702	.315	.026			
(1, 1, 1)	(ref.)					
(0, 1, 2, 3, 4)				1.838	.451	.000
(0, 1, 3, 3, 3)/(1, 1, 1, 3, 4) [a]				–		
(0, 2, 2, 2, 4)				1.455	.779	.062
(0, 2, 2, 3, 3)/(1, 1, 2, 2, 4)				(ref.)		
(1, 1, 2, 3, 3)				−.847	.747	.257
(1, 2, 2, 2, 3)				−.308	.632	.626
(2, 2, 2, 2, 2) [a]				–		
Number of obs.		268			215	
Log likelihood		−54.699			−58.014	
X^2 [b]		4.96 (p=.026)			33.82 (p=.000)	
Df		1			4	

Note: Two-sided *p*-values for coefficients.
Note: Standard errors adjusted for multi-way clustering.
[a] Removed due to estimation problems caused by near-perfect prediction
[b] Wald test

Results

Table: Conditional logistic regressions on whether particular alternating equilibrium confgurations are more likely to occur than others after accounting for their hypothesized probability.

	Model 2			Model 3		
	Coeff.	s.e.	p	Coeff.	s.e.	p
Baseline probability		(offset)			(offset)	
(0, 1, 2)	.702	.315	.026			
(1, 1, 1)	(ref.)					
(0, 1, 2, 3, 4)				1.838	.451	.000
(0, 1, 3, 3, 3)/(1, 1, 1, 3, 4) [a]				–		
(0, 2, 2, 2, 4)				1.455	.779	.062
(0, 2, 2, 3, 3)/(1, 1, 2, 2, 4)				(ref.)		
(1, 1, 2, 3, 3)				−.847	.747	.257
(1, 2, 2, 2, 3)				−.308	.632	.626
(2, 2, 2, 2, 2) [a]				–		
Number of obs.		268			215	
Log likelihood		−54.699			−58.014	
X^2 [b]		4.96 (p=.026)			33.82 (p=.000)	
Df		1			4	

Note: Two-sided *p*-values for coefficients.
Note: Standard errors adjusted for multi-way clustering.
[a] Removed due to estimation problems caused by near-perfect prediction
[b] Wald test

Summary/Contributions

- Social game with partner-specific choices

Summary/Contributions

- Social game with partner-specific choices
- Norms of reciprocity for egalitarian outcomes

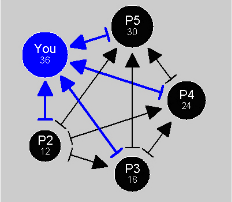
Summary/Contributions

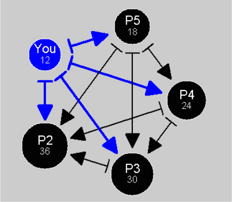
- Social game with partner-specific choices
- Norms of reciprocity for egalitarian outcomes
    - More likely to be established in small groups

Summary/Contributions

- Social game with partner-specific choices
- Norms of reciprocity for egalitarian outcomes
  - More likely to be established in small groups
  - Direct reciprocity is more common than indirect reciprocity

Summary/Contributions





- Social game with partner-specific choices
- Norms of reciprocity for egalitarian outcomes
  - More likely to be established in small groups
  - Direct reciprocity is more common than indirect reciprocity
  - Preferred outcomes have egalitarian payoff distributions but hierarchical action configurations