

Relationship between friendships and delinquent behavior among pupils

Dominik Gerstner, Elena Kotyrlo, Marko and
Natasia Lovric, Isabelle Ruin

Theoretical background

2 possible causes for similarities in the delinquent behavior of friends found in the criminology

Influence

- Behavior is influenced by social relationships
- All types of behavior are influenced by social norms

Durkheim's (1897, 1951)

Friendship Selection

- The idea that people prefer similar others as friends
- Homophily is a fundamental principle of social structure

Lazarsfeld , Merton (1954)

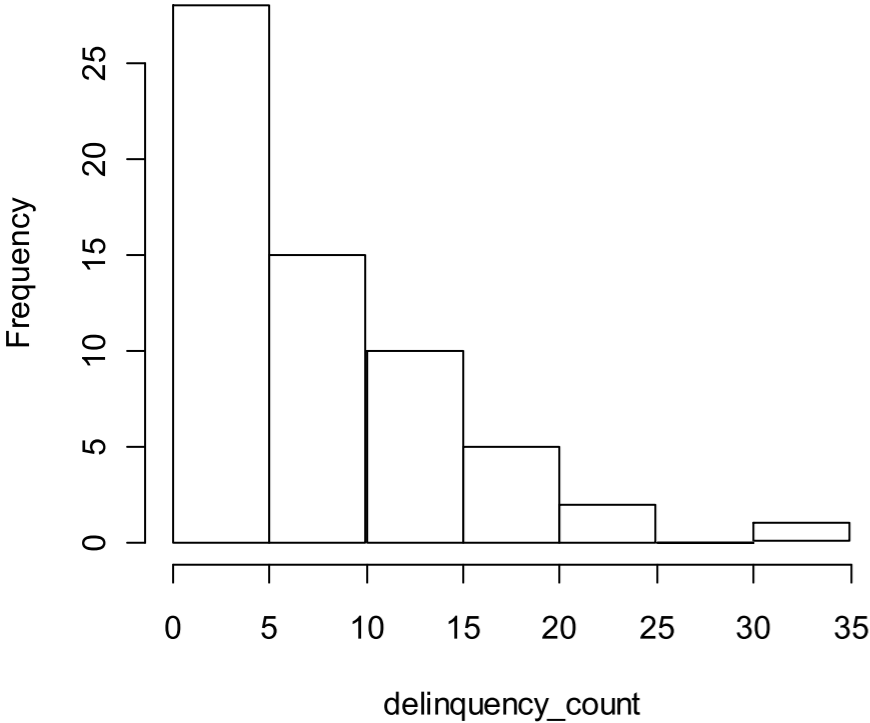
Data description

Evolution of a **friendship network and delinquent behavior**, between 2 time points, of pupils in 19 Dutch school classes

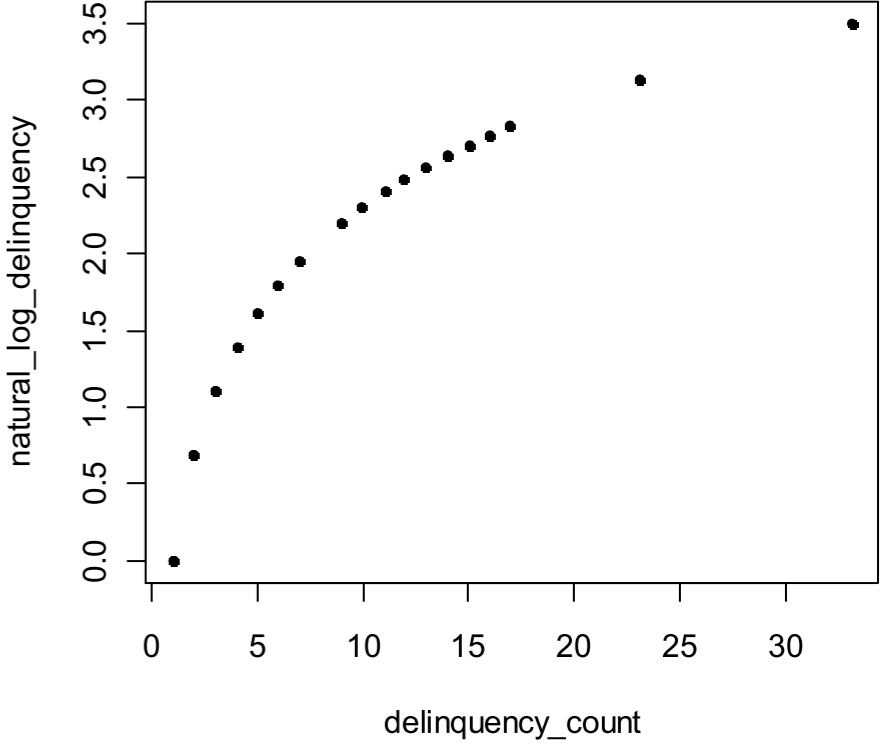
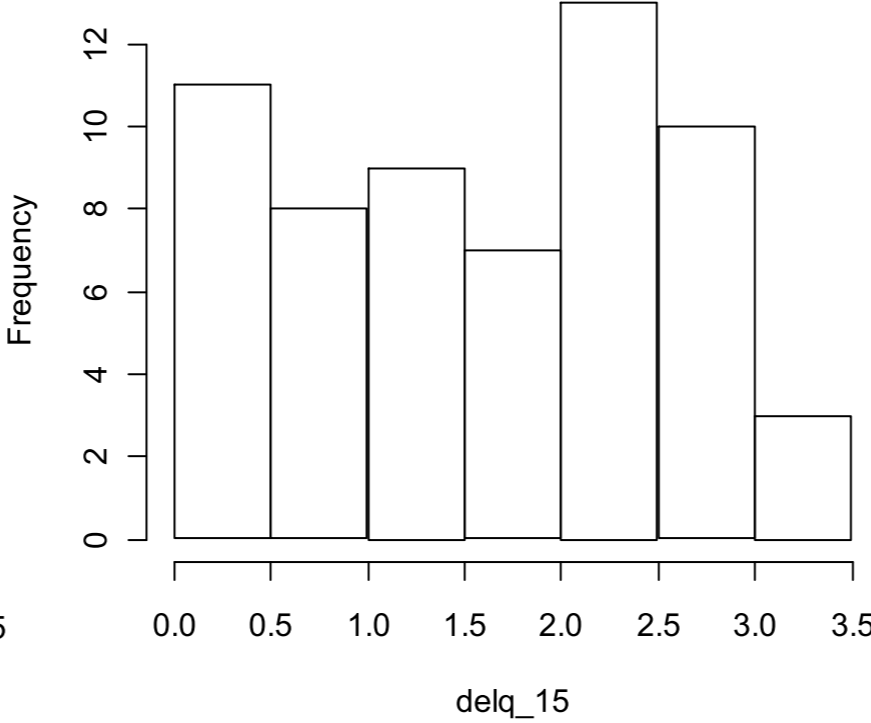
- 1 year in-between waves
- Data:
 - **Friendship network:** relation is defined as giving and receiving emotional support
 - **Delinquency Behavior:** self-report questionnaire counting the number of times minor offences (from a list of 23 different ones) were committed during the year \Rightarrow *integer*
 - **Actor attributes= Constant Covariates:**
 - ✓ Gender: boy = 1 & girl = 2
 - ✓ Measure of delinquent behavior
 - ✓ Importance of school friends: scale from 1 (very important) to 4 (unimportant)
 - **Dyadic covariate:** Same ethnicity = 1

delinquent behavior

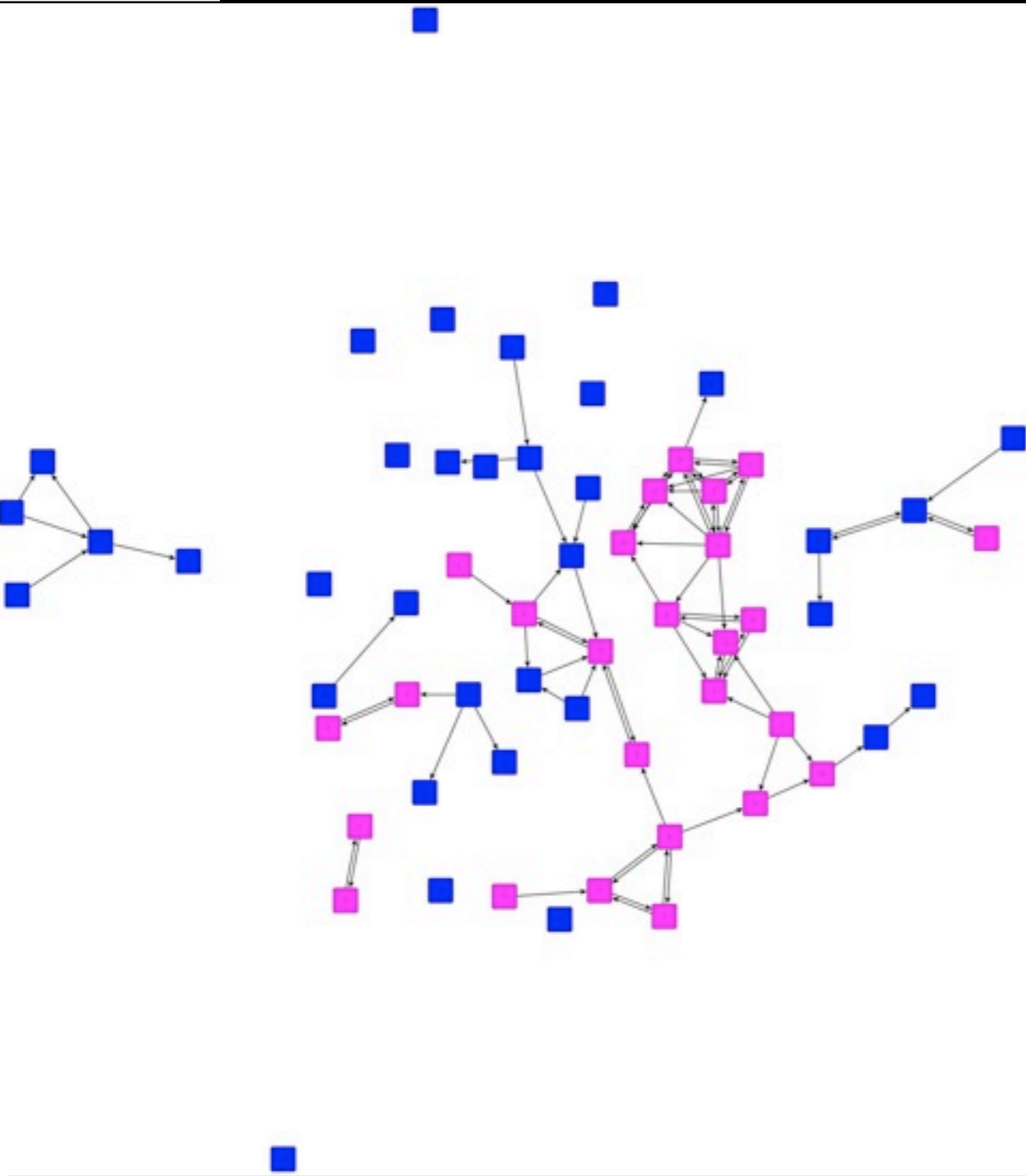
Histogram of delinquency_count



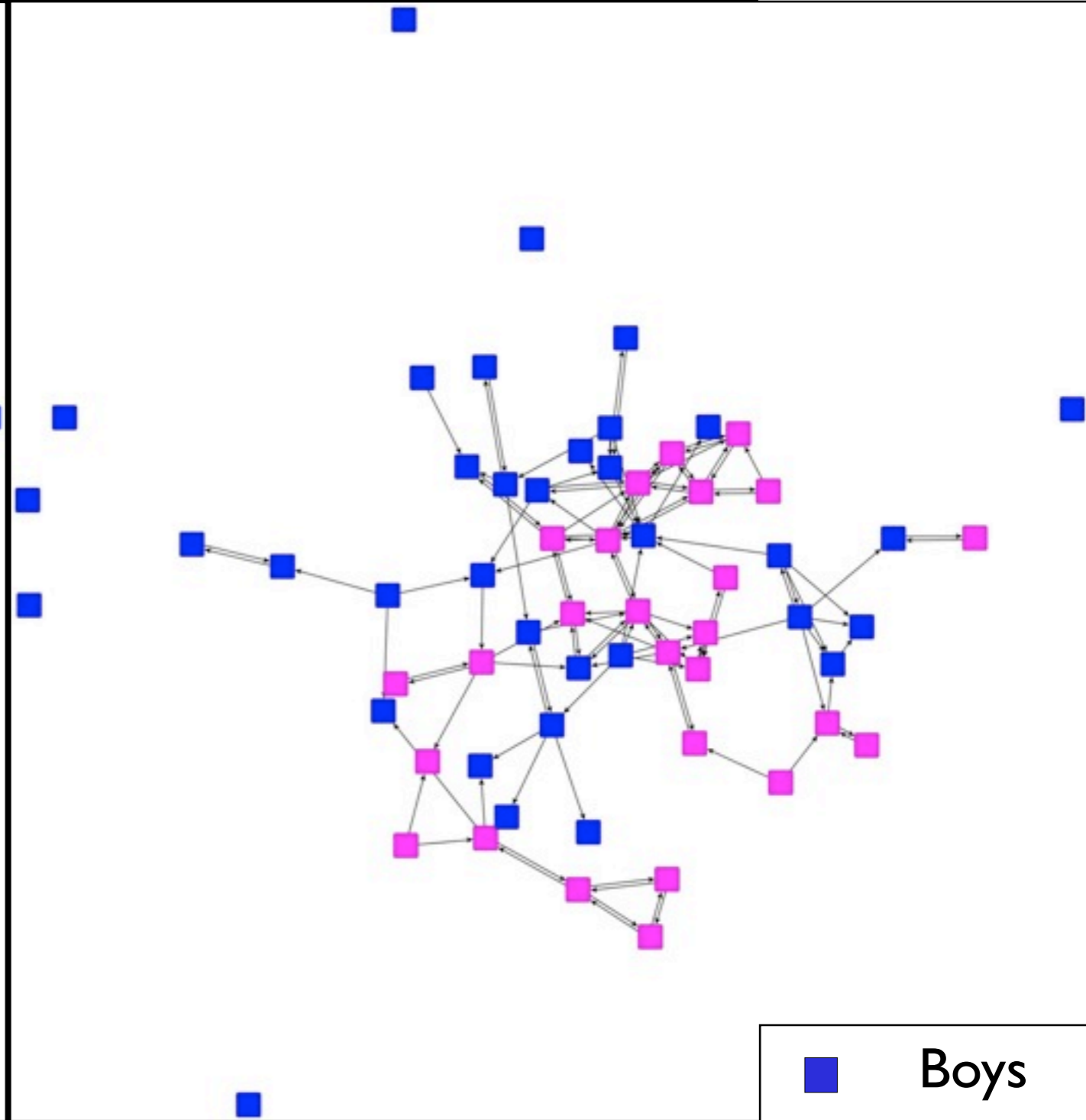
Histogram of delq_15



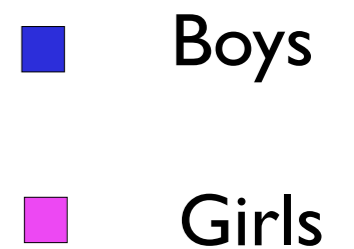
School 15: girls-boys ties



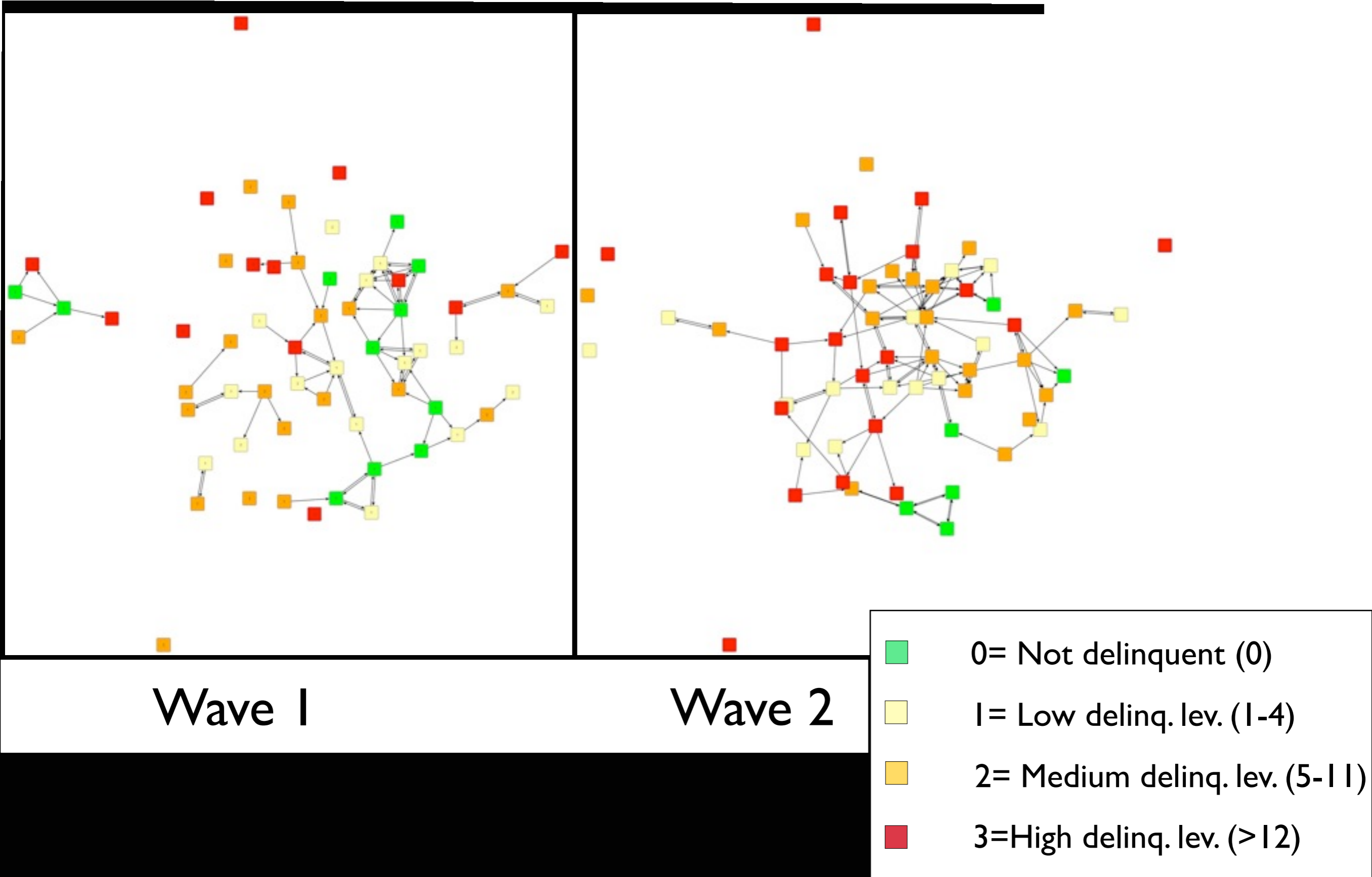
Wave 1



Wave 2



School 15: Friendship network dynamic



Wave 1

Wave 2

- 0= Not delinquent (0)
- 1= Low delinq. lev. (1-4)
- 2= Medium delinq. lev. (5-11)
- 3= High delinq. lev. (> 12)

Hypotheses on friends' selection process

Are adolescents' friendship choices affected by shared attributes (homophily)?

#1 => Are adolescents' friendship choices affected by shared ethnicity backgrounds?

ethnic X : expected sign + : if same ethnicity at the beginning then more chance to be friend later => myeff[70,9] <- TRUE

#2 => Are adolescents' friendship choices affected by gender similarity?

gender: sameX : expected sign + : if same gender then more chance to become friend => myeff[97,9] <- TRUE

#3 => Are adolescents' friendship choices affected by shared levels of delinquency?

delinq similarity (127) : expected sign + => myeff[128,9] <- TRUE

#4 => The more delinquent actors are, the less friends they will have in the future

delinq alter (118) : expected sign - => myeff[119,9] <- TRUE

#5 => If importance of school friends scores high then you'll nominate more people

impsf ego (161) : expected sign + => myeff[162,9] <- TRUE

Hypotheses on influence/contagion process

Are adolescents' delinquency levels affected by their friends' delinquency levels?

#6.1 => If alter friends are more delinquent then ego might become more delinquent

```
# behavior behDelinq average alter: expected sign + => myeff[294,9] <- TRUE
```

#6.2 => If school's friends are important to ego then his level of delinquency is more likely to evolve similarly as the one of his school's friends

```
# behavior behDelinq average Sim x Impsf: expected sign + => myeff[340,9] <- TRUE
```


Descriptive statistics

Change in networks:

For the following statistics, missing values (if any) are not counted.

Network density indicators:

observation time	1	2
density	0.023	0.033
average degree	1.361	1.967
number of ties	83	120
missing fraction	0.000	0.000

The average degree is 1.664

School 15

Tie changes between subsequent observations:

periods	0 => 0	0 => 1	1 => 0	1 => 1	Distance	Jaccard	Missing
1 ==> 2	3504	73	36	47	109	0.301	0 (0%)

School 1

Tie changes between subsequent observations:

periods	0 => 0	0 => 1	1 => 0	1 => 1	Distance	Jaccard	Missing
1 ==> 2	1798	78	40	64	118	0.352	0 (0%)

School 3

Tie changes between subsequent observations:

periods	0 => 0	0 => 1	1 => 0	1 => 1	Distance	Jaccard	Missing
1 ==> 2	1246	48	17	21	65	0.244	0 (0%)

School 4

Tie changes between subsequent observations:

periods	0 => 0	0 => 1	1 => 0	1 => 1	Distance	Jaccard	Missing
1 ==> 2	997	14	23	22	37	0.373	0 (0%)

Descriptive statistics

Marginal distribution

values	Observations	
	1	2
0	11	6
1	17	15
2	20	20
3	13	16
4	0	4

No missings

Changes in Delinquent Behavior

School 15

periods	actors:	down	up	constant	missing	;	steps:	down	up	total
1 => 2		10	25	26	0			10	33	43

School 1

periods	actors:	down	up	constant	missing	;	steps:	down	up	total
1 => 2		9	11	25	0			12	11	23

School 3

periods	actors:	down	up	constant	missing	;	steps:	down	up	total
1 => 2		8	6	23	0			10	6	16

School 4

periods	actors:	down	up	constant	missing	;	steps:	down	up	total
1 => 2		10	9	14	0			17	10	27

Co-evolution of friendship network and delinquent behavior

	School 15			School 1		School 3		School 4	
Network Dynamics	Est.	S.E.	t	Est.	S.E.	Est.	S.E.	Est.	S.E.
1. rate basic rate parameter friendship	4,43	0,91 **	0,07	6,64	1,90 **	3,68	0,93 **	2,68	0,64 **
2. eval outdegree (density)	-2,52	0,27 **	0,08	-2,01	2,07	-3,41	0,67 **	-3,30	1,22 **
3. eval reciprocity	2,81	0,37 **	0,07	1,75	0,46 **	2,39	0,39 **	6,28	5,23
4. eval transitive triplets	0,93	0,19 **	0,11	0,49	0,24 *	1,03	0,29 **	3,31	1,86 +
5. eval 3-cycles	-0,80	0,34 *	0,09	0,32	0,63	-0,67	0,62	-1,94	5,09
6. eval indegree - activity	-0,10	0,13	0,08	-0,27	0,36	0,13	0,34	-2,48	4,13
7. eval ethnic	-0,08	0,20	-0,01	-0,17	0,27	-0,10	0,30	0,18	0,81
8. eval same gender	0,28	0,19 +	0,01	0,35	0,80	1,23	0,40 **	0,13	0,66
9. eval delq_c alter	0,08	0,09	-0,08	-0,18	0,13	-0,03	0,17	0,13	0,46
10. eval delq_c similarity	-0,02	0,42	-0,03	0,37	0,80	1,02	0,89	-0,91	1,73
11. eval impf ego	-0,20	0,22	-0,02	0,05	0,28	0,41	0,38	-0,11	0,71
Behavior Dynamics									
12. rate rate beh period 1	1,57	0,40 **	0,02	0,89	2,04	0,89	0,30 **	2,46	1,25 *
13. eval behavior beh linear shape	0,78	0,48 +	0,05	1,25	22,43	-0,30	0,35	-0,22	0,28
14. eval behavior beh quadratic shape	-0,51	0,81	0,03	-0,42	7,64	-0,19	0,36	-0,20	0,18
15. eval behavior beh average alter	1,38	1,81	0,02	6,57	125,77	0,42	1,14	-0,83	1,04
16. eval behavior beh: av.sim. (friendship) x impf	-18,08	64,57	-0,04	19,56	342,34	-5,90	14,15	-0,89	6,95

Multi-group analysis of friendship ties between 8 school classes

Network Dynamics

1. rate:	constant F rate (period 1)	7.5354	(1.1458)
2. rate:	constant F rate (period 3)	6.8407	(2.2987)
3. rate:	constant F rate (period 5)	2.6076	(0.7562)
4. rate:	constant F rate (period 7)	9.1923	(2.6040)
5. rate:	constant F rate (period 9)	7.4922	(1.5219)
6. rate:	constant F rate (period 11)	4.9132	(0.9289)
7. rate:	constant F rate (period 13)	5.3664	(1.3183)
8. rate:	constant F rate (period 15)	4.0608	(0.8603)
9. eval:	outdegree (density)	-2.5943	(0.1364)
10. eval:	reciprocity	2.3761	(0.1482)
11. eval:	transitive triplets	0.7885	(0.0723)
12. eval:	3-cycles	-0.5921	(0.1318)
13. eval:	indegree - activity	-0.1123	(0.0585)
14. eval:	coethn	-0.0473	(0.0825)
15. eval:	same gender	0.4310	(0.0935)
16. eval:	del alter	-0.0667	(0.0640)
17. eval:	del similarity	0.1658	(0.2645)
18. eval:	impsf ego	-0.0089	(0.0824)

Behavior Dynamics

19. rate:	rate B (period 1)	1.2104	(0.3569)
20. rate:	rate B (period 3)	10.7212	(5.5545)
21. rate:	rate B (period 5)	53.3155	(5.1427)
22. rate:	rate B (period 7)	5.9114	(3.1917)
23. rate:	rate B (period 9)	11.1642	(10.2594)
24. rate:	rate B (period 11)	5.8728	(2.4309)
25. rate:	rate B (period 13)	1.2095	(0.3241)
26. rate:	rate B (period 15)	9.5796	(12.4033)
27. eval:	behavior B linear shape	0.0514	(0.0400)
28. eval:	behavior B quadratic shape	-0.0768	(0.0399)
29. endow:	dec. beh. B average alter	-0.0854	(0.1662)
30. eval:	behavior B: alter's (F) impsf average	-0.1378	(0.2488)

Multi-group network analysis

- The 5 considered school different networks have been combined in one large network;
- The assumption is ties between the networks are absent;
- Set of variables is identical.
- 61 actors in 5 groups and measured at two points in time

Hypotheses

- Homophily as principles for the selection of others
 - Behaviour (delinquency at $t1$);
 - Homogeneous background characteristics (gender, ethnicity).

Model I

Other parameters:

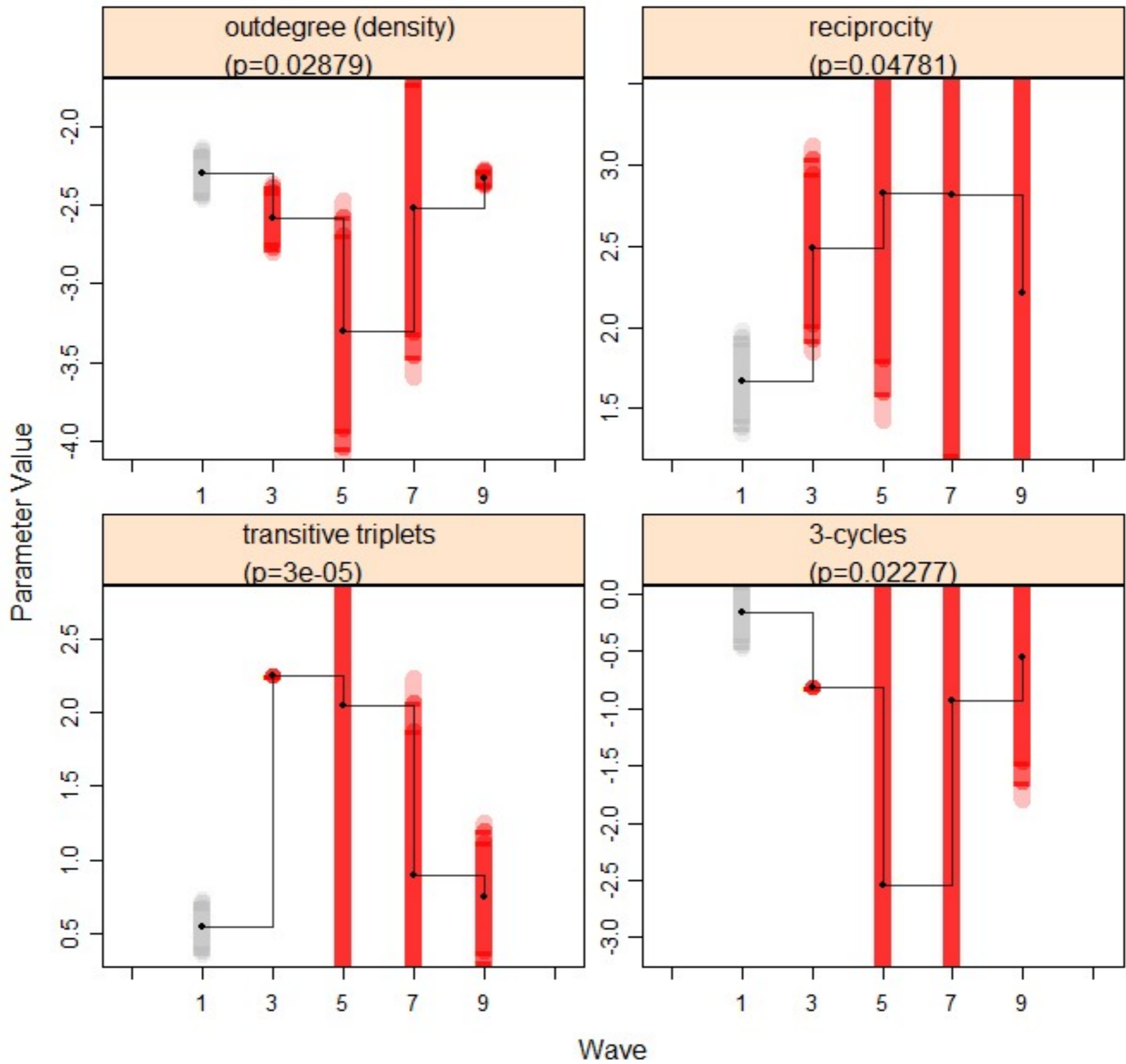
1. eval outdegree (density)	-2.4925	(0.0729)	0.0646
2. eval reciprocity	2.1753	(0.1371)	0.0289
3. eval transitive triplets	0.6792	(0.0647)	0.0051
4. eval 3-cycles	-0.4838	(0.1203)	0.0196
5. eval sex similarity	0.5946	(0.1039)	0.0068

- All structural variables are significant and converge well;
- Sex is important in explanation of friendship;
- Seems to be a local hierarchy among students.

Time-test

- check that the tendencies in the dependent variable or variables, upward/stable/downward, are not too different between the sub-projects.
- Joint significance test of the dummy parameters:
 $p\text{-Val} = 2.689689e-08$ means the hypothesis is rejected.
- It exists a significant deviation from homogeneity of nested groups of students.
- It is strongest for “transitive triplets” variable;
- School #3 seems to be different from the others.

(*) Dummy3:outdegree (density)	0.0000000	-0.4318382	0.00204
(*) Dummy5:outdegree (density)	0.0000000	-1.0138144	0.00706
(*) Dummy7:outdegree (density)	0.0000000	-0.2116994	0.52010
(*) Dummy9:outdegree (density)	0.0000000	-0.1340277	0.45103
(*) Dummy3:reciprocity	0.0000000	0.9103109	0.00267
(*) Dummy5:reciprocity	0.0000000	1.0790021	0.07144
(*) Dummy7:reciprocity	0.0000000	1.2688995	0.18812
(*) Dummy9:reciprocity	0.0000000	0.6318111	0.89396
(*) Dummy3:transitive triplets	0.0000000	1.4690634	0.00000
(*) Dummy5:transitive triplets	0.0000000	1.8335099	0.81419
(*) Dummy7:transitive triplets	0.0000000	0.3233337	0.82528
(*) Dummy9:transitive triplets	0.0000000	0.1494718	0.86331
(*) Dummy3:3-cycles	0.0000000	-0.6486327	0.00000
(*) Dummy5:3-cycles	0.0000000	-2.7176509	0.26821
(*) Dummy7:3-cycles	0.0000000	-0.7291506	0.86060
(*) Dummy9:3-cycles	0.0000000	-0.4264666	0.99227
(*) Dummy3:sex similarity	0.0000000	0.6796401	0.00013
(*) Dummy5:sex similarity	0.0000000	-0.1709672	0.05734
(*) Dummy7:sex similarity	0.0000000	-0.1272969	0.30891
(*) Dummy9:sex similarity	0.0000000	-0.1272969	0.30891



Model 2

- The school #3 has been excluded;
- The same structural parameters for friendship analysis: outdegree, reciprocity, transitive, and sex similarity, shows the same result.
- Time-test does not show that schools are homogenous.

Multi-group effects on behavior evolution

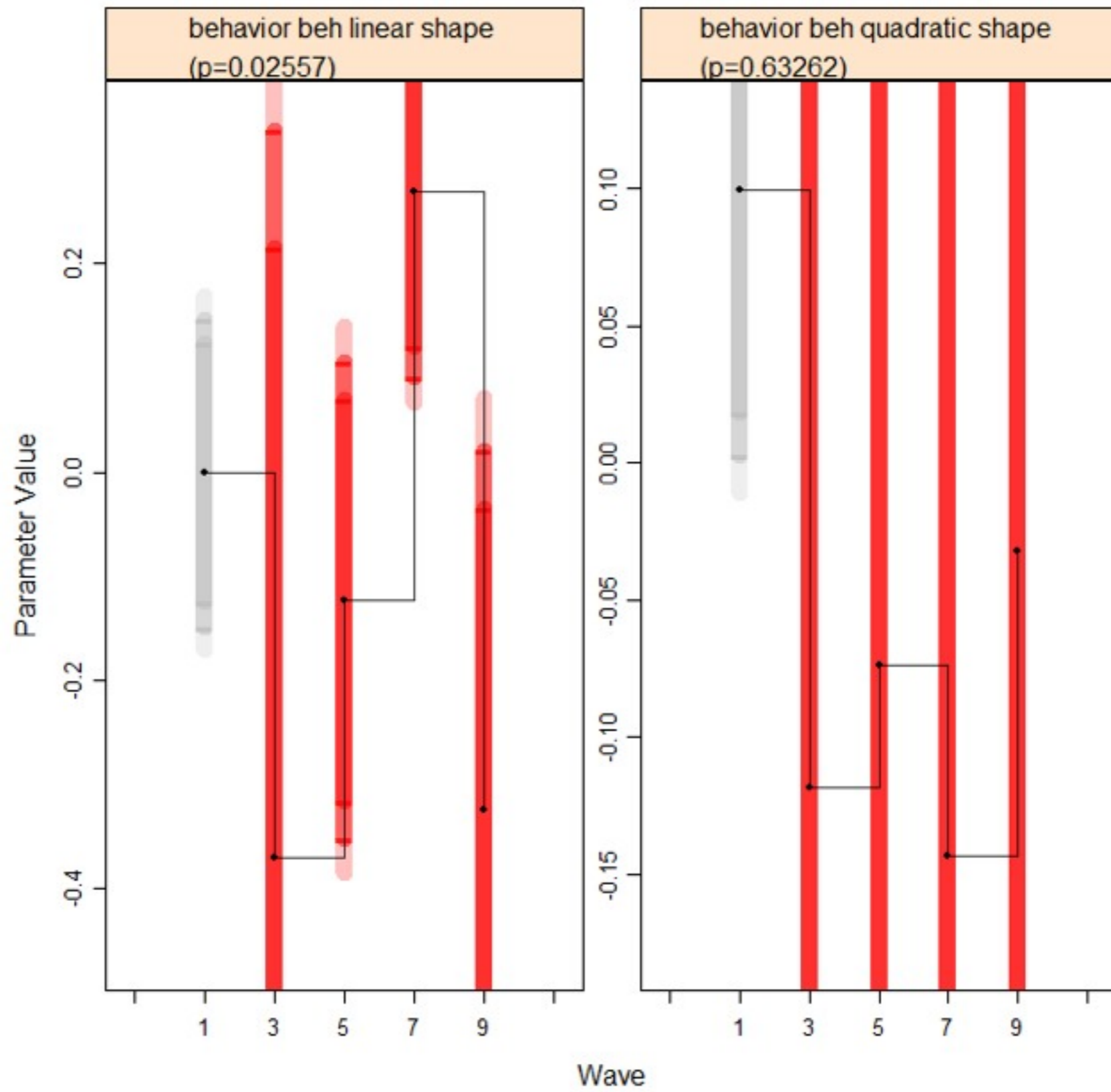
	Estimate	Standard Error	Convergence t-ratio
<u>Network Dynamics</u>			
1. rate constant F rate (period 1)	6.3912	(1.0173)	0.0283
2. rate constant F rate (period 3)	5.8734	(1.9117)	-0.0969
3. rate constant F rate (period 5)	2.4833	(0.5647)	0.0062
4. rate constant F rate (period 7)	4.5685	(0.7047)	0.0328
5. rate constant F rate (period 9)	5.4909	(0.7630)	0.0360
6. eval outdegree (density)	-2.3830	(0.0742)	0.0331
7. eval reciprocity	2.2963	(0.1437)	0.0120
8. eval transitive triplets	0.6946	(0.0844)	0.0358
9. eval 3-cycles	-0.5127	(0.1442)	0.0366
<u>Behavior Dynamics</u>			
10. rate rate beh (period 1)	1.1996	(0.3110)	-0.0133
11. rate rate beh (period 3)	0.9331	(0.3226)	-0.0330
12. rate rate beh (period 5)	3.0112	(1.0304)	0.0853
13. rate rate beh (period 7)	2.0976	(0.5370)	0.0584
14. rate rate beh (period 9)	1.2382	(0.3292)	0.0061
15. eval behavior beh linear shape	-0.0409	(0.0756)	0.0709
16. eval behavior beh quadratic shape	-0.0811	(0.0492)	0.0121

Time(group)-test

- Joint significance test of the dummy parameters:
- p-Val = 1.47935e-07

(*) Dummy3:behavior beh linear shape	0.00000000	-0.3689275803	0.29971
(*) Dummy5:behavior beh linear shape	0.00000000	-0.1220859732	0.29680
(*) Dummy7:behavior beh linear shape	0.00000000	0.2693584381	0.00288
(*) Dummy9:behavior beh linear shape	0.00000000	-0.3242277015	0.06655
(*) Dummy3:behavior beh quadratic shape	0.00000000	-0.2175203702	0.73258
(*) Dummy5:behavior beh quadratic shape	0.00000000	-0.1726571551	0.67918
(*) Dummy7:behavior beh quadratic shape	0.00000000	-0.2423356076	0.57803
(*) Dummy9:behavior beh quadratic shape	0.00000000	-0.1309998568	0.85311

- Schools 7 and 15 are different in behaviour evolution



Conclusion

- **Friendship selection**
 - ➔ Structural effects: reciprocity, transitive triplets and 3-cycles (sign = local hierarchy)
 - ➔ Gender Homophily
- **Influence of friendship on delinquent behavior**
 - ➔ Not significant