

# Analysing the dynamic interdependence of network structures and individual performance in organizations

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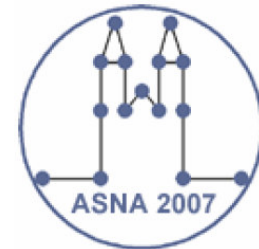
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# Research background

In organisation research, the role of networks in empirical studies generally is one out of two:

**Antecedent role:** *networks determine individual outcomes*

- job performance,
- career mobility,
- personnel turnover,
- accumulation of social capital,
- etc.

**Consequence role:** *networks are (partly) results of processes on the individual level*

- balance,
- reciprocity,
- homophily,
- reputation / expertise,
- etc.

## Research question

Realistically, both roles of networks co-exist.

*...which casts doubt on studies that assume only one process operates! Hence, we ask:*

How are organizational outcomes influenced by social network structures that may themselves be changing as a function – at least in part – of those same outcomes?

**How do social networks and individual behavior co-evolve?**

# Research method

## Strategy:

**multivariate analysis:** *treat network(s) and behaviour as joint dependent variables*

**first explicitly test for interdependence:** *estimate “simple” independence model and test for goodness-of-fit increase upon adding effects of interdependence*

**then estimate effects that operationalise this interdependence:** *assimilation to neighbours, main effect of popularity in the network on performance*

## How?

Fit **SIENA models** to our data set.

## Data set studied

- 75 students enrolled in an MBA program;
- 4 network variables: advice-seeking, communication, friendship, professional esteem;
- co-evolving behavioural dimension: performance (grade in examinations);
- several other actor variables: gender, age, experience, nationality;
- 3 waves in yearly intervals.

*We analyse the four networks separately [for lack of better method, at the moment], but do not include main effects of networks on each other.*

# Testing for interdependence

We estimated, for all four networks, a model of separately evolving network and behaviour.

By means of a score-type test, we assessed whether the goodness-of-fit would improve upon adding effects that operationalise interdependence:

- homophile selection
- assimilation to neighbours

Results indicate it is worth the effort to include these interdependence effects:

$\chi^2=28.8$ ,  $p<0.001$  **advice**,

$\chi^2=10.4$ ,  $p=0.034$  **professional esteem**,

$\chi^2=54.4$ ,  $p<0.001$  **communication**,

$\chi^2=54.5$ ,  $p<0.001$  **friendship**.

Hence we estimated “big models” ...

## DETERMINANTS OF NETWORK EVOLUTION

| EFFECTS                                | ADVICE |          |         | PROF.ESTEEM |          |         | COMMUNICATION |          |         | FRIENDSHIP |          |         |
|--|--------|----------|---------|-------------|----------|---------|---------------|----------|---------|------------|----------|---------|
|  | param. | st.err.  | signif. | param.      | st.err.  | signif. | param.        | st.err.  | signif. | param.     | st.err.  | signif. |
| 1. rate period 1                       | 11.45  | ( 1.66 ) |         | 9.58        | ( 1.26 ) |         | 22.87         | ( 1.58 ) |         | 21.10      | ( 2.00 ) |         |
| 2. rate period 2                       | 8.09   | ( 0.94 ) |         | 10.28       | ( 1.21 ) |         | 15.50         | ( 0.87 ) |         | 11.49      | ( 0.98 ) |         |
| 3. performance alter                   | 0.06   | ( 0.06 ) |         | 0.13        | ( 0.08 ) |         | -0.07         | ( 0.02 ) | **      | -0.08      | ( 0.03 ) | **      |
| 4. performance ego                     | -0.07  | ( 0.06 ) |         | 0.57        | ( 0.17 ) | ***     | -0.05         | ( 0.02 ) | *       | -0.08      | ( 0.03 ) | **      |
| 5. performance similarity              | 0.98   | ( 0.71 ) |         | -3.38       | ( 1.17 ) | **      | 1.02          | ( 0.28 ) | ***     | 1.19       | ( 0.41 ) | **      |
| 6. outdegree (density)                 | -3.25  | ( 0.18 ) | ***     | -1.18       | ( 0.47 ) | *       | -1.54         | ( 0.22 ) | ***     | -2.24      | ( 0.22 ) | ***     |
| 7. reciprocity                         | 0.64   | ( 0.14 ) | ***     | 0.45        | ( 0.18 ) | *       | 0.97          | ( 0.07 ) | ***     | 0.96       | ( 0.10 ) | ***     |
| 8. transitive triplets                 | 0.15   | ( 0.04 ) | ***     | 0.27        | ( 0.04 ) | ***     | 0.09          | ( 0.01 ) | ***     | 0.13       | ( 0.01 ) | ***     |
| 9. (direct and indirect) ties          | 0.50   | ( 0.14 ) | ***     | 0.17        | ( 0.15 ) |         | 0.57          | ( 0.16 ) | ***     | 0.88       | ( 0.14 ) | ***     |
| 10. number of actors at distance 2     | 0.24   | ( 0.16 ) |         | 0.01        | ( 0.01 ) |         | -0.10         | ( 0.04 ) | **      | -0.03      | ( 0.02 ) |         |
| 11. popularity of alter (sqrt measure) | 0.11   | ( 0.10 ) |         | -0.35       | ( 0.13 ) | *       | -0.15         | ( 0.04 ) | ***     | -0.20      | ( 0.07 ) | **      |
| 12. 3-cycles                           | -0.05  | ( 0.07 ) |         | -0.15       | ( 0.07 ) | +       | -0.11         | ( 0.01 ) | ***     | -0.14      | ( 0.03 ) | ***     |
| 13. betweenness                        | -0.07  | ( 0.04 ) | +       | -0.35       | ( 0.09 ) | ***     | -0.04         | ( 0.01 ) | ***     | -0.06      | ( 0.01 ) | ***     |
| 14. advice                             | —————  |          |         | 0.84        | ( 0.13 ) | ***     | 0.58          | ( 0.10 ) | ***     | 0.42       | ( 0.11 ) | ***     |
| 15. CTL                                | 0.75   | ( 0.14 ) | ***     | —————       |          |         | 0.13          | ( 0.09 ) |         | 0.14       | ( 0.12 ) |         |
| 16. communication                      | 1.03   | ( 0.13 ) | ***     | 1.04        | ( 0.13 ) | ***     | —————         |          |         | 0.89       | ( 0.07 ) | ***     |
| 17. friendship                         | 0.27   | ( 0.11 ) | *       | 0.08        | ( 0.14 ) |         | 0.61          | ( 0.07 ) | ***     | —————      |          |         |
| 18. gender (M) alter                   | 0.11   | ( 0.13 ) |         | 0.01        | ( 0.12 ) |         | 0.12          | ( 0.06 ) | *       | 0.08       | ( 0.08 ) |         |
| 19. gender (M) ego                     | -0.23  | ( 0.10 ) | *       | -0.69       | ( 0.20 ) | ***     | -0.11         | ( 0.06 ) | +       | -0.04      | ( 0.07 ) |         |
| 20. gender (M) similarity              | 0.10   | ( 0.09 ) |         | 0.27        | ( 0.10 ) | *       | 0.11          | ( 0.05 ) | *       | 0.14       | ( 0.07 ) | +       |
| 21. GPA alter                          | 0.19   | ( 0.11 ) | +       | 0.04        | ( 0.11 ) |         | 0.11          | ( 0.06 ) | +       | -0.01      | ( 0.08 ) |         |
| 22. GPA ego                            | -0.18  | ( 0.12 ) |         | -0.13       | ( 0.15 ) |         | -0.01         | ( 0.05 ) |         | 0.02       | ( 0.08 ) |         |
| 23. GPA similarity                     | 0.35   | ( 0.19 ) | +       | 0.30        | ( 0.21 ) |         | -0.12         | ( 0.11 ) |         | -0.06      | ( 0.15 ) |         |
| 24. age alter                          | -0.03  | ( 0.02 ) | *       | 0.03        | ( 0.02 ) |         | 0.03          | ( 0.01 ) | **      | 0.01       | ( 0.01 ) |         |
| 25. age ego                            | 0.03   | ( 0.02 ) | +       | -0.04       | ( 0.03 ) |         | 0.01          | ( 0.01 ) |         | 0.02       | ( 0.01 ) | +       |
| 26. age similarity                     | 0.12   | ( 0.32 ) |         | -0.83       | ( 0.36 ) | *       | 0.48          | ( 0.16 ) | **      | 0.67       | ( 0.21 ) | **      |
| 27. experience alter                   | 0.01   | ( 0.09 ) |         | 0.02        | ( 0.11 ) |         | -0.12         | ( 0.06 ) | *       | -0.11      | ( 0.07 ) |         |
| 28. experience ego                     | 0.06   | ( 0.09 ) |         | 0.38        | ( 0.16 ) | *       | -0.03         | ( 0.05 ) |         | -0.07      | ( 0.07 ) |         |
| 29. experience similarity              | 0.11   | ( 0.08 ) |         | 0.05        | ( 0.08 ) |         | 0.06          | ( 0.05 ) |         | 0.02       | ( 0.06 ) |         |
| 30. nationality (non-I) alter          | 0.08   | ( 0.24 ) |         | -0.31       | ( 0.21 ) |         | 0.24          | ( 0.09 ) | **      | 0.16       | ( 0.12 ) |         |
| 31. nationality (non-I) ego            | -0.35  | ( 0.23 ) |         | -0.16       | ( 0.26 ) |         | 0.14          | ( 0.09 ) |         | 0.06       | ( 0.12 ) |         |
| 32. nationality (non-I) similarity     | 0.24   | ( 0.17 ) |         | 0.33        | ( 0.18 ) | +       | 0.14          | ( 0.09 ) |         | 0.18       | ( 0.11 ) |         |

+ p<0.1, \* p<0.05, \*\* p<0.01, \*\*\* p<0.001 (two-sided)

## DETERMINANTS OF THE EVOLUTION OF PERFORMANCE

| EFFECTS                 | ADVICE |          |         | PROF.ESTEEM |          |         | COMMUNICATION |          |         | FRIENDSHIP |          |         |
|-------------------------|--------|----------|---------|-------------|----------|---------|---------------|----------|---------|------------|----------|---------|
|                         | param. | st.err.  | signif. | param.      | st.err.  | signif. | param.        | st.err.  | signif. | param.     | st.err.  | signif. |
| 1. rate period 1        | 4.20   | ( 0.89 ) |         | 3.99        | ( 0.78 ) |         | 4.20          | ( 1.23 ) |         | 3.96       | ( 0.86 ) |         |
| 2. rate period 2        | 2.74   | ( 0.78 ) |         | 2.62        | ( 0.74 ) |         | 2.82          | ( 0.68 ) |         | 2.73       | ( 0.56 ) |         |
| 3. average similarity   | 4.65   | ( 2.54 ) | +       | 3.88        | ( 2.17 ) | +       | 5.40          | ( 2.09 ) | **      | 5.15       | ( 1.88 ) | **      |
| 4. indegree             | 0.04   | ( 0.03 ) |         | 0.03        | ( 0.03 ) |         | 0.03          | ( 0.01 ) | +       | 0.02       | ( 0.02 ) |         |
| 5. shape (linear)       | -0.54  | ( 0.29 ) | +       | -0.45       | ( 0.22 ) | *       | -0.55         | ( 0.26 ) | *       | -0.21      | ( 0.18 ) |         |
| 6. shape (quadratic)    | -0.03  | ( 0.05 ) |         | -0.05       | ( 0.05 ) |         | 0.02          | ( 0.07 ) |         | 0.02       | ( 0.06 ) |         |
| 7. gender (M)           | -0.03  | ( 0.20 ) |         | 0.02        | ( 0.22 ) |         | -0.01         | ( 0.19 ) |         | 0.07       | ( 0.19 ) |         |
| 8. GPA                  | 0.07   | ( 0.19 ) |         | 0.14        | ( 0.22 ) |         | 0.15          | ( 0.18 ) |         | 0.23       | ( 0.19 ) |         |
| 9. age                  | -0.01  | ( 0.03 ) |         | -0.02       | ( 0.03 ) |         | -0.01         | ( 0.03 ) |         | -0.01      | ( 0.03 ) |         |
| 10. experience          | 0.06   | ( 0.20 ) |         | 0.03        | ( 0.21 ) |         | 0.10          | ( 0.19 ) |         | 0.10       | ( 0.19 ) |         |
| 11. nationality (non-I) | 0.04   | ( 0.32 ) |         | -0.08       | ( 0.30 ) |         | 0.02          | ( 0.28 ) |         | 0.06       | ( 0.29 ) |         |

+ p<0.1, \* p<0.05, \*\* p<0.01, \*\*\* p<0.001 (two-sided)

Highlighted are the ‘effects of interest’, i.e., those that operationalise interdependence.

**Previous slide:** *performance-related activity, popularity and homophily in the four networks;*

**This slide:** *influence of the number of network neighbours and the average performance of network neighbours on own performance.*



# Results

The individual network neighbourhood of the students affects their performance by way of assimilation:

- strongest for **communication** and **friendship**,
- less for **advice** and **professional esteem**

Likewise, the performance of actors does determine selection of network partners

- **Friends** and **communication partners** are similar, and
- low performers are more involved in these networks.
- High performers give more **professional esteem**,
- But generally, **esteem** is given to others who perform not on the same level (competition?).

There is more in the results than this alone...