How communication events shape social networks

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What is the problem?

With the advent of communication technology, access to interaction and communication data has increased dramatically. We can now trace communication *events* such as sending and receiving emails, text messages, and other forms of interaction via ICT. But how can we use this data to understand the structure of social networks and their development?

More specifically, how do **events** explain the structure of *ties*? Consider the inherent differences between these concepts:

	Event	Tie
Type of relation between actors	Many-to-Many	One-to-One
Lifetime	Fleeting	Part of a durable structure
Type of variables	Manifest	Latent
Interdependencies	Depends on previous events	Depends on patterns of encompassing ties

Social mechanisms

The structural properties of networks depend on the *type* of emails from which they are constructed:
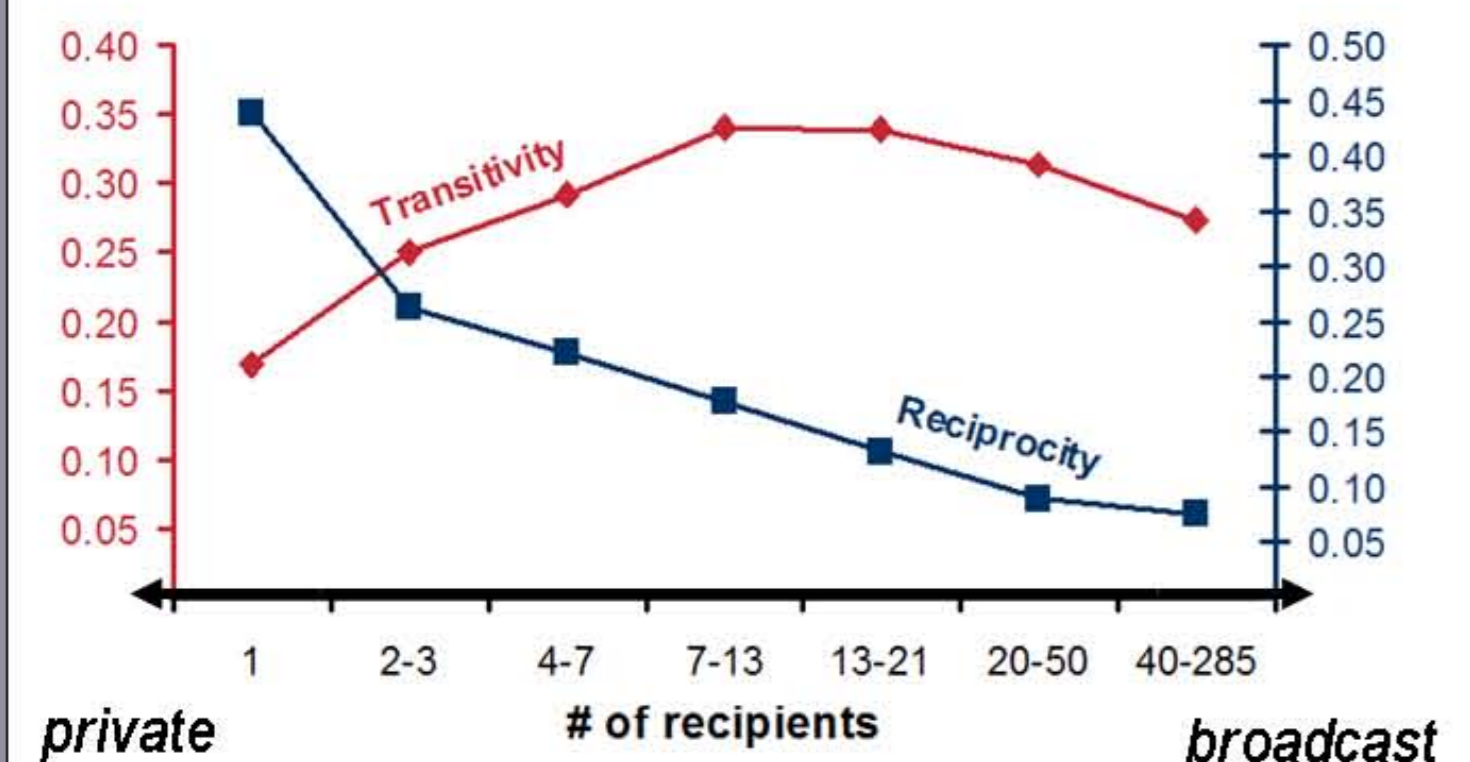

Hypothesis I: *Private* emails produce networks with more reciprocity, partly due to *social loafing*, *social capital* and *intentionality level* mechanisms.

Hypothesis II: *Broadcast* emails produce networks with more transitivity, partly due to *cognitive balance* or *homophily* mechanisms.

Network structures

Different types of events lead to networks with different structural properties. The figures below are two network models of a group of 254 individuals communicating over a period of three months. The difference between the networks stems from the *type* of emails used for their construction. Single recipient emails *('private')* were used to construct the network on the left. Emails with twenty recipients or more *('broadcast')* were used to construct the network on the right.
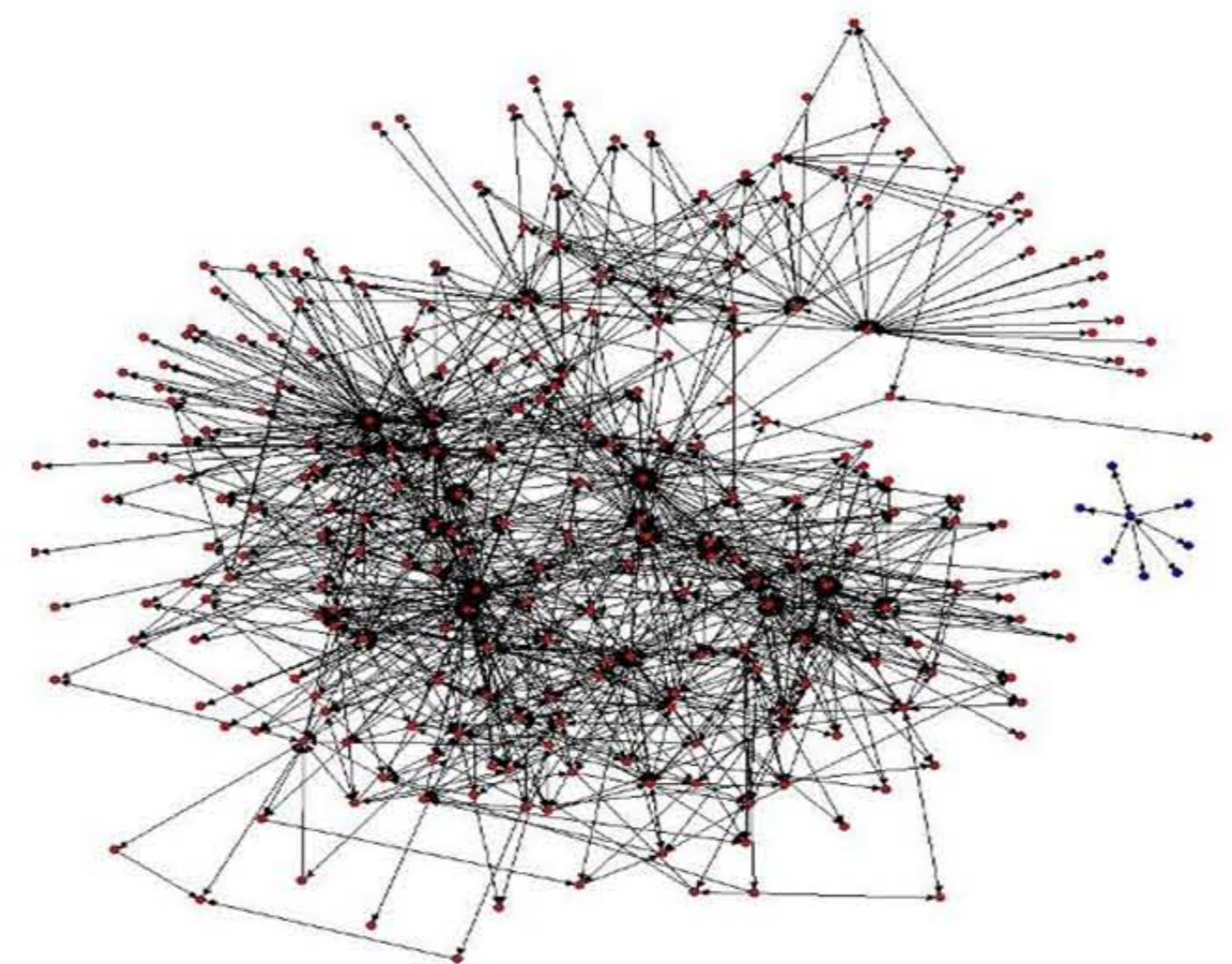
Private emails (one recipient each)

N = 254   Reciprocity = 31.2%
Ties = 1471   Transitivity = 17%
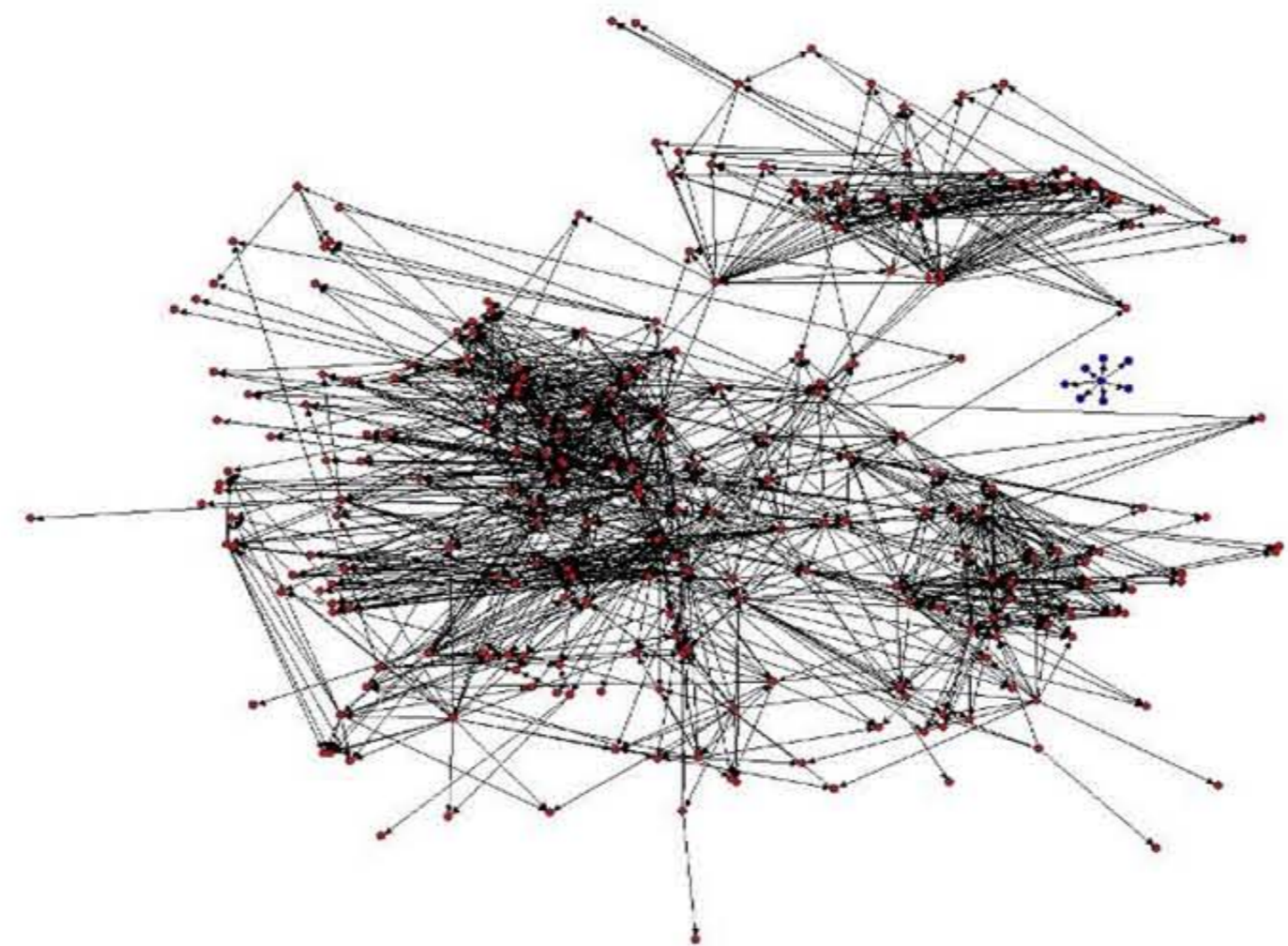
Broadcast emails (over 20 recipients)

N = 254   Reciprocity = 8%
Ties = 1327   Transitivity= 30.9%

Method

Hypothesis I was tested using emails as described above. 71 senders and receivers have exchanged 2973 emails, with the number of recipients ranging between 1 and 18. Each recipient receives a 'copy' of the message, and each copy was treated as a nested case in a multilevel logistic crossed factor analysis.
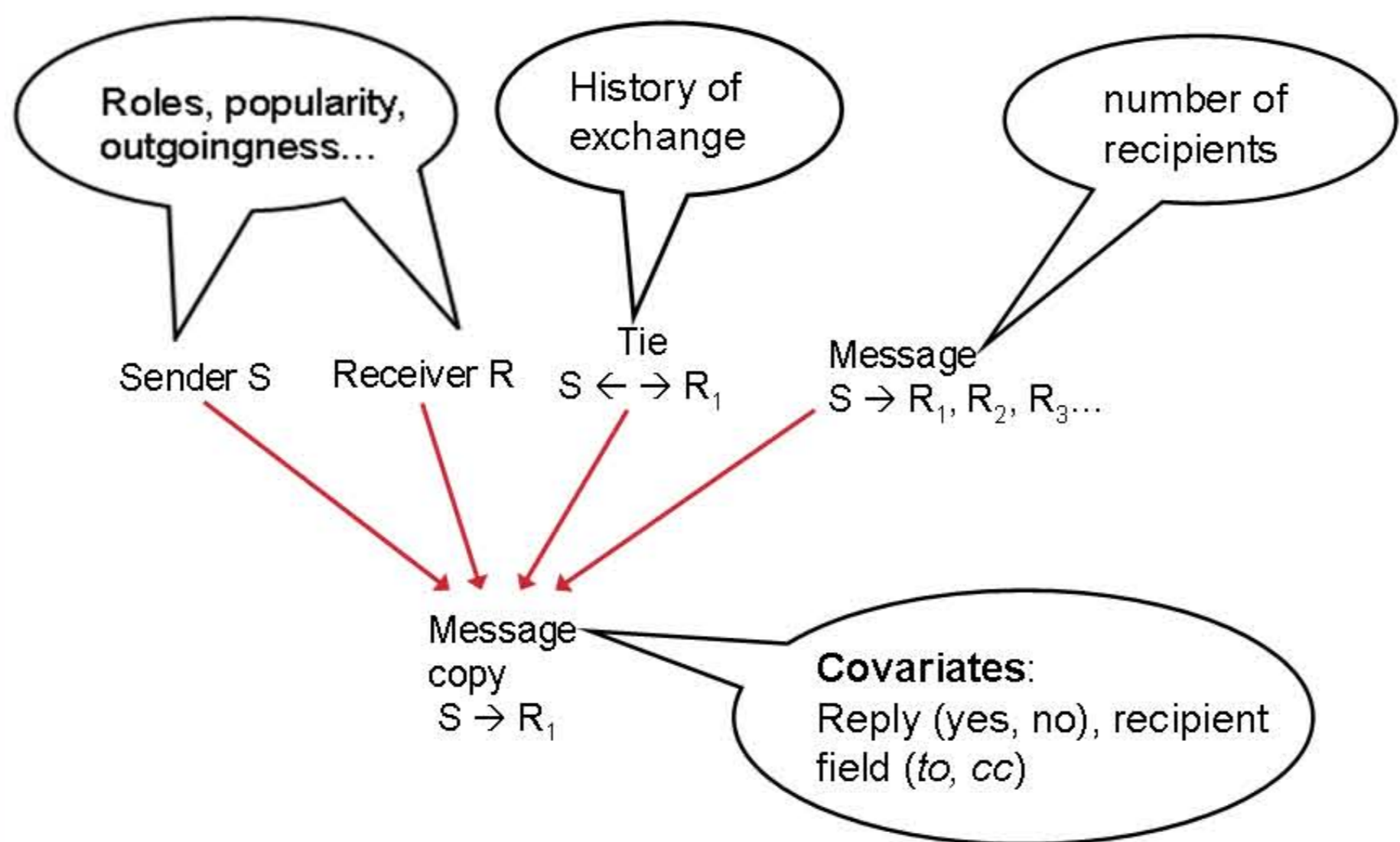
Response Variable - Reply: Did the recipient reply to the message?

Random effects:
- Sender and receiver
- Tie
- Message
- Message Copy

Results

	Model 1	Model 2	Model 3	Model 4
Constant	-2.06**	-2.55**	-2.70**	-3.45**
To field				0.94**
# of recipients				-0.05**
# exchanged emails				0.03**
σ_{sender}	0.70	0.47	0.47	0.28
$\sigma_{recipient}$	0.68	0.50	0.50	0.19
σ_{tie}			1.13	1.18	1.16
$\sigma_{message}$				0.66	0.63
Deviance	2925	2833	2829	2700

Dependent variable: reply to email (yes, no)
Analysis conducted using R and WinBUGS

Likelihood of reply can be explained by fixed and random effects. Fixed effects include:
- The privacy of the message
- The recipient field (*to, cc*)
- The history of the sender-receiver relationship
- The roles and properties of the actors

Conclusion

This project is within the tradition of network analysis defined as the study of the co-evolution of *individuals'* actions and network *structure*. Its contribution lies in the way it addresses:

- *Method:* how to bridge the gap between event *data* and network *models*?

- *Social mechanisms:* which social mechanisms drive the network structures and how?

- *Generalization:* how do the idiosyncrasies of the medium affect the network's structure?

Major challenges:

- *Evaluation:* To what extent was **Hypothesis I** confirmed?

- *Modeling:* How should one best confirm **Hypothesis II**?