

## ERGMs 1.1

### RECENS / BCE PhD course

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With thanks to Garry Robins, Paola Zappa, Vörös András and Boda Zsófia

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valósult meg | <http://recens.tk.mta.hu>

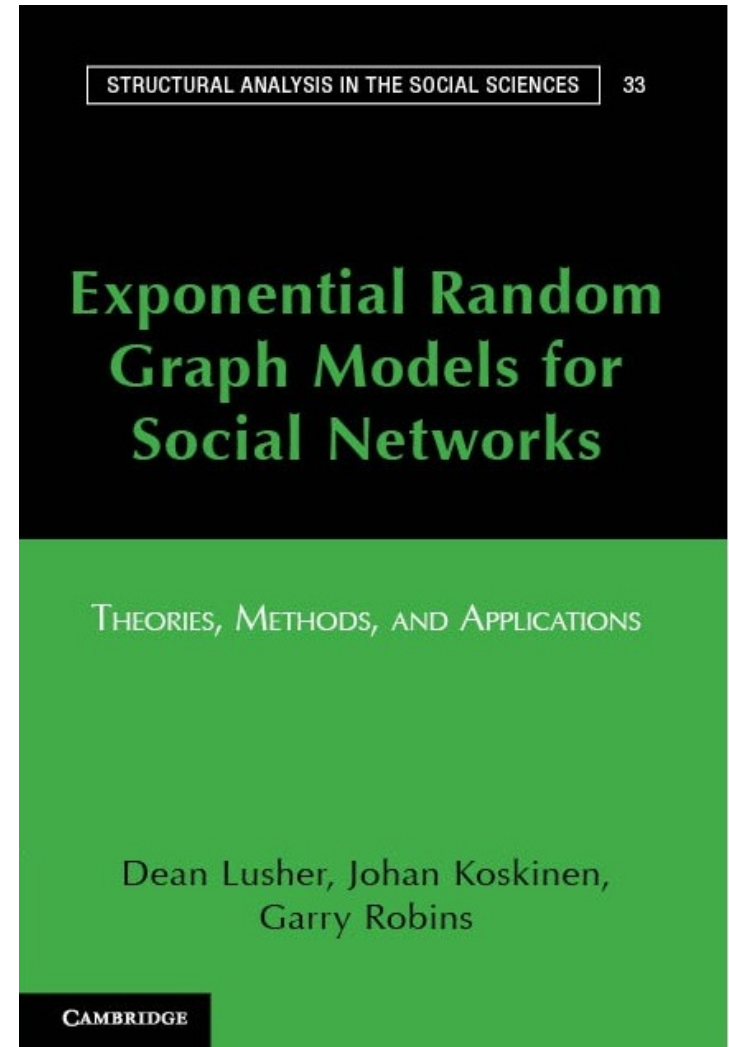


# 1. Introduction

- Lusher, D., Koskinen, J., & Robins, G. (2013). *Exponential random graph models for social networks: Theory, methods and applications*. Cambridge University Press
- Robins, G., Pattison, P., Kalish, Y., & Lusher, D. (2007). An introduction to exponential random graph ( $p^*$ ) models for social networks. *Social Networks*, 29, 173-191.
- Robins, G.L., Snijders, T.A.B., Wang, P., Handcock, M., & Pattison, P. (2007). Recent developments in exponential random graph ( $p^*$ ) models for social networks. *Social Networks*, 29, 192-215.
- Robins, G., Lewis, J. M. and Wang, P. (2012) Statistical Network Analysis for Analyzing Policy Networks. *Policy Studies Journal*, 40, 375-401.

# Main reference

Throughout this workshop we shall draw on *Lusher, Koskinen & Robins (2013)* where you can find more detail about the issues we present



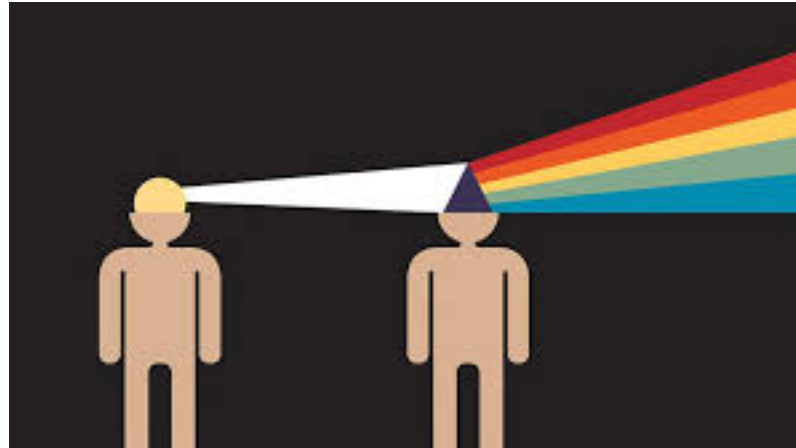
- MpNet
  - <http://www.swinburne.edu.au/fbl/research/transformational-innovation/our-research/MelNet-social-network-group/PNet-software/index.html>
  - <http://www.swinburne.edu.au/fbl/research/transformational-innovation/our-research/MelNet-social-network-group/PNet-software/resources/MPNetManual.pdf>
- R: statnet / ergm package
  - <https://statnet.org/trac>
  - <http://www.statnet.org>

- **Communication** among executives (Lusher et al, 2013).
  - Networks: comm\_undirected.txt; communication.txt (with attributes)
- **Fishermen's** network (Crona & Bodin, 2006)
  - Networks: FishermenTies.txt
- **Researchers** and research projects (bipartite network)
  - Networks: collaboration.txt
- **Multilevel** organizational dataset
  - Networks: NetA\_hierarchy; NetB\_advice; NetX\_affiliation
- **Two workteams** within organizations
  - Networks: team1.txt; team2.txt; Two\_teams.txt; zero.txt
- **Collaboration** among 50 researchers in an institute
  - Networks: net50.txt plus attribute file Perf.txt

## 2. ERGM rationale

# I eat predominantly vegetarian food

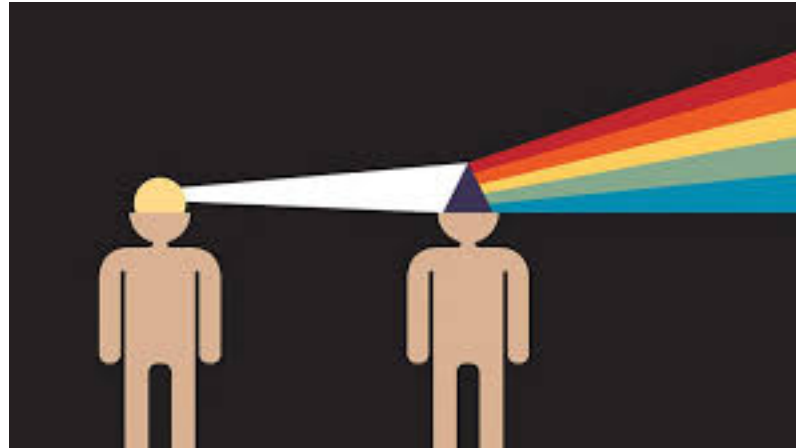
- Ethical
- Economics
- Health
- Taste





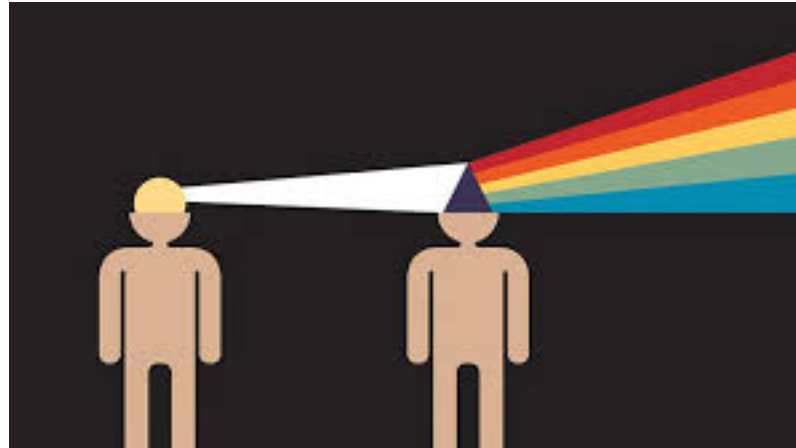
# I eat predominantly vegetarian food

- Ethical
- Economics
- Health
- Taste



# I eat predominantly vegetarian food

- Ethical
- Economics
- Health
- Taste



- Because I have a vegetarian partner

# I eat predominantly vegetarian food

- Ethical
- Economics
- Health
- Taste



- And vegetarian friends

# Relational approach

- Treating actors with their characteristics as independent entities, and
- individualising social structure is problematic (Emirbayer, 1997, *Manifesto for relational sociology*)
- We are "*actors in social relations*" (Abbott, 1997: 1152)
- The social is by definition relational: if we want to understand the social we need to understand social relations
- To understand social relations, we need a relational methodology ... not a methodology that assumes every individual is independent

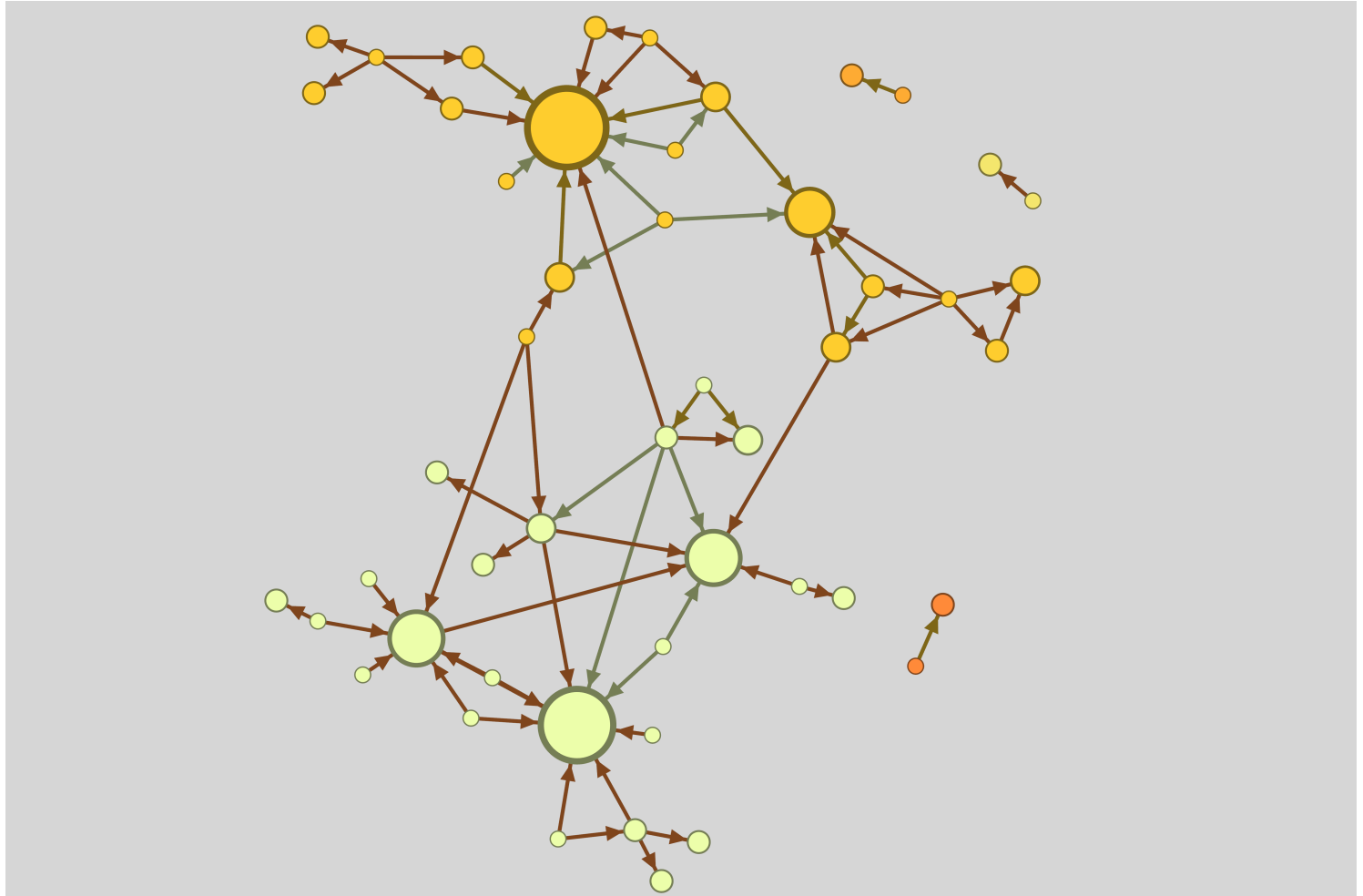


# Elements social network theory

- Reciprocity as a basic human activity (Blau 1964; Emerson, 1976)
- Balance (Heider, 1958)
- Closure of strong and weak ties is different (Granovetter, 1973)
- Structural holes and network brokerage (Burt, 1992)
- Popularity may induce more popularity (Merton, 1968): preferential attachment or Matthew effect
- Homophily (McPherson Smith-Lovin & Cook, 2001)

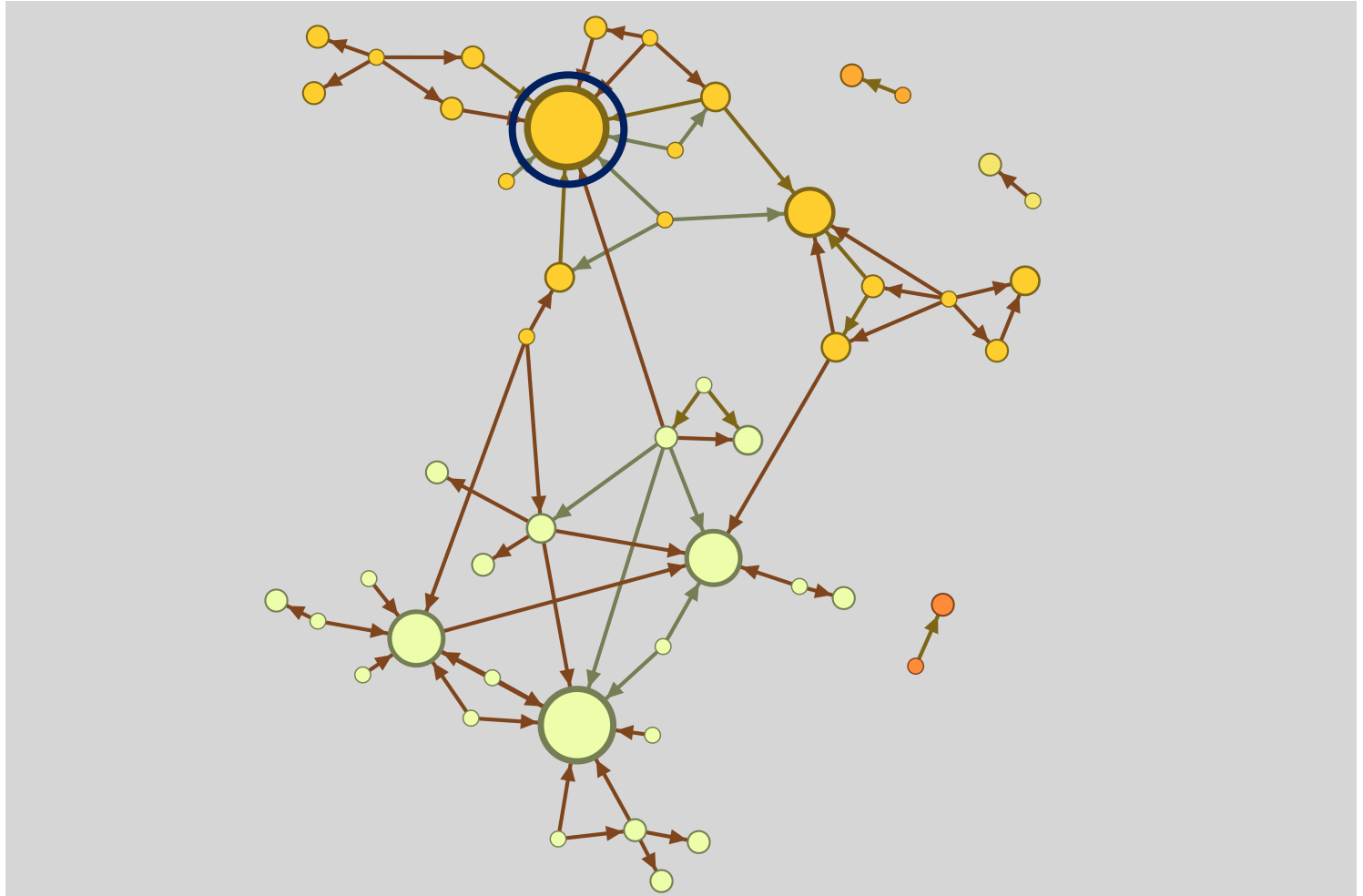
# Network configurations

A random social network with attributes



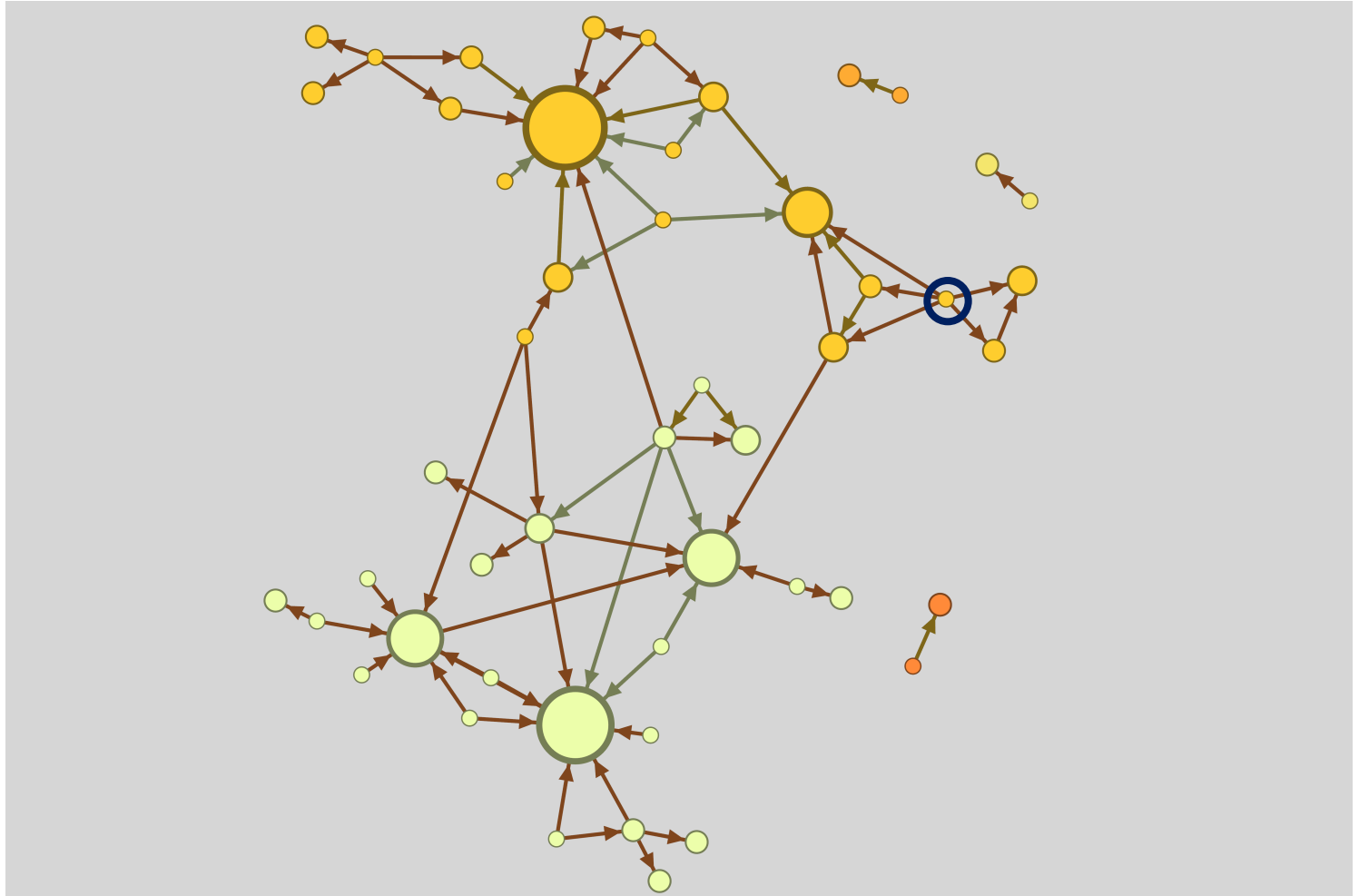
# Network configurations

High (in)degree node



# Network configurations

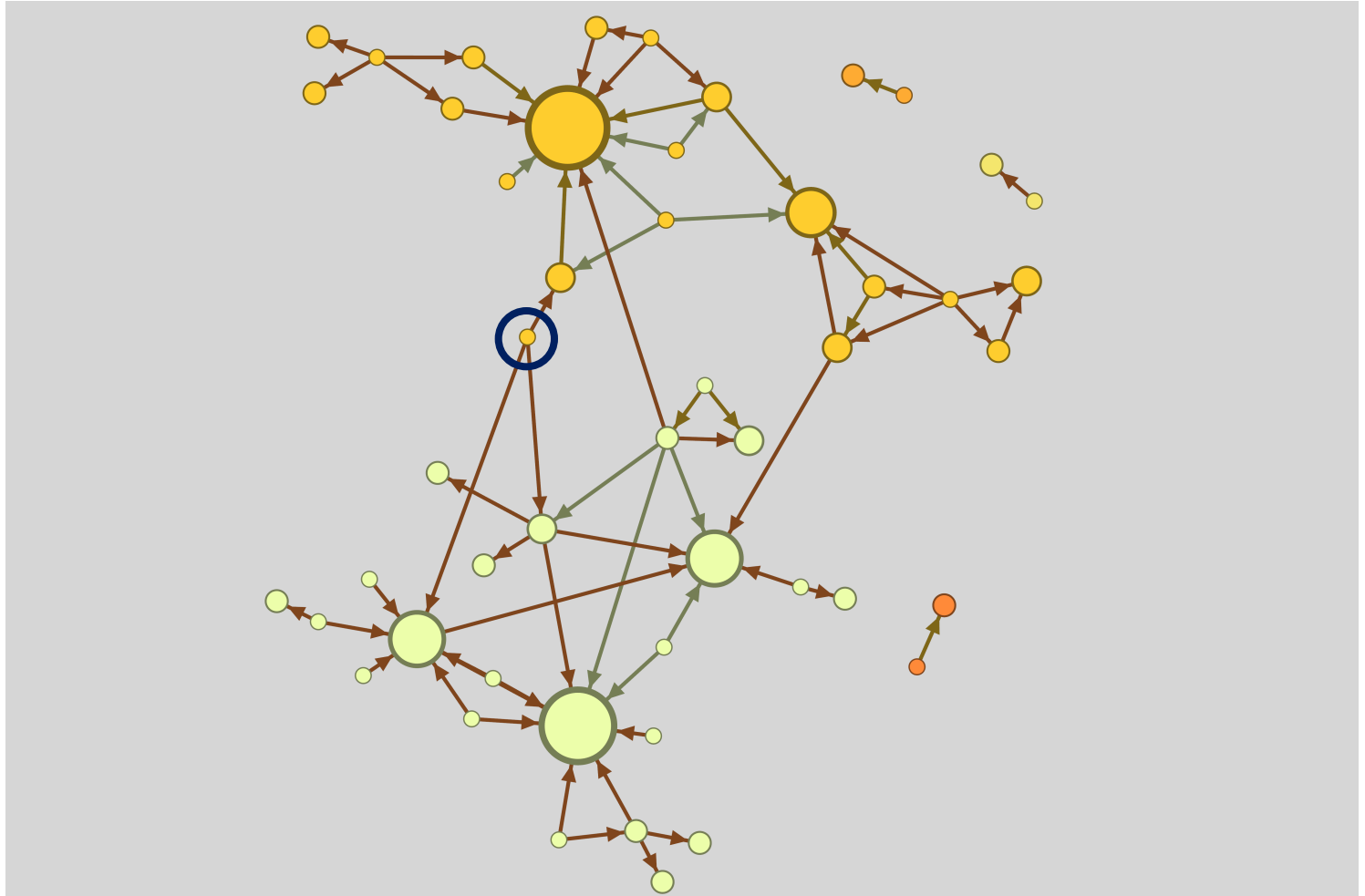
High (out)degree node





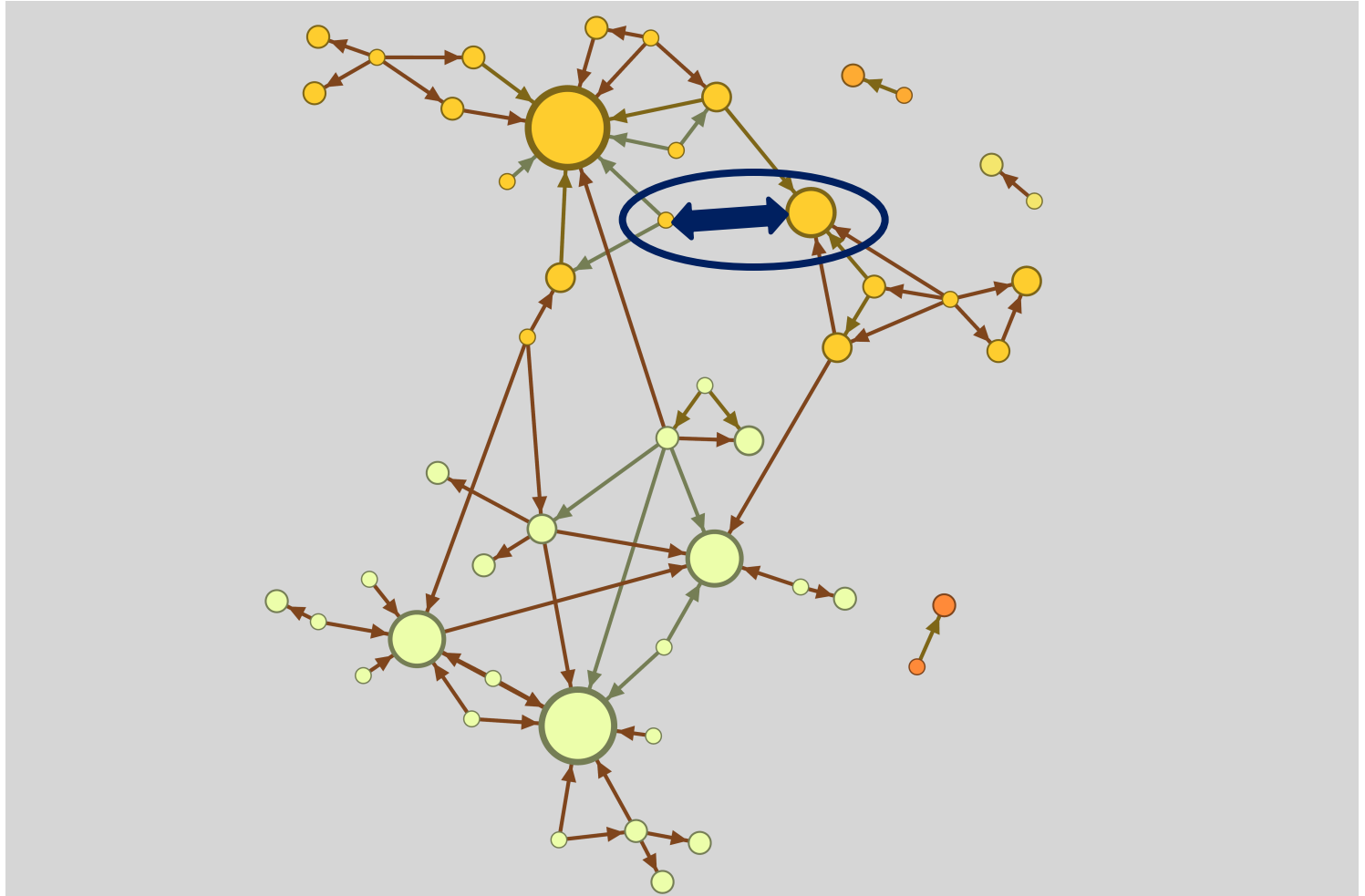
# Network configurations

Brokerage



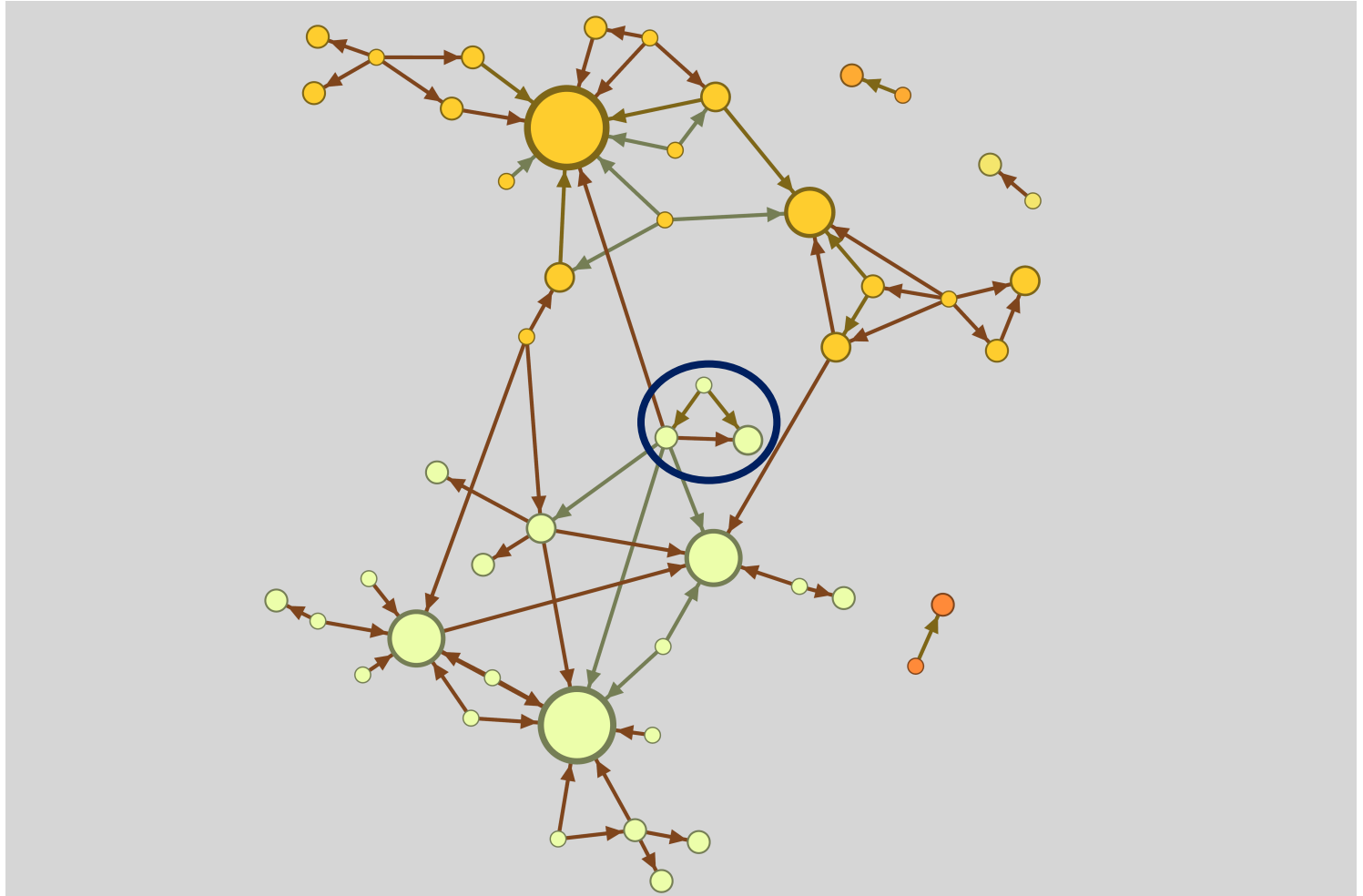
# Network configurations

Reciprocation



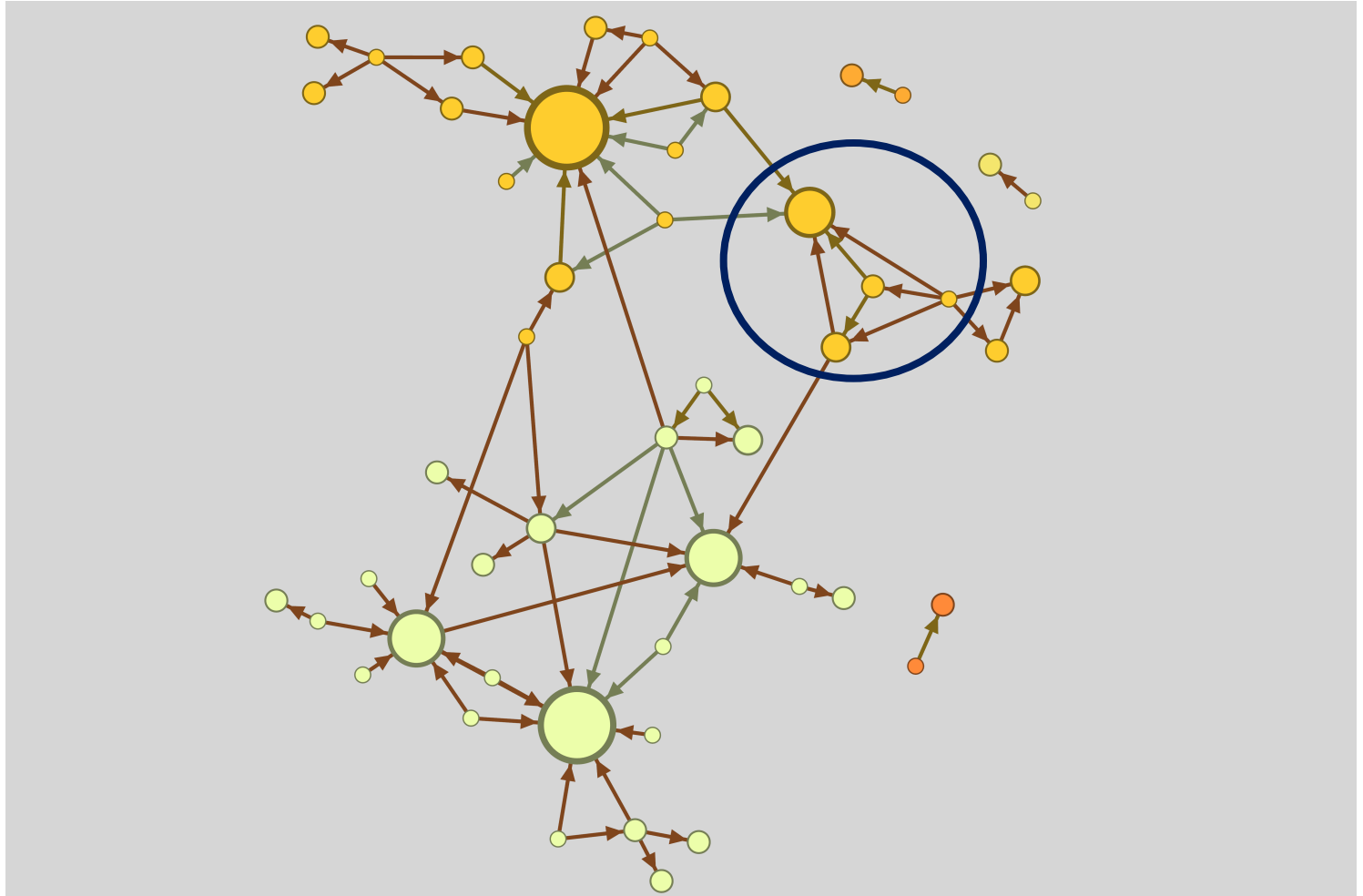
# Network configurations

Triangulation



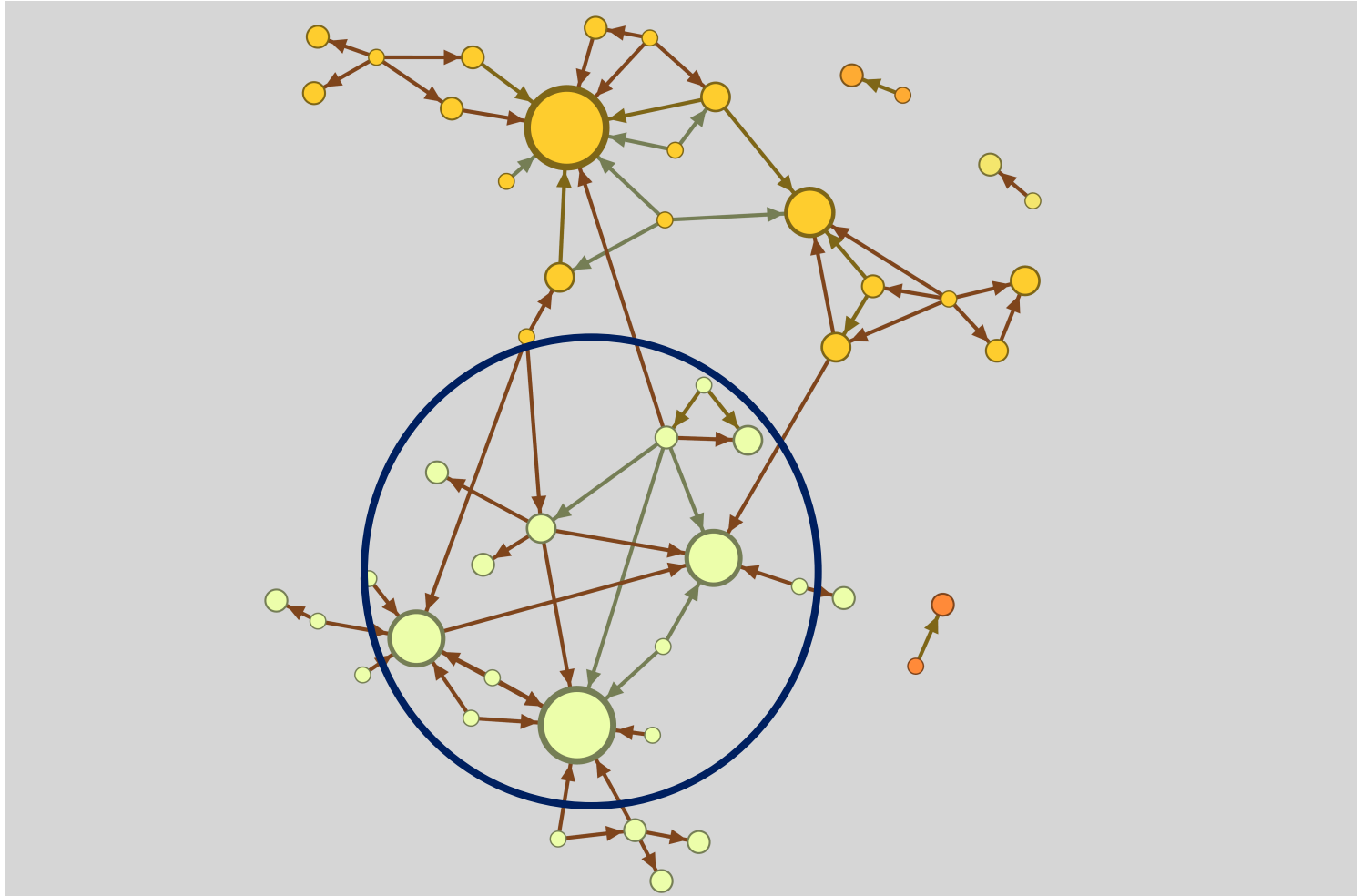
# Network configurations

Multiple triangulation



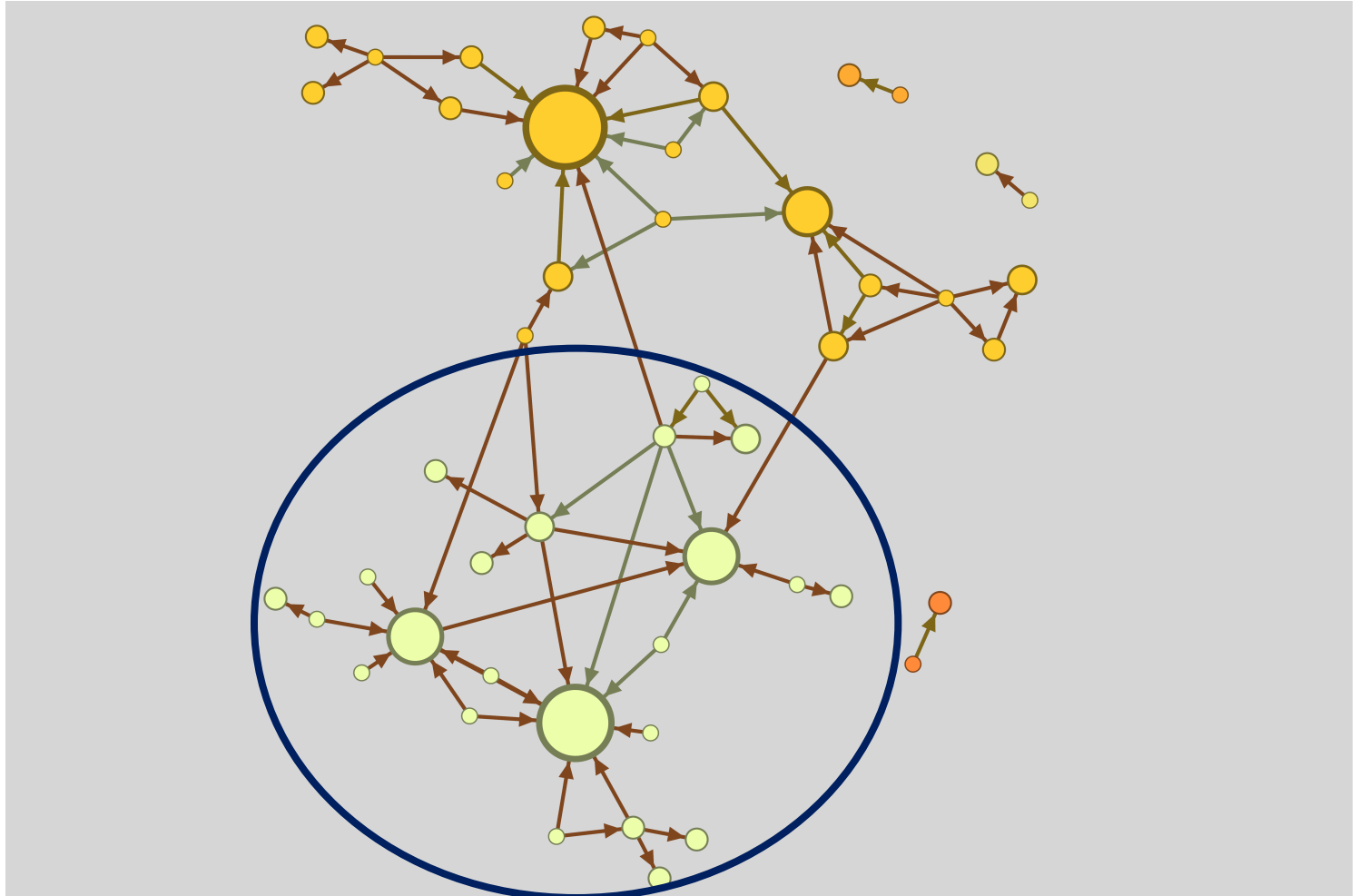
# Network configurations

Multiple triangulation (denser regions)



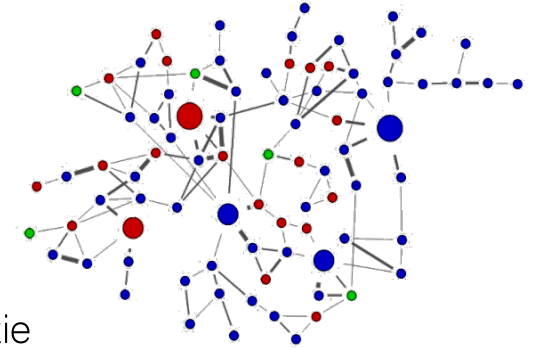
# Network configurations

Homophily

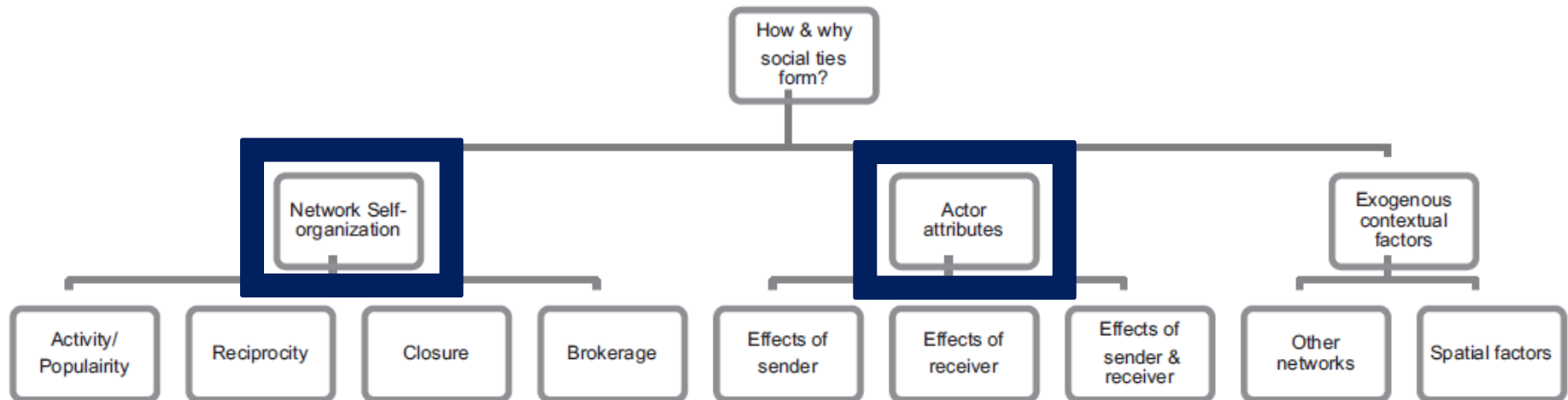


# Elements social network theory

- Locally emergent:
  - local patterns form global structures
- Network-ties self-organize:
  - through dependence among ties
  - the presence of one tie leads to an other tie
  - (this concept is essentially longitudinal and can be captured even cross-sectionally)
- Network patterns are evidence of ongoing structural processes
  - Static patterns of dynamic social processes
- Multiple processes operate simultaneously
- Social networks processes are structured, yet stochastic



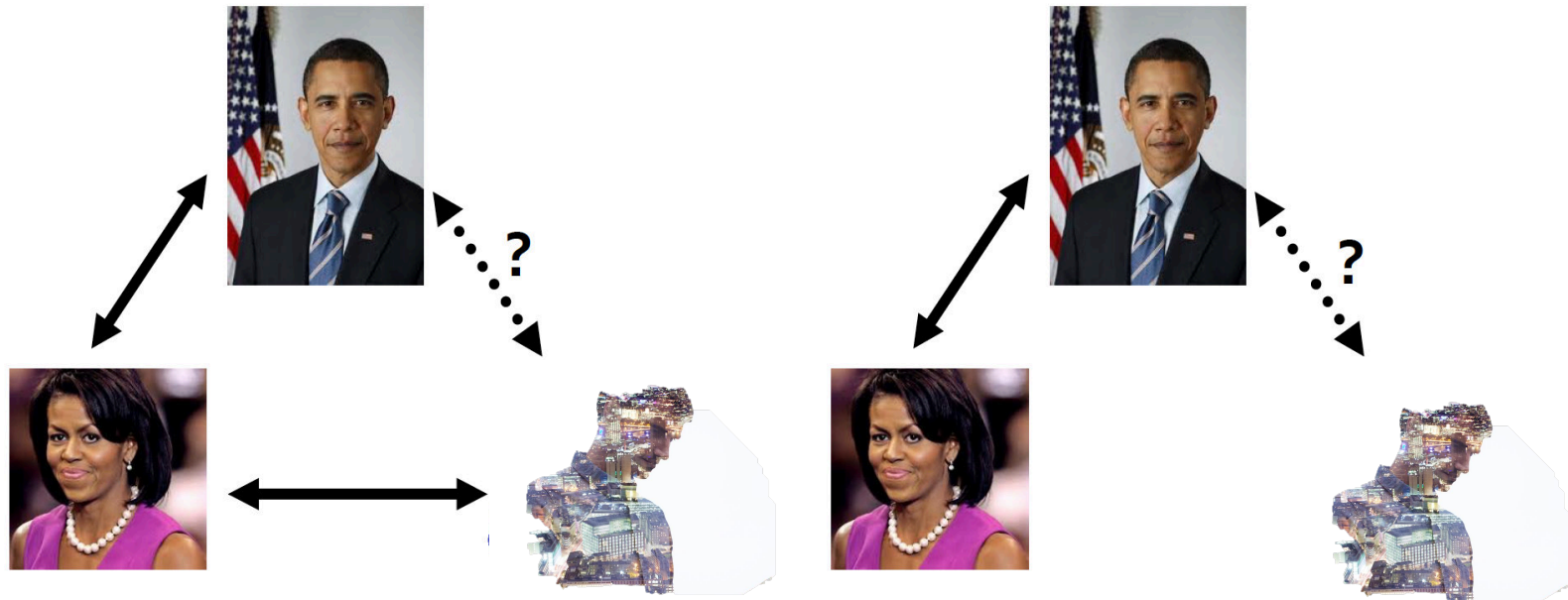
# Why do social network ties form?



Degree centrality measures fail to distinguish between ties that form due to **network self-organisation**, and those that are due to **actor attributes** (Figure 3.3, Lusher et al, 2013).

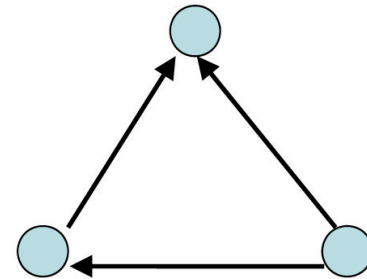
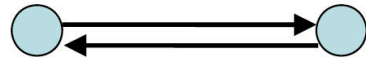


# A model that accounts for dependency



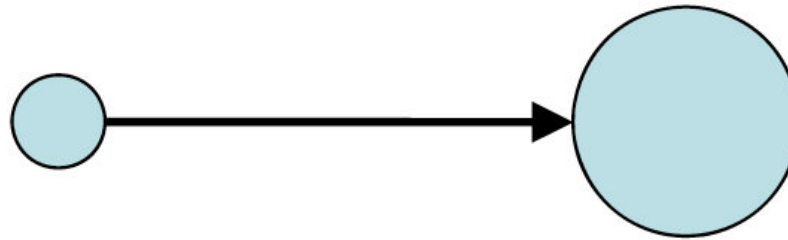
We want a model that says if you know Michelle Obama that you are more likely to meet President Obama ... the likelihood of the tie between me and President Obama **depends on** the tie between me and Michelle Obama

# Network self-organisation



Ties occur due to the presence or absence of other ties, whether it's social grooming or my connection to President Obama ...

# Actor-related effects



Ties occur due to the presence of actor attributes ... “I trust my colleague who has lots of experience”

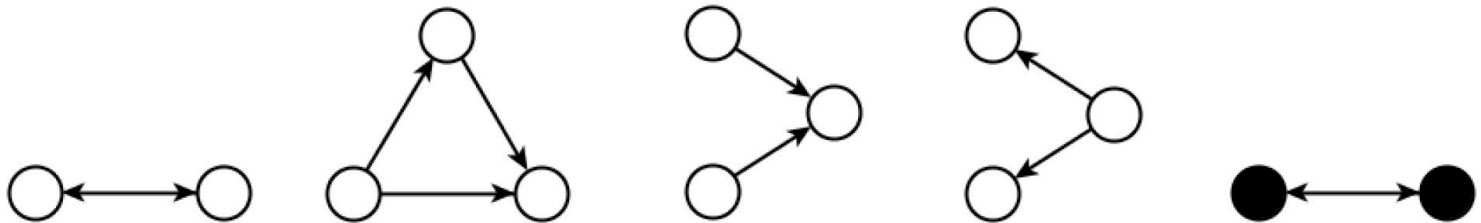
# Exogenous effects



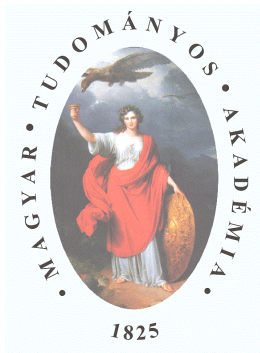
Ties occur due to the presence of other “fixed” or “formal” ties ... Formal reporting lines affect informal social ties (“I trust my boss”)

# Elements social network theory 2

- Would anyone suggest that a network is explained ONLY by:
  - Reciprocity?
  - Transitive closure?
  - Preferential attachment?
  - Brokerage?
  - Homophily?
- If not, then we need a model that can examine a network for ALL of these processes at the same time



Let's see that model ...



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