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Social Network Analysis with Digital Behavioral Data

Meet the Experts! – GESIS online talks

Haiko Lietz ▪ November 25, 2021

Leibniz Gemeinschaft

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Meet the Experts

Speaker

Dr. Haiko Lietz

- Postdoc in the team Digital Society Observatory, department of Computational Social Science at GESIS
- Ph.D. in sociology
- Social Network Science, Complexity Theory
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Logistics

- This talk will be recorded.
  We do not record the Q&A session after the talk.
- Participants are muted during the session. Questions will be collected during presentation and answered after the talk.
- Please use the private chat function and send questions to the account "Q&A host (MTE)".
  If you post in the general chat, your name and message will be visible to all participants. Of course, this is also possible; we kindly ask you to prefer the private chat to "Q&A host (MTE)" while the presentation is going on.
- Recording and slides will be made publicly available on the GESIS website and on our YouTube channel.

Paper accompanying this talk

Lietz, H., Schmitz, A., & Schaible, J. (2021)

- Social Network Analysis with Digital Behavioral Data
- Analyse sozialer Netzwerke mit digitalen Verhaltensdaten

easy_social_sciences, 66

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Meet the Experts

Agenda

- Network Analysis
  - History
  - Philosophy
- Digital Behavioral Data
  - As transactions
  - Definition
  - 3 types
- Application scenarios
  - Socio-semantic analysis
  - Mechanistic modeling
- Challenges

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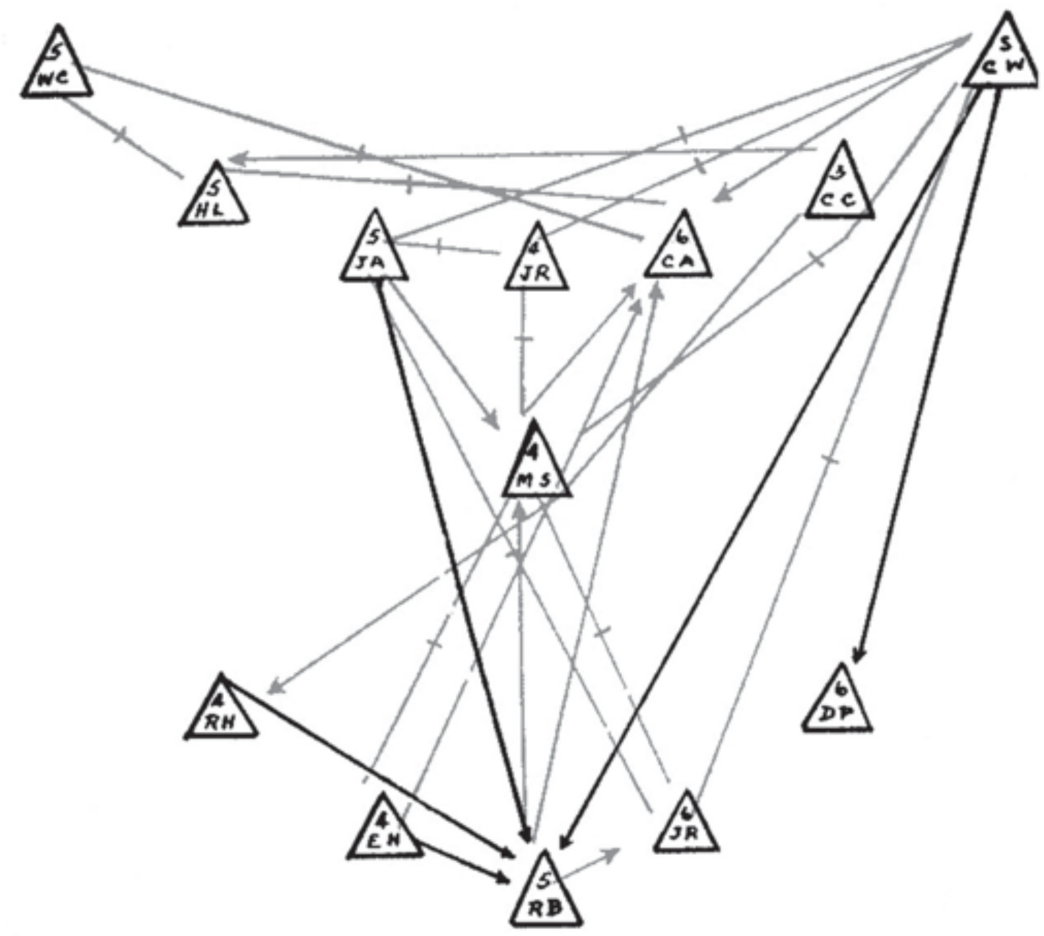
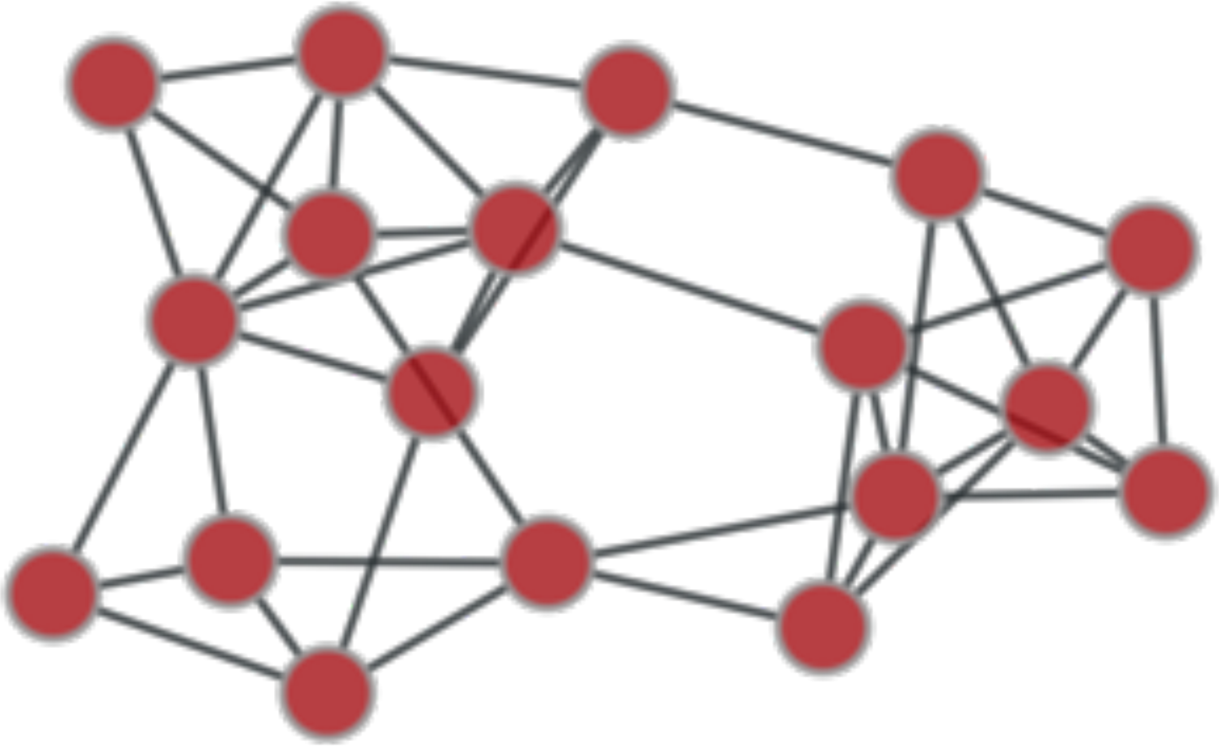
Network analysis goes back to Moreno (1936)

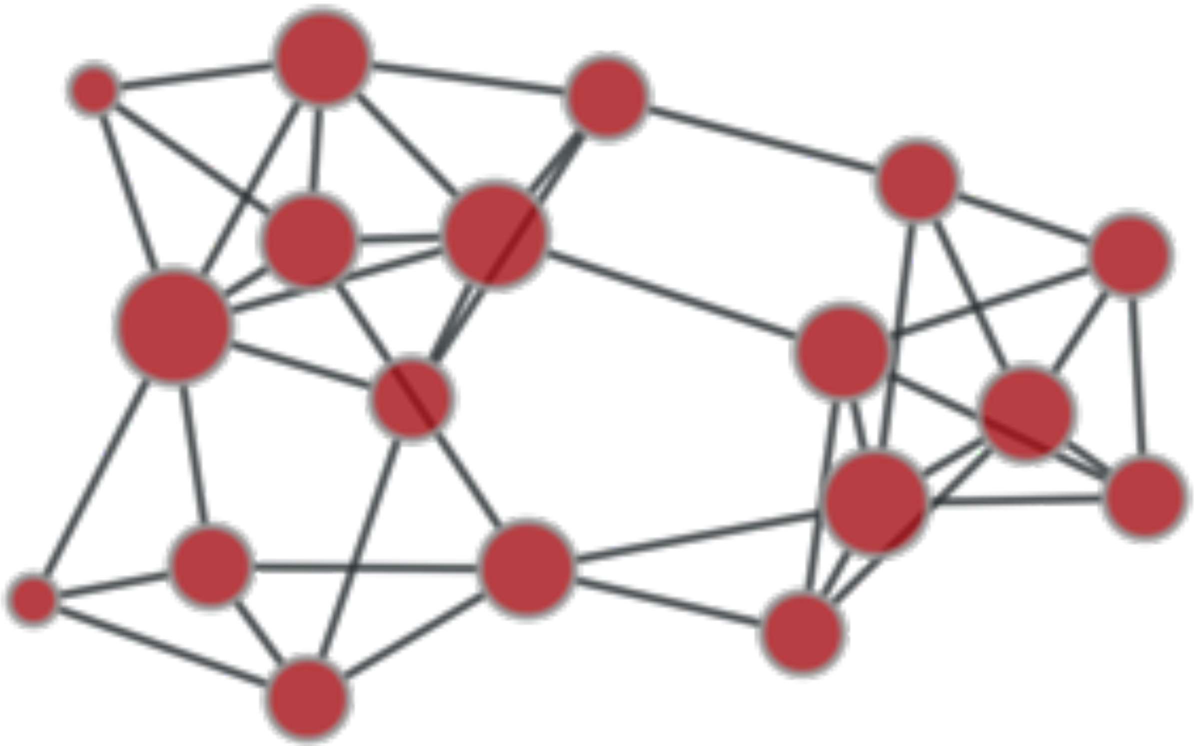


[1] Freeman, L. (2004). *The Development of Social Network Analysis*. Empirical Press.

Networks consist of nodes and edges

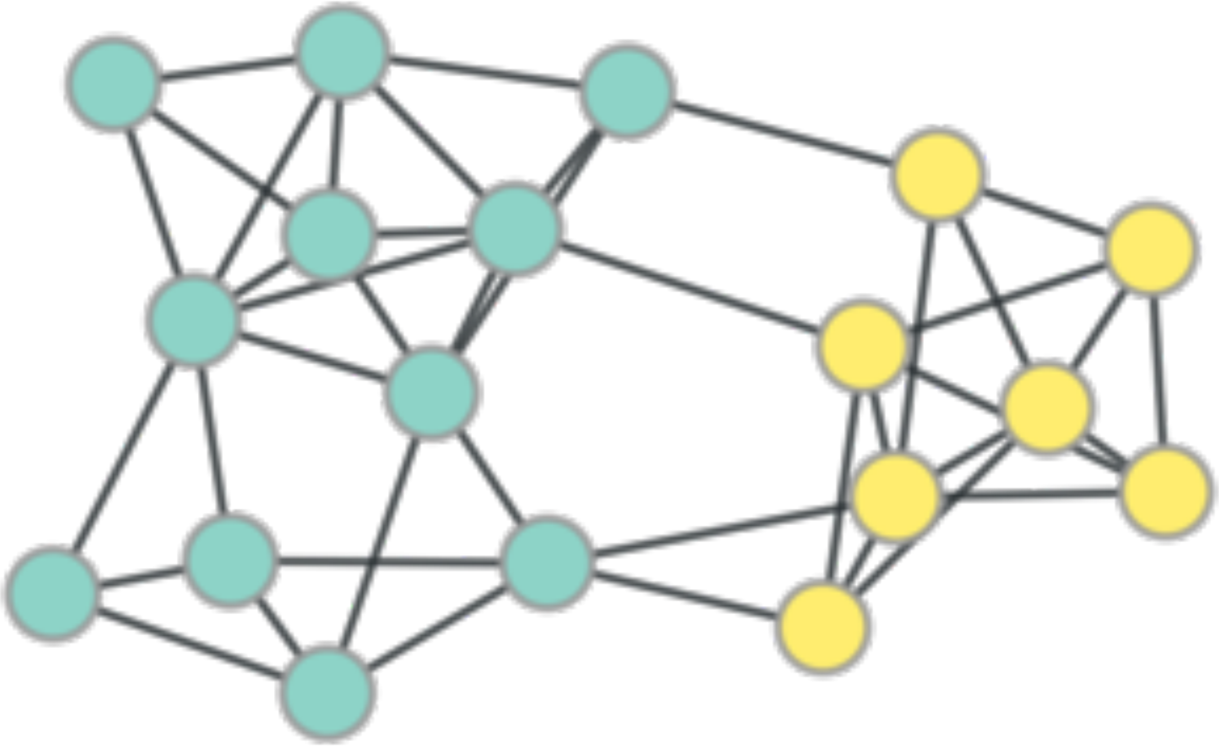


Micro (node) level analysis



Node size depicts degree centrality

Macro (graph) level analysis



Node color depicts cluster belonging

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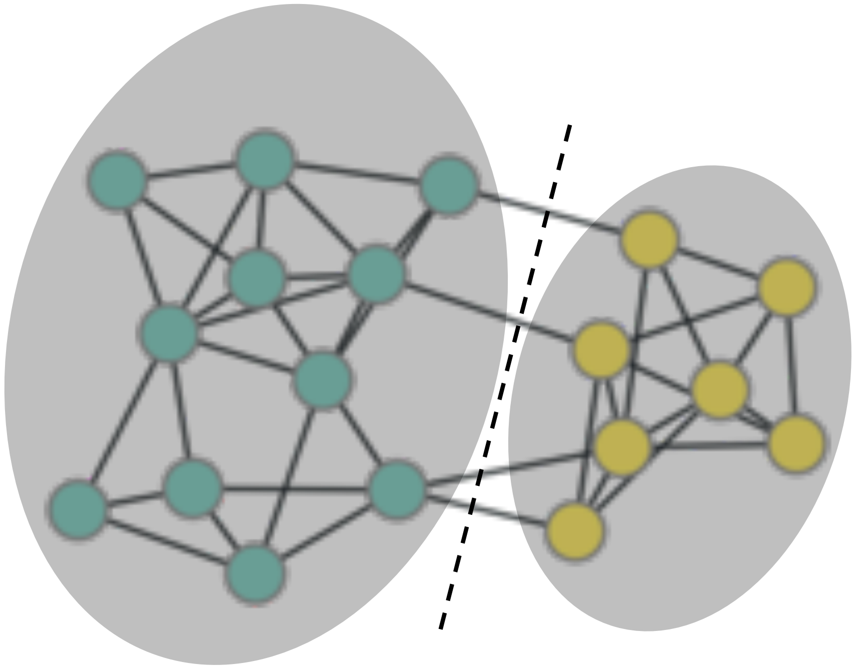
Some insights in Social Network Analysis



- Social networks consist of groups
- Often groups are homogeneous [2]
- There are structural holes between groups [3]
- Ties that bridge structural holes are sources of novelty [3,4]

[2] Kossinets, G. & Watts, D.J. (2009). *Am. J. Sociol.*, 115(2), 405–450.
[3] Burt, R.S. (1992). *Structural Holes*. Harvard University Press.
[4] Granovetter, M.S. (1973). *Am. J. Sociol.*, 78(6), 1360–1380.

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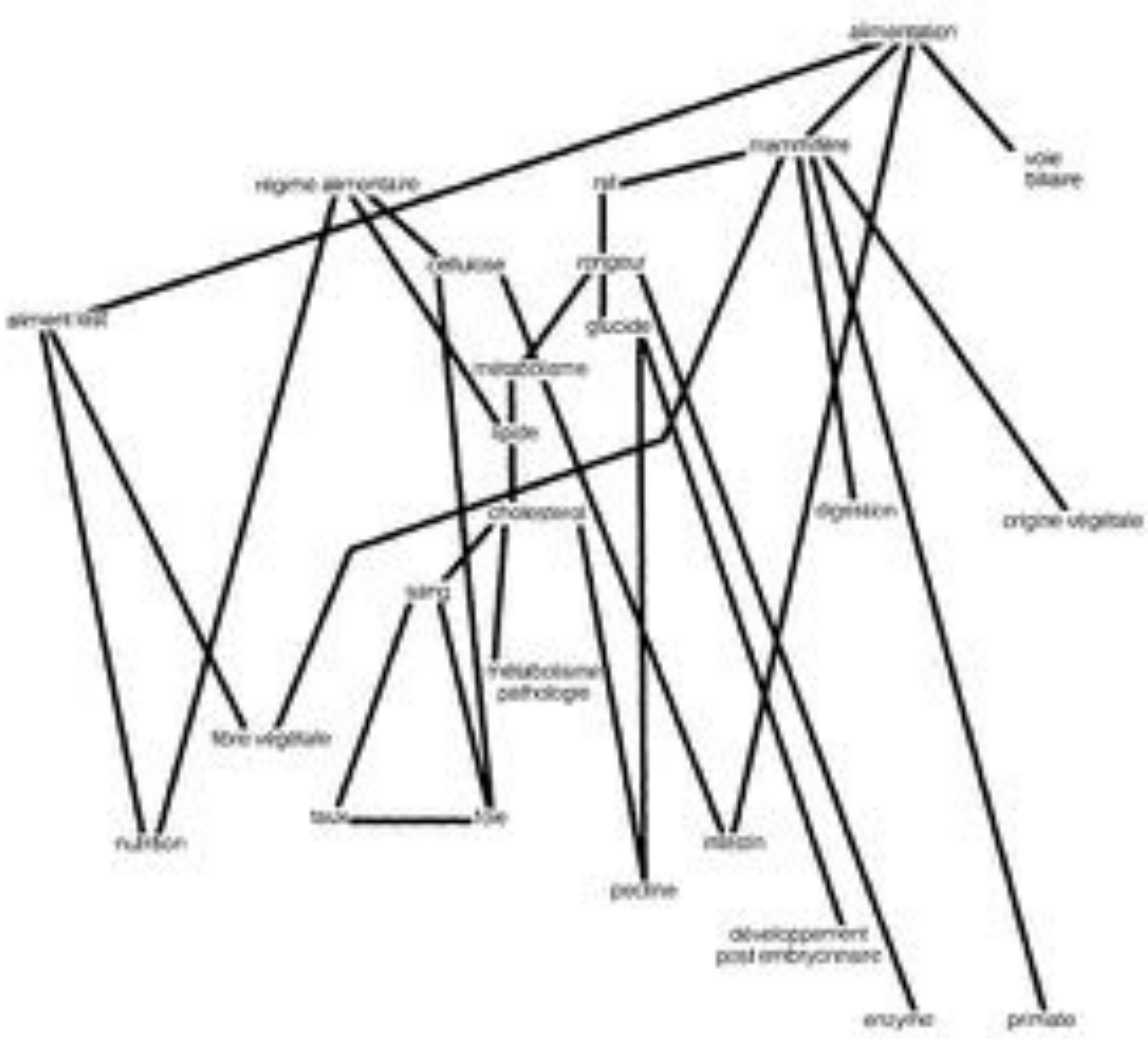
Semantic networks emerged in the 80s



[5] Callon, M., et al. (1983). *Soc. Sci. Inf.*, 22(2), 191–235.

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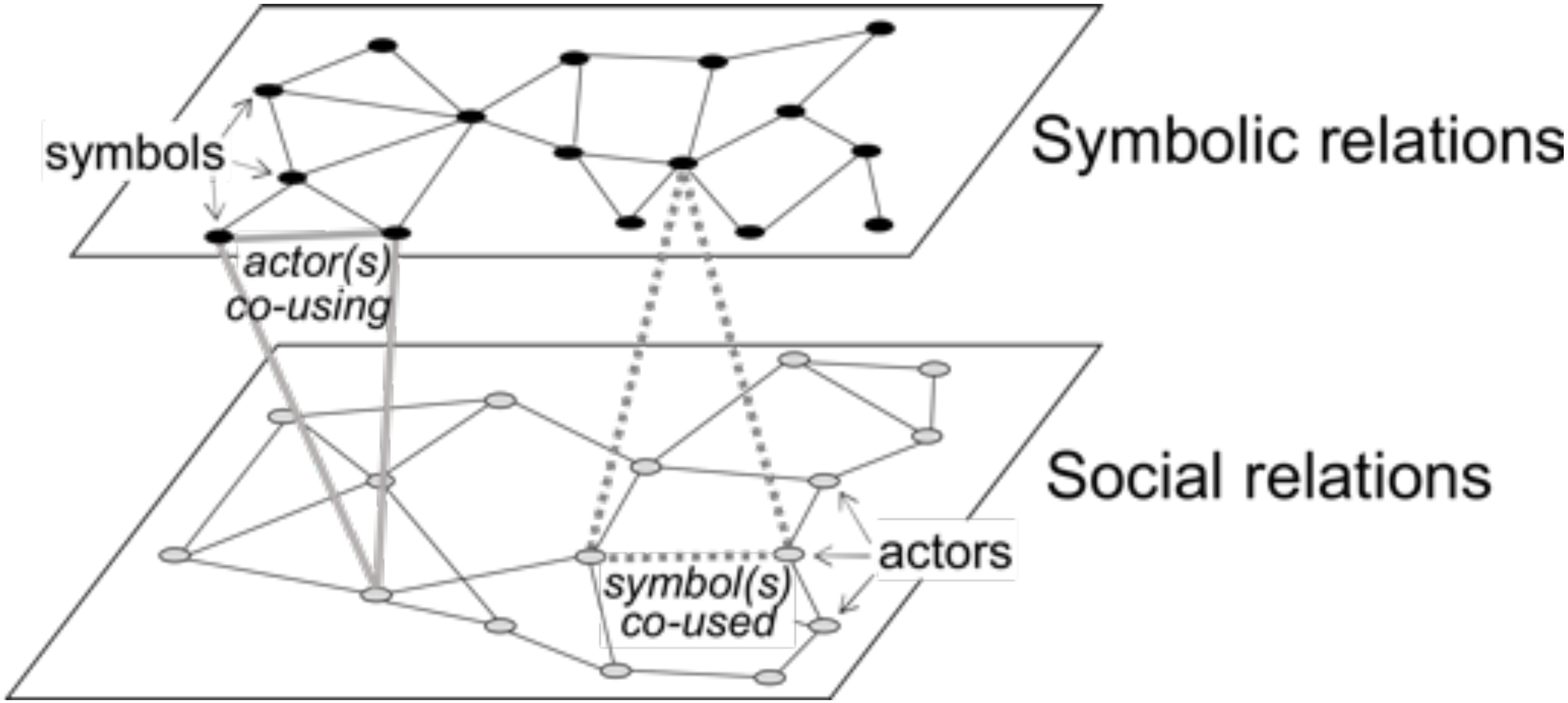
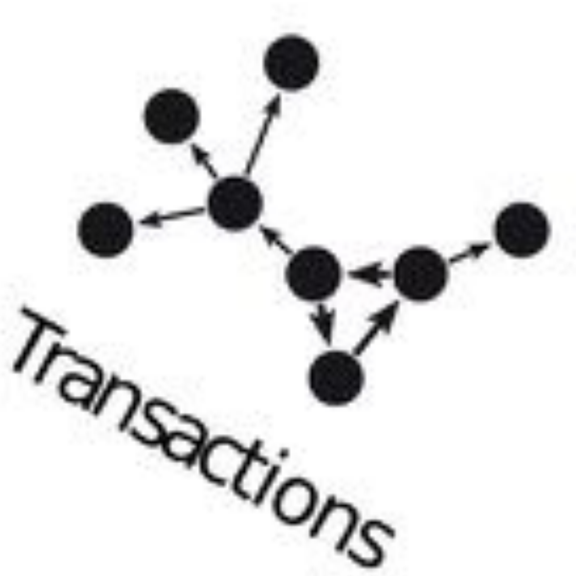
Socio-semantic networks emerged in the 90s



[6] Fuhse, J,. et al. (2020). *Poetics*, 78, 101363.

Relational epistemology



- Network analysis builds on full samples
- Relations are units of observation

→ Relations are *trans*actions (as opposed to *self*actions or *inter*actions) [7]

[7] Emirbayer, M. (1997). *Am. J. Sociol.*, 103(2), 281–317.

Revolution in social science

[8] Watts, D.J. (2011). *Everything is Obvious*. Crown Business.

The „new telescope“ of social science

Digital Behavioral Data

+

Hardware & software to analyze it

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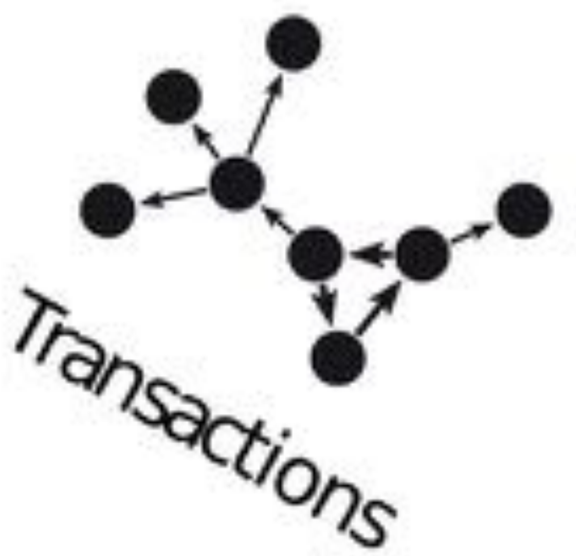
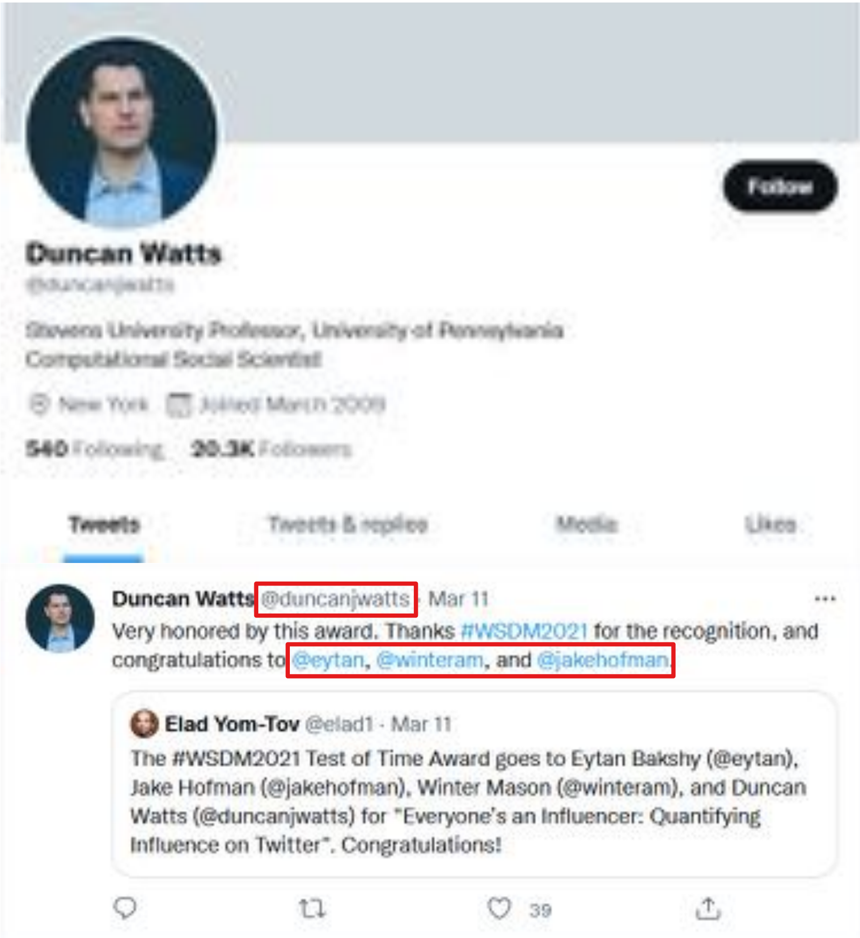
Digital Behavioral Data as transactions

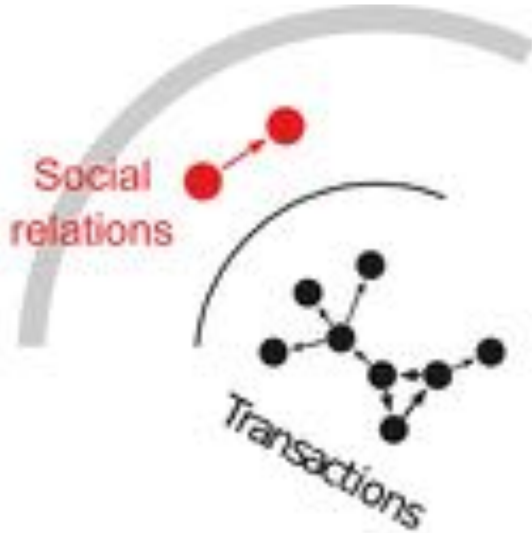
Digital Behavioral Data (DBD) are records of transactions [6]



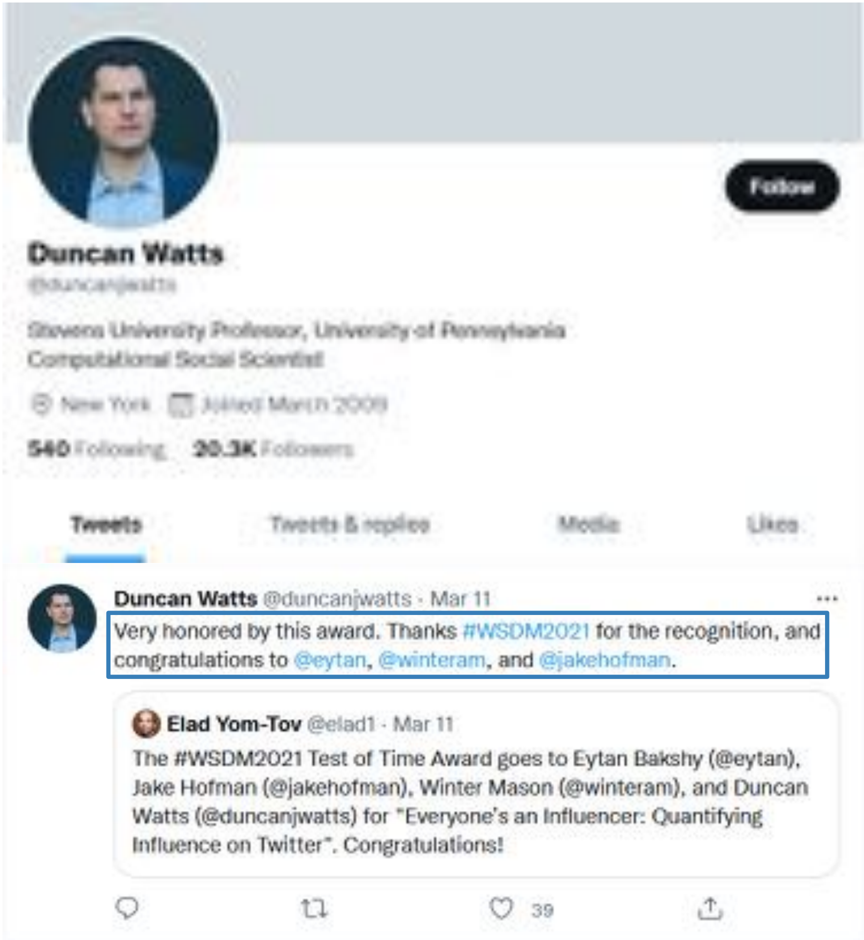
[7] Emirbayer, M. (1997). *Am. J. Sociol.*, 103(2), 281–317.

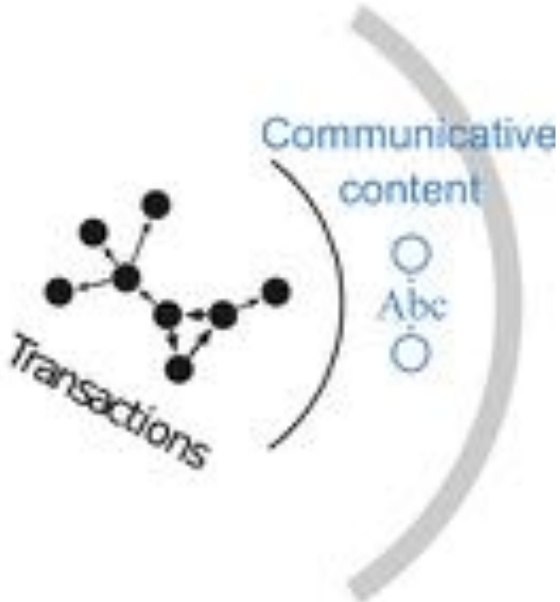
Four dimensions of transactions



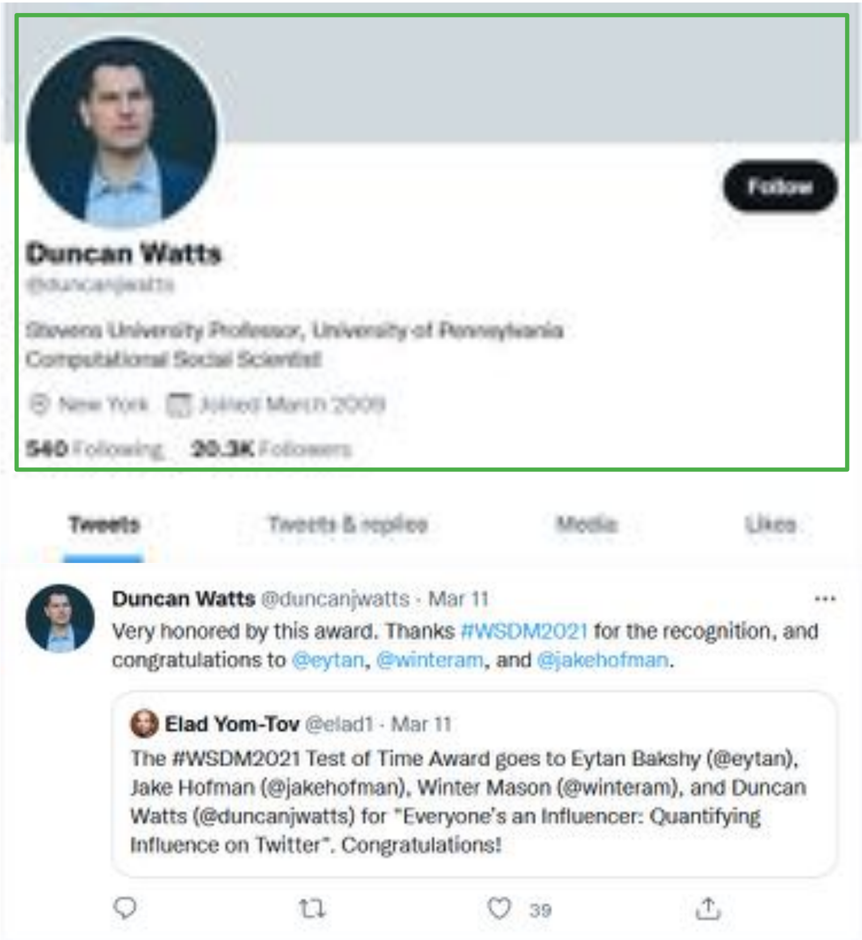


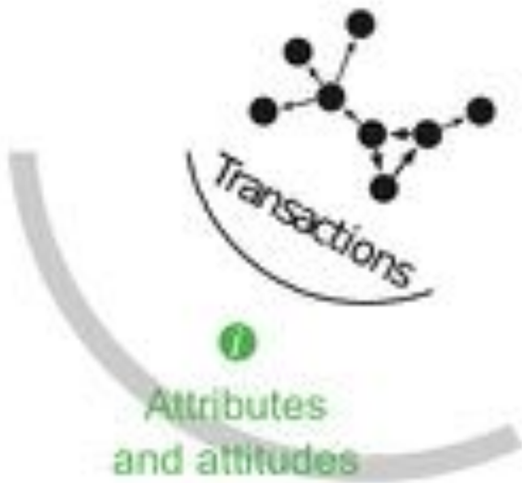
Four dimensions of transactions



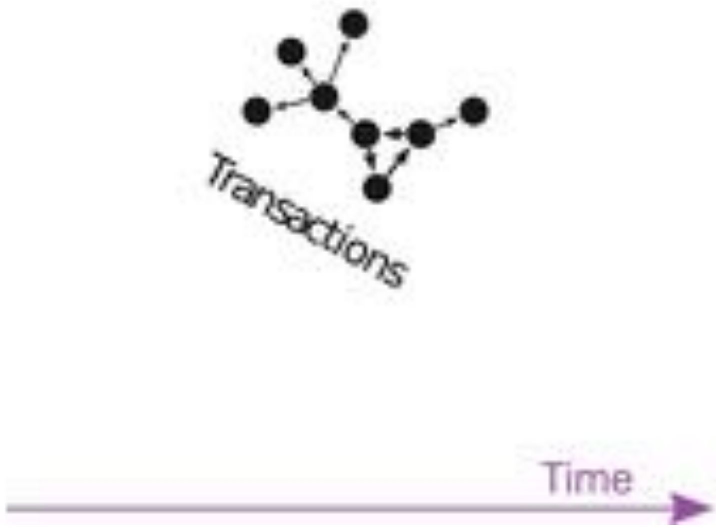


Four dimensions of transactions



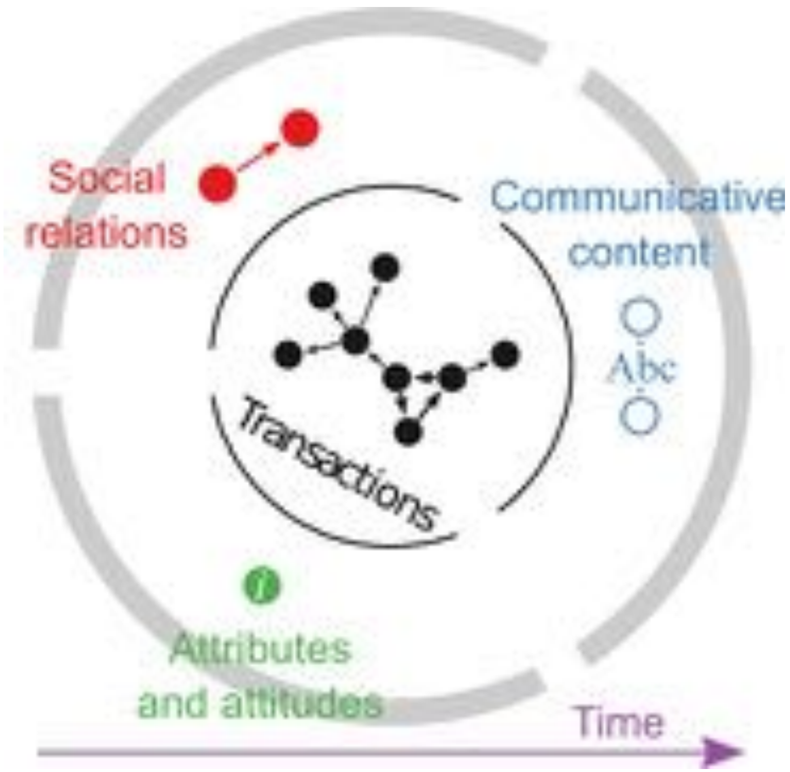


Four dimensions of transactions



Four dimensions of transactions

- Social relations
- Communicative content
- Attributes and attitudes
- Time



Definition of Digital Behavioral Data

Digital Behavioral Data (DBD) are traces of behavior left by uses of, or harnessed by, digital technology.

References for next slides:

[9] Howison, J., et al. (2011). *J. Assoc. Inf. Sys.*, 12(12), 767–797.
[10] Lazer, D. & Radford, J. (2017). *Annu. Rev. Sociol.*, 43(1), 19–39.

Traces of behavior

/

… are left by uses of digital technology?

/

Yes („found data“) [9]

/

… are actions and their tech. observation? [10]

/

Yes („digital life“)

e.g., Twitter

Type 1

Social relations ✓

Communicative content ✓

Attributes and attitudes ✓

Time ✓

Traces of behavior

… are left by uses of digital technology?

Yes („found data“) [9]

… are actions and their tech. observation? [10]

No

e.g., E-Mail @

Type 2

Social relations ✓

Communicative content ✓

Attributes and attitudes

Time ✓

Traces of behavior

… are left by uses of digital technology?

No („designed data“)

„digitized life“

e.g., face-to-face interactions

SocioPatterns.org

Type 3

Social relations ✓

Communicative content

Attributes and attitudes

Time ✓

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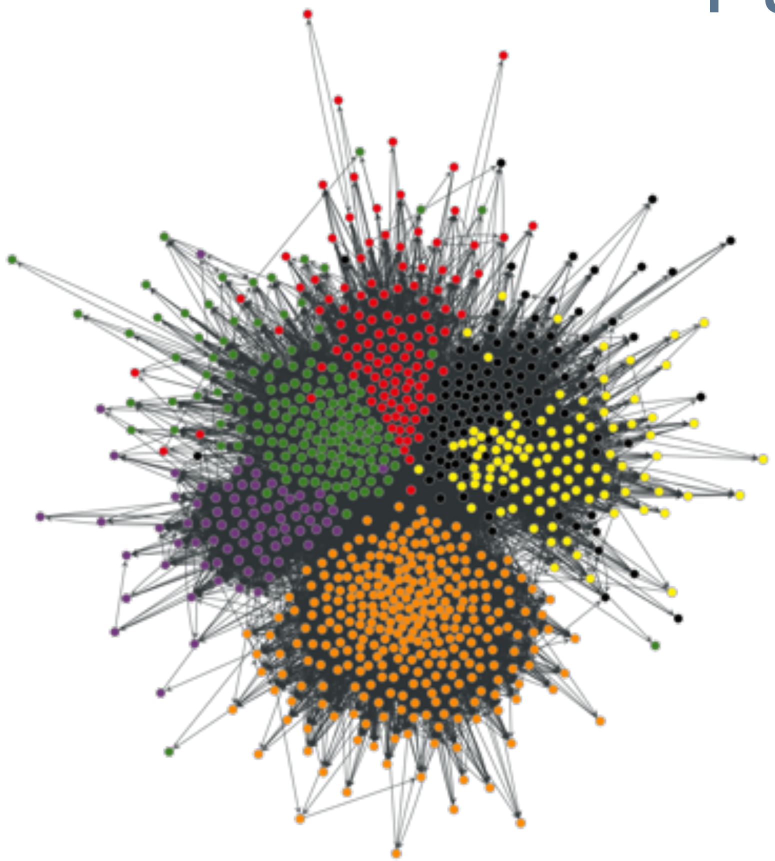
Types of Digital Behavioral Data

	Type 1	Type 2	Type 3
Example	Twitter	E-Mail	SocioPatterns
Social relations	✓	✓	✓
Communicative content	✓	✓	
Attributes and attitudes	✓		
Time	✓	✓	✓

→ Application scenario 1: Socio-semantic analysis

→ Application scenario 2: Mechanistic modeling

Patterns



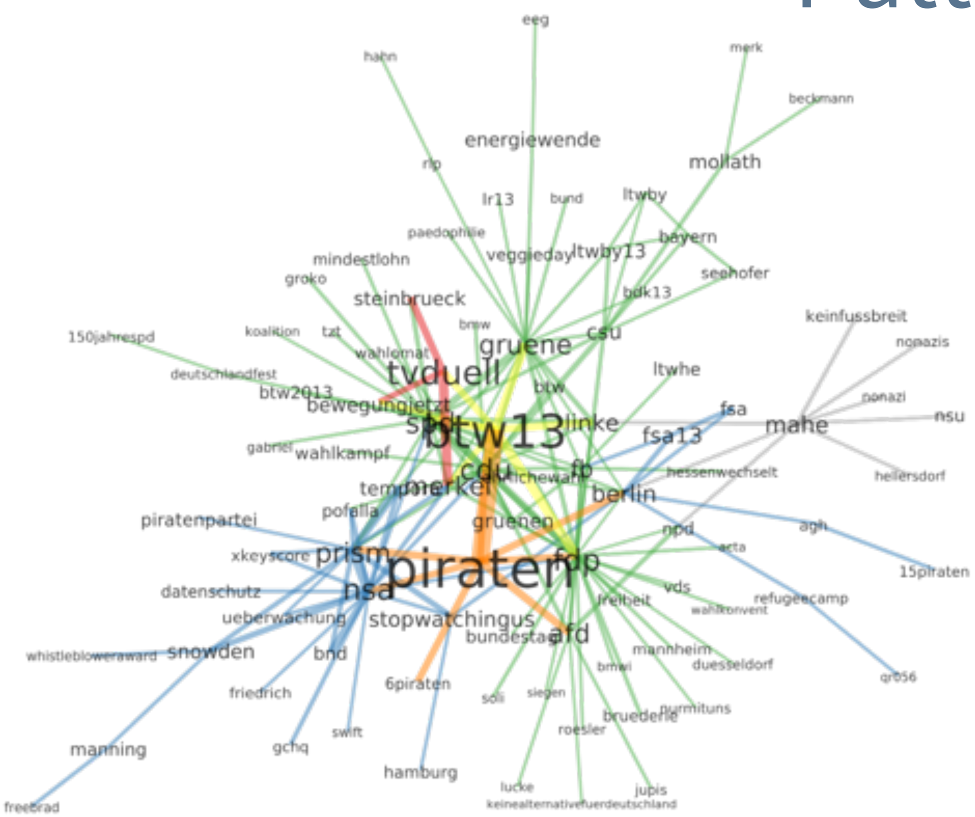
Follower network of politicians, color indicates party affiliation [11]

Patterns are regularities in the macrobehavior of a system

→ e.g., existence of groups of actors

[11] Lietz, H., et al. (2014). *Proc. ICWSM*, 8(1), 285–294.

Patterns



Semantic network of hashtags co-used in tweets, color indicates topics [11]

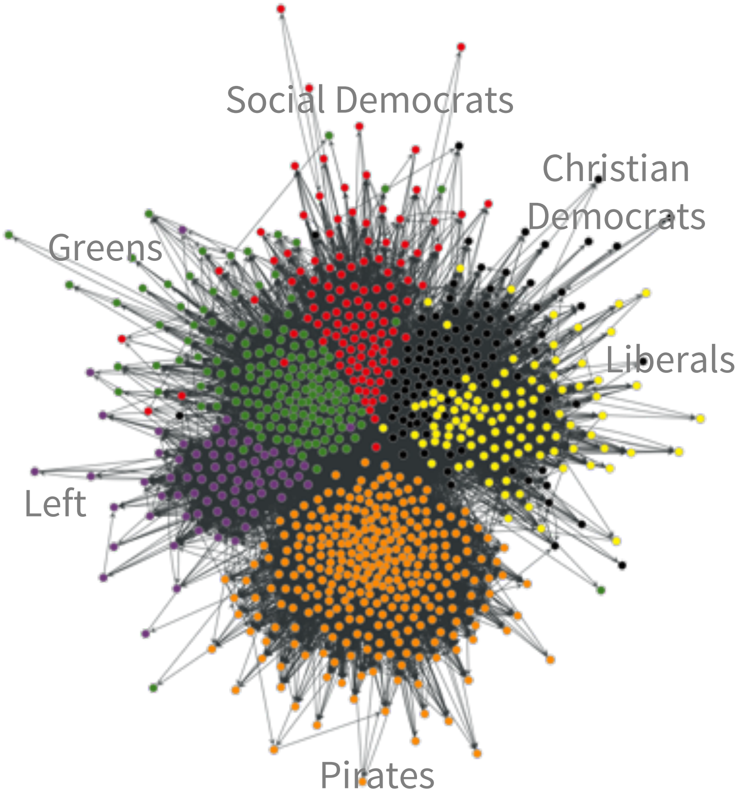
Patterns are regularities in the macrobehavior of a system

→ e.g., structured discourse

[11] Lietz, H., et al. (2014). *Proc. ICWSM*, 8(1), 285–294.

App. scenario 1: Socio-semantic analysis

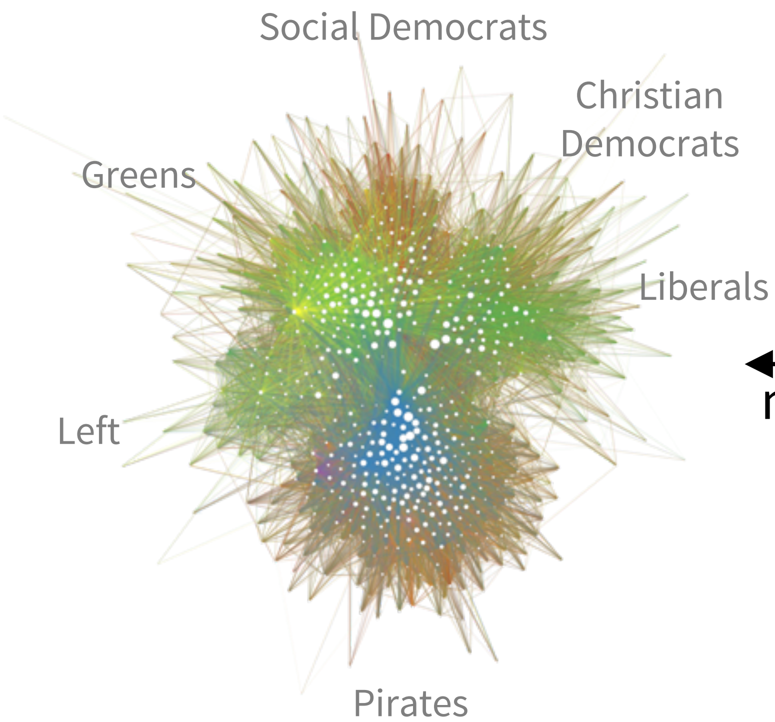
Actors



Social network

App. scenario 1: Socio-semantic analysis

Actors → make → Transactions → use → Artifacts

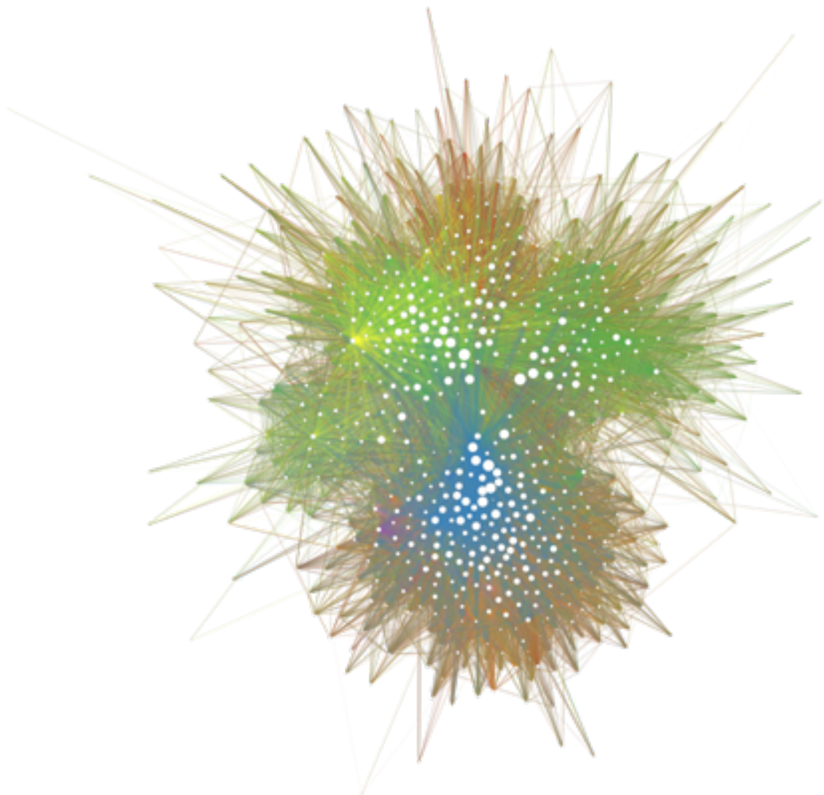


← map

Socio-semantic network

Semantic network

App. scenario 1: Socio-semantic analysis



- Actors are just one entity among others
- Transactions are the unit of observation

→ More approaches to socio-semantic analysis in *Poetics* [12]

[12] Volumes 68 and 78.

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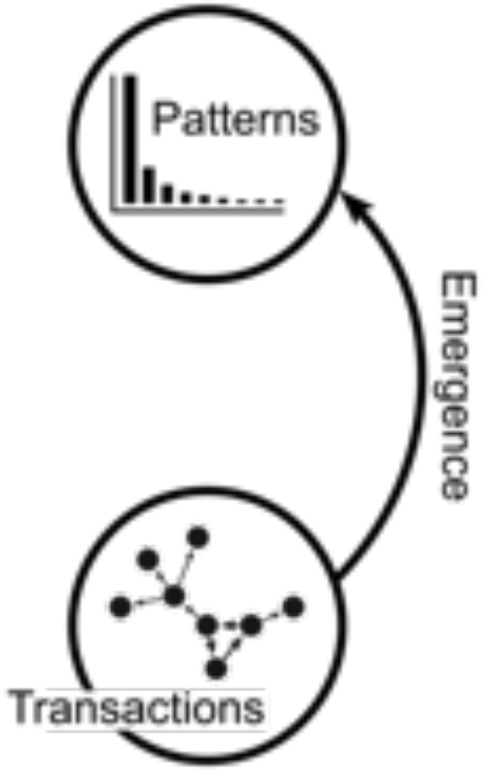
Patterns in individualistic models of behavior



- Emergence: Patterns arise from transactions
- e.g., methodological individualism

→ *Under*socialized conception of human action [13]

[13] Granovetterm. (1985). *Am. J. Sociol.*, 91(3), 481–510.

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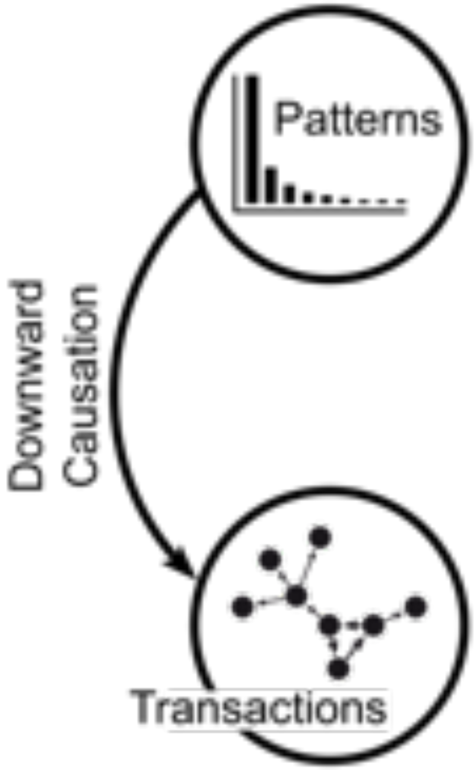
Patterns in functionalistic models of behavior

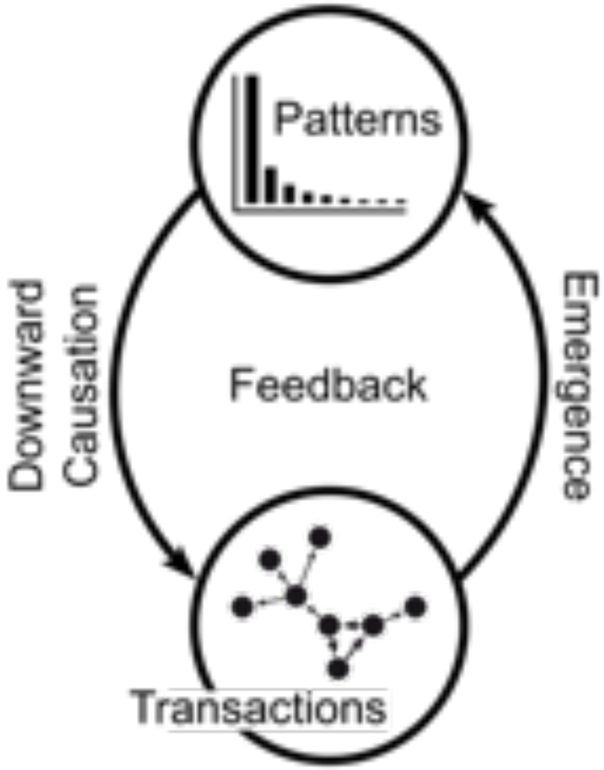


- Downward causation: Patterns influence transactions
- e.g., structural functualism

→ *Over*socialized conception of human action [13]

[13] Granovetterm. (1985). *Am. J. Sociol.*, 91(3), 481–510.

Patterns in analytical models of behavior



- Feedback: Patterns arise from, and later influence, transactions
- e.g., enabling [3] vs. constraining [4] effect of structure

→ Mechanistic conception of human action [14]

[3] Burt, R.S. (1992). *Structural Holes*. Harvard University Press.
[4] Granovetter, M.S. (1973). *Am. J. Sociol.*, 78(6), 1360–1380.
[14] Hedström, P. (2005). *Dissecting the Social*. Cambridge University Press

App. Scenario 2: Mechanistic modeling

Origins of Homophily in an Evolving Social Network[1]

Gueorgi Kossinets
Google Inc.

Duncan J. Watts
Yahoo! Research

The authors investigate the origins of homophily in a large university community, using network data in which interactions, attributes, and affiliations are all recorded over time. The analysis indicates that highly similar pairs do show greater than average propensity to form new ties; however, it also finds that tie formation is heavily biased by triadic closure and focal closure, which effectively constrain the opportunities among which individuals may select. In the case of triadic closure, moreover, selection to "friend of a friend" status is determined by an analogous combination of individual preference and structural proximity. The authors conclude that the dynamic interplay of choice homophily and induced homophily, compounded over many "generations" of biased selection of similar individuals to structurally proximate positions, can amplify even a modest preference for similar others, via a cumulative advantage–like process, to produce striking patterns of observed homophily.

[2] Kossinets, G. & Watts, D.J. (2009). *Am. J. Sociol.*, 115(2), 405–450.

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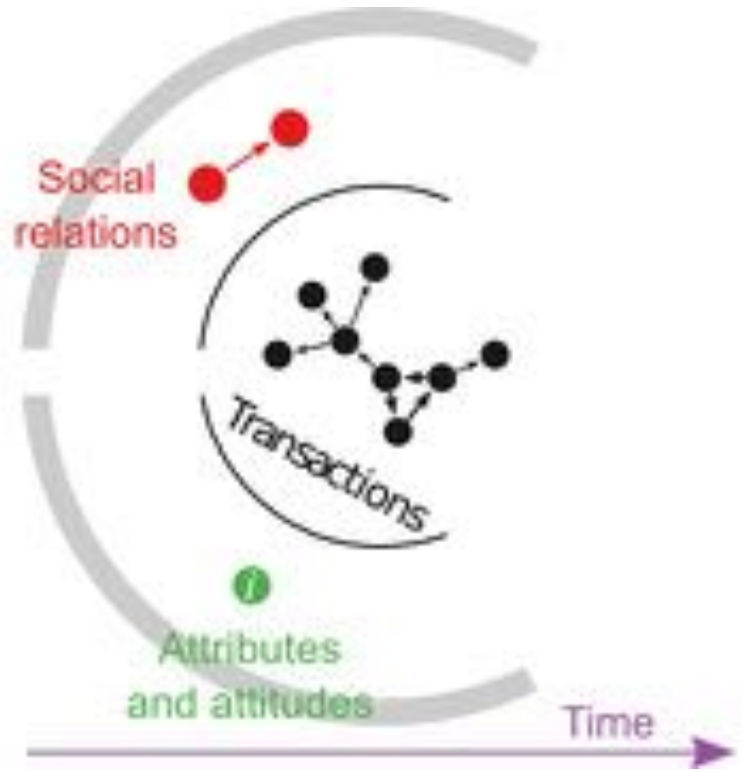
App. Scenario 2: Mechanistic modeling



Data

- Social relations: E-Mails by 30.396 persons with a university account
- 6 attributes: Gender, age, status, field, year, and state
- Time: 270 days

[2] Kossinets, G. & Watts, D.J. (2009). *Am. J. Sociol.*, 115(2), 405–450.

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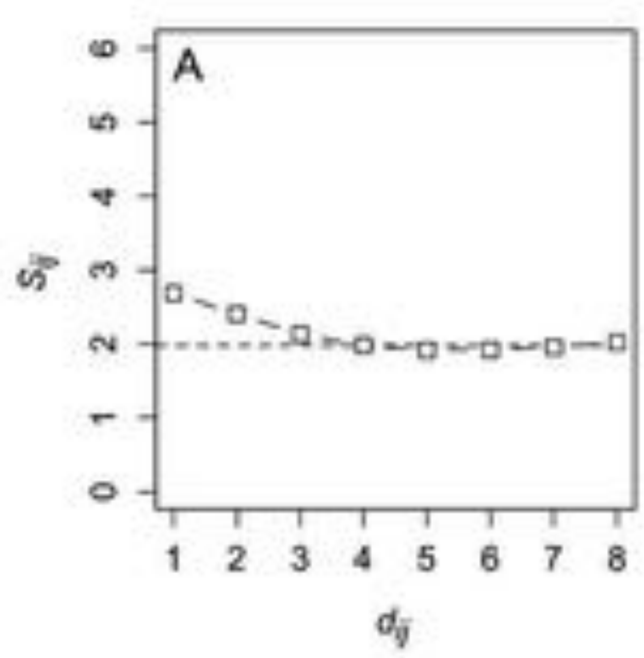
App. Scenario 2: Mechanistic modeling

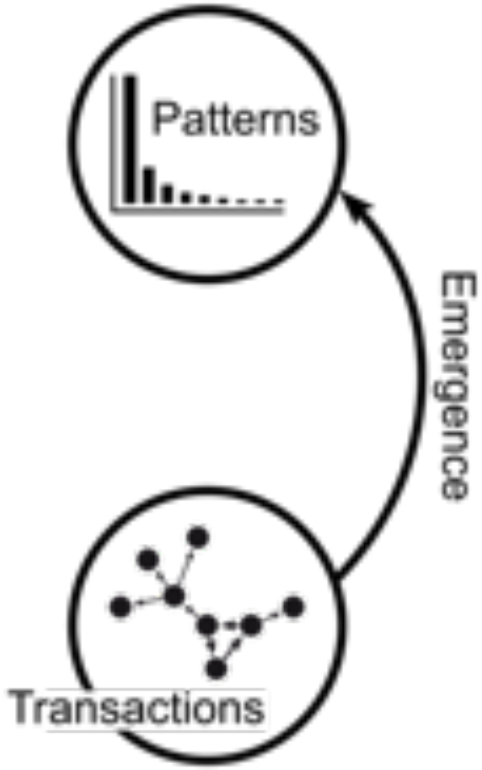


Pattern

- Persons in short network distance d_{ij} have more attributes S_{ij} in common

[2] Kossinets, G. & Watts, D.J. (2009). *Am. J. Sociol.*, 115(2), 405–450.

App. Scenario 2: Mechanistic modeling



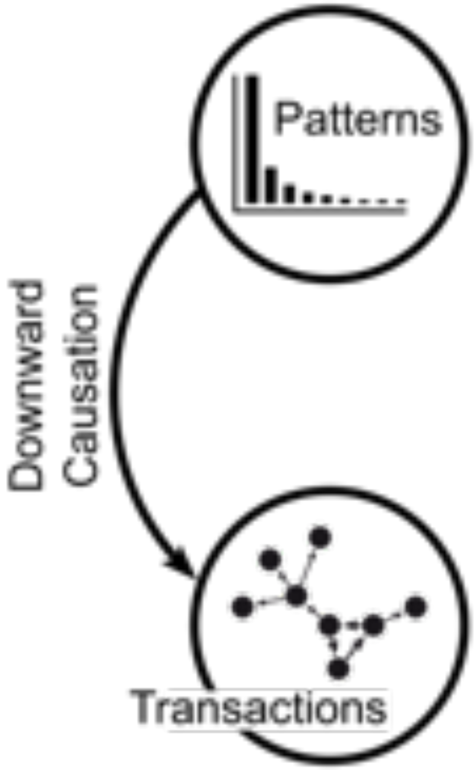
Research question

- Do persons chose relations to similar others even though they could do otherwise?

→ Choice homophily

[2] Kossinets, G. & Watts, D.J. (2009). *Am. J. Sociol.*, 115(2), 405–450.

App. Scenario 2: Mechanistic modeling



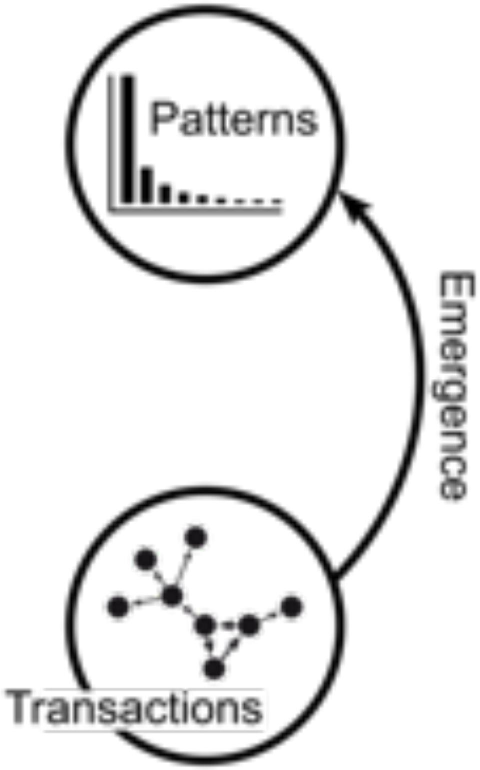
Research question

- Do persons chose relations to similar others because they have no other choice?

→ Induced homophily

[2] Kossinets, G. & Watts, D.J. (2009). *Am. J. Sociol.*, 115(2), 405–450.

App. Scenario 2: Mechanistic modeling



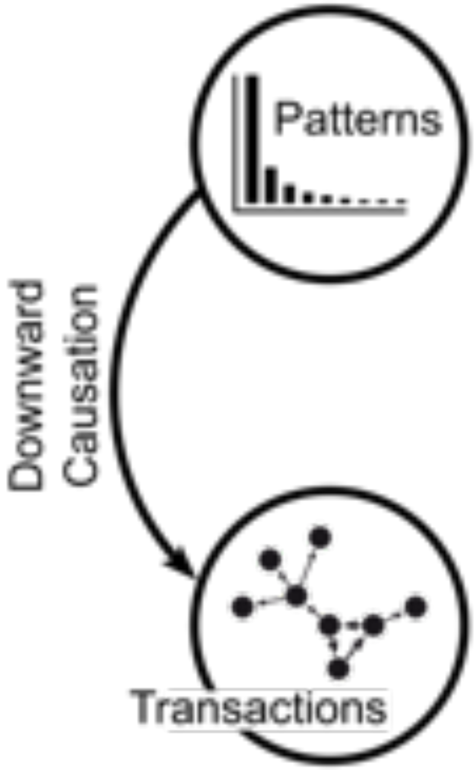
Results

- The more similar two persons are, the more likely they are to send a mail on the next day

→ Choice homophily

[2] Kossinets, G. & Watts, D.J. (2009). *Am. J. Sociol.*, 115(2), 405–450.

App. Scenario 2: Mechanistic modeling



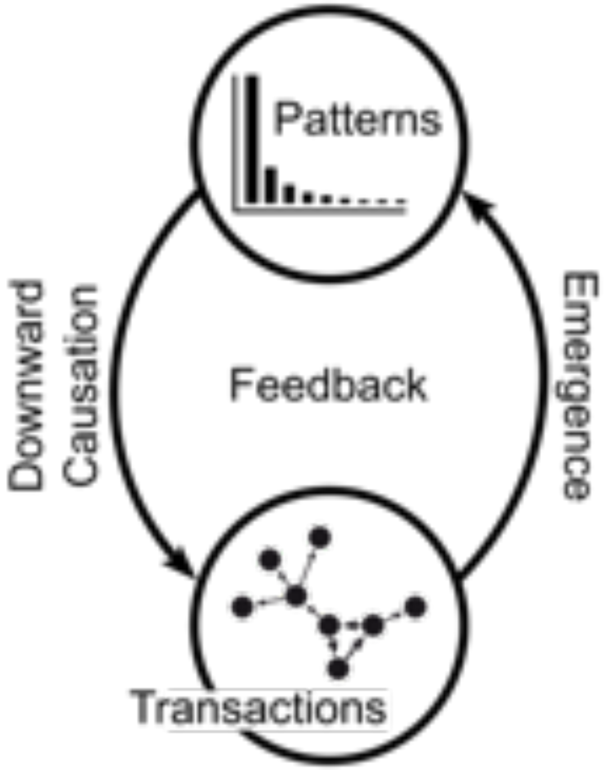
Results

- The effect is weaker, the larger the distance in the network
- The effect vanishes when persons share a focus (e.g., a class)

→ Induced homophily

[2] Kossinets, G. & Watts, D.J. (2009). *Am. J. Sociol.*, 115(2), 405–450.

App. Scenario 2: Mechanistic modeling



Summary

- Network proximity and attribute similarity converge as distant but similar persons are drawn together, facilitated by shared activities

→ Homophily as feedback mechanism

[2] Kossinets, G. & Watts, D.J. (2009). *Am. J. Sociol.*, 115(2), 405–450.

Conclusion

DBD offers fresh research opportunities

- Combination of social relations and communicative content (socio-semantic analysis)
- Enrichment of transactions by attributes and attitudes
- Availability of highly dynamic observations of behavior at scale (mechanistic modeling)

Challenges

1. Data management: Need to handle DBD
2. Data quality: Validity issues, measurement and representation errors

   Meet the Experts: Dr. F. Floeck & I. Sen: Digital traces of human behaviourin online platforms
3. Reproducibility: Open data and methodology

Challenges

4. Reflexivity: Understanding modes of data generation
   - Meet the Experts: Dr. Roberto Ulloa: Auditing Algorithms
   - Meet the Experts: Dr. K. Weller & O. Watteler: Ethics and Data Protection in Social Media Research
5. Theory: Constitutive pillar for the consolidation of Computational Social Science

Thank you !

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Contact: you can reach the speaker/s via e-mail:
haiko.lietz@gesis.org

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June 24 Katrin Weller: **A Short Introduction to Computational Social Science and Digital Behavioral Data**

July 01 Fabian Flöck, Indira Sen: **Digital Traces of Human Behavior from Online Platforms – Research Designs and Error Sources**

July 08 Sebastian Stier, Johannes Breuer: **Combining Survey Data and Digital Behavioral Data**

Sept 16 Katrin Weller, Oliver Watteler: **Ethics and Data Protection in Social Media Research**

Sept 30 Roberto Ulloa: **Introduction to Online Data Acquisition**

Oct 07 Roberto Ulloa: **Auditing Algorithms: How Platform Technologies Shape our Digital Environment**

Oct 14 Marius Sältzer, Sebastian Stier: **The German Federal Election: Social Media Data for Scientific (Re-)Use**

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