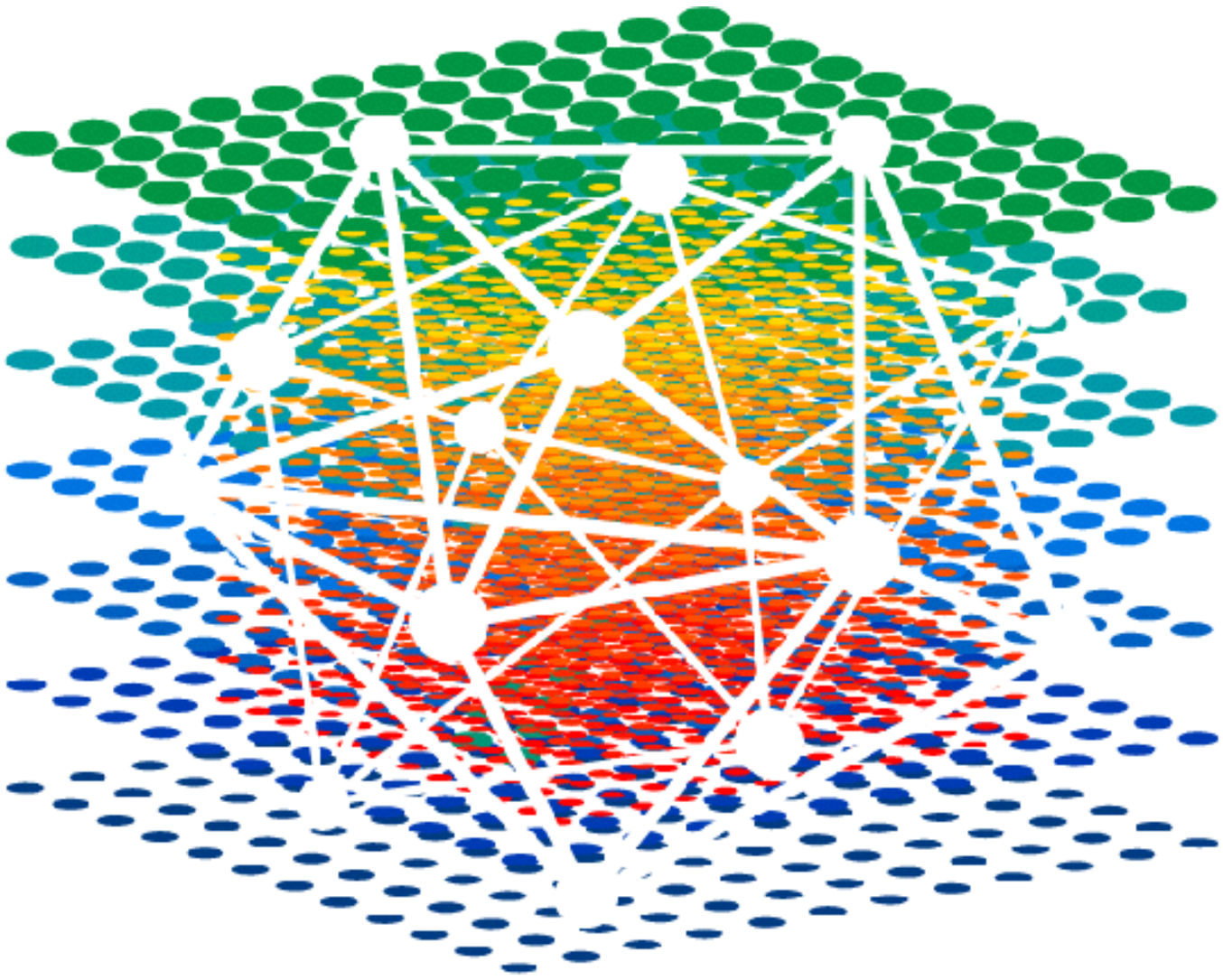


Socio-Semantic Networks and the Structural Space

Adina Nerghes

KNAW Humanities Cluster
DIGITAL HUMANITIES LAB

Digital Humanities Lab

- Advancing the humanities through digital methods
- Focus on big ‘textual’ data
- Interdisciplinary
- Events & Entities
- Change
- Connections

Marieke van Erp

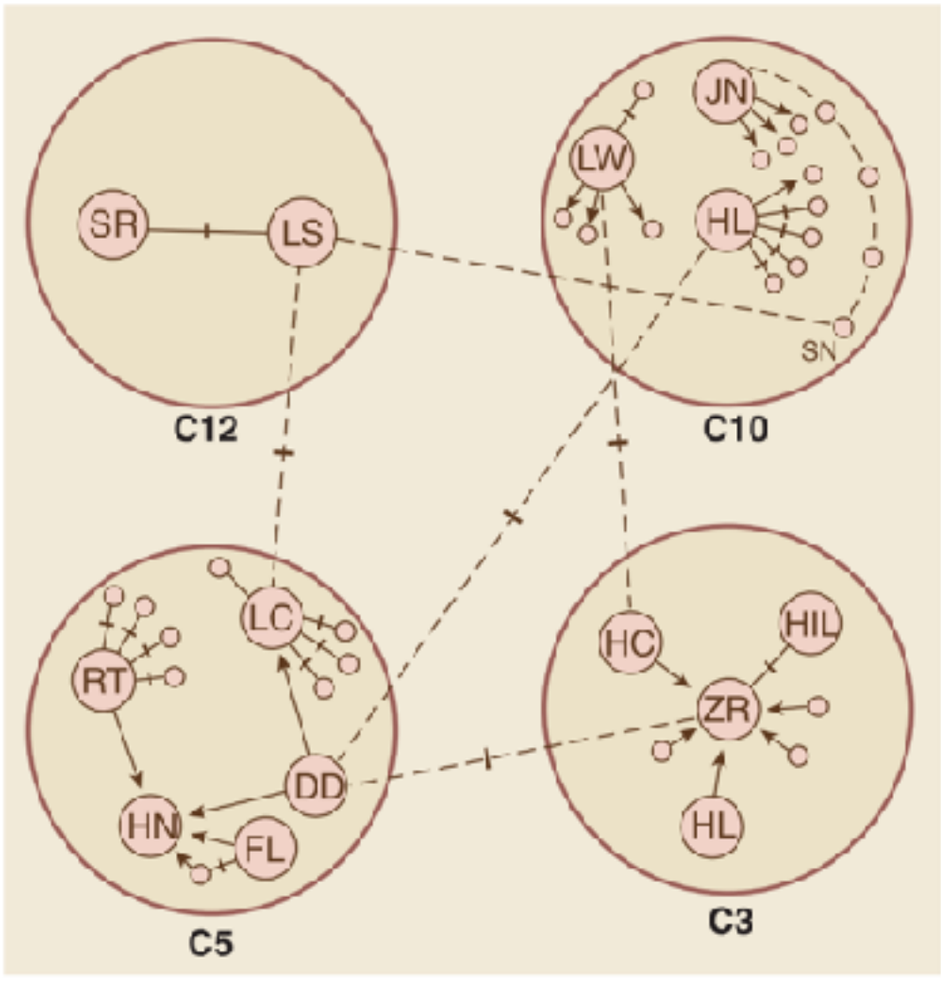
Melvin Wevers

Adina Nerghes

KNAW Humanities Cluster DIGITAL HUMANITIES LAB

Jacob Moreno and the Birth of Social Network Analysis

- Psychiatrist and psychodrama founder
- Moreno conducted studies to research group behavior using "sociometric tests”
- The four features of social network analysis (Freeman, 2004):
  - Motivated by a structural intuition based on ties linking social actors
  - Grounded in systematic empirical data
  - Use of graphic imagery
  - Relied on the use of mathematical and/or computational models



Moreno’s network of runaways.

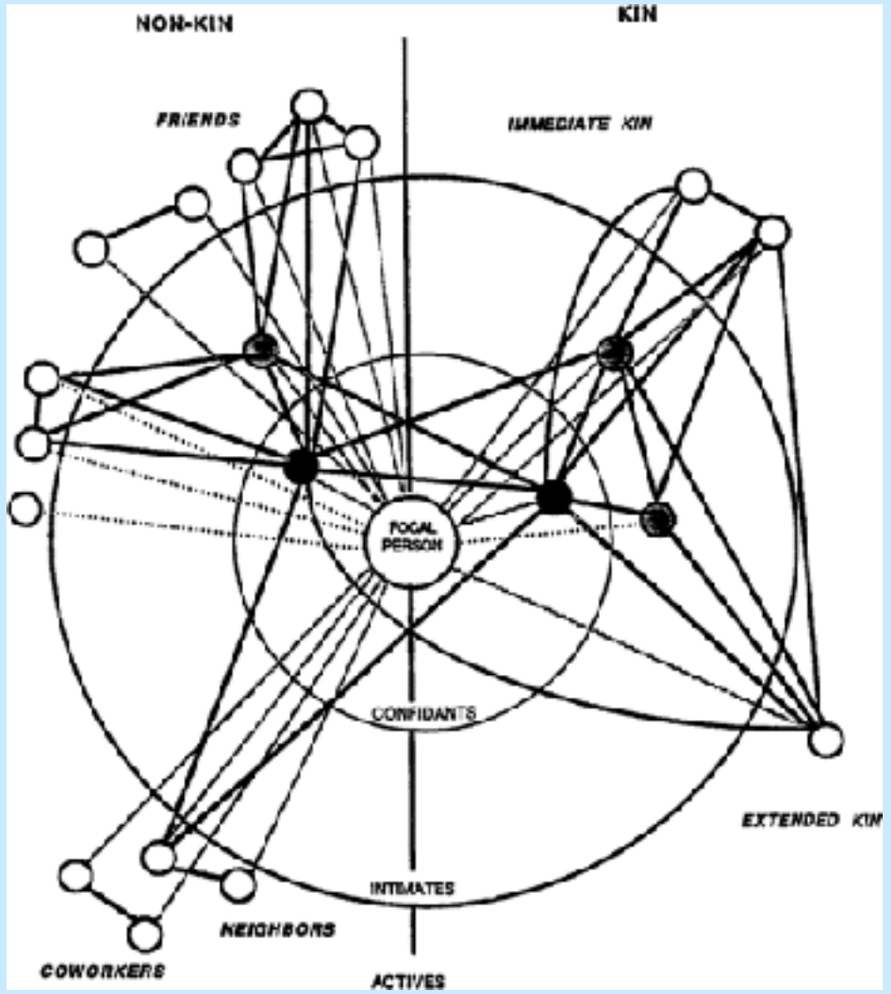
(Freeman, 2004)

A relational and structural perspective

- The network perspective involves the study of entities as embedded in a network of **relations** and seek explanations for social behavior in the **structure** of these networks rather than in the individuals alone

- **Not just a methodology:** it is a unique perspective on how society functions. Instead of focusing on individuals and their attributes, or on macroscopic social structures, it centers on **relations**

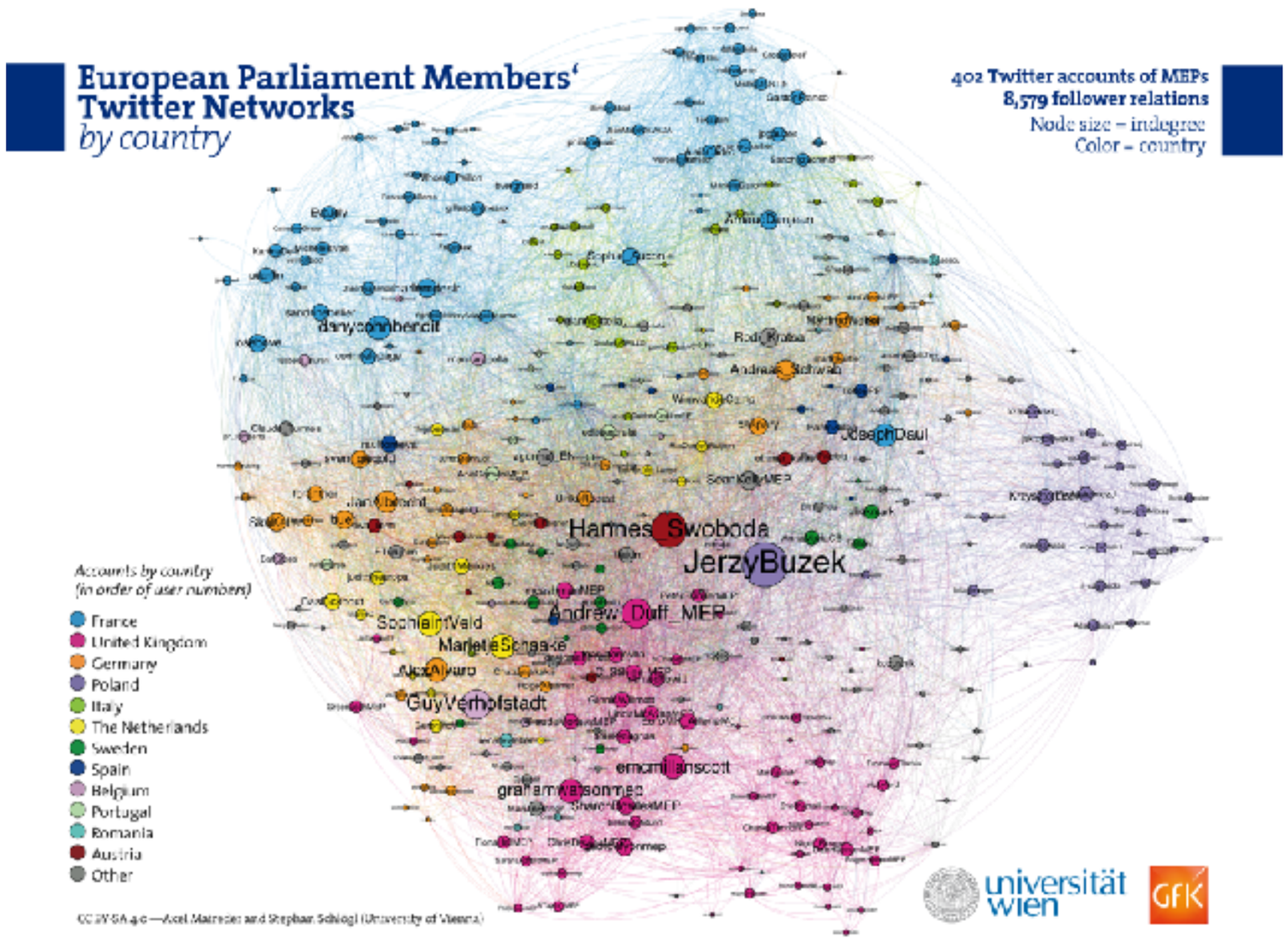
- Applications:
  - Understand how to improve the **effectiveness** of a network
  - Uncover **patterns** in relationships or interactions
  - Find/follow **paths** that information flows
  - Identify **key** players
  - Test **hypotheses**
  - Promote social **cohesion**



This is an early depiction of what we call an ‘ego’ network, i.e. a personal network. The graphic depicts varying tie strengths via concentric circles (Wellman, 1998)

Similarities			Social Relations				Interactions	Flows
Location	**Membership**	**Attribute**	**Kinship**	**Other role**	**Affective**	**Cognitive**	e.g.,	e.g.,
e.g.,	e.g.,	e.g.,	e.g.,	e.g.,	e.g.,	e.g.,	Sex with	Information
Same spatial and temporal space	Same clubs	Same gender	Mother of	Friend of	Likes	Knows	Talked to	Beliefs
	Same events	Same attitude	Sibling of	Boss of	Hates	Knows about	Advice to	Personnel
	etc.	etc.		Student of	etc.		Helped	Resources
				Competitor of		Sees as happy	Harmed	etc.
						etc.	etc.	

(Borgatti et. al., 2009)



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Similarities			Social Relations				Interactions	Flows
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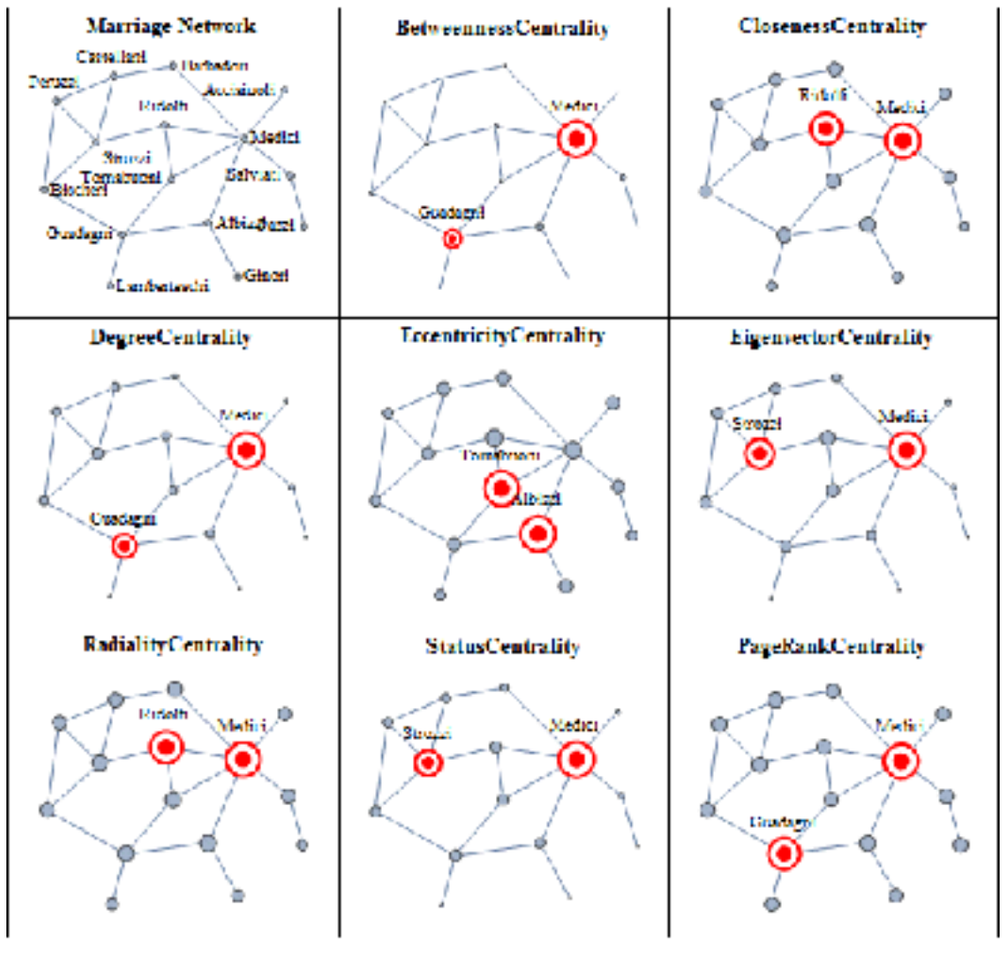
				Competitor of		Sees as happy	Harmed	etc.
						etc.	etc.	



Centrality and Prestige of Florentine Families

https://www.wolfram.com/mathematica/new-in-9/social-network-analysis/centrality-and-prestige-of-florentine-families.html

Similarities			Social Relations				Interactions	Flows
Location	**Membership**	**Attribute**	**Kinship**	**Other role**	**Affective**	**Cognitive**	e.g.,	e.g.,
e.g.,	e.g.,	e.g.,	e.g.,	e.g.,	e.g.,	e.g.,	Sex with	Information
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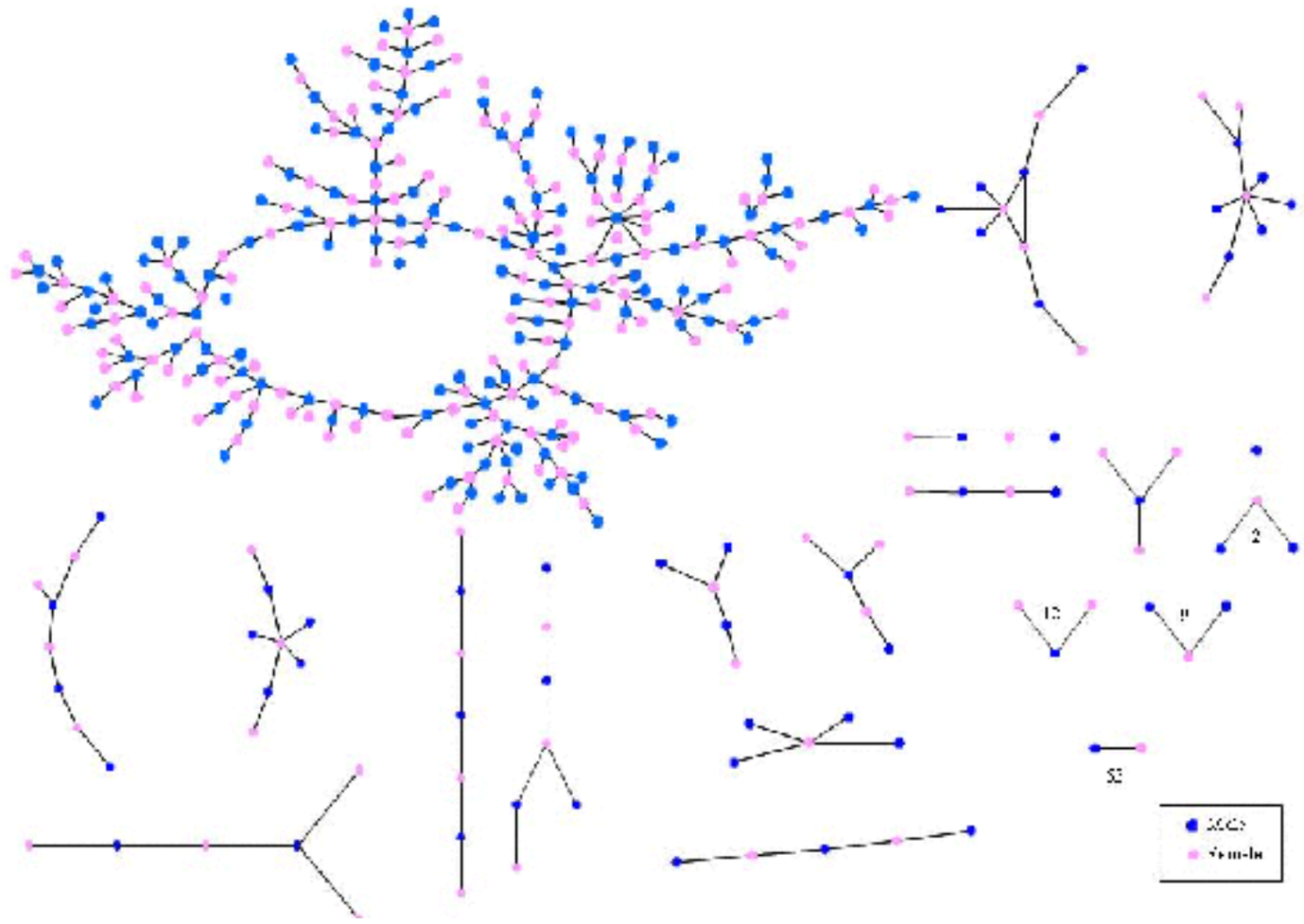
						etc.	etc.	



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Bearman, P. S., Moody, J., & Stovel, K. (2016). *Chains of affection: The structure of adolescent romantic and sexual networks*. Handbook of Applied System Science, 110(1), 164–190.

Similarities			Social Relations				Interactions	Flows
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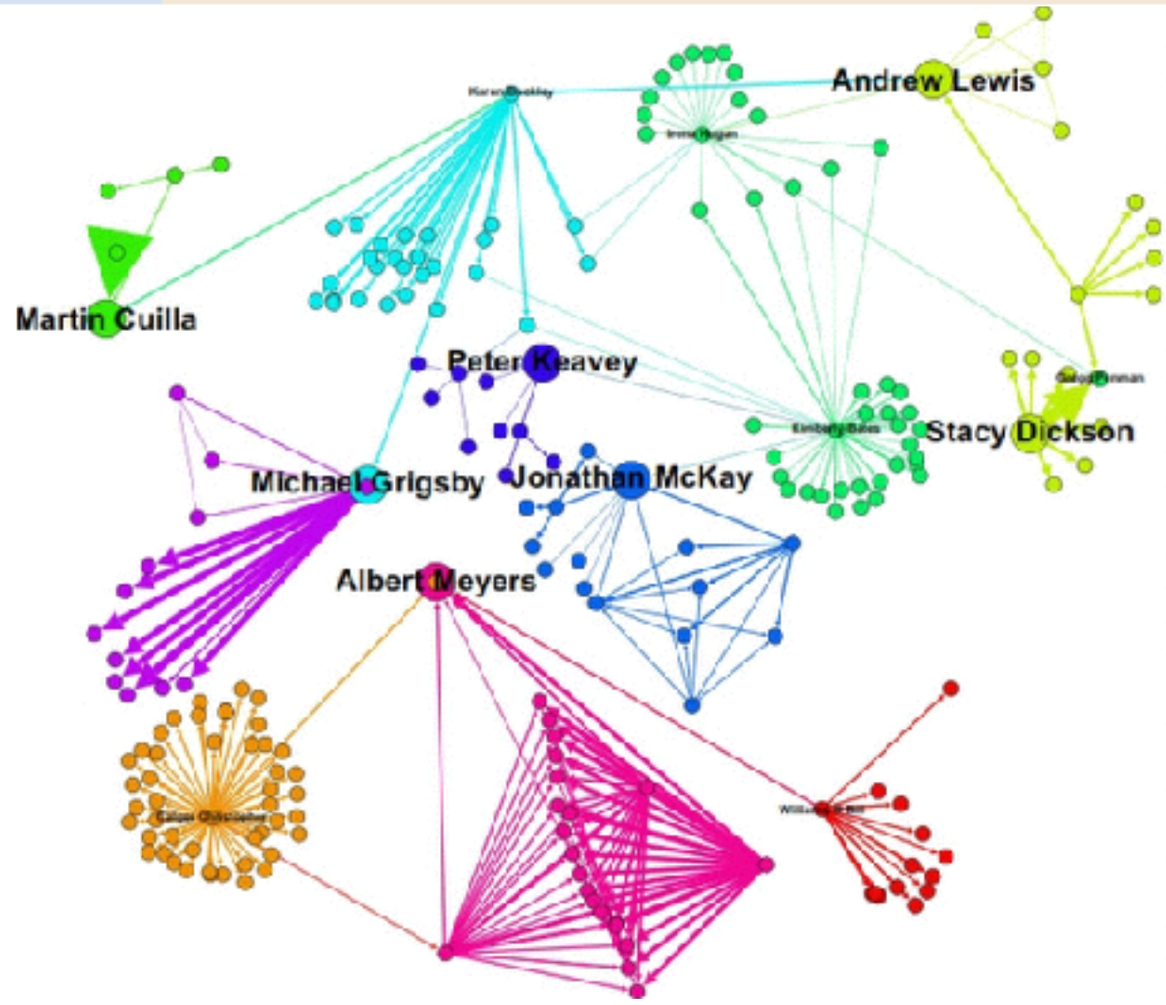


A reduced social network depicting email flow from group leaders in a number of groups in Enron.

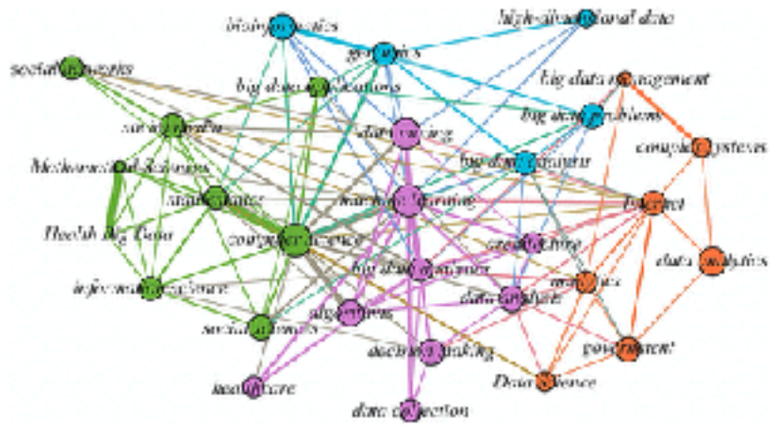
Irons, A., & Lallie, H. (2014). *Digital Forensics to Intelligent Forensics*. Future Internet, 6(3), 584–596.

Semantic networks

- Defined as: ``representational format [that would] permit the `meanings' of words to be stored, so that humanlike use of these meanings is possible'' (Quillian, 1968, p. 216)

- The meaning of a word could be represented by the set of its verbal associations

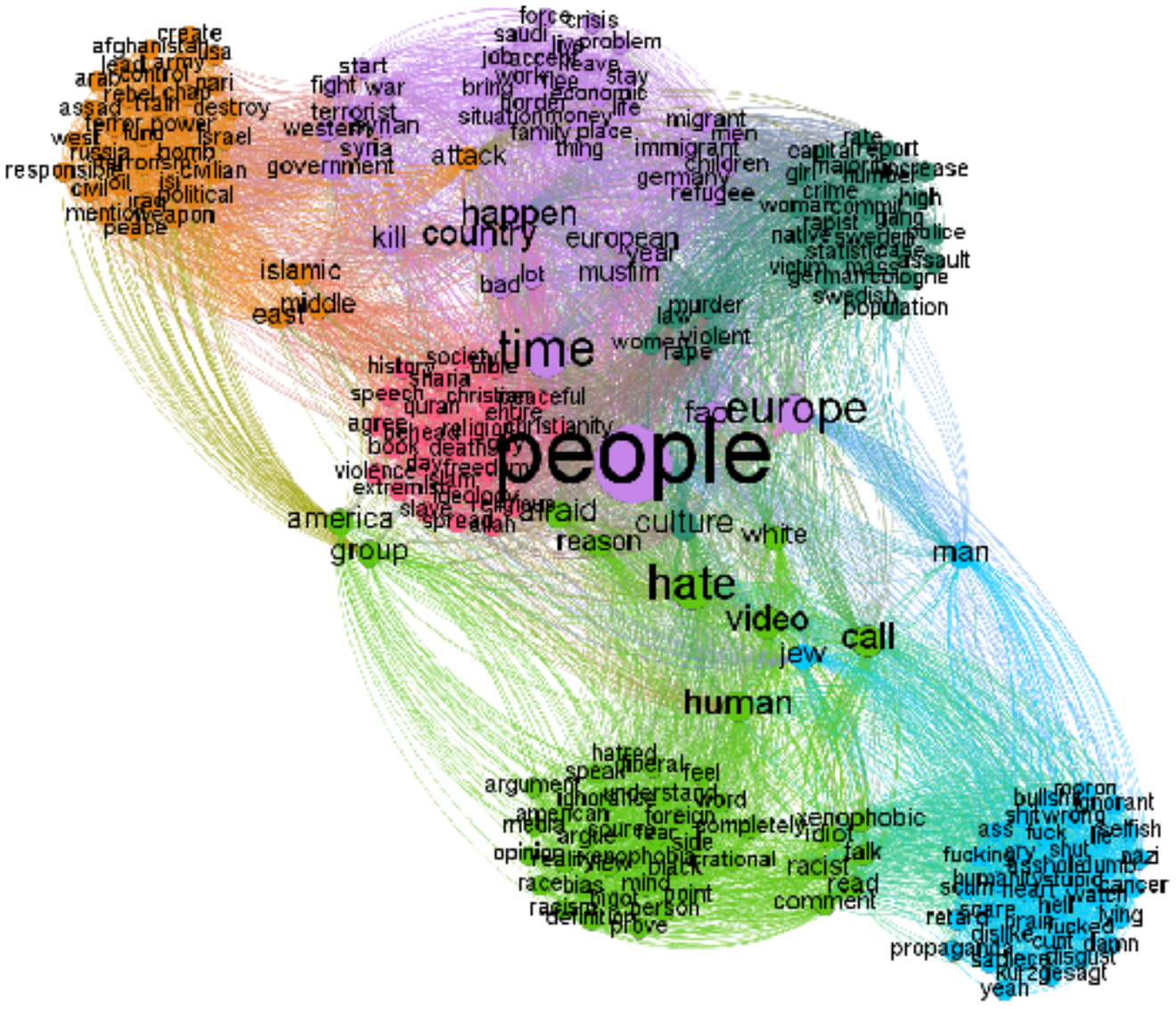
- Basic assumption: language (is) can be modeled as networks of words and the (lack of) relations among words



Networks of words

Semantic Networks

Networks of concepts



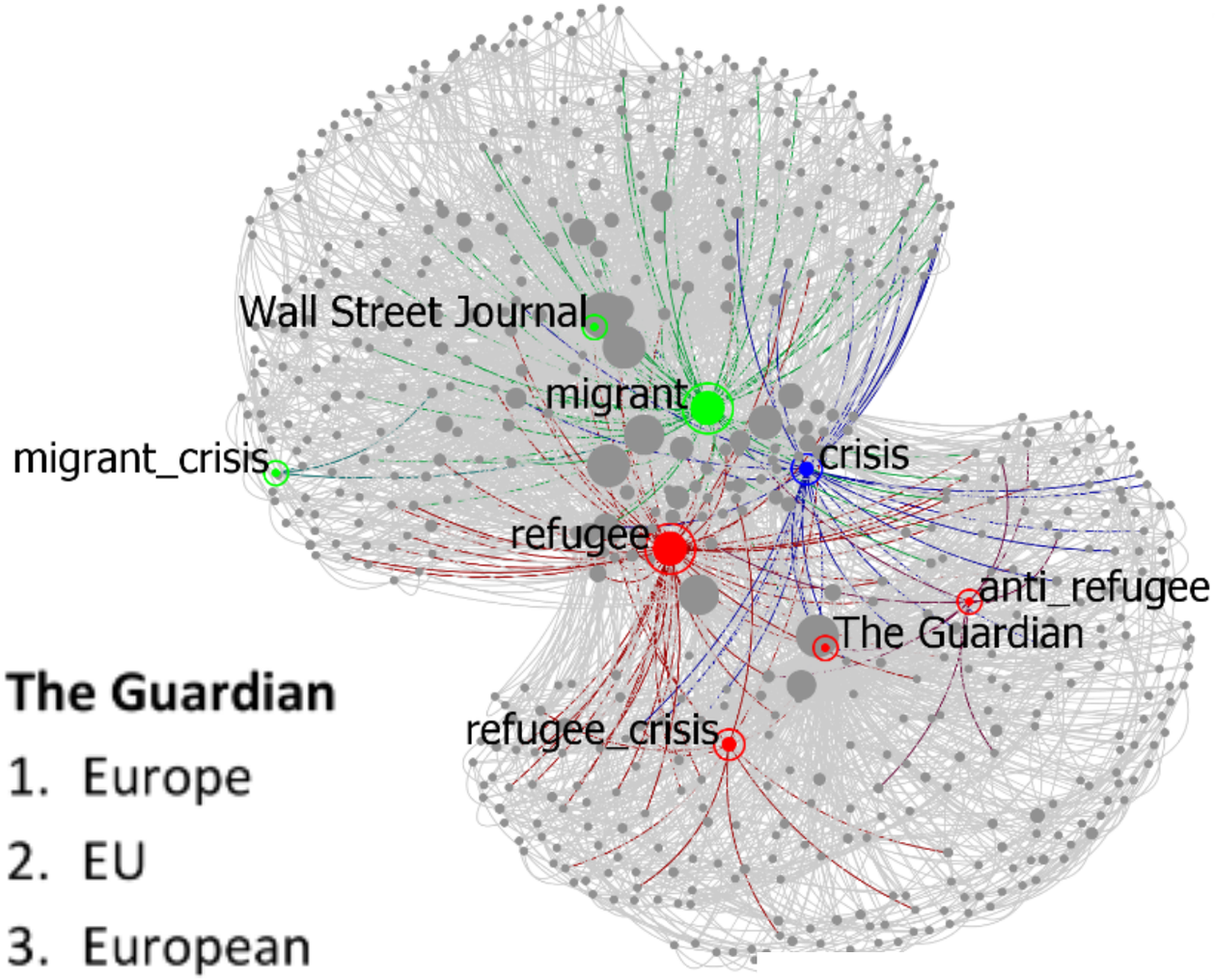
Content networks

Co-word maps

Maps

What makes semantic networks interesting?

- Correspond to a natural way of **organizing information** and the way humans think
- Semantic networks allow to **model** semantic relationships (Sowa, 1991)
- Investigate the meaning of texts by detecting the **relationships** between and among words and themes (Alexa, 1997; Carley, 1997a)
- Allow the analysis of words in their **context** (Honkela, Pulkki, & Kohonen, 1995)
- Expose semantic **structures** in document collections (Chen, Schuffels, & Orwig, 1996)
- Very **flexible** way of organizing data: you can easily **extend** the structure of semantic networks if needed
- You can easily convert **almost any** other data structure into semantic networks
- To represent **knowledge** or to support automated systems for reasoning about knowledge.

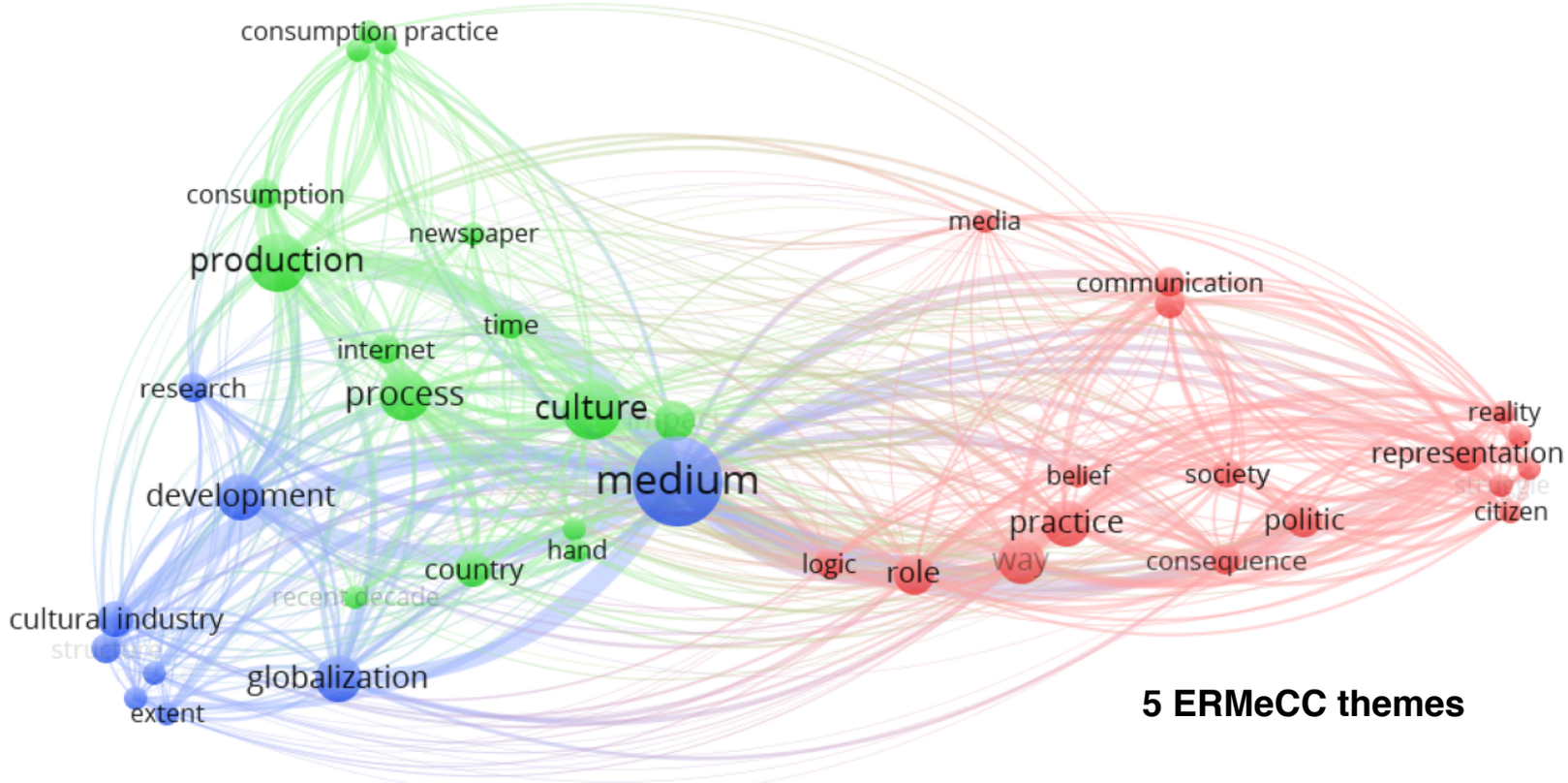


Wall Street Journal

1. Balkan
2. People
3. Asylum
4. Germany
5. Asylum seeker

The Guardian

1. Europe
2. EU
3. European
4. Poland
5. Bad



5 ERMeCC themes

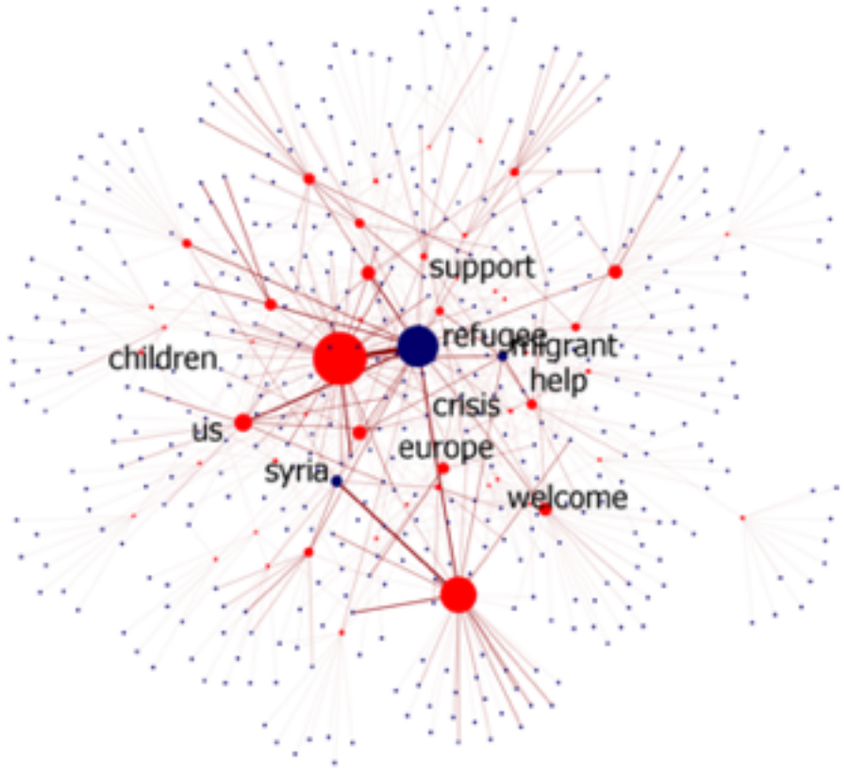
Socio-semantic networks

- The socio-semantic framework can account for the **meaning** structure along with the underlying **social** structures

- Can map not only how **meaning** is created through word co-use but also map this to the **pattern** of users connected to words and user interactions

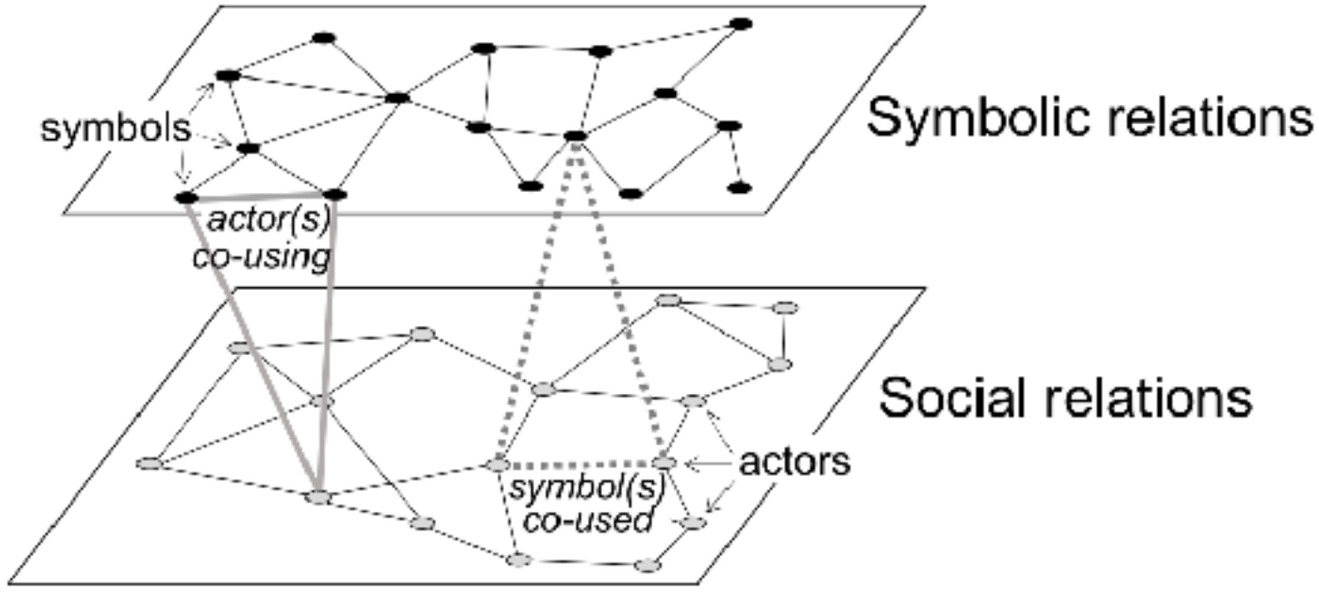
- Based on 2-mode networks:

    - two-mode representations of actors/ entities and the concepts they employ



Socio-semantic networks

- Actors can be related to each other through the different symbolic forms they use, e.g. ideologies, as in a two-mode network of actors and symbols.

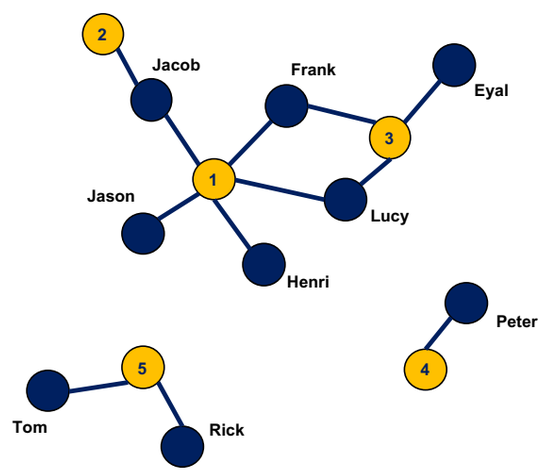


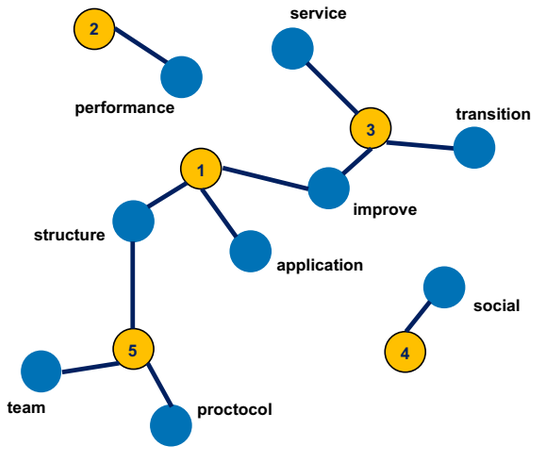
Fuhse, J., Stuhler, O., Riebling, J., & Martin, J. L. (2019). Relating social and symbolic relations in quantitative text analysis. A study of parliamentary discourse in the Weimar Republic. Poetics.

Ideas with impact:
How connectivity shapes idea diffusion

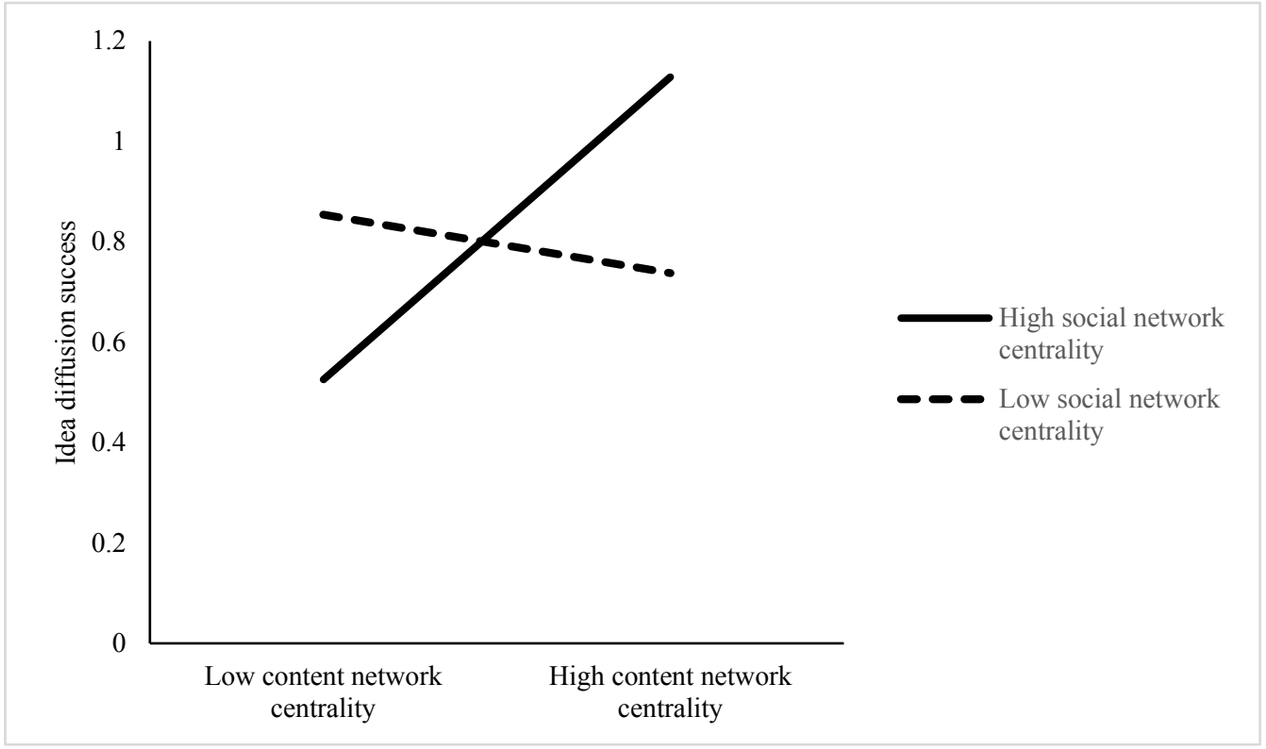
- A **positive interaction** between content and social network connectivity

- The highest diffusion success can be attributed to publications with **high content connectivity** and **high social connectivity**





- Ideas which **bridge** different knowledge domains in the content network will amass even **more citations** when they are developed by teams that are **highly connected** in the social network of co-authorship teams



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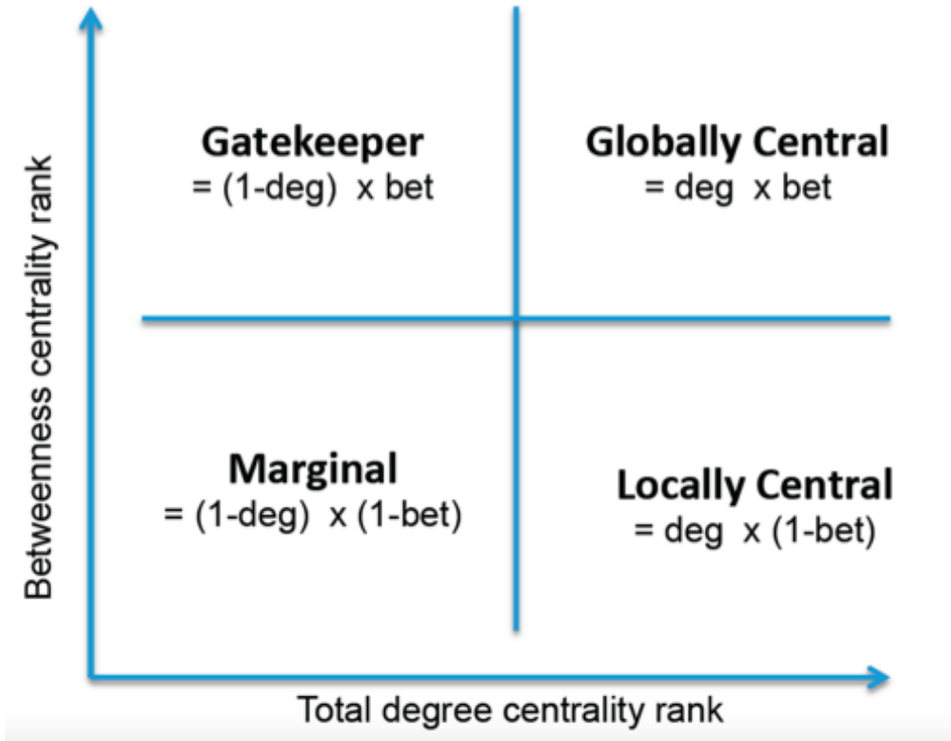
Deichmann, D., Moser, C., Birkholz, J., Nerghes, A., Groenewegen, P., & Wang, S. (2020). *Ideas with Impact: How Connectivity Shapes Idea Diffusion*. Research Policy, 49(1).

The Structural Space

- The joint analysis of degree and betweenness centralities
- Useful in identifying those nodes that defy patterns often found in various network topologies



- **Total Degree Centrality**
  - Local measure
  - Popular concepts
  - Important
  - A hot topic's central key concept
  - Able to activate many other key concepts
- **Betweenness Centrality**
  - Global measure
  - Connective
  - Influential
  - Controls access to other key concepts
  - Gatekeepers between different domains

$$C_{\mathrm{D}}^{\mathrm{rank}}(i) = 100 \cdot \frac{j}{n} \mid \left(x_j^{\mathrm{ordered}} = C_{\mathrm{D}}(i)\right)$$

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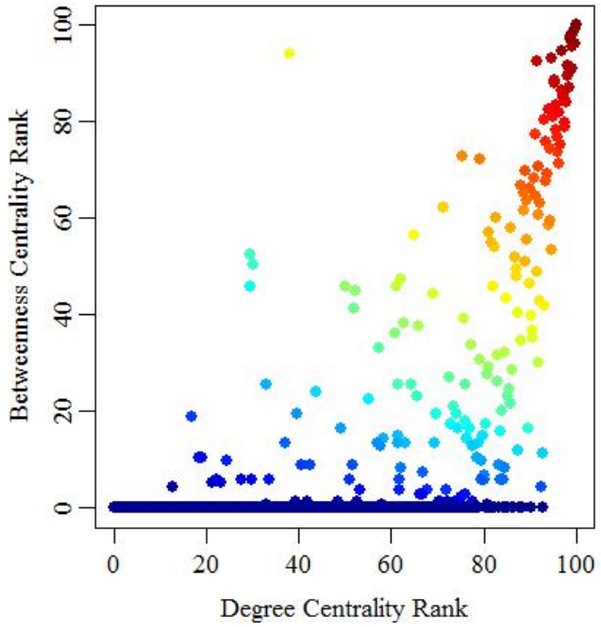
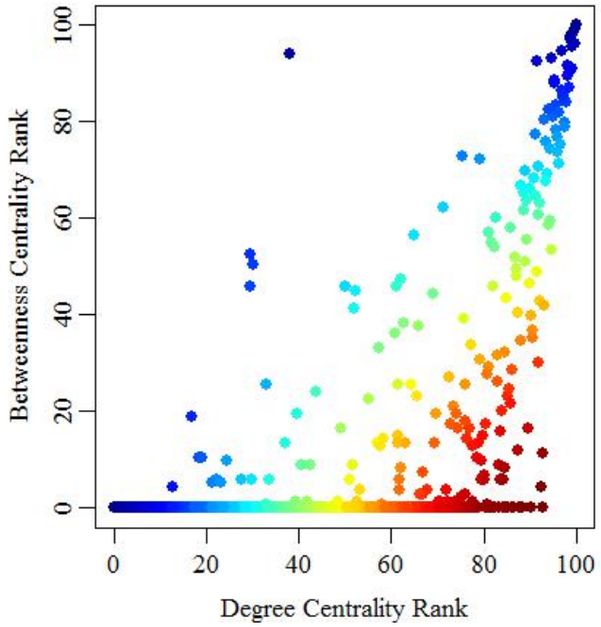
Nerghes, A., Lee, J. S., Groenewegen, P., & Hellsten, I. (2015). *Mapping discursive dynamics of the financial crisis: a structural perspective of concept roles in semantic networks*. Computational Social Networks, 2(1), 16.

4 Structural Roles

High popularity
+
High connectivity



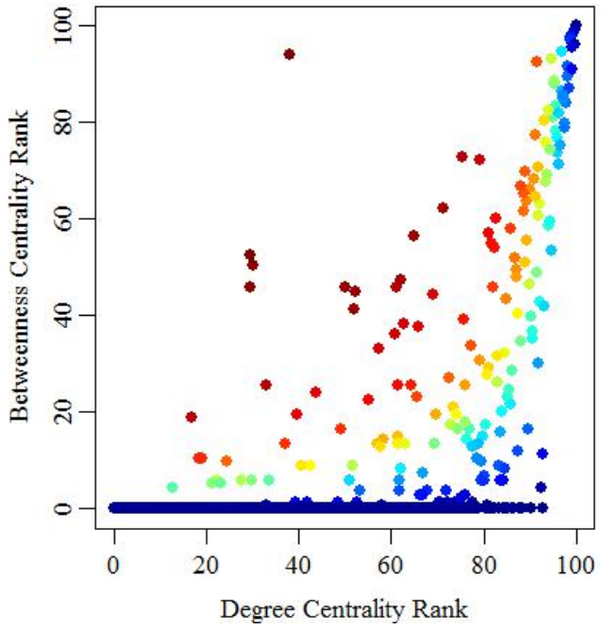
(a) Globally Central (GC)



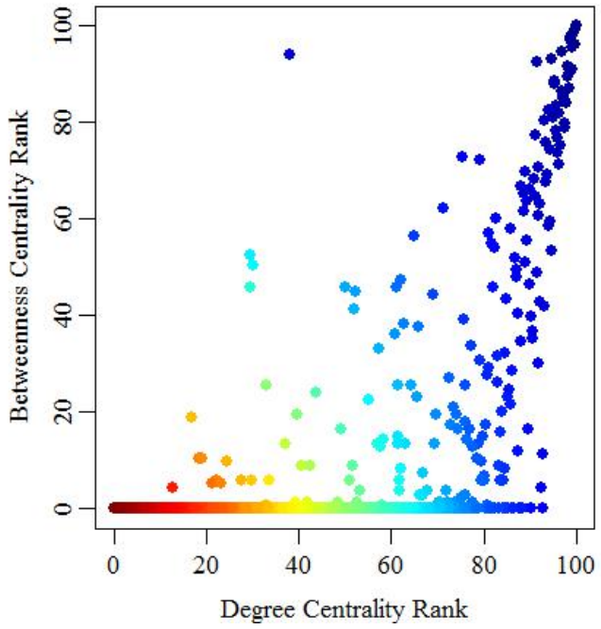
(b) Locally Central (LC)

High popularity (local)

High connectivity



(c) Gatekeepers (G)

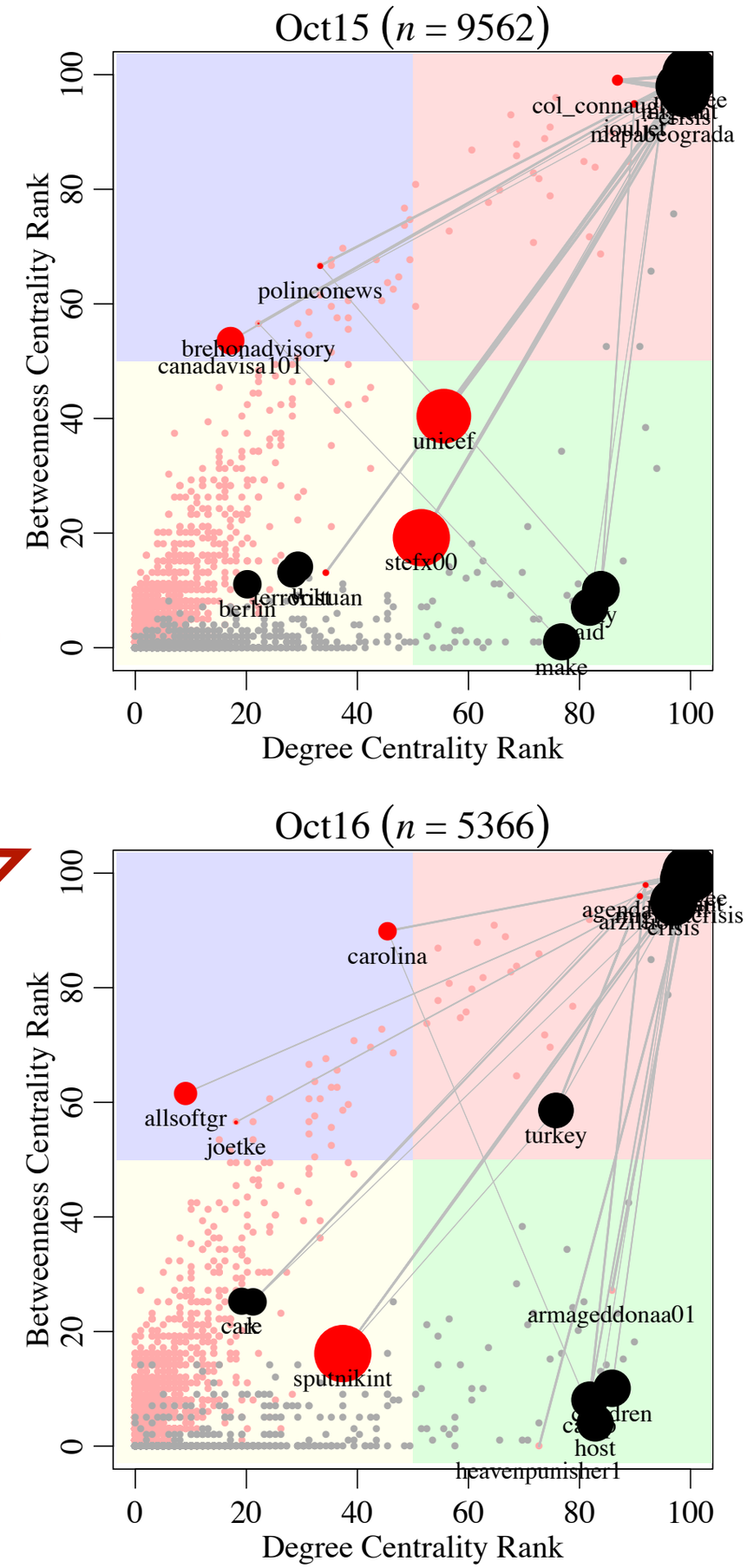


(d) Marginal (M)

Potential

Shifts in perspectives and positions on Twitter on the Refugee Crisis

- `refugee', `migrant', and `crisis' at the center of the debate (GC) throughout
- Aid organizations enter the debate strategically positioned to span discussion communities
- By Oct16, charitable and issue-oriented organizations are replaced by 'self-proclaimed' activists
- Marginalized issues and individual enter the debate (refugee camps within Africa)



Thank you!

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“Whenever we look at life, we look at networks.” - Fritjof Capra

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