

Network science meets Digital humanities: **MANY** challenges and **ONE** success story

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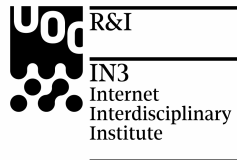
**Diana
Roig Sanz**



**Elisabet
Carbó Catalan**



**Ainamar
Clariana Rodagut**







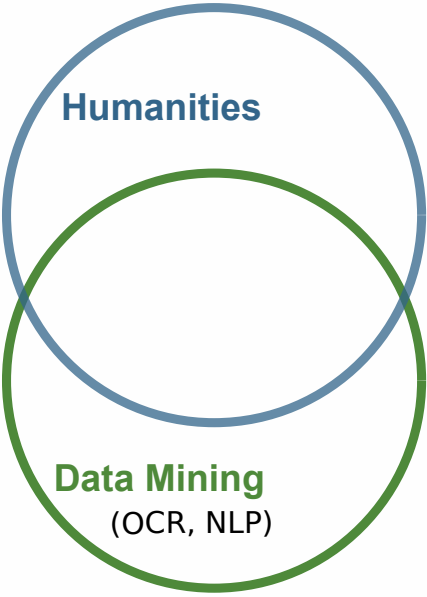
I want
to be best in
point of view.
Translation
another language;
language foreign to
written communication
might



What are Digital Humanities?



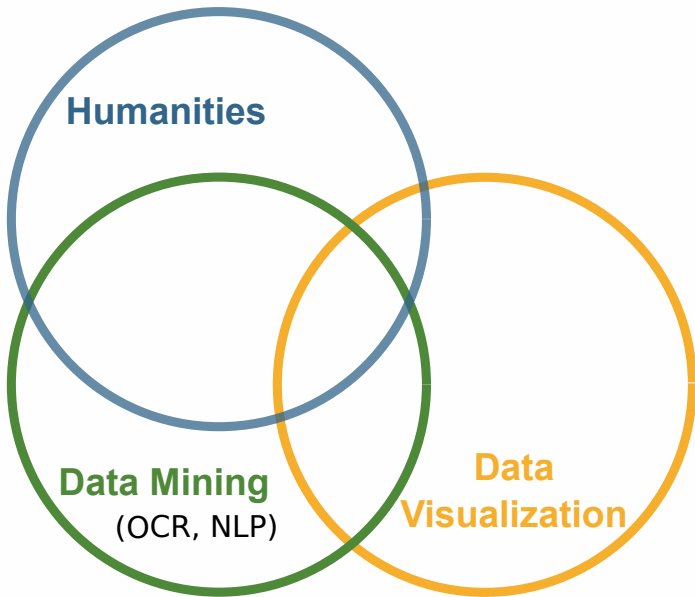
Humanities

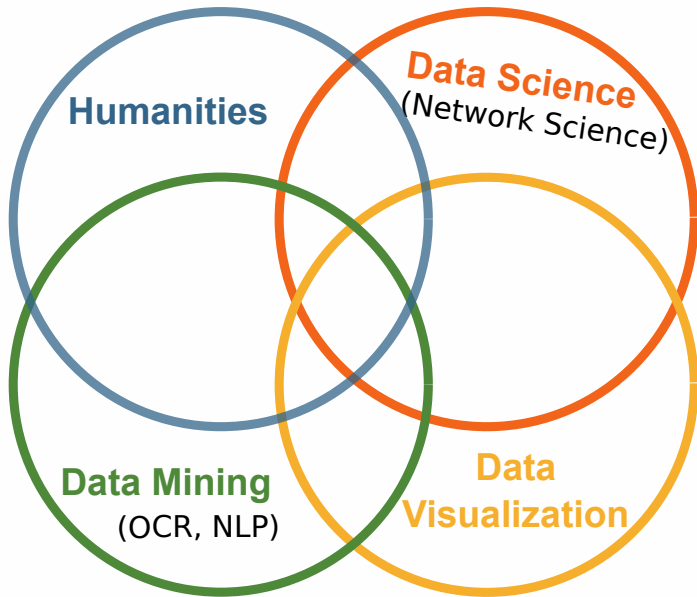


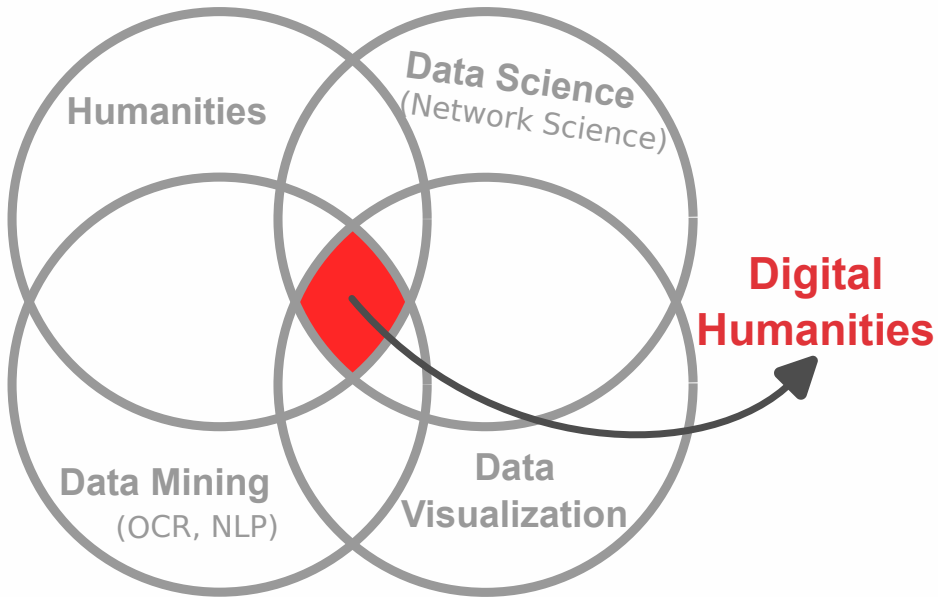
A Venn diagram consisting of two overlapping circles. The top circle is blue and labeled 'Humanities'. The bottom circle is green and labeled 'Data Mining (OCR, NLP)'. The circles overlap in the center, representing the intersection of the two fields.

Humanities

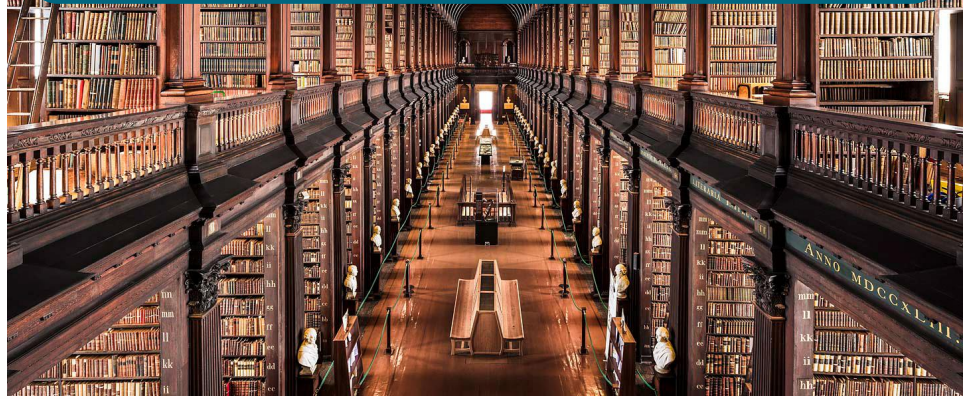
Data Mining
(OCR, NLP)







How complexity science can help us in
addressing research questions
*relevant for scholars working in art and
humanities?*



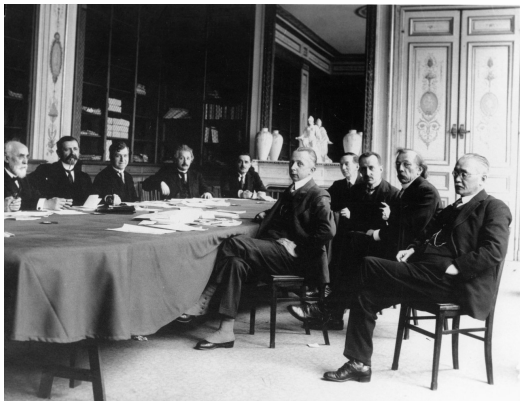
Geopolitics of intellectual cooperation during the interwar period





International Committee on Intellectual Cooperation (ICIC)

- Founded in 1922.
- Based in Geneva.
- Advisory organization of the League of Nations.



- <https://unesco.libguides.com/IICI>

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International Institute of Intellectual Cooperation (IIIC)

- Founded in 1926.
- Based in Paris.
- Created to support the work ICIC as an **executive branch**.
- Ancestor of UNESCO.

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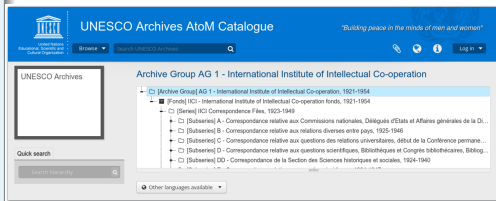




What was the **role** played by countries in the web of global intellectual cooperation?

The data: UNESCO's archives

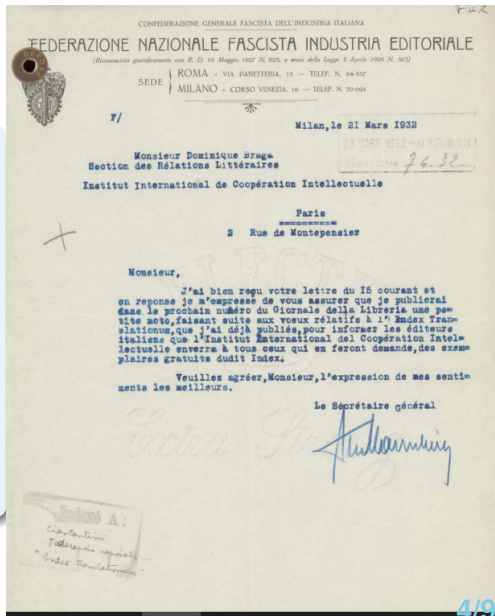
- 1 Scanned documents of one folder (folder A: *internal affairs*) of the IIIC's archive.



<https://atom.archives.unesco.org/iiic>

The data: UNESCO's archives

- 1 Scanned documents of one folder (folder A: *internal affairs*) of the IIC's archive.
- 2 Over the 59,820 documents available in folder A, we extract 4,265 typewritten letters with an **origin** and **destination** locations.

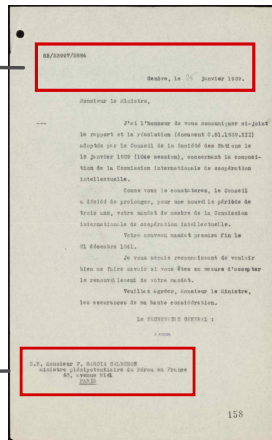


The data: UNESCO's archives

- 1 Scanned documents of one folder (folder A: *internal affairs*) of the IIC's archive.
- 2 Over the 59,820 documents available in folder A, we extract 4,265 typewritten letters with an **origin** and **destination** locations.

Origin
Country
(Switzerland)

Destination
Country
(France)



Method: Network cartography in a nutshell

Method: Network cartography in a nutshell

- A technique to **assign roles to nodes** by studying their connectivity pattern.

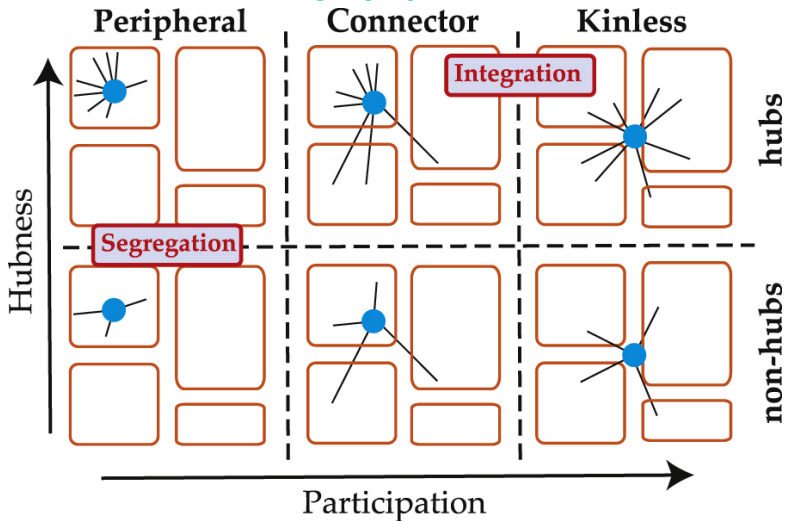
- R. Guimerá, and L. A. N. Amaral, "*Functional cartography of complex metabolic networks*". Nature, **433**, 895, (2005). DOI: [10.1038/nature03288](https://doi.org/10.1038/nature03288)

Method: Network cartography in a nutshell

- A technique to **assign roles to nodes** by studying their connectivity pattern.
- **It requires a partition of the network into groups** (*i.e.*, the results *depend* on the partitioning criterion).

• R. Guimerá, and L. A. N. Amaral, “*Functional cartography of complex metabolic networks*”. Nature, **433**, 895, (2005). DOI: [10.1038/nature03288](https://doi.org/10.1038/nature03288)

Method: Network cartography in a nutshell



- F. Klimm, et al. "Individual node's contribution to the mesoscale of complex networks". New Journal of Physics, **16**, 125006, (2014). DOI: 10.1088/1367-2630/16/12/125006

Method: Network cartography in a nutshell



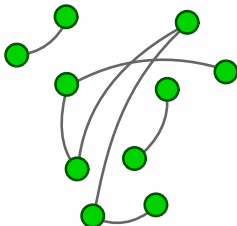
Results

Results

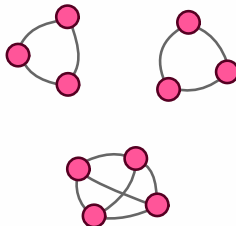
Modularity

$$Q = \frac{1}{2E} \sum_{i,j=1}^N \left[a_{i,j} - \frac{k_i k_j}{2E} \right] \delta(g(i), g(j))$$

$Q \approx 0$



$Q \simeq 1$



Results

Results

N_{comms}	15
Q	0.242

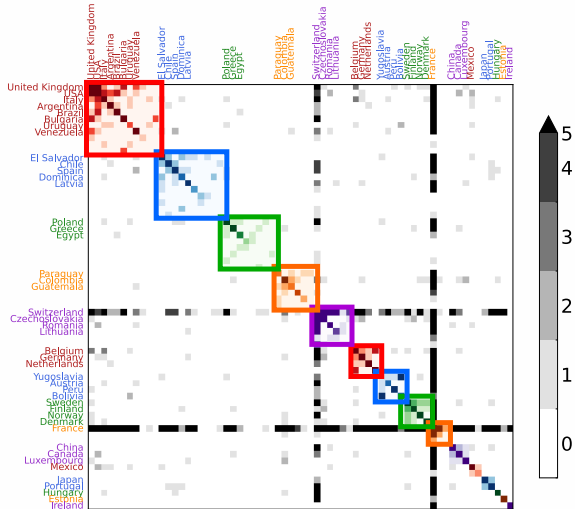
- V. A. Traag, et al. "From Louvain to Leiden: guaranteeing well-connected communities". Sci. Rep., **9**, 5233, (2019). DOI: [10.1038/s41598-019-41695-z](https://doi.org/10.1038/s41598-019-41695-z)

Results

N_{comms}
 Q

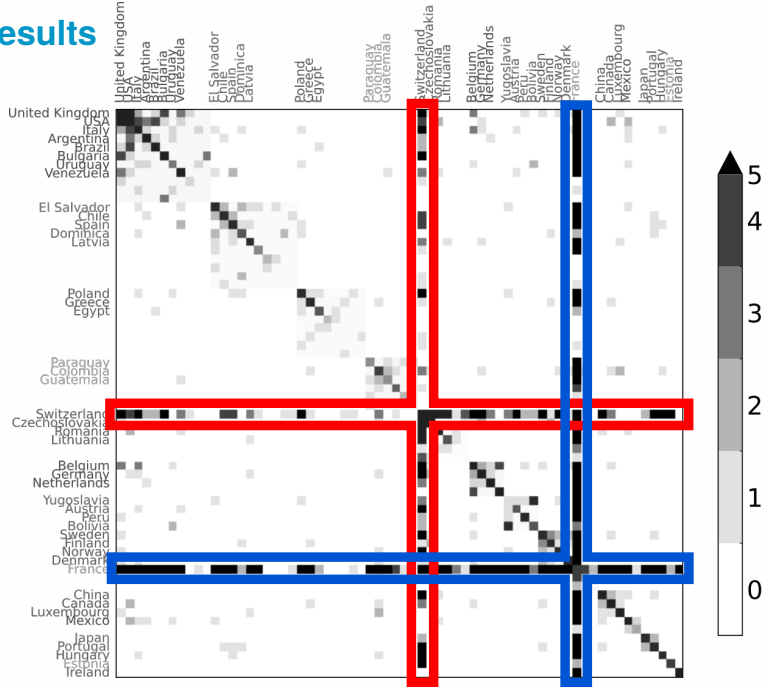
15

0.242

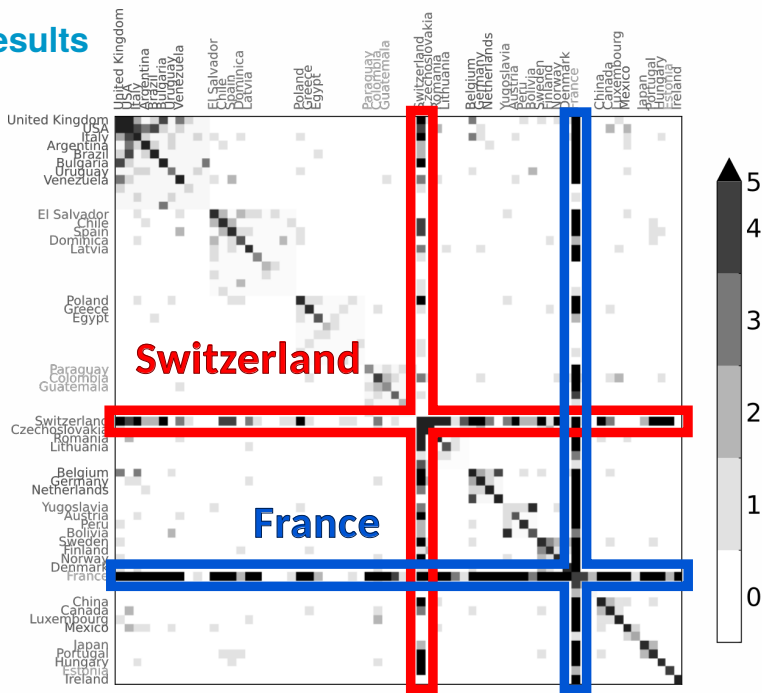


• V. A. Traag, et al. "From Louvain to Leiden: guaranteeing well-connected communities". Sci. Rep., 9, 5233, (2019). DOI: 10.1038/s41598-019-41695-z

Results



Results



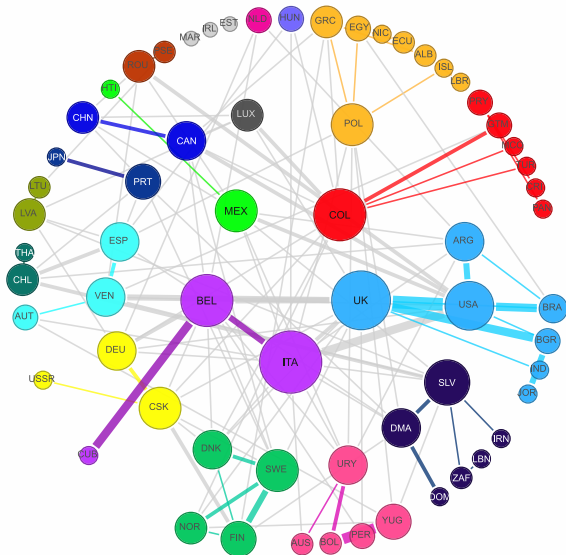
Was there intellectual cooperation
beyond that *with* (and *between*)
France and Switzerland?

Results

N_{comms}
 Q

21

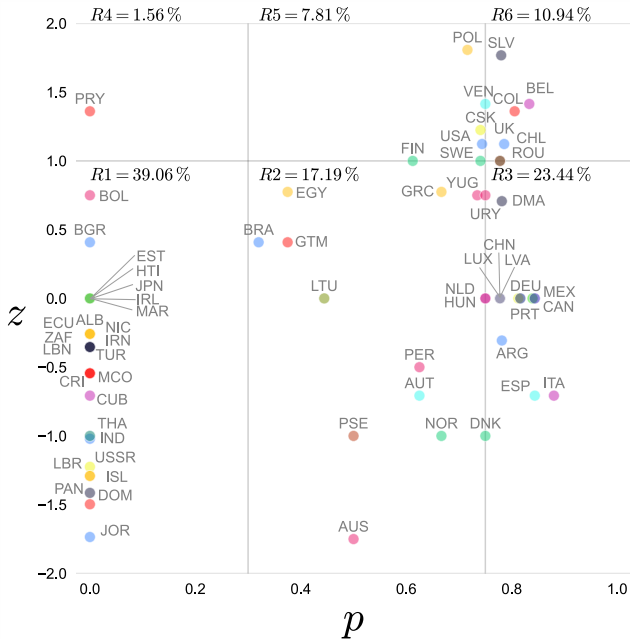
0.787



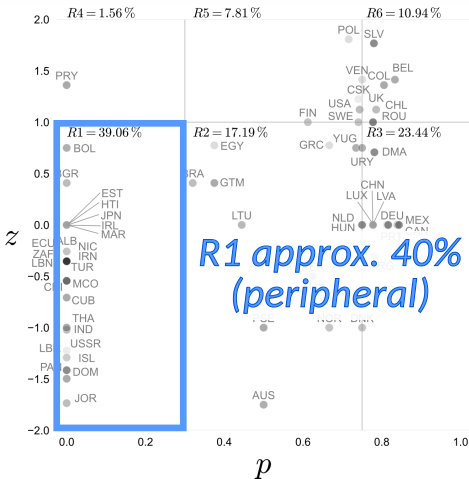
• R. Rodríguez-Casañ *et al.*, Hum. Soc. Sci. Commun. **11**, 1408 (2024).

DOI: 10.1057/s41599-024-03829-1

Results



Results



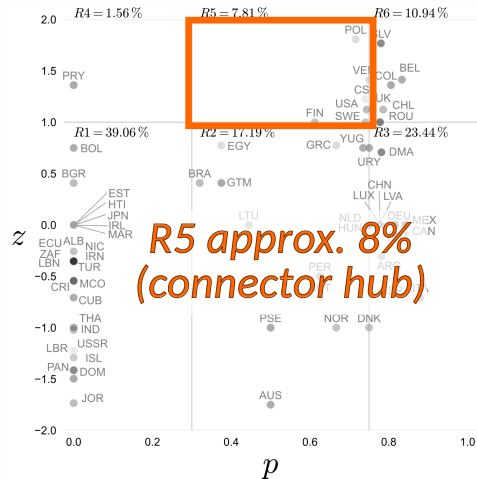
R1

Estonia, Iceland, Monaco, **USSR**, Ireland, Bulgaria, Albania, Turkey, Morocco, Nicaragua, Cuba, Panama, Costa Rica, Haiti, Ecuador, Bolivia, Dominican Republic, Iran, Jordan, Lebanon, South Africa, Liberia, **India**, **Japan**, Thailand.

• R. Rodríguez-Casañ *et al.*, Hum. Soc. Sci. Commun. **11**, 1408 (2024).

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Results

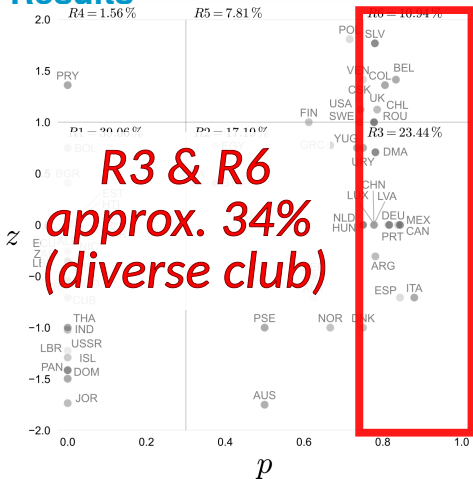


R5 United States of America, Sweden, Finland, Czechoslovakia, Poland.

• R. Rodríguez-Casañ *et al.*, Hum. Soc. Sci. Commun. **11**, 1408 (2024).

DOI: 10.1057/s41599-024-03829-1

Results



R6

Belgium, United Kingdom,
Romania, Chile, **Colombia,**
El Salvador, Venezuela.

R3

Italy, Spain, Portugal, Germany,
Hungary, Netherlands,
Luxembourg, **Denmark,** Latvia,
China, Canada, Mexico,
Argentina, Uruguay, Dominica.

- R. Rodríguez-Casañ *et al.*, Hum. Soc. Sci. Commun. **11**, 1408 (2024).

DOI: 10.1057/s41599-024-03829-1

- M. A. Bertolero, *et al.* "The diverse club." Nat. Comms. **8**, 1277, (2017).

DOI: 10.1038/s41467-017-01189-w

Conclusions

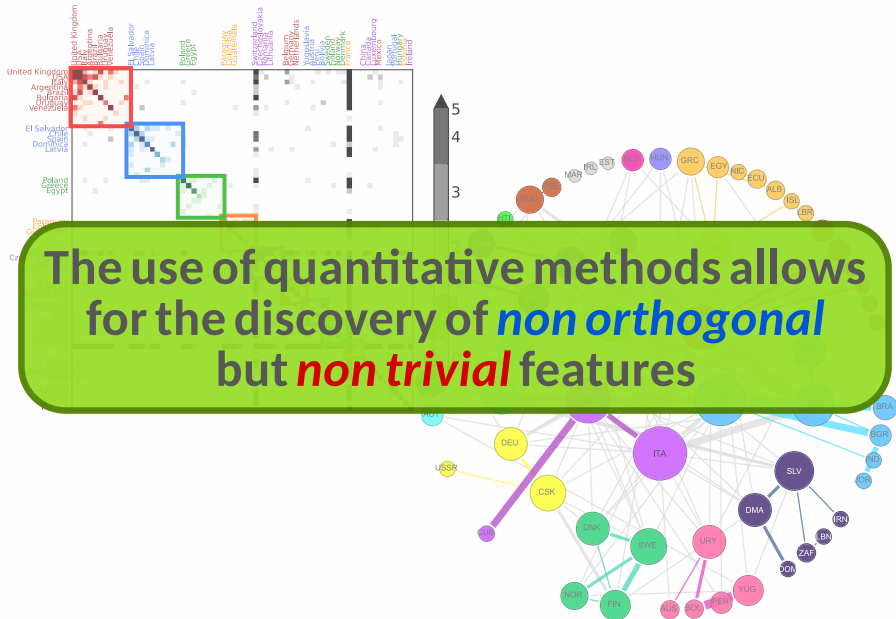
Take Home Messages



Digital humanities *ARE an opportunity* for Complexity science



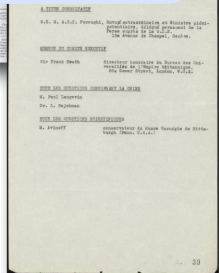
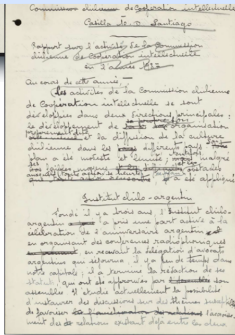
Take Home Messages



Take Home Messages



All that glitters is not gold: we have to deal with *biased*, *unstructured*, *incomplete*, and *noisy* data.



Acknowledgments II



DOI: 10.1057/s41599-024-03829-1

Open Dataset
DOI: 10.34810/data985

Acknowledgments II



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The shameless plug



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Universidad de Zaragoza, Spain
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Universitat Rovira i Virgili, Spain

Program Chairs:

- Carmen Cabrera
University of Liverpool, UK
- Alessio Cardillo
Universitat de Barcelona, Spain



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Extra content

Cartography

within module degree κ

$$\kappa_i = \sum_j a_{ij} \delta_{c_i, c_j}$$

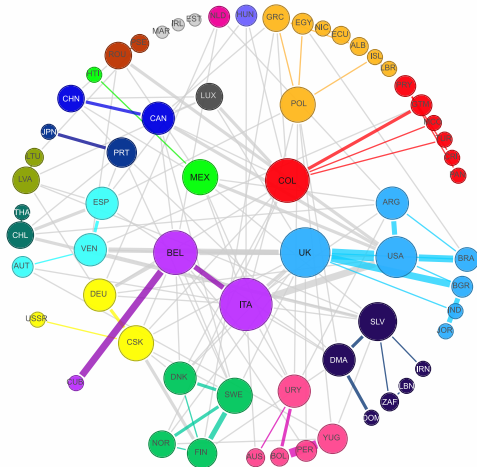
hubness z

$$z_i = \frac{\kappa_i - \overline{\kappa_{c_i}}}{\sigma_{\kappa_{c_i}}}$$

Participation coefficient p

$$p_i = 1 - \sum_j^{N_c} \left(\frac{\kappa_i(c_j)}{k_i} \right)^2$$

IIIC – partition into groups



C1 **Poland**, Greece, Albania, Nicaragua, Ecuador, Iceland, Egypt, and Liberia.

C2 **United Kingdom**, **United States of America**, Argentina, Brazil, Bulgaria, India, and Jordan.

C3 **Colombia**, **Paraguay**, **Guatemala**, Monaco, Turkey, **Costa Rica**, and **Panama**.

C6 Sweden, Denmark, Norway, and Finland.

C7 Spain, Austria, and Venezuela.

C8 Germany, Czechoslovakia, and USSR.

C9 **Belgium**, **Italy**, and Cuba.

Others All other countries.

IIIC – Historical grouping

Group's name	Countries
EU western and USA	France, United Kingdom, Switzerland, Germany, Italy, Belgium, The Netherlands, Spain, and United States of America
EU central countries	Austria, Czechoslovakia, Hungary, and Poland
EU eastern countries	Albania, Bulgaria, Greece, Yugoslavia, and Romania
Baltic countries	Estonia, Latvia, and Lithuania
Nordic countries	Denmark, Finland, Norway, Iceland, and Sweden
Latin countries	Portugal, Argentina, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Chile, Dominican Republic, Ecuador, Dominica, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, Paraguay, El Salvador, Uruguay, and Venezuela
UK's Dominions	Australia, Canada, India, South Africa, and Ireland
Colonies	Egypt, Benin, French Guiana, Haiti, Turkey, Lebanon, Jordan, Morocco, and Palestine
Eastern countries	China, Japan, Cambodia, and Thailand
Middle East	Iran
Other countries	Luxembourg, Monaco, Liberia, and USSR

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