



LIBRARY AND INFORMATION CENTER OF
THE HUNGARIAN ACADEMY OF SCIENCES
DEPARTMENT OF SCIENCE POLICY AND SCIENTOMETRICS

Authors' cognitive distance on collaboration networks via Author Bibliographic Coupling Analysis

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- Research Collaboration Networks – RCN
- Similarities/ Distances between actors
- Research questions
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- Findings

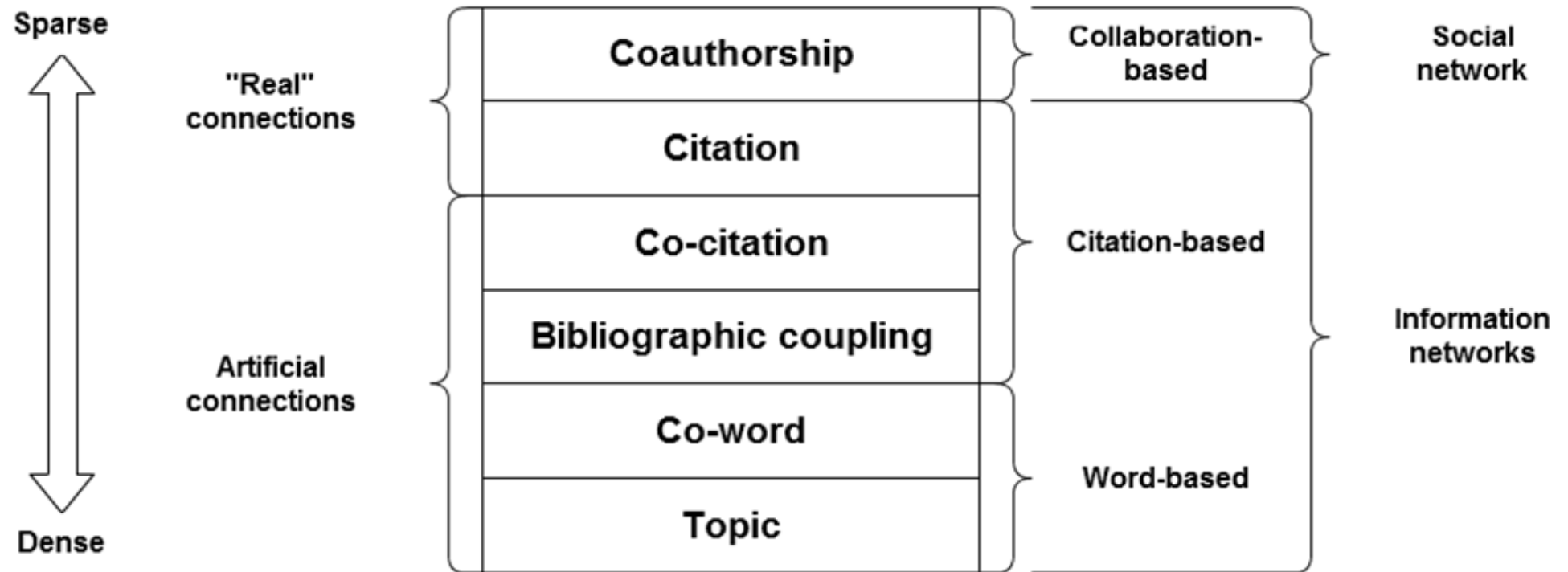


- In this study by ‘collaboration’ we mean only co-authorship.
- Numerous factors influence the formation of research collaboration networks.
- In this study we focus on three main factors: geographical, social and cognitive distance.



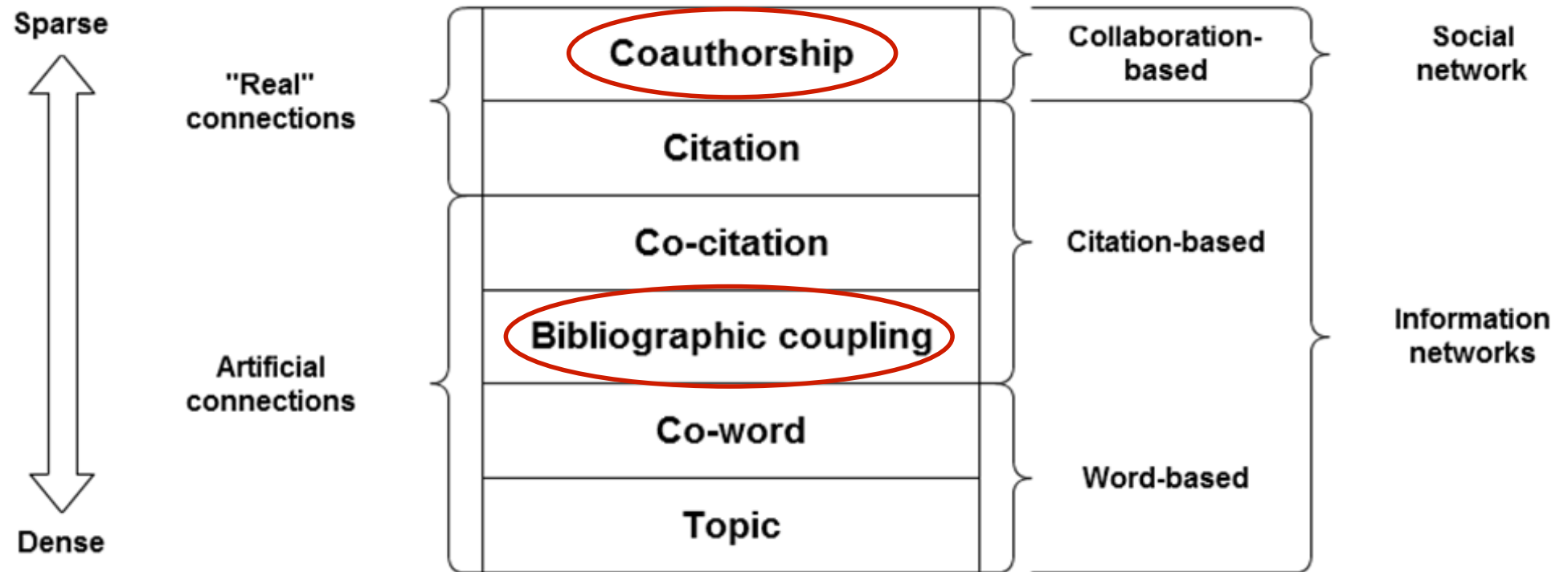
- **The *geographical distance***
distance in kms between actors (Boschma, 2005, Zitt et al, 2000, Acosta et al, 2011, Hoekman et al., 2010, Frenken et al., 2009)
- **The *social distance***
dissimilarity of actors along social and economic components (Narin et al. 1991, Zitt et al 2000, Acosta et al 2011).
researchers' relationships, collaboration (Frenken et al. 2009, White et al. 2004)
- **The *cognitive distance***
dissimilarity of researchers' knowledge base (Frenken et al., 2009, Small, 1973, Yan and Ding, 2012, Boyack and Klavans, 2010, Jarneving, 2007, Kessler, 1963)
Measuring via artificial connections as co-citation, Bibliographic coupling (BC), co-word or topic detection analyses

Viewing scholarly networks from different perspectives



Source: Yan and Ding, 2012, 1331 p.

Viewing scholarly networks from different perspectives



Source: Yan and Ding, 2012, 1331 p.



1. How can we measure social and cognitive similarity between authors?
2. What does cognitive similarity contain?
3. What is the relation between social and cognitive similarity?
4. Are there any differences at structure formations between "hard" and „soft“ science fields?



- We analyzed WoS records of two fields with cited references between 2010-2014 which contain at least one Hungarian author.
- We chose a “soft” field, economics and a “hard” one, physical geography
- We don’t only use the tighter Web of Science Category (WC). We use those WCs which are in strong relation with these WCs.
- The chosen WCs:
 - **economics:**
 - agricultural economics & policy;
 - business, finance;
 - economics;
 - **physical geography:**
 - geography, physical;
 - geosciences, multidisciplinary;
 - imaging science & photographic technology;
 - remote sensing;
 - engineering, geological

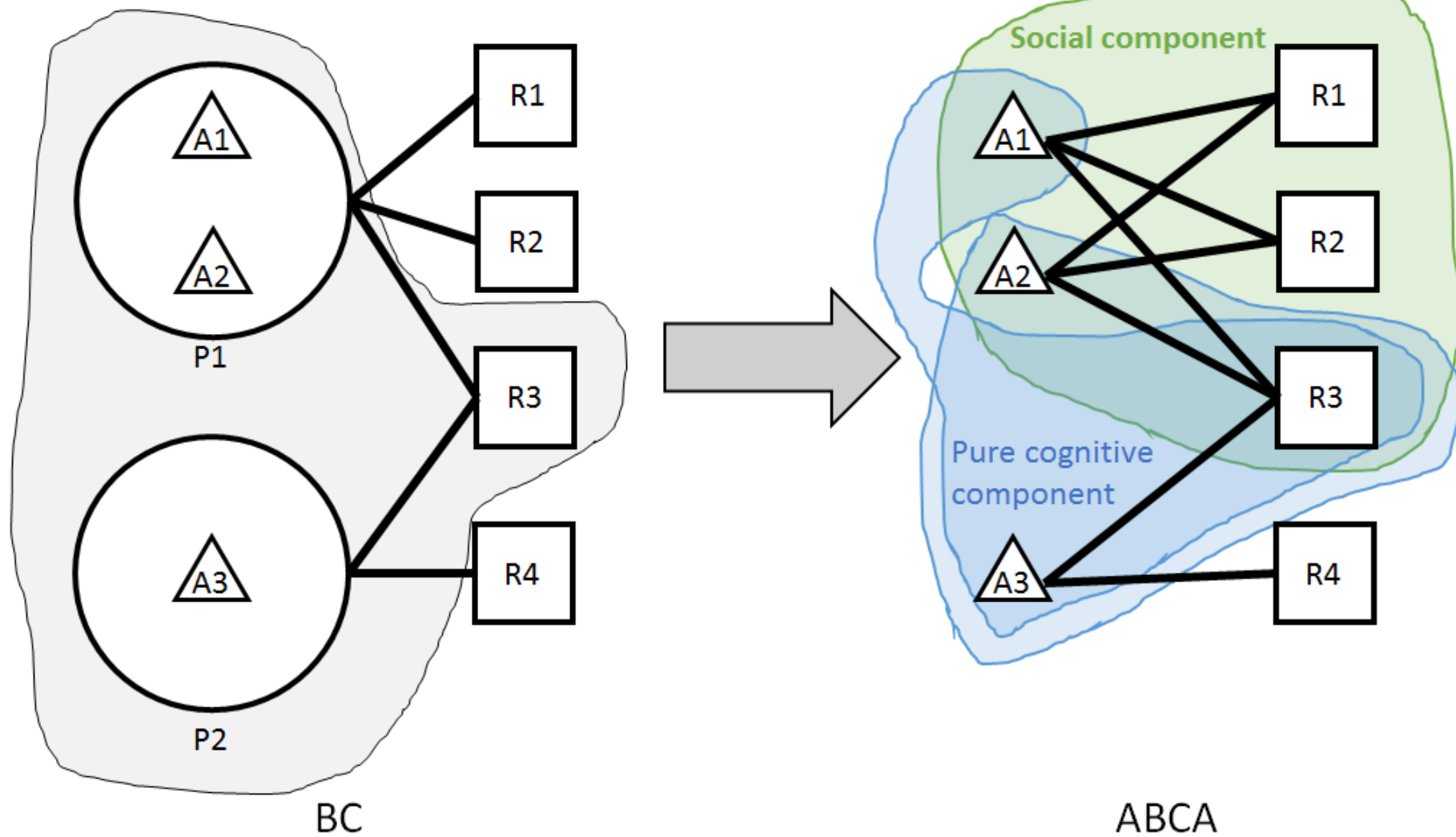
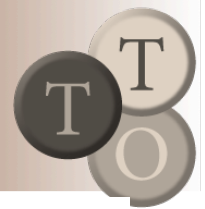


METHODS



- Bibliographic coupling (BC) is a method addressing the cognitive similarity of papers based on the overlapping in references (Kessler, 1963, Jarneving, 2007)
- ABCA is a version of BC which addresses the similarity of authors by the overlap between the aggregated references of their papers. (Zhao and Strotmann 2008a, 2008b)

Similarities on Author level – New model





- ***Full cognitive distance:*** We set up the ABCA adjacency matrix and we determined the similarity between authors with Salton's Cosine similarity (Hamers et al., 1989, Nguyen and Bai, 2010).
- ***Social distance:*** As we saw in the previous Figure the social component derives from co-authorship. To determine it, we described the co-authorship with similarity matrix using Salton's Cosine similarity.
- ***Pure cognitive distance:*** We subtracted the social component similarity matrix from the entire cognitive similarity matrix.



- We compared the three similarity matrices
- For comparison we obtained a network analytic method called Quadratic Assignment Procedure (QAP) correlation.
- From the three similarity matrices we created weighted non-directed networks:
 - Nodes: authors
 - Edges: similarity values
- We compare the three networks via different QAP correlation.
- For the calculation we used the R statistical software (R Core Team, 2015, Meyer and Buchta, 2015).



FINDINGS

Size of dataset – Hungarian articles between 2010-2014 in two fields



	Economics	Physical Geography
Number of articles	722	653
Number of articles with cited references	470	644
Number of authors	704	2294

Main characteristics of networks



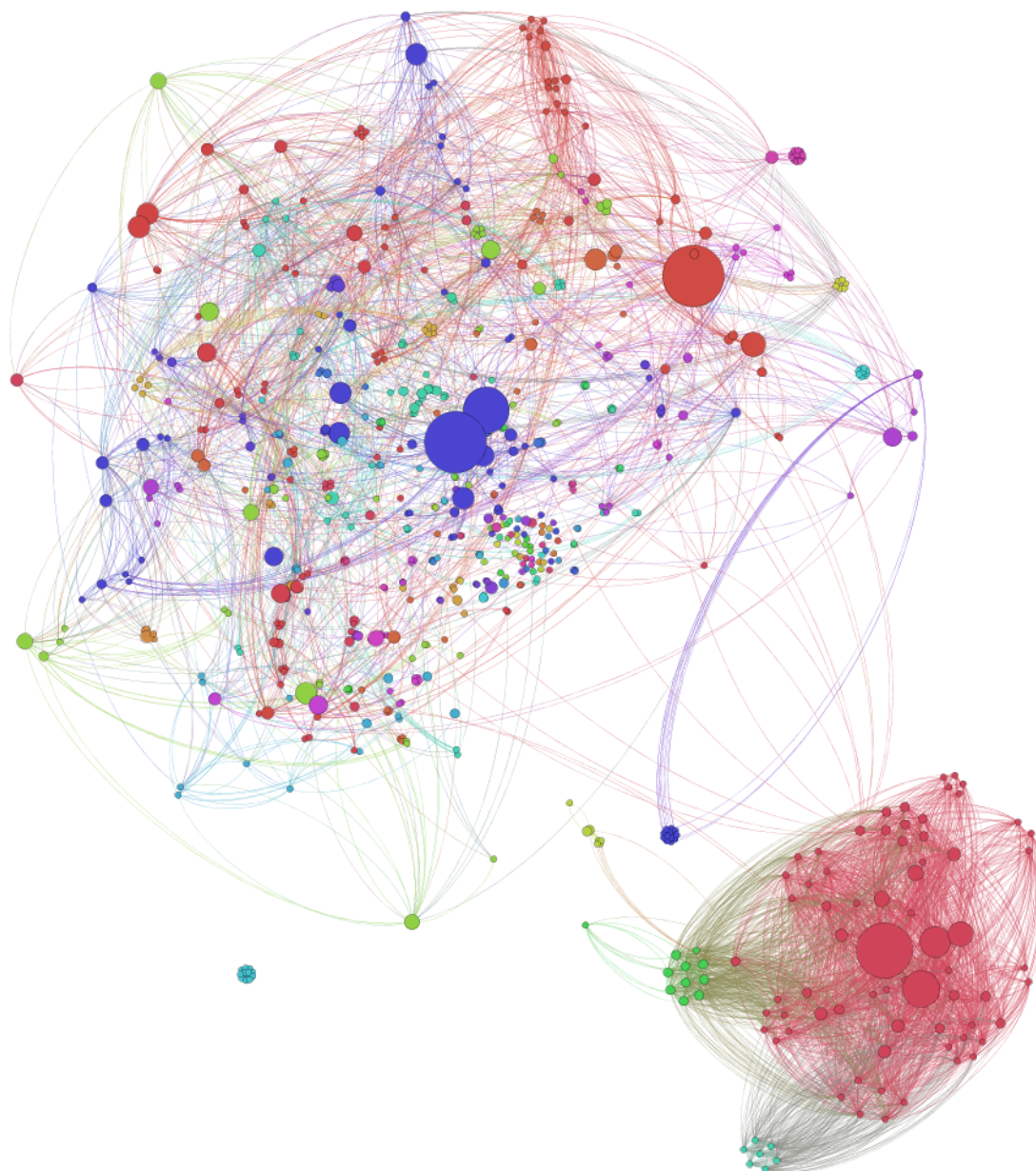
		Economics	Physical Geography
Full cognitive network	<i># nodes</i>	704	2294
	<i># edges</i>	5145	67282
	<i>density</i>	2.0792	2.5582
Social network	<i># nodes</i>	704	2294
	<i># edges</i>	1347	16351
	<i>density</i>	0.5443	0.6217
Pure cognitive network	<i># nodes</i>	704	2294
	<i># edges</i>	4874	61157
	<i>density</i>	1.9696	2.3253

QAP correlation between networks

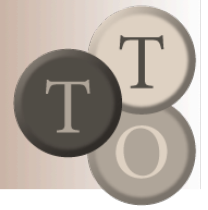


	<i>Full cognitive network</i>	<i>Social network</i>	<i>Pure cognitive network</i>		<i>Full cognitive network</i>	<i>Social network</i>	<i>Pure cognitive network</i>
Economics				Physical Geography			
<i>Full cognitive network</i>	1	0.9872	0.1899	<i>Full cognitive network</i>	1	0.9896	0.1930
<i>Social network</i>	0.9872	1	0.0311	<i>Social network</i>	0.9896	1	0.0499
<i>Pure cognitive network</i>	0.1899	0.0311	1	<i>Pure cognitive network</i>	0.1930	0.0499	1

Entire cognitive network - Economics



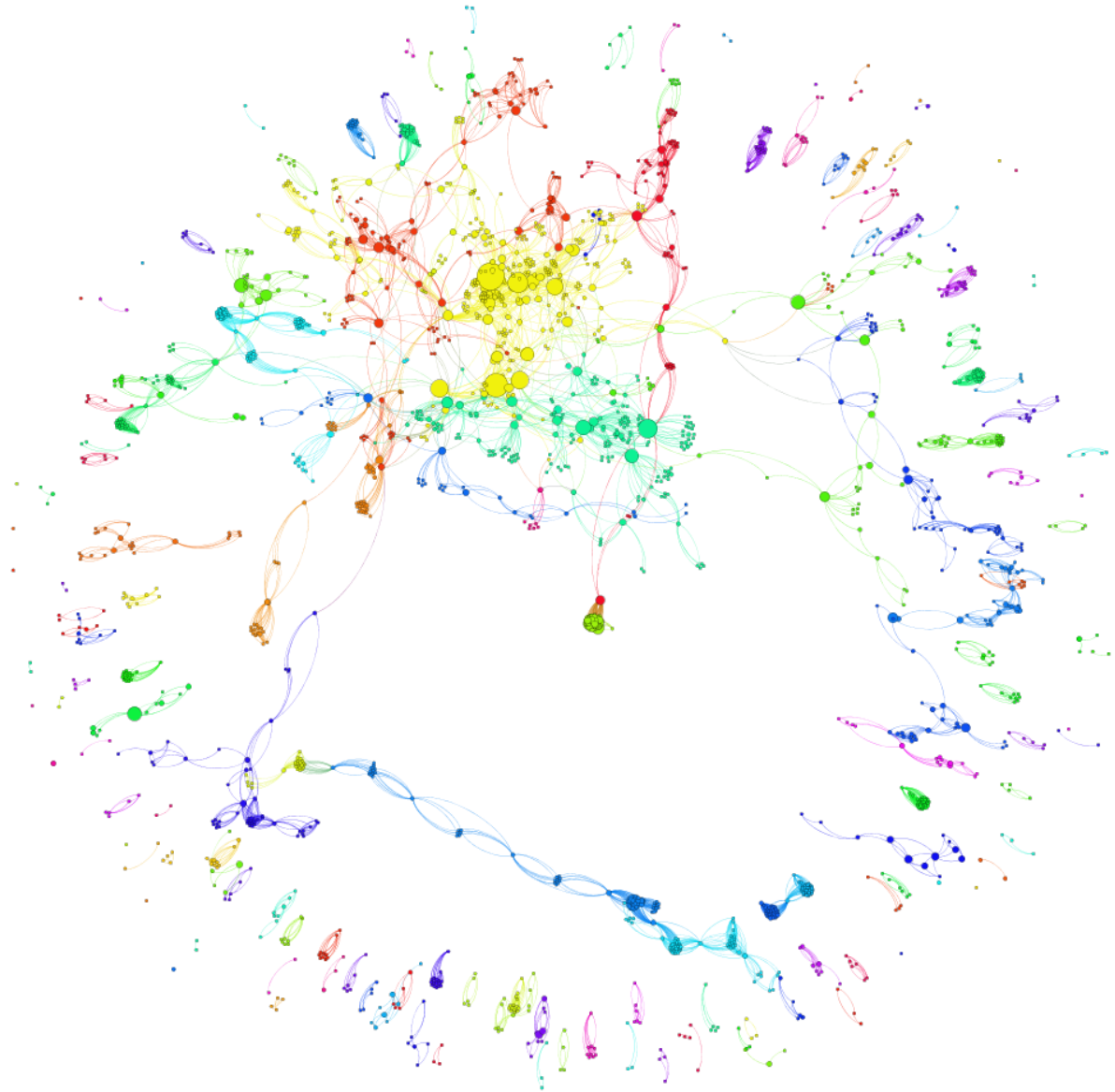
Entire cognitive network - Physical Geography



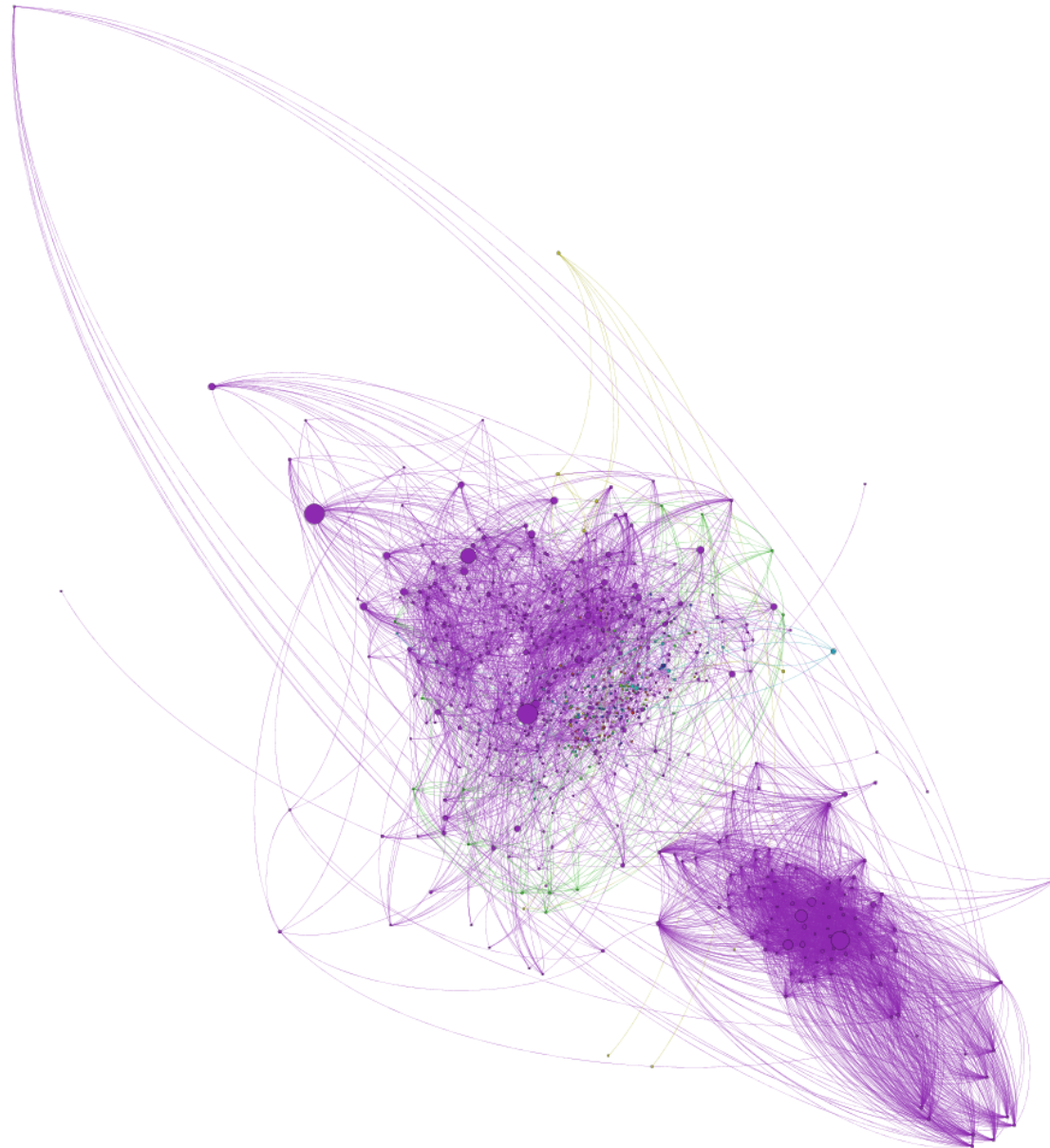
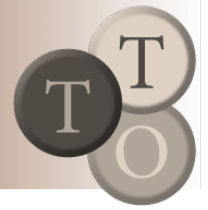
Social network - Economics



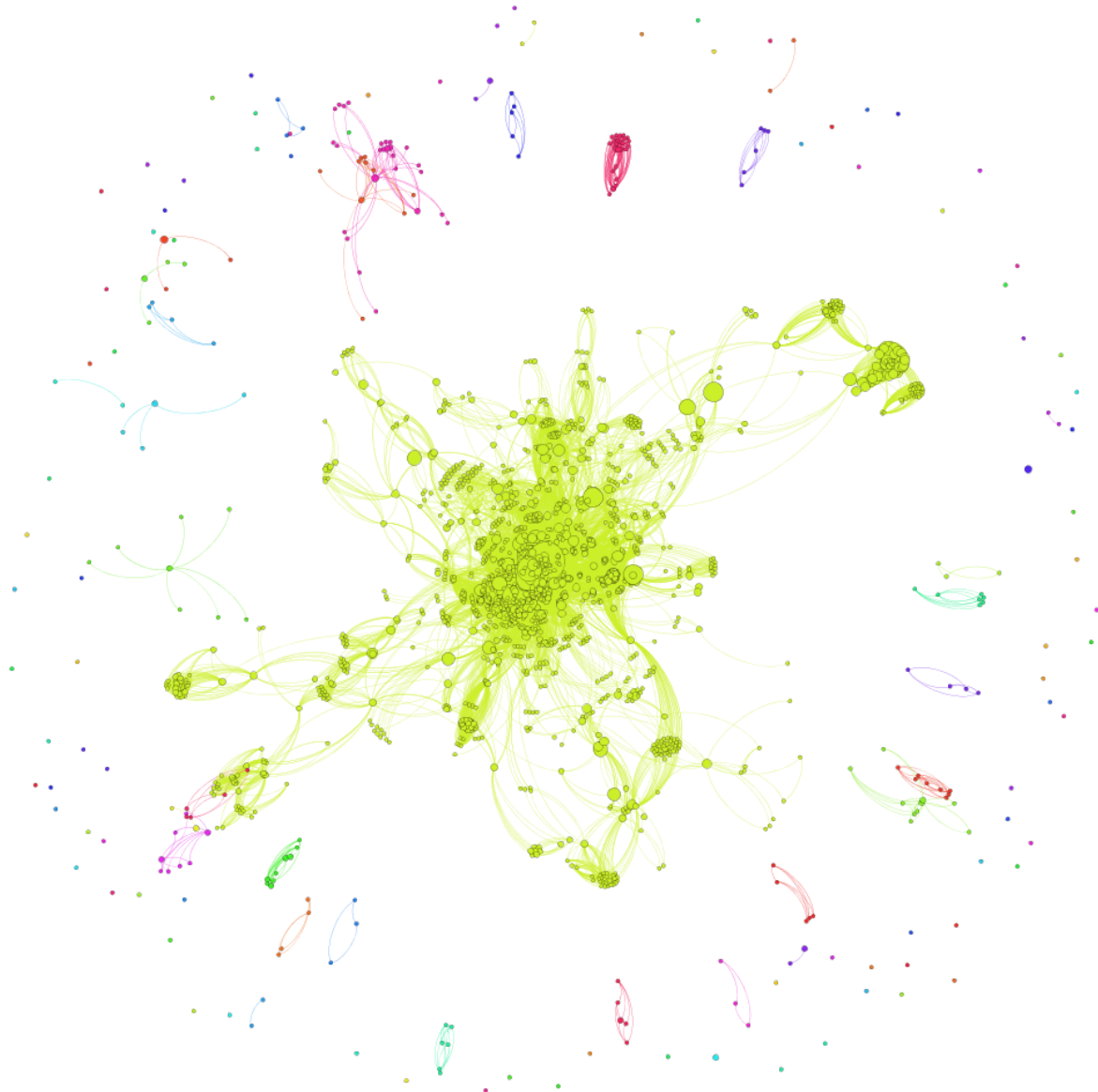
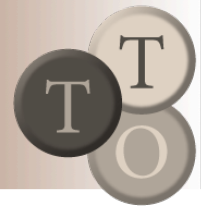
Social network - Physical Geography



Pure cognitive network - Economics



Pure cognitive network - Physical Geography





- We determine the entire cognitive distance between authors via ABCA
- We separate two components within entire cognitive distance
 - Social component which derives from co-authorship
 - Pure cognitive component; the cognitive distance without the effect of co-authorship
- The social component had a stronger relation with entire cognitive distance than pure cognitive distance. This was more relevant in Physical Geography



THANK YOU!



References



- Acosta, M., Coronado, D., Ferrándiz, E. & León, M.D. (2011). Factors affecting inter-regional academic scientific collaboration within Europe: the role of economic distance. *Scientometrics* 87, 63-74.
- Boschma, R. (2005). Proximity and Innovation: A Critical Assessment. *Regional Studies*, 39, 61-74.
- Boyack, K. W., & Klavans, R. (2010). Co-citation analysis, bibliographic coupling, and direct citation: Which citation approach represents the research front most accurately?. *Journal of the American Society for Information Science and Technology*, 61(12), 2389-2404.
- Frenken, K., Hardeman, S., & Hoekman, J. (2009). Spatial scientometrics: Towards a cumulative research program. *Journal of Informetrics*, 3(3), 222-232.
- Hamers, L., Hemeryck, Y., Herweyers, G., Janssen, M., Keters, H., Rousseau, R., & Vanhoutte, A. (1989). Similarity measures in scientometric research: the Jaccard index versus Salton's cosine formula. *Information Processing & Management*, 25(3), 315-318.
- Hoekman, J., Frenken, K., & Tijssen, R. J. (2010). Research collaboration at a distance: Changing spatial patterns of scientific collaboration within Europe. *Research Policy*, 39(5), 662-673.
- Kessler, M. M. (1963). Bibliographic coupling between scientific papers. *Journal of the Association for Information Science and Technology*, 14(1), 10-25.
- Jarneving, B. (2007). Complete graphs and bibliographic coupling: A test of the applicability of bibliographic coupling for the identification of cognitive cores on the field level. *Journal of Informetrics*, 1(4), 338-356.
- Narin, F., Stevens, K., & Whitlow, E. (1991). Scientific co-operation in Europe and the citation of multinationally authored papers. *Scientometrics*, 21(3), 313-323.
- Nguyen, H. V., & Bai, L. (2010). Cosine similarity metric learning for face verification. In *Computer Vision—ACCV 2010* (pp. 709-720). Springer Berlin Heidelberg.
- Small, H. (1973). Co-citation in the scientific literature: A new measure of the relationship between two documents. *Journal of the Association for Information Science and Technology*, 24(4), 265-269.
- Yan, E., & Ding, Y. (2012). Scholarly network similarities: How bibliographic coupling networks, citation networks, cocitation networks, topical networks, coauthorship networks, and cword networks relate to each other. *Journal of the American Society for Information Science and Technology*, 63(7), 1313-1326.
- White, H. D., Wellman, B., & Nazer, N. (2004). Does citation reflect social structure? Longitudinal evidence from the “Globenet” interdisciplinary research group. *Journal of the American Society for Information Science and Technology*, 55(2), 111–126.
- Zhao, D., & Strotmann, A. (2008a). Evolution of research activities and intellectual influences in information science 1996–2005: Introducing author bibliographic-coupling analysis. *Journal of the American Society for Information Science and Technology*, 59(13), 2070-2086.
- Zhao, D., & Strotmann, A. (2008b). Author bibliographic coupling: Another approach to citation-based author knowledge network analysis. *Proceedings of the Association for Information Science and Technology*, 45(1), 1-10.
- Zitt, M., Bassecoulard, E., Okubo, Y. (2000), Shadows of the past in international cooperation: Collaboration profiles of the top five producers of science. *Scientometrics*, 47: 627–657.