

Analyzing Research Collaborations Using Social Network Analysis

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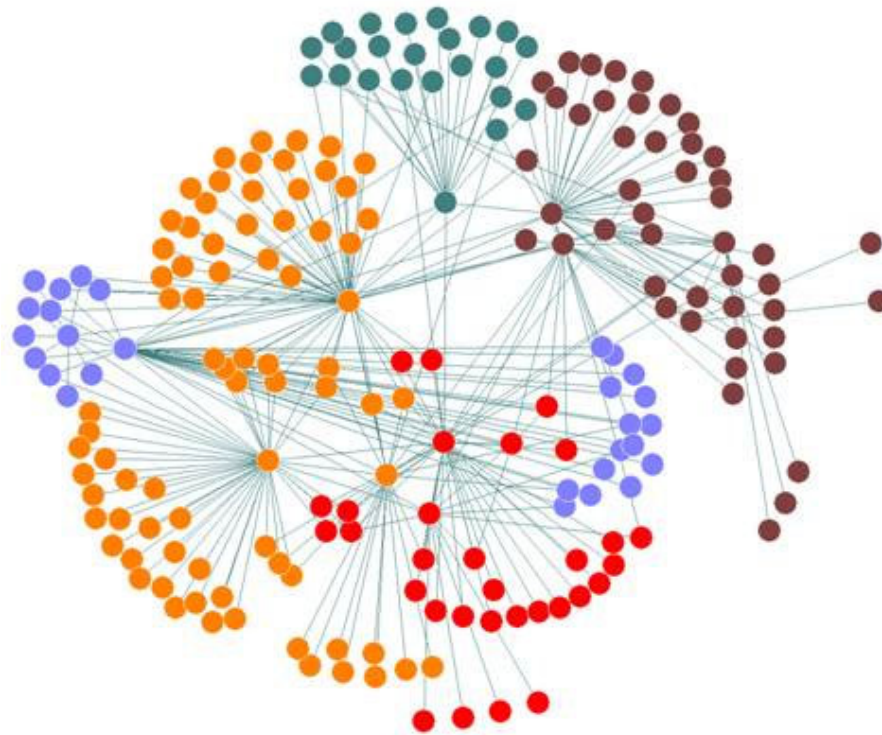


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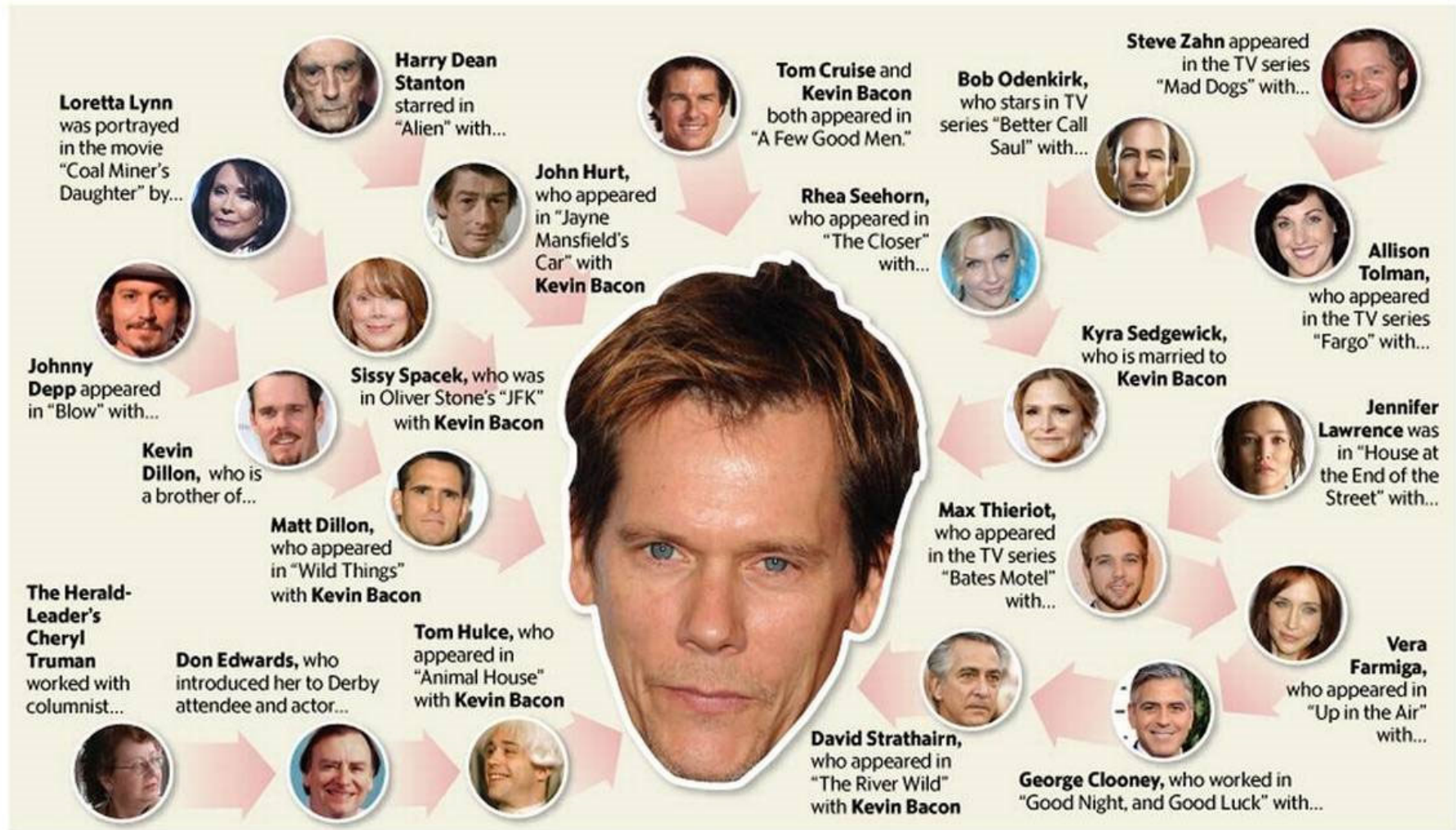
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Social Network Analysis

- Social network analysis (SNA) is the process of investigating social structures through the use of networks and graph theory.



"Six Degrees of Separation"



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Theory of “Six Degrees of Separation”



Theory to Practice: Your “Six Degrees of Separation”

- Form groups of 2-3.
- Map out your connections in six degrees or less!



Theory to Practice: What are the Benefits of Your Professional Connections?

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Theory to Practice: What are the Benefits of Your Professional Connections?

- Networking
- Information
- Friendships
- Job opportunities



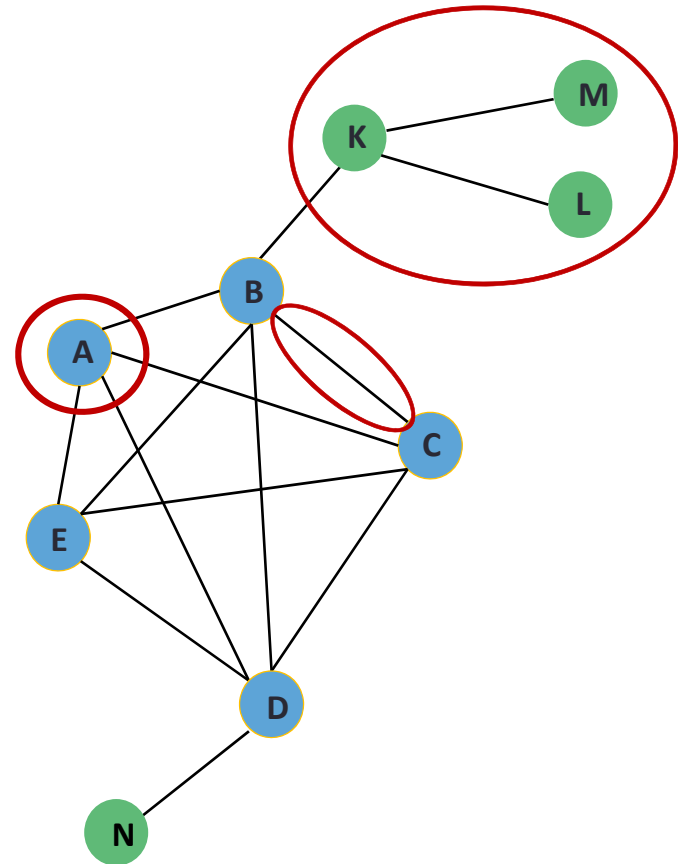
Social Network Analysis

- Social network analysis (SNA) is the process of investigating social structures through the use of networks and graph theory.
- SNA can be used to understand and evaluate the complex dynamics of team science/scientific collaborations.



Network Characteristics

- Actor/node
 - Individual actors, people, or things within the network
- Lines/edges/ties
 - i.e. Relationships or interactions between actors/nodes
- Communities
 - Groups of actors/nodes



Network Characteristics

- Scientists tend to collaborate with others most like them, a phenomenon called homophily in the field of social network science.
- Forming collaborative ties with those who are different than you, termed heterophily or diversity, results in:
 - Solving complex problems
 - Producing transformative science, like patent development & driving policy change
 - Publication in journals with high impact factors
 - Higher citation rates

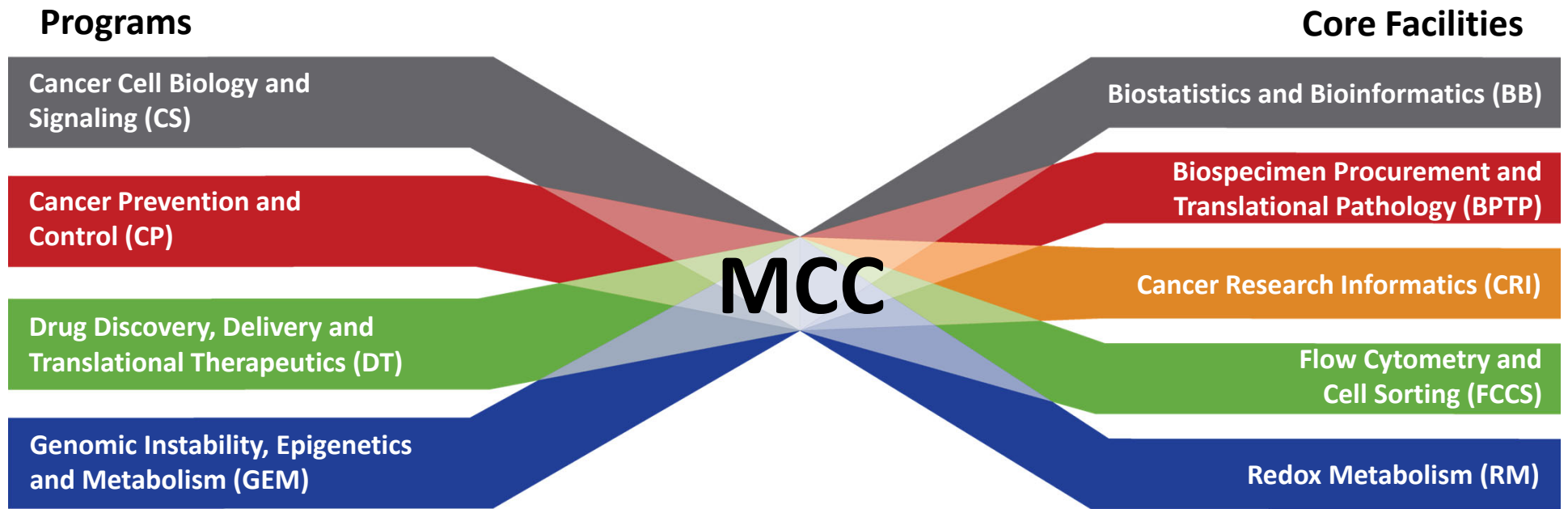


Evaluating Team Science Using SNA

- We conducted a case study using SNA to evaluate team science/collaborations over time among Markey Cancer Center (MCC) scientists.
- Analysis of co-authorships on 1,047 publications between 2007-2014.



Markey Cancer Center



- NCI designated cancer center (2013, 2018)
- 120 members
 - From 8 Colleges and 28 Departments

- \$41.9M total cancer research funding
- ~200 publications/year



Characteristics of MCC Member Co-Authorship Networks, 2007 - 2014

Year	# Articles	# Authors	Number of Components	Mean Degree	Centralization	Modularity
2007	103	46	27	1.79	0.062	0.93
2008	193	54	28	1.96	0.069	0.92
2009	305	62	29	2.13	0.060	0.92
2010	412	74	29	2.26	0.072	0.91
2011	546	83	21	2.41	0.074	0.90
2012	676	90	21	2.55	0.074	0.88
2013	857	98	13	2.59	0.065	0.87
2014	1047	106	11	2.66	0.057	0.86

Mean degree of the network: Average number of authors that an author collaborates with.	Degree centralization: How much of the co-authorship in this network is concentrated in just a few members.	Modularity: Degree to which researchers co-author with other researchers in their “dense group” versus people outside of their dense group.
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MCC Member Co-Authorship Network Clusters

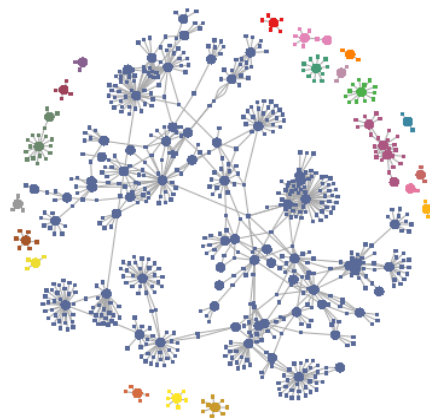
2007



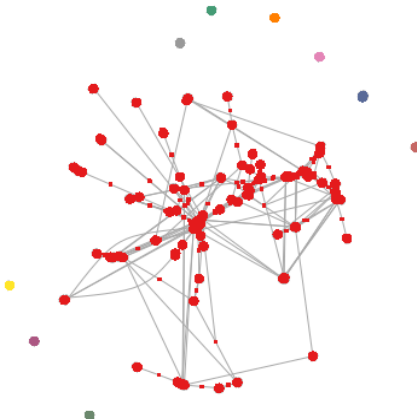
2010



2012



2014



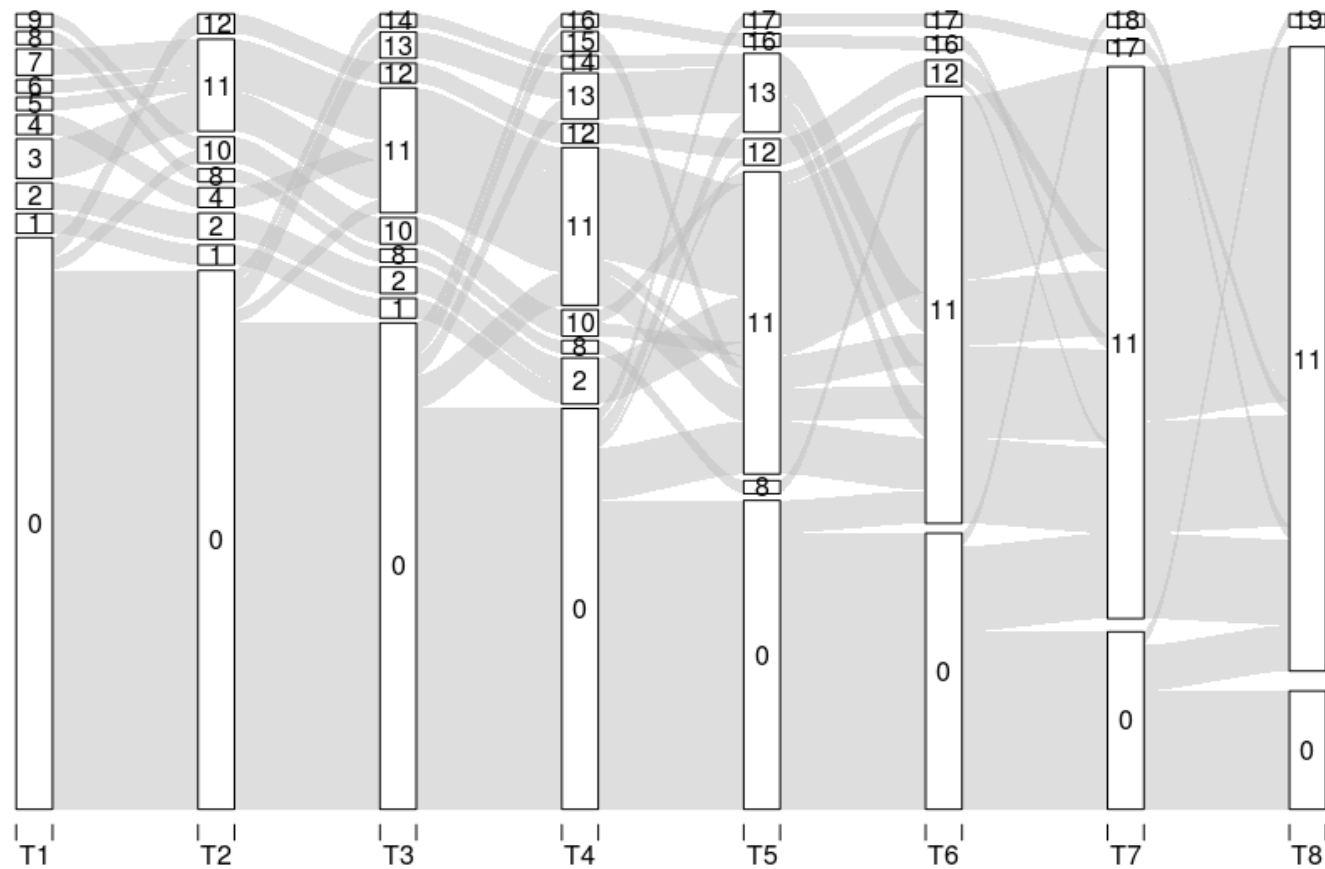
Large Circles =
Author nodes

Smaller Squares =
Article nodes

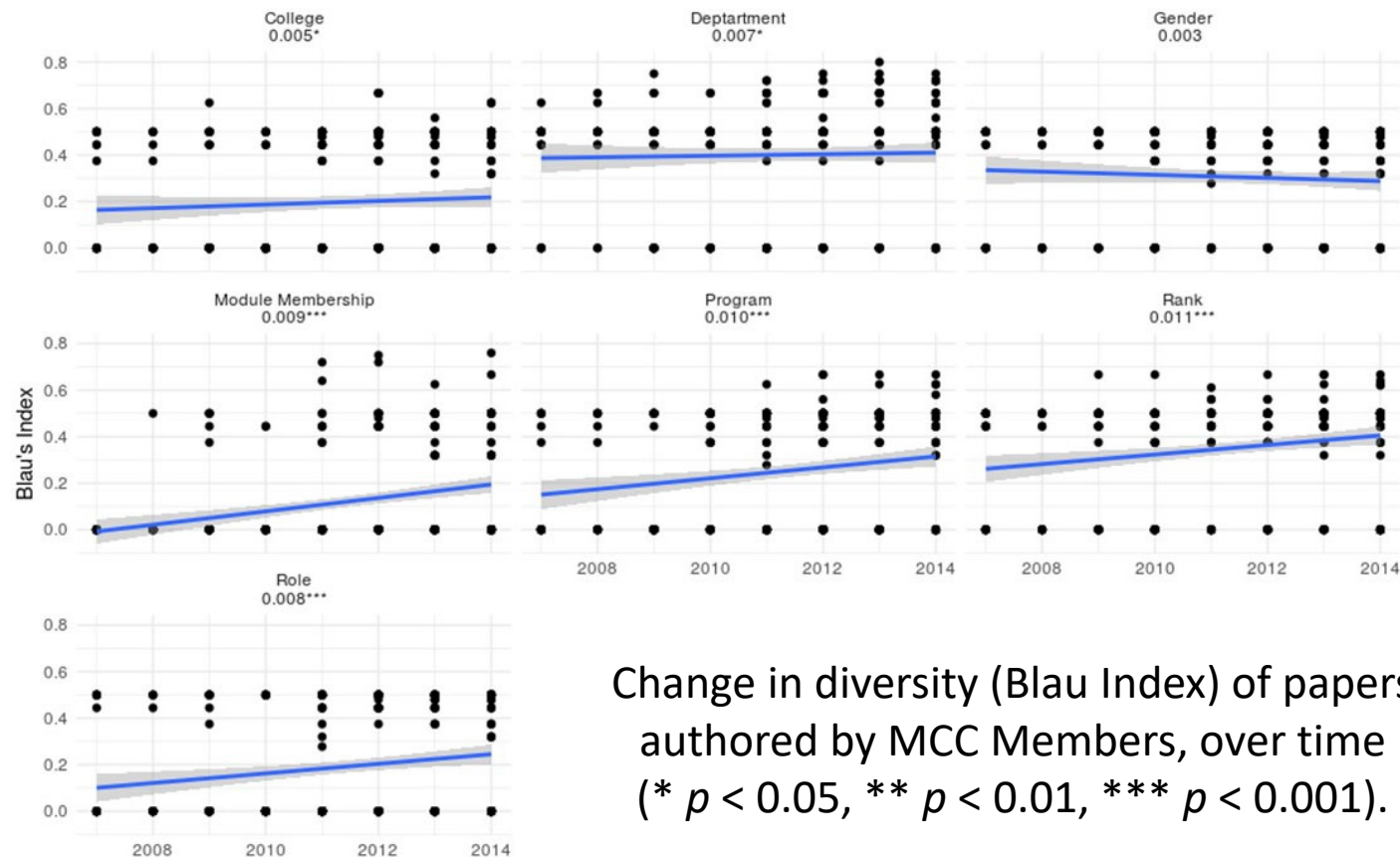
A tie between an author
node and an article node
indicates that an author
was listed as an author
on that article.



MCC Co-Authorship Community Changes Over Time



Change in Diversity of MCC Co-Authorships



Change in diversity (Blau Index) of papers authored by MCC Members, over time (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).



Conclusions

- Interdisciplinary collaborations (heterophily) increased
 - More collaboration occurred across programs, roles, ranks, departments, colleges, and informal co-authorship communities over the 8-year time period.
- Some level of homophily is driving the formation of new co-authorship ties.
 - i.e. in the same department, in the same research program
 - The effect of same research program decreased over time as inter-programmatic co-authorship ties grew.
- The greatest increase in diversity occurred in diversity of program, reflecting the success of programs in place to improve this interdisciplinary research.
- Decrease in diversity for gender indicated authors collaborated more within their same gender over time.
- SNA is a robust method for measuring team science.



Theory to Practice: What are Some Benefits of Research Collaborations?

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Theory to Practice: What are Some Benefits of Research Collaborations?

- Increasing the “impact” of research
- Enhancing productivity
- Increasing publications
- Increasing grant funding



Theory to Practice: What Can We Do to Increase Research Collaborations?

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Theory to Practice: What Can We Do to Increase Research Collaborations?

- Pilot grants
- Tenure and promotion criteria
- Interdisciplinary working groups



Collaborators

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Anderson School of
Management*

Heidi Weiss, PhD

*University of Kentucky
Markey Cancer Center and
Department of Surgery*

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*Indiana University Network
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Justin S. Levens

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Markey Cancer Center*



Questions?

