Investigating Collaborative Processes of Research Teams through Social Network Analysis

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CNTN
CENTER FOR NEURODEGENERATION AND TRANSLATIONAL NEUROSCIENCE

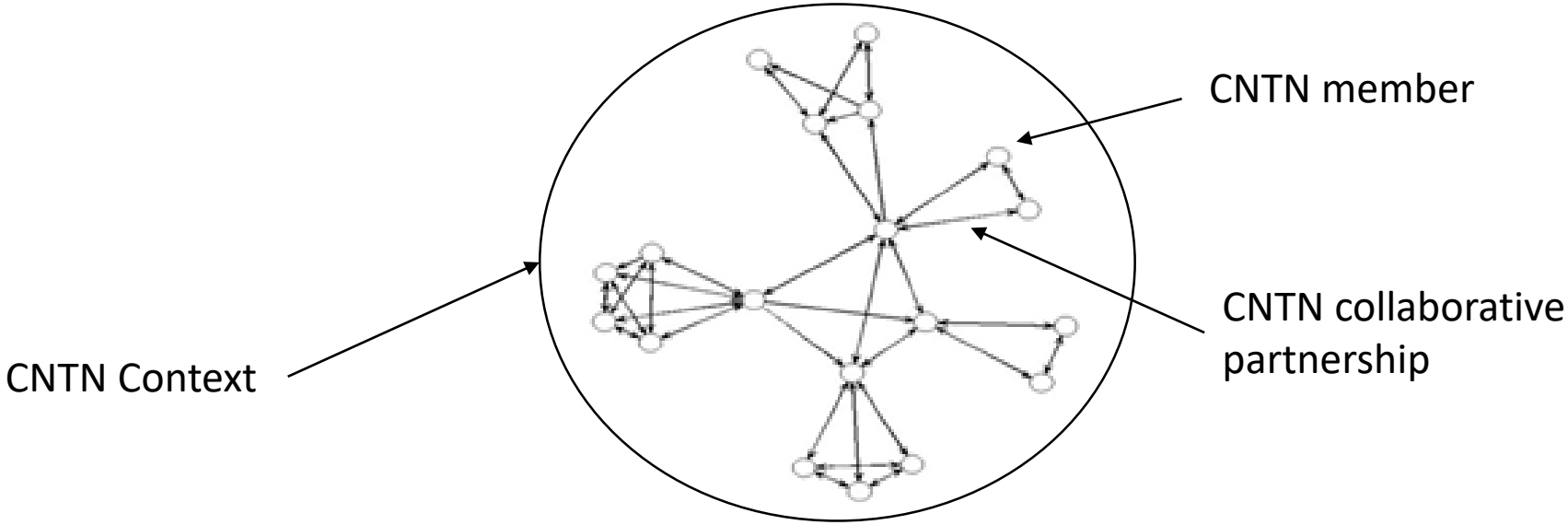
Research Context

- Center for Neurodegeneration and Translational Neuroscience (CNTN), partnership between UNLV and Cleveland Clinic.
- Funded through the National Institute of General Medical Sciences (NIGMS) Centers for Biomedical Research Excellence (COBRE)
- Evaluation to examine the development of human capital and research infrastructure (Marchand, Hilpert, Bragg, & Cummings, 2018).

CNTN = Research Center focused on Alzheimer's/ Parkinson’s Disease

Study Purpose

- The purpose of this project was to examine the social network of researchers and technicians in the CNTN.
- Do collaborative relationships among members of the laboratory predicted increased scholarly publication of laboratory findings?

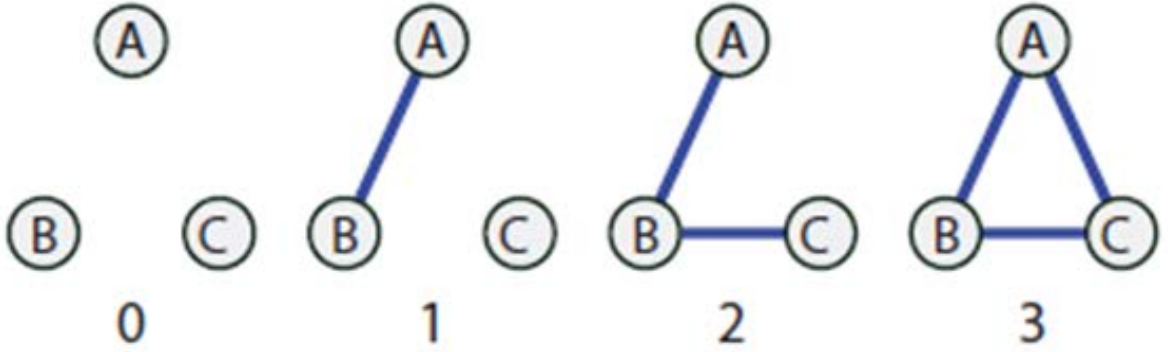


Science of Team Science

- The CNTN is reflective of the emerging trend in team science that has gained ground in biomedical research (Trochim et at., 2013).
- Growing evidence that scientific advances are more likely to result from collaborative science efforts (Borner et al., 2010; Fiore et al., 2015).
- Evaluations efforts that conceptualize teams as complex systems (e.g. Ramos, et al., 2018) can yield important new insights.
  - Improved understanding of team functioning (Hilpert & Marchand, 2018)
  - Improved metrics for renewal of funded centers (Marchand & Hilpert, 2018)

Social Networks and SciTS

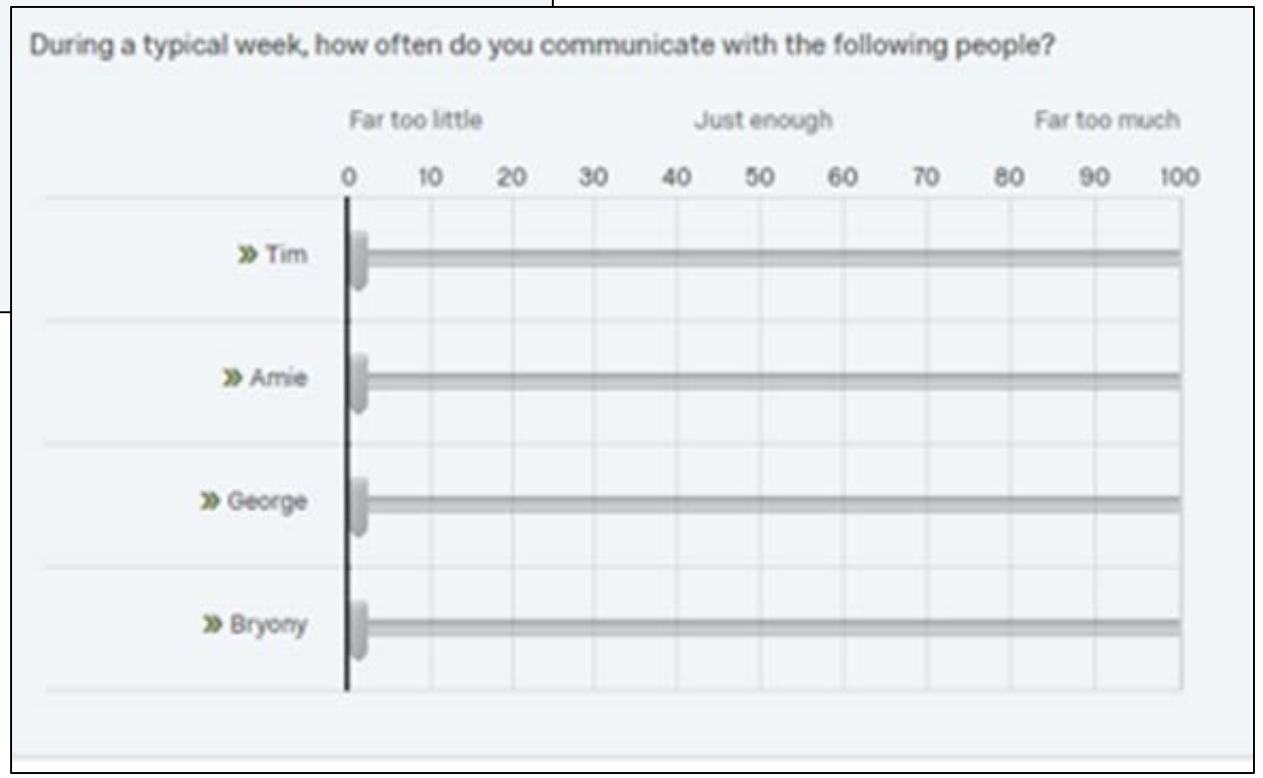
- Social network approaches can provide critical information about the development of team infrastructure and collaborative activity.
- Network configurations are metrics of team cohesion and representations of team dynamics and self organization (Lusher, 2014).



**Does the formation of these configurations predict increased publication?*

Social Network Analysis

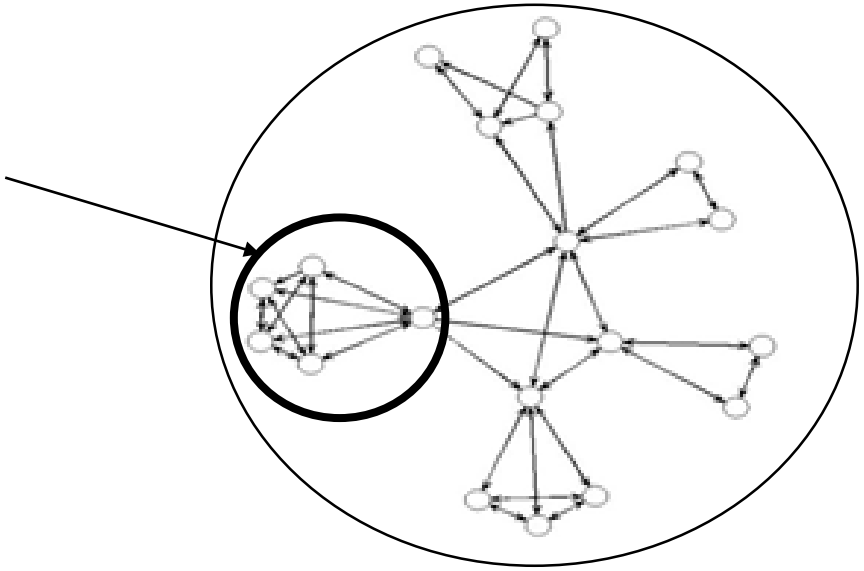
- SNA hinges upon identifying key personnel and assessing the qualities of their ***attributes*** and ***relationships***.



Research Questions

- Did CNTN scholarly productivity increase from 2017 to 2018?
- Did CNTN collaboration increase from 2017 to 2018?
- Did CNTN collaboration lead to increased scholarly productivity?

Does the self organization of these kinds of configurations lead to increased scholarly productivity of CNTN members?



Method

- Social network survey technique where CNTN members reported their collaborative partnerships within the CNTN and *how much they relied on that collaboration* for their work in the laboratory.
  - 59 CNTN members from 2016
  - 79 CNTN members from 2017.
- Scholarly productivity data were collected by scrubbing web of science to find publications listing the research grant number.
- The 2016 survey data were used to predict 2017 productivity, and 2017 survey data were used to predict 2018 productivity.

Analysis

- Exponential Random Graph Modeling (ERGM) was conducted using the statnet, sna, and ergm packages within the R statistical platform (Goodreau, et al., 2008).
- Gephi was used to create visual models of these networks. Two models each were created for the 2017 and 2018 data showing the networks based on number of collaborative partnerships and total publications.

Network Descriptive Statistics

Table 1
Publication Statistics by Year

	2017	2018
Book	1	0
Book Chapter	8	0
Abstract	0	5
Peer Reviewed Article	72	137
Presentation	185	91
Review Article	1	10
Total Publication	267	243

Note: Products produced with grant number listed

Table 2
Network Summary Statistics

Statistic	2017	2018
Number of Nodes in Network	59	79
Network Edge Count	614	962
Network Dyad Count	3422	6162
Network Density	0.18	0.16
Network Transitivity	0.48	0.44

Note: Network Density = dyad count / total possible number of edges
Transitivity = number of closed triangles / number of total triangles closed and unclosed

Network Descriptive Statistics cont.

Table 3
Triad Census Statistics

Type of Triad	2017	2018
 102	8,962	19,869
 201	2,908	6,157
 300	907	1,618

ERGM Results

Table 4
2017 Total Publications

	Est.	*SE*	*zValue*
Edges	-2.516	0.083	-30.17***
Nodecov	0.080	0.005	17.198***
Transitiveties	0.576	0.096	5.967***

Note: Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

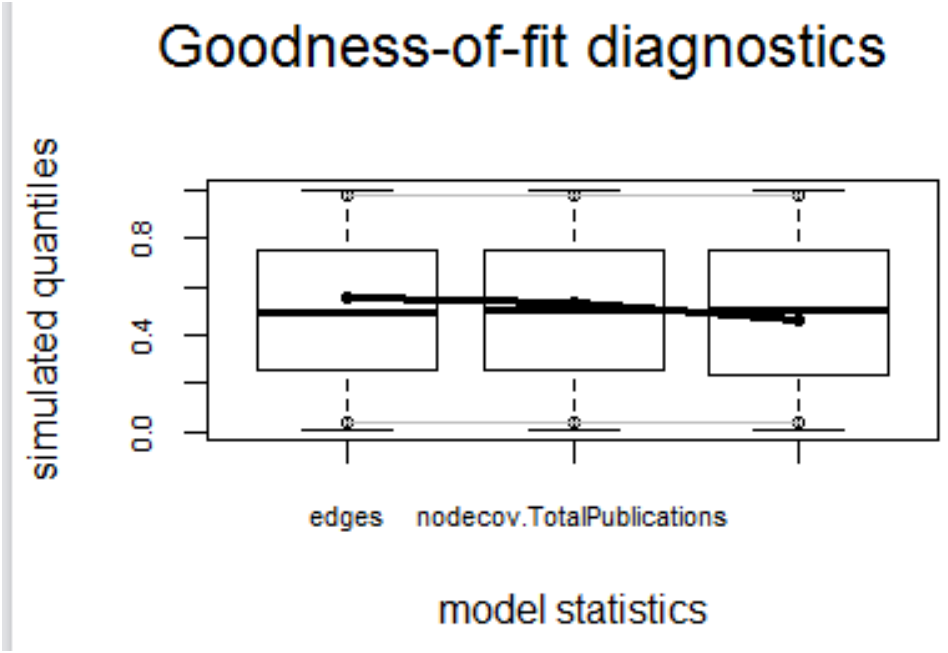
Table 5
2018 Total Publications

	Est.	*SE*	*zValue*
Edges	-2.753	0.065	-42.16***
Nodecov	0.116	0.005	24.88***
Transitiveties	0.625	0.072	8.73***

Note: Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

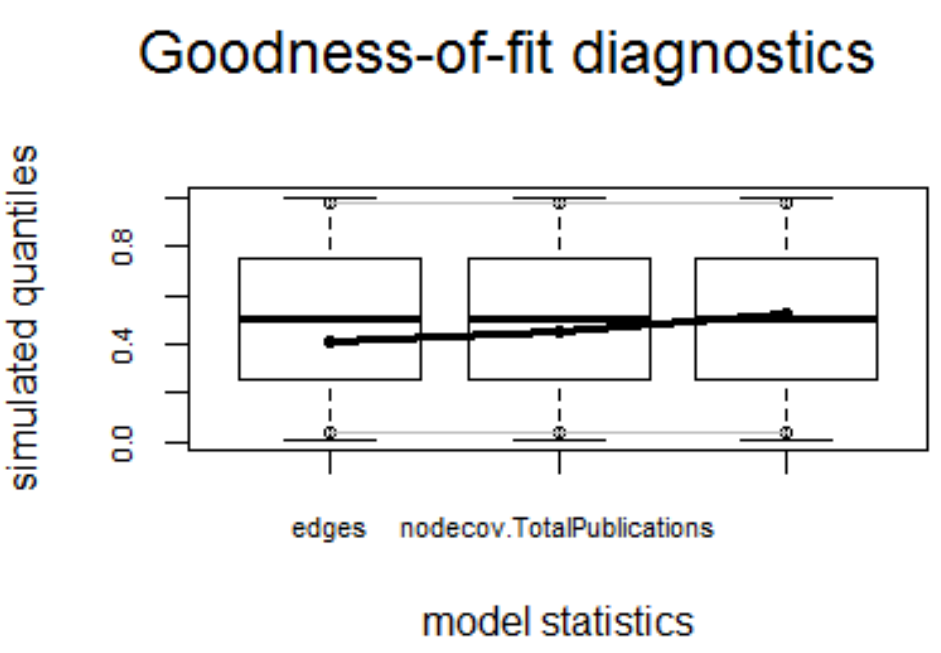
ERGM Goodness of Fit

2017



	obs	min	mean	max	MC p-value
edges	614	569	617.15	669	0.92
nodecov.TotalPublications	9202	8420	9216.15	10045	0.96
transitiveties.TotalPublications	48	18	48.06	98	0.92

2018



	obs	min	mean	max	MC p-value
edges	962	887	957.70	1018	0.82
nodecov.TotalPublications	12138	11342	12123.86	13027	0.90
transitiveties.TotalPublications	84	39	84.24	145	1.00

Network Visualizations

2017 by Degree

2017 by Total Publications

2017 Key:

Light Purple – Project 1

Pink – Project 2

Orange – Project 3

Grey – Clinical Core

Light Blue - DMSC

Light Green – Administrative Core

Teal – Not Assigned

2018 by Degree

2018 by Total Publications

2018 Key:

Purple – Project 1

Pink – Project 2

Red – Project 3

Light Blue – Clinical Core

Light brown – DMSC

Blue/green – Administrative Core

Forest Green – Not assigned

Darker blue – Missing

Research Highlights

- The size of the CNTN network and the amount of scholarly collaboration among CNTN members increased from 2017 to 2018.
- Scholarly productivity in CNTN grant years 2017 and 2018 was significantly and positively related to collaboration among CNTN members.
  - Members who established collaborative scholarly relationships with other CNTN members in 2016 were more likely to produce CNTN grant related publications in 2017.
  - Members who established collaborative scholarly relationships with other CNTN members in 2017 were more likely to produce CNTN grant related publications in 2018.

Implications for Team Science

- Self organization of collaborative dyads and triads are likely to lead to the emergence of increased knowledge production (Beriter & Scardemalia, 2014)
- Conceptual models that treat teams a complex systems can lead to method and analysis that produced improved understanding of the formation of team infrastructure (Hilpert & Marchand, 2018)

Thank you!

- Please contact the Center for Research for Evaluation and Assessment (CREA) at UNLV with any comments or questions in the future.
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