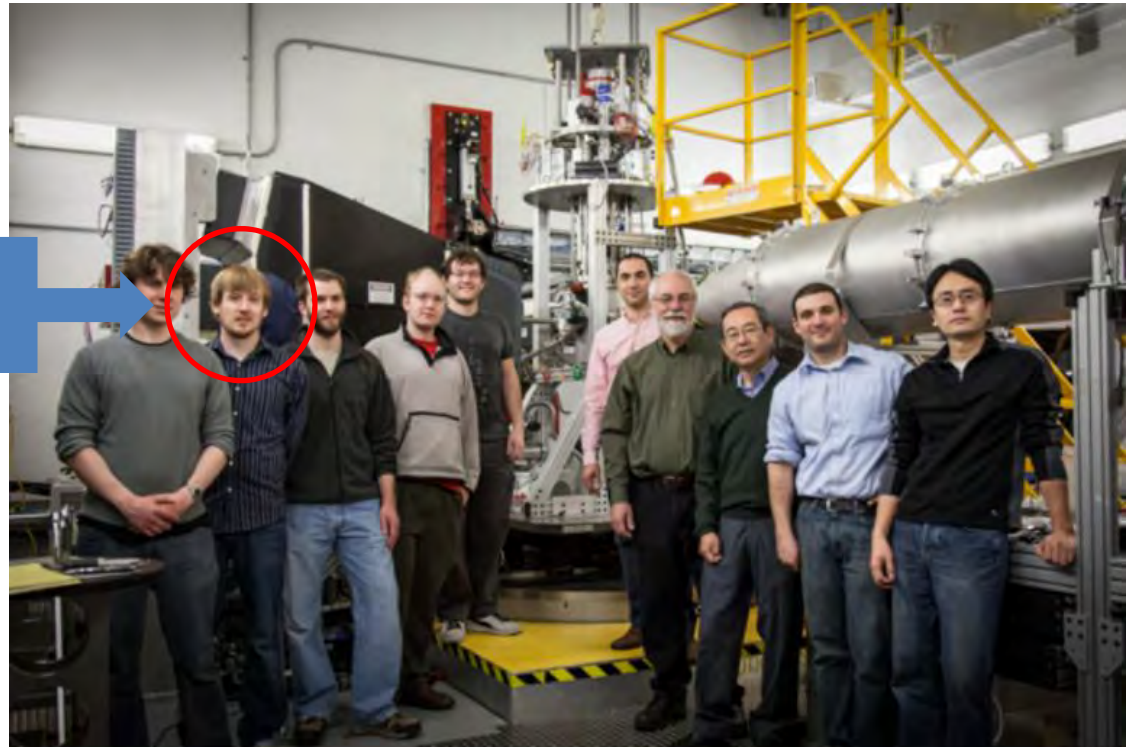
Big Egos in Big Science?

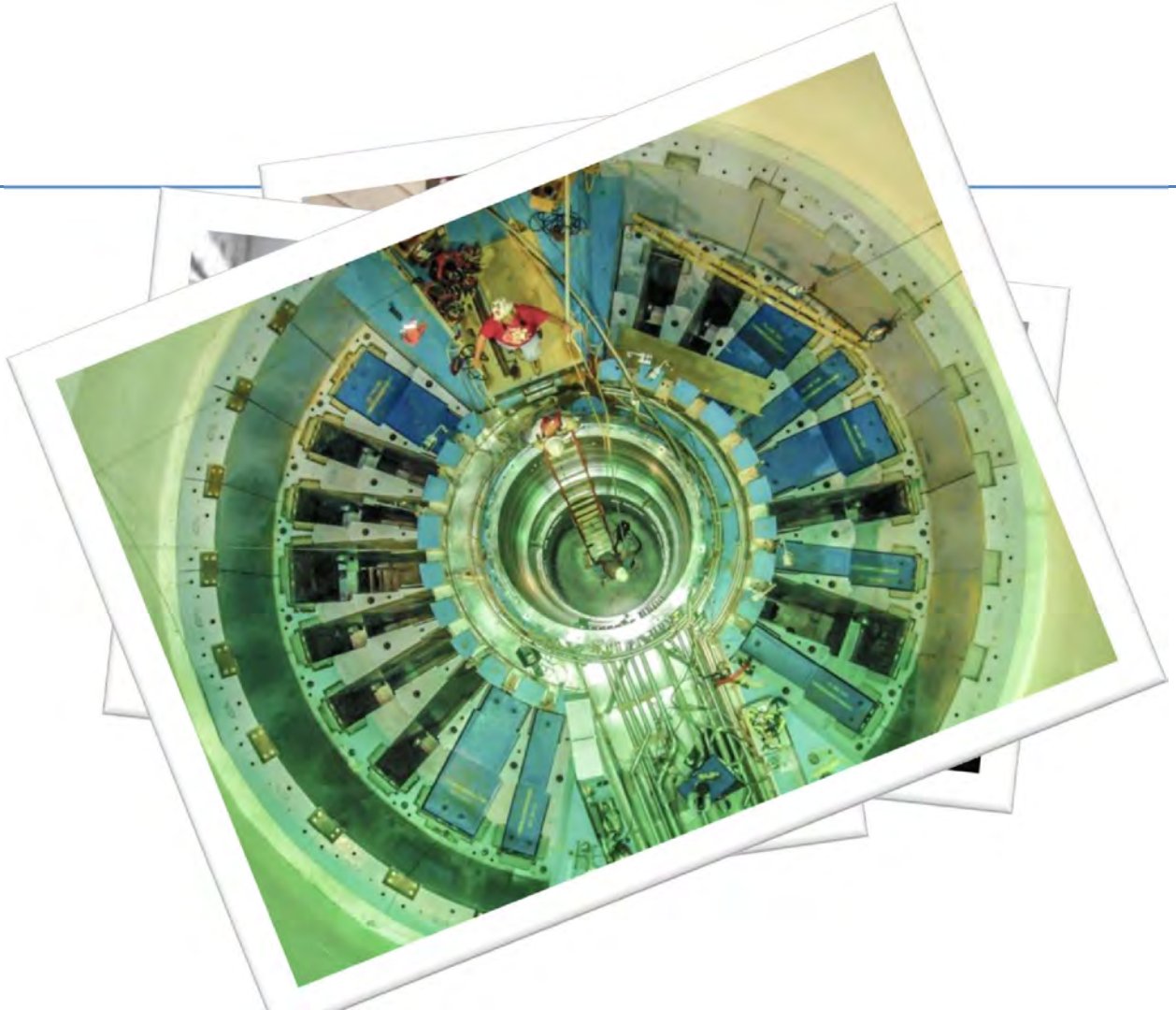
Peer and Status effects in research collaboration

By Jacob Jeppesen, Kristina Vaarst Andersen,
Giancarlo Lauto and Finn Valentin

CBS COPENHAGEN BUSINESS SCHOOL
HANDELSHØJSKOLEN

Neutron Scattering and Levitating Liquids to Hot to Hold





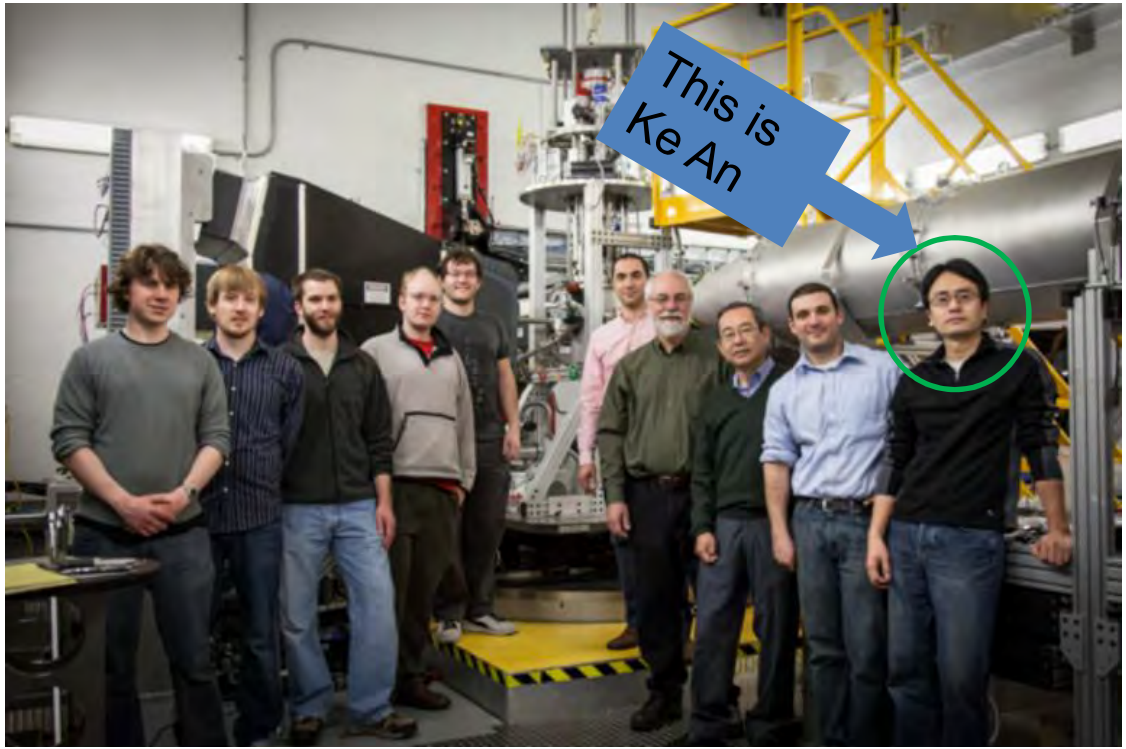
Will collaboration make me more ‘popular’?

How should I choose my collaborators?

How can I divide my work most optimally?

How can i come to excel in my field?

How can I come to mengle with my Big Ego Idol, Ke An?


This is
Ke An

Research Gap

- Team composition/configuration and relation to outcome, fairly well established (e.g. Bercovitz & Feldman, 2011; Taylor & Greve, 2006; Gupta & Wilemon, 1996)
- Interpersonal network composition and relation to outcome, fairly well established (Phelps et.al., 2012)
- However, without knowing how individuals choose their collaborators AND how these choices translates to certain outcomes, how can we say anything strategically for the individual?

Research Gap

- A need for longitudinal network models explaining not only the outcome of knowledge networks, but especially the emergence and evolution (Ahuja et.al. 2012; Smith-Doerr & Powell, 2003)
- A need for research exploring the microfoundations of knowledge networks (Phelps et.al. 2012)
- And how this affect strategic organization (Felin & Foss, 2005)

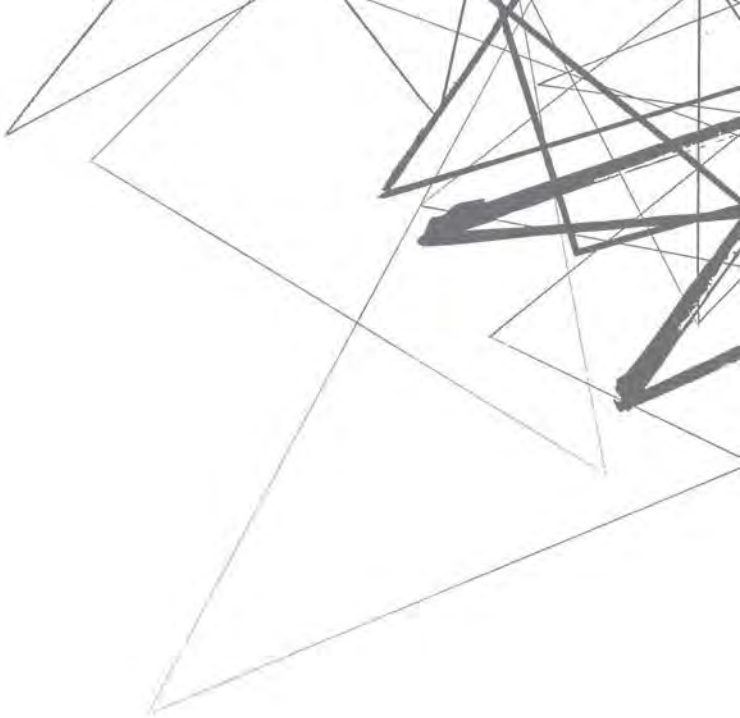
Research Question

Research Question: How do network dynamics influence the choice with whom to collaborate, and, in turn, how does collaboration affect performance?

CBS COPENHAGEN BUSINESS SCHOOL HANDELSHØJSKOLEN

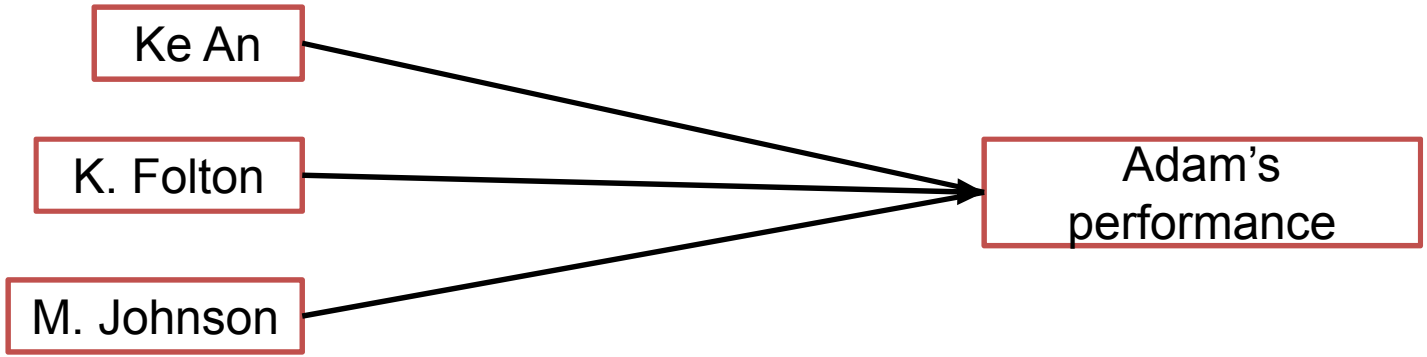
EFMD EQUIS ACCREDITED · Accredited by Association of MBAs · AACSB ACCREDITED · CEMS · PIM

The Problems and Premises



Identifying Social Network Effects

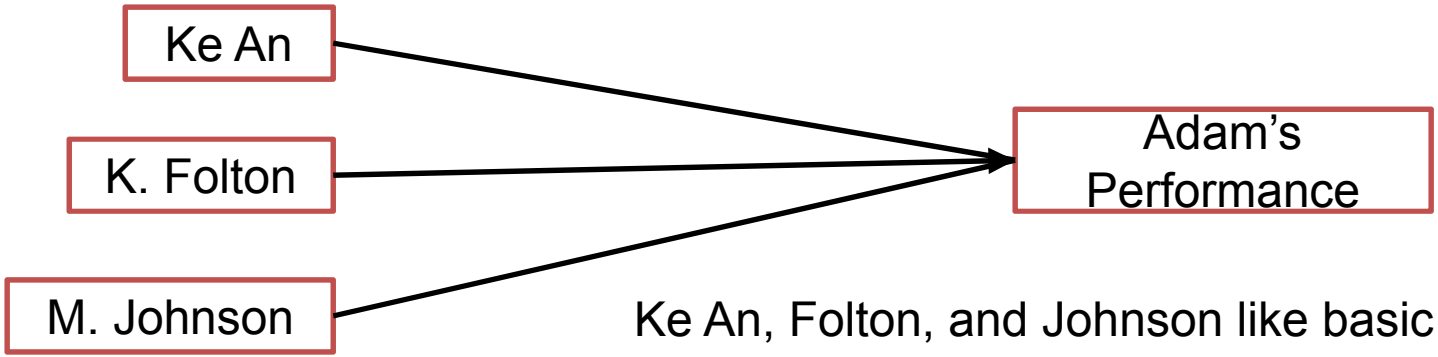
Imagine that we want to know how my peers affect my performance…



Identifying Social Network Effects

We have three problems:

1. We select our collaborators and they tend to be similar to us.

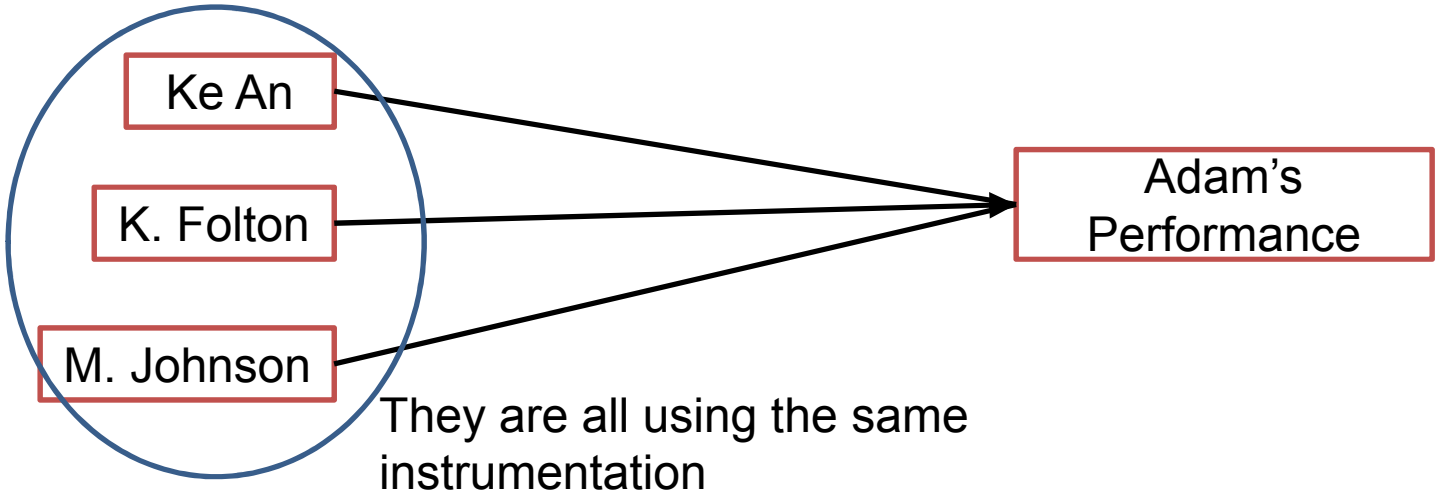


Ke An, Folton, and Johnson like basic physics

Identifying Social Network Effects

We have three problems:

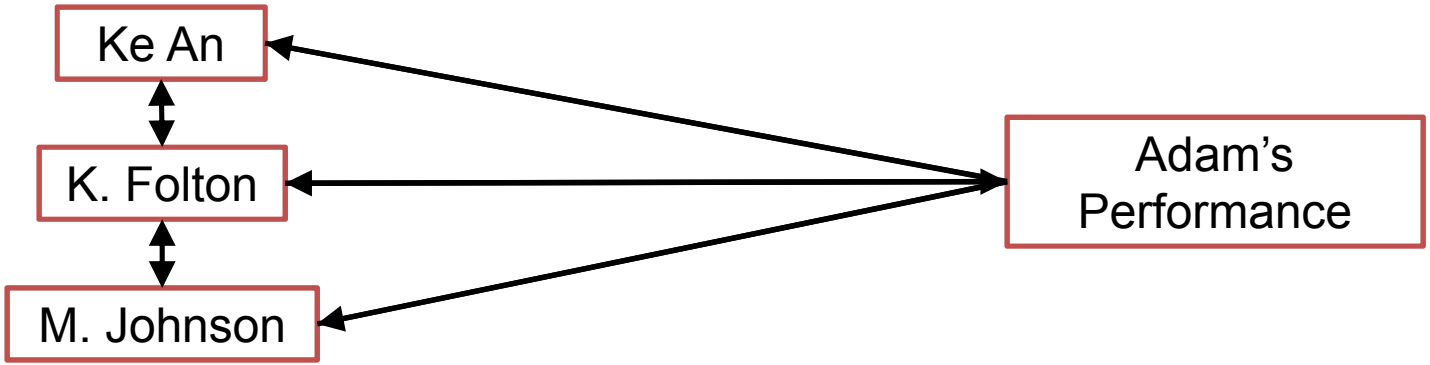
2. Similarity in selection results from a combination of opportunity and preference.



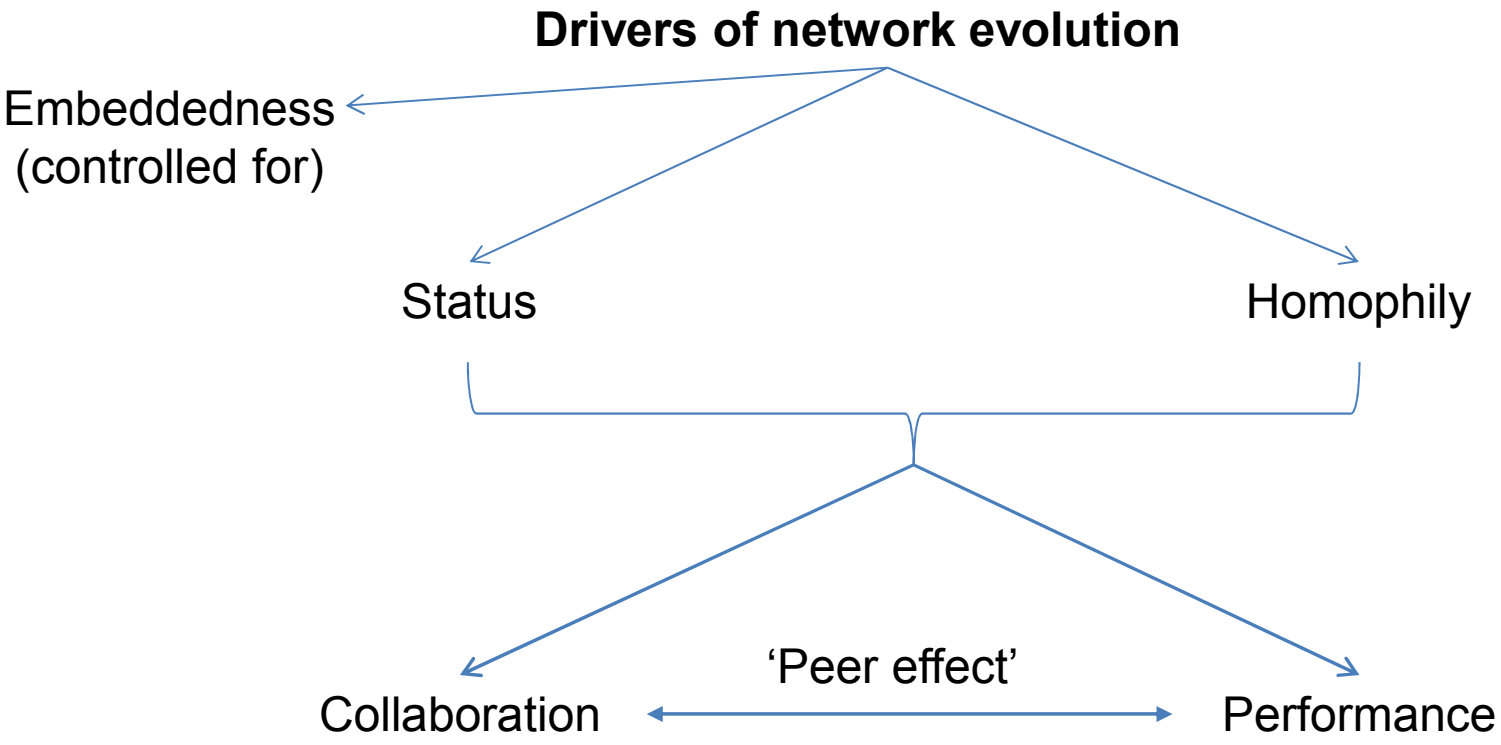
Identifying Social Network Effects

We have three problems:

3. Influence does not flow in only one direction.

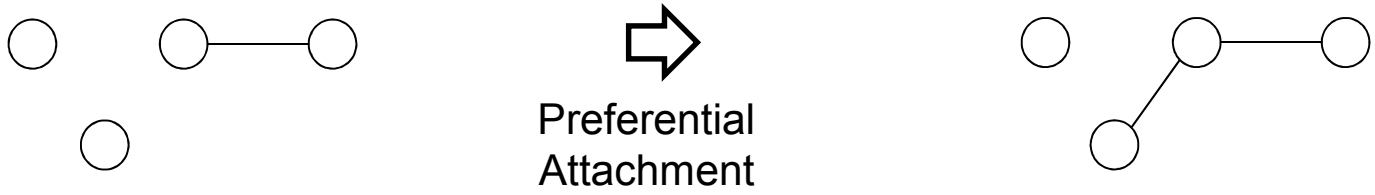


Theoretical Framework



Status effects: ”Big Egos”

- Actors looking for new connections use an actor’s degree as a **proxy for fitness** (Uzzi, et.al. 2010)
- The appearance of scale free networks guided by **Preferential Attachment** (Barabási & Albert, 1999)
- Echos Merton’s notion of the existence of a **‘Matthew Effect’** (Merton, 1968).
- Both Newman, 2001 and Jeong, 2003, find evidence of this **effect in diverse networks**.



Status effects: Cumulative Advantage

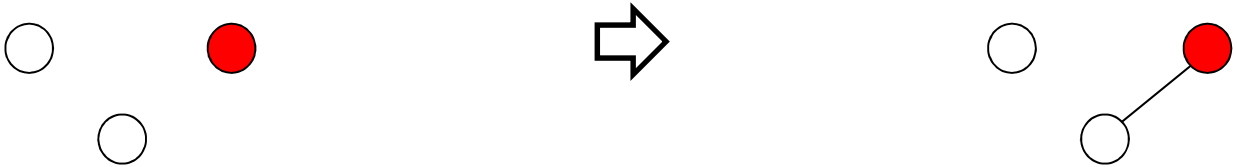
- Highly productive scientists tend to maintain or increase their productivity (Allison & Stewart, 1984)
- Social status as a signal of quality, and increases influx of opportunity (Merton, 1968).
- Social status has a counter-part in productivity:

Status effects: Collaboration with Stars

- Individuals with knowledge on competence levels of peers prefer to collaborate with individuals at same or higher level (Schwab, 2009)

- Collaborating with alters with **higher performance**, can have a positive signalling effect to third parties – i.e. reflected glory (Cialdini, 1976; Kilduff & Krackhardt, 1994)

- Thus Agents will seek collaborative opportunities in high performers:



Alter Performance

Homophily: Activity and Performance

- ”Friendships form between those who are alike” (Lazarsfeld & Merton, 1954)
- Assortative attachment one of the main factors distinguishing social networks from biological and technical (Newman, 2002).
- Maintaining and achieving high levels of performance requires **consistent collaboration** with others **at similar or higher performance** (Groysberg et.al., 2008).

The Peer Effect

- Agents tend to **assimilate to the average performance** of collaborators (Lomi, et.al., 2011) or average productivity (Rawling and McFarland, 2010)

Peer effect

Hypotheses

Hypothesis 1a:	*Agents having many collaborative partners experience increased probability of forming new ties.*
Hypothesis 1b:	*Agents having many collaborative partners experience a positive impact on performance.*
Hypothesis 2:	*Agents will seek to collaborate with agents performing at higher levels than themselves*
Hypothesis 3a:	*Highly active agents tend to form new collaborations with other highly active agents*
Hypothesis 3b:	*Agents tend to form new collaborations with other agents performing at a similar level.*
Hypothesis 3c:	*Agents tend to assimilate to their collaboration partners level of performance*

The Problems

Key Issues to resolve:

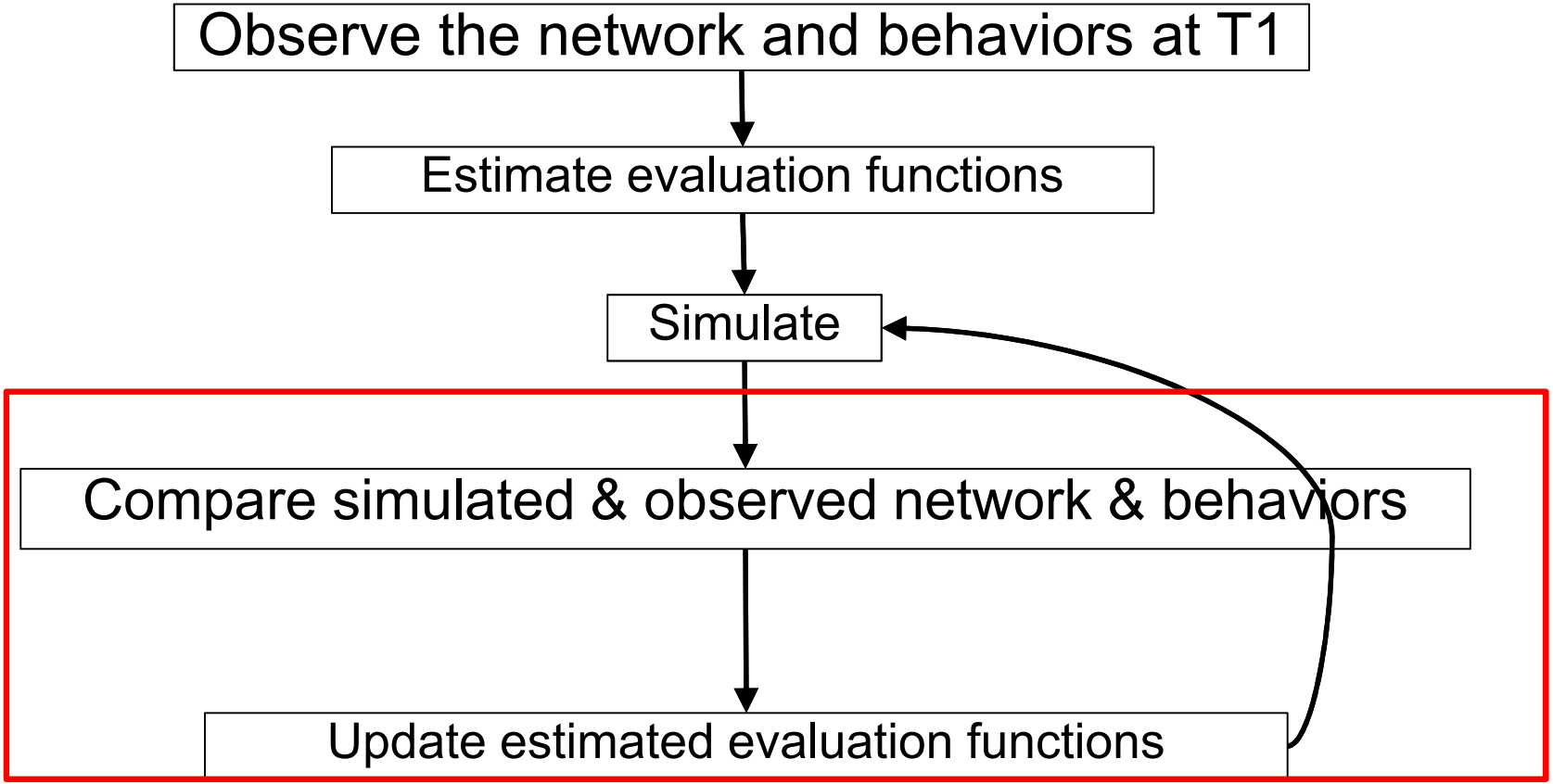
- Network dependency
- Alternative mechanisms
- Incomplete observations of networks and behaviors
- Separating selection from influence

SIENA as a solution

SIENA deals with each of these issues:

- Continuous-time simulation
- Actor/agent based model
- Separation of selection and influence

Method, part 3: Estimation



Dependent Variables

Network Evolution

$$\Pr\left(x(i \to j \mid x, z\right) = \frac{\exp\left(\sum_k \beta_k^{net} s_{ik}^{net}(x(i \to j), z)\right)}{\sum_{l=1}^{N} \exp\left(\sum_k \beta_k^{net} s_{ik}^{net}(x, z(i \to l), z)\right)}$$

Performance change

$$\Pr\left(z(i \updownarrow \delta \mid x, z\right) = \frac{\exp\left(\sum_k \beta_k^{beh} s_{ik}^{beh}(x, z(i \updownarrow \delta))\right)}{\sum_{\phi=-1}^{1} \exp\left(\sum_k \beta_k^{beh} s_{ik}^{beh}(x, z(i \updownarrow \phi))\right)}$$

Modeling independent variables

- Basically the model consists of some rate function λ, modelling the speed by which each actor gets an opportunity for change:

$$\lambda_{i1}^{net} = \rho_m^{net}$$

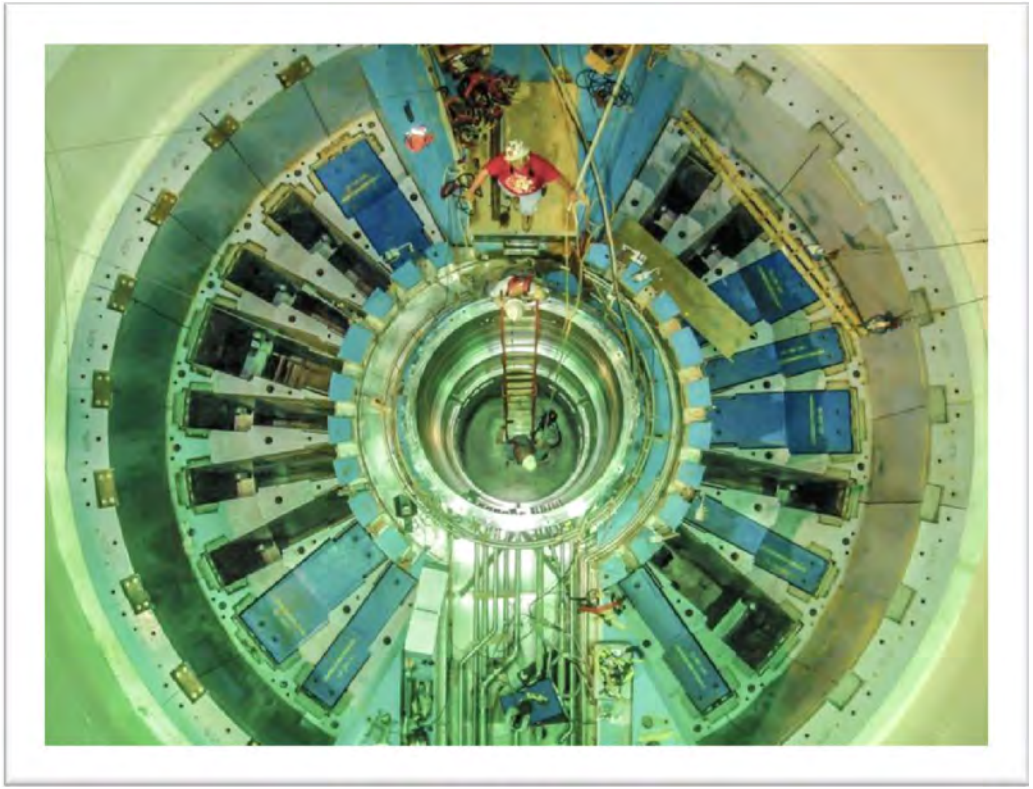
- And an evaluation function for each of the dependent variables modelling an actors 'satisfaction' with his/her local network configuration:

$$f_i^{beh}(x,z) = \sum_k \beta_k^{beh} s_{ik}^{beh}(x,z)$$

$$f_i^{net}(x,z) = \sum_k \beta_k^{net} s_{ik}^{net}(x,z)$$

Unit of analysis

- Spallation Neutron Source & High Flux Isotope Reactor, Oak Ridge National Laboratories



Data

- SCOPUS
  - Goal: **Full bibliographic** data of scientists having been at SNS & HFIR + demographical data (e.g. Gender, tenured..).
  - Now: Bibliographic data on scientists **when at SNS & HFIR**.
- Based on co-authorships
  - Affiliation matrix → Incidence Matrix
- 2180 scientists from 386 different institutions.

Key Variables

Independent Variables:

- Network Structural measures:
  - degree of ego and alter, assortativity

- Performance measured as total count of citations each year corrected for self citations.

Controls:

Organizational foci, country, researcher type, CHI-level, triadic closure, similarity.

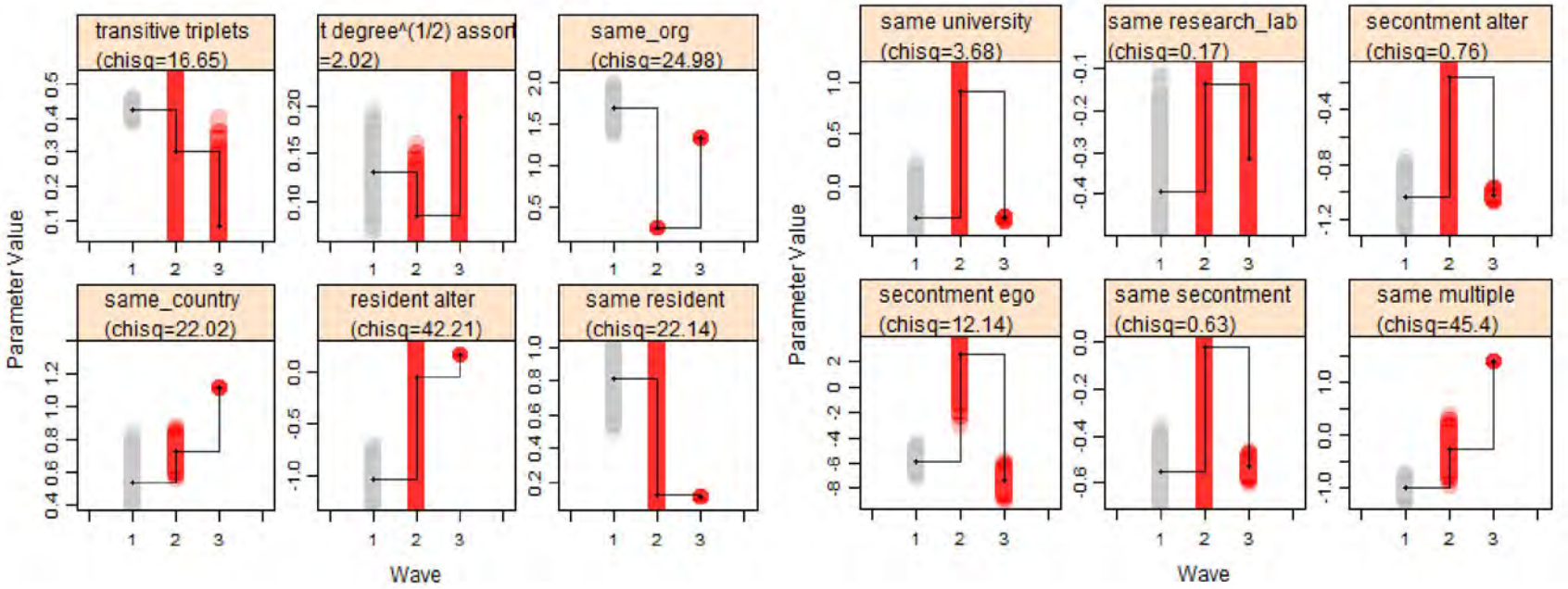
Variable	Model 1 (controls only)		Model 2		Model 3	
	β	SE	β	SE	β	SE
Hypotheses 1a:						
Preferential Attachment			-		-0.1785*	(0.05)
Hypotheses 2:						
Citations x alter			0.1369	(0.11)	0.1468	(0.10)
Citations x ego			0.4030***	(0.06)	0.4625***	(0.06)
Hypotheses 3a & 3b:						
Similar activity			0.4852**	(0.16)		
Similar performance			1.3202*	(0.40)	1.5451*	(0.61)
Rate Parameter Controls:						
Period 1	1.4212***	(0.02)	1.2479***	(0.03)	1.3470***	(0.03)
Period 2	0.7013***	(0.01)	0.6758***	(0.01)	0.6959***	(0.01)
Period 3	1.9599***	(0.02)	1.9691***	(0.02)	1.9479***	(0.03)
Controls:						
Same country	0.8292***	(0.12)	0.7013***	(0.14)	0.7161***	(0.13)
Same organization	0.9311***	(0.13)	0.6250***	(0.14)	0.6006***	(0.13)
CHI x ego	0.9071**	(0.28)	1.4868***	(0.43)	1.2672***	(0.32)
CHI similarity	2.1204***	(0.27)	0.5066	(0.32)	0.4371	(0.32)
Triadic closure			0.5921***	(0.02)	0.5196***	(0.02)
Same researcher type controls	YES		YES		YES	YES
† p < 0.1; * p < 0.05; ** p < 0.01; *** p < 0.001						

	Model 2		Model 3	
Variable	β	SE	β	SE
Rate performance: **Period 1** **Period 2** **Period 3**	 21.2305*** 5.2080*** 2.5941***	 (11.67) (2.12) (0.11)	 20.4705*** 5.3094*** 2.6357***	 (11.66) (2.07) (0.08)
Linear Shape **Quadratic Shape**	-0.0892 0.1305*	(0.10) (0.06)	-0.0410 0.1216*	(0.09) (0.04)
Hypothesis 3c: **Performance Similarity**	3.2799***	(0.08)	3.3797***	(0.08) (0.09)
Hypothesis 1b: **Cumulative advantage**	-0.0082	(0.01)	-0.0116	(0.01)

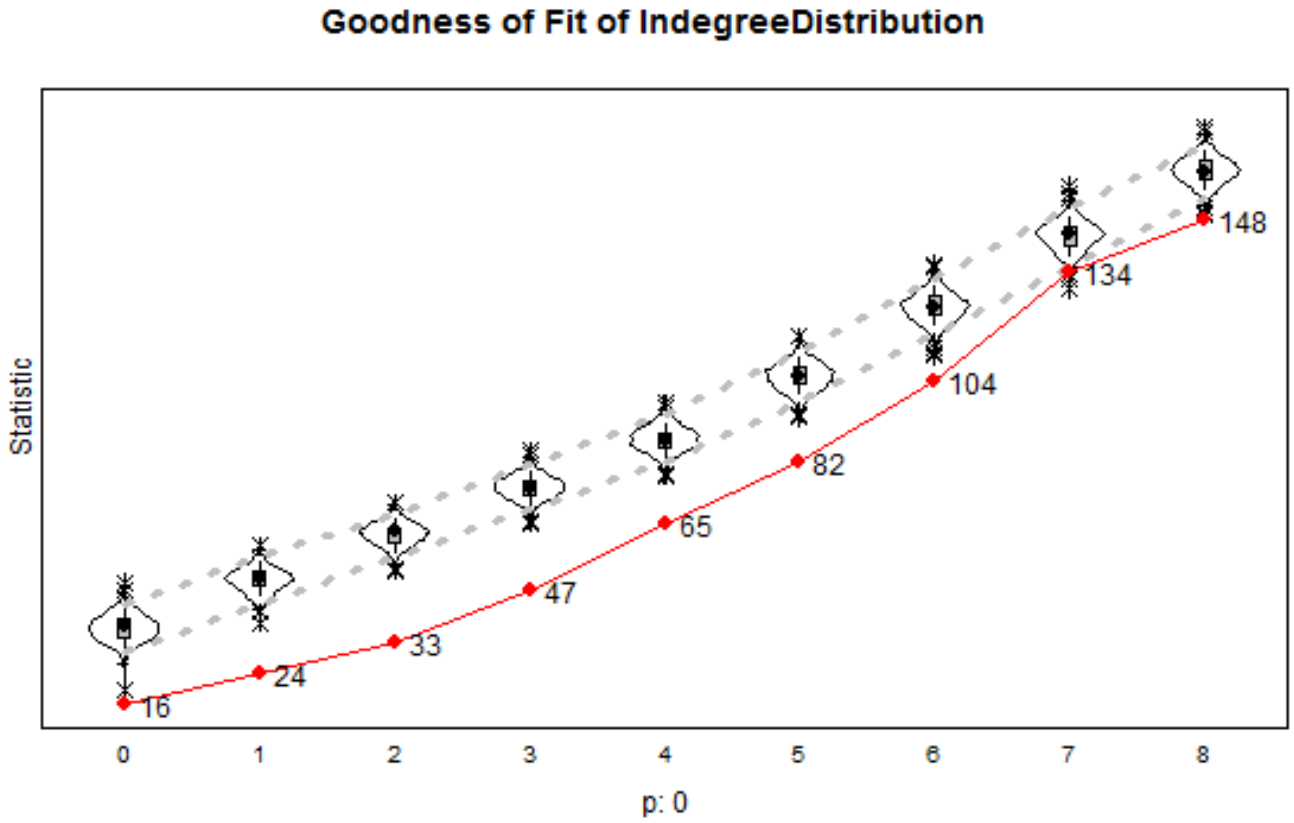
Results overview

Variable	Coeff.		Coeff.
Hypothesis 1a & b:		***Hypothesis 3a, b & c:***	
Preferential Attachment	÷ *	*Assortativity*	+ *
Cumulative advantage	-	*Similar performance*	+ *
Hypothesis 2:		*Performance similarity*	+ ***
Citations alter	-		

Time heterogeneity



Goodness of fit



Conclusions and implications

- Network evolution seems to be governed by positive assortativity and negative pref. attachment at the structural level = ”Rich old boys club”.
- Collaborating seems to have no significant influence on performance, but high performers tend to collaborate a lot.
- Significant support for existence of peer effects

Next steps for this paper

- Collect more data (e.g. gender and full bibliography)!
- Control for prior collaboration and prior stardom.
- Derive a measurement of performance based on full bibliography
- Emphasis on contribution to existing lit. on intra-organizational networks (Felin-Foss-view).

Thank you for your attention!
- comments are more than welcome.