

Entrepreneurial networks and social capital of academic scientists

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Introduction

Social capital and network theorists agree that the primary source of social capital is the network of individual's contacts (Coleman 1988; Burt 1997; Lin 2000; Seibert, Kraimer et al. 2001; van Emmerik 2006). Individual differences, including ones human capital and structural position in the broader network of relationships determine variation in the accessed social capital or resources that are embedded in individual's network. Resources embedded in the network, its structure, as well as content of its ties determine what resources and individual can mobilized from one's network. Lin (2001b) has argued that resources embedded in social networks enhance outcomes of individual actions in four ways - by facilitation of the flow of information, exertion of influence on the critical decisions, confirmation of individuals' social credentials, and by reinforcement of ones identity and recognition. Yet, access to these resources is in part dependent on network structure. For example, networks that are rich in the structural holes where individuals access non-redundant resources across the various members in their network tend to provide more resources (Burt 1992; Burt 1997; Burt 1997; Burt 2000; Burt 2001; Burt 2004; Burt 2005). Further, "entrepreneurial networks" that consist of strong ties with individuals outside of ones organization (Higgins and Kram 2001) also provide access to new and different resources that may benefit the individual.

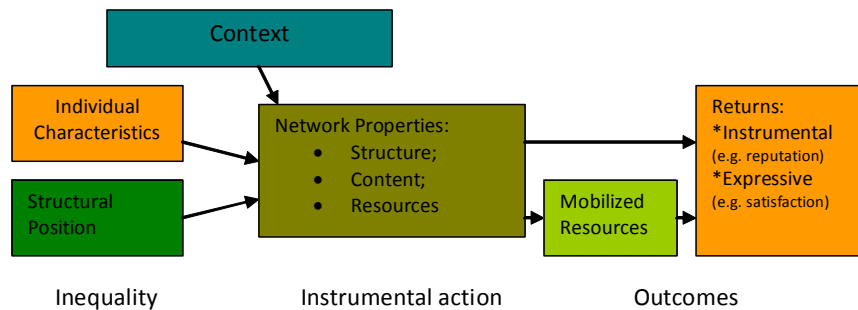
In this paper we develop and test a model addressing the social aspects of knowledge production. Drawing from a 2006 national survey of academic scientists in six fields of science and engineering, We examine the non-collaborative professional networks of academic scientists that provide research-relevant career development support. The primary argument of this paper is that academic scientists with entrepreneurial networks will be able to mobilize more of the knowledge production related resources in their network. In the development of our model, we build upon Burt's structural holes argument, which suggests that individuals benefit from "open networks" that allow them reach out to unconnected groups and obtain non-redundant information. We argue that individuals who are able to obtain more research-related resources embedded in their networks are more likely to rely upon ties that are well developed and trustworthy than upon weak ties.

Social Capital (Network Resources): Effects of Network Properties

Lins network theory of social capital (2001a) conceptualizes resources embedded in social networks as a form of a capital, a value that individuals obtain from and through their social contacts (Lin 2001; Totterdell, Holman et al. 2008). In the academic setting, faculty interact with colleagues inside and outside of their institution, and through various professional venues. The mobilized resources can be more tangible, such as research or funding related knowledge, or less tangible, such as introduction to potential colleagues. The accessed resources provide faculty with returns in the form of valued academia outcomes such as reputation, trust in ones scientific capability and quality of work and so on.

As with the others forms of capital, in order to benefit from it, individuals need to invest in its creation and be purposeful about its use. Social capital implies “investment in social relations with expected returns(Lin 2001). Figure 1 depicts the process of creation and use of social capital.

Figure 1 Model of Creation and Use of the Social Capital (Adapted from (Lin, Cook et al. 2001).



A core issue in the ability to invest and benefit from the social capital in one’s networks is that individual networks vary in terms of key characteristics, specifically (1) the structure (Burt 2005), (2) strength (Granovetter 1973; Burt 2005) and content of the ties (Podolny and Baron 1997) among others) and (3) resources that are embedded in the network (Lin, Ensel et al. 1981; Lin 2001) among others).

(1) Structure of networks

The social capital approach to network resources point at the instrumental nature of social capital - networks that provide individuals with valued resources are means of goal attainment (Lin 2001). Individual invests in the building and maintaining relationships in order to obtain valued resources and achieve desired ends (Burt 2000; Lin 2001). In this process some individuals are able to create social structures that make them better off compare to their peers, and some individuals are able to achieve better returns from their social capital than others (Burt 2004; Burt 2005; van Emmerik 2006). Two particular types of network structures that have been associated with entrepreneurial individuals and with better individual outcomes are, first, networks that are rich in the structural holes(Burt 1992; Burt 1997; Burt 1997; Burt 2000; Burt 2001; Burt 2004; Burt 2005) and, second, networks that consist of strong ties with individuals outside of ones organization (Higgins and Kram 2001). Structural holes in the network refer to a situation where an individual is located between two otherwise unconnected people. Burt (2004) argues that the mechanism by which such structural holes in the network provide social capital is brokerage. People connected across the groups are able to obtain a “vision of options otherwise unseen” and can make strategically smart moves in competitive situations. Furthermore, such people are recognized as a valuable asset to the organization and rewarded accordingly (Aldrich and Herker 1977; Tushman and Scanlan 1981).

Given the market like nature of the knowledge production in sciences, we can expect that scientists who have relationships with otherwise unconnected individuals will be able to obtain more of the social capital.

H1: Individuals with networks rich in structural holes will receive more social capital from their network.

(2) Strength and content of relationship

The network literature has adapted Granovetter's perspective on the strength of social ties – strong ties oppose to weak ties are close, stable and binding (1973). There are number of arguments of how strength of the ties impact creation of social capital. Granovetter (1973) argued that weak ties are the source of social capital because they provide non-redundant information. Others, in turn, argued that strong ties are source of social capital (Krackhardt 1992; Ibarra 1995) among others) and particularly in a workplace (Lin, Ensel et al. 1981; Nelson 1989). It is important, though, to notice that all of these arguments have been supported by the evidence from different settings. Given the importance of the trust and reputation in the academic science and its competitive nature (Stephan 1996), we can expect that individuals will benefit more from strong than week relationships.

Social network research has also shown that not only the structure and strength of relationships determine individual outcomes, but also the content (Podolny and Baron 1997). Content of the relationship can be analyzed in several distinct ways. First, it can be assessed in the functional terms with respect to the desired outcomes (Sandefur and Laumann 1998; Putnam 2001; Flap, Snijders et al. 2006) as instrumental or expressive (van Emmerik 2006). Instrumental relationships are associated with obtainment and accumulation of performance related resources while expressive relationships with support and friendship (Ibarra 1993; Gersick, Bartunek et al. 2000; van Emmerik 2006). Second, the link between the same two people may consist of one or more types of relationships – relationships can be simplex or multiplex (McPherson, Smith-Lovin et al. 2001). For example, people can collaborate, be friends and support each other providing childcare support. Thus, multiplexity refers to the “exchange of multiple resources within relationships within one strong tie” and is associated with high levels of trust (van Emmerik 2006). Similarly as in any other context, in the academic setting we can expect that that individuals who engage in multiplex relationships are able to obtain more of the valued resources. For example, given that individuals contribute to the building each others reputation by nominating them for award, we could expect that not willing risk with own reputation academics would suggest those, whom they know better through multiple types of exchanges. Or, when asked for potential collaborator, they would suggest people whom they know as trustworthy both in terms of their research capacity and reliability as a collaborator. In our previous work we found that multiplex collaborative ties provide more advice and support than any other ties in individuals' network (Melkers, Kiopa and Fonseca, 2008). We hypothesize, that

H2: Individuals with networks rich with multiplex relationships will receive more social capital from their network.

Main business of academic science is to produce new knowledge. In this process both being well connected and having accesses to non-redundant sources of knowledge can be important, and having trusted reliable relationships are equally important. This has been well depicted by the Higgins and Kram (2001) who defined of entrepreneurial developmental networks as networks of strong ties that link individuals with others outside of their organizations. Typically, however, literature maintains that when unique information is sought, network rich in structural holes brings better outcomes, and when cooperation and trust is necessary, closed network serves best (Flap and Völker 2001) among others). In this study we expect that the efficiency of multiplex network ties will have positive effect on the social capital individual is able to mobilize for her or his instrumental purposes . We build upon above discussed arguments – Burts’ structural holes, Higgins’ network classification, and various takes on the tie strength and content. We suggest that in academic science entrepreneurial networks are those that consist of multiplex non-redundant ties. In other words, networks that are rich with multiplex relationships with unconnected alters. We hypothesize, that

H3: Individuals with networks rich with multiplex relationships with unconnected alters will receive more social capital from their network.

A number of scholars has pointed at the gender differences in accessing, mobilizing and using social capital for their benefit (van Emmerik 2006). Some have found that men better at capitalizing on their social capital (van Emmerik 2006) and that men and women’s network differ structurally (Moore, 1990.)

Therefore, we hypothesize that:

H3a: All other equal men with networks rich with multiplex relationships with unconnected alters will receive more social capital from their networks;

Data source and methodology

Data

The data for this study comes from a national survey of scientists and engineers that collected data individual background, career path, productivity, satisfaction and network data.¹ Individuals were alerted to the survey via traditional mail with a series of personalized email follow-ups. They were provided with a unique user-id and password (and directed to the website). The complex nature of the name generator and interpreter questions required a specialized electronic platform where names could be reduced (provided same spellings) and piped into the appropriate name interpreter questions. In addition to the social network questions, respondents were asked about their research activities,

¹Data to be analyzed in this proposed research were collected under the auspices of the 2005-08 project, “Women in Science and Engineering: Network Access, Participation, and Career Outcomes”, (NETWISE 2007) a project funded by the National Science Foundation (Grant # REC-0529642) (co-PI’s Dr. Julia Melkers and Dr. Eric Welch). Opinions expressed in this paper are not necessarily shared by the NETWISE 2007 project leadership and/or the University of Illinois at Chicago or the Georgia Institute of Technology. The survey was implemented online using Sawtooth Software®.

including grant submission and success rate, teaching and committee responsibilities, attitudes about and involvement in interdisciplinary research, work environment, and detailed demographic and academic background questions.

The study is unique in that it gathers data on network content and knowledge exchange but at a national scale. The survey uses an ego-centric network design to explore the respondents relationships with individuals in the respondents collaborative and advice networks, not the global network of which individuals are members (Wasserman and Faust 1994). Through the use of detailed survey questions respondents describe their networks for select activities and their relations with network members (Burt and Minor 1983). As a result, the survey captures multiple dimensions of the collaborative and advice networks that are not accessible through existing data such as bibliometrics.

To capture these data, the survey included a series of *name generator* and *name interpreter* questions. Respondents were first asked to write in the names of key collaborators or advisors in research collaboration as well as advice and support networks into five name generator questions. These included closest collaborators within their own university, closest collaborators outside their university, individuals with whom “they talk about their research but have never collaborated” and individuals in two types of advice scenarios – those with whom they talk about career advice and with whom they discuss departmental matters. Although, the first three (research) networks are mutually exclusive, there is some overlap between the research and advice networks. In this paper we focus on the “research advice network” and its overlap with other advice networks.

Once the survey respondent provided names in each of the five name generator questions, the respondent was then asked a series of *name interpreter* questions about each of the individuals they had named. Name interpreter questions addressed the nature of the collaboration (nature of research product), details about the level of relationship and origin of acquaintance, closeness of research expertise, communication frequency, grant activity, and general demographics.

The survey sample of 3,677 was randomly drawn from the population of academic scientists and engineers in six disciplines in Carnegie-designated Research I universities (151 universities.). The selection of the sample was stratified by gender, rank and discipline. The disciplines (biological sciences, chemistry, computer science, earth and atmospheric sciences, electrical engineering, and physics) were selected based on the level of female representation (low, medium and high). Overall, 1,764 survey were returned for a 50.1% response rate and a usable response rate of 47%². Responses were fairly evenly distributed across the six fields, gender (48% women) and rank (27 % assistant professor, 28 % associate professor, and 45 % full professor.)

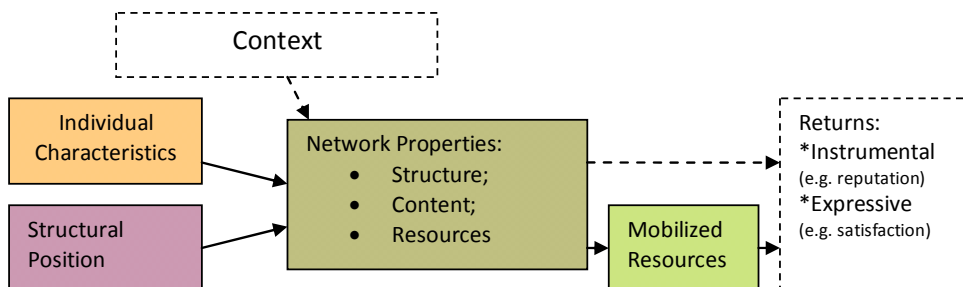
² Data were cleaned for incomplete responses. In the cleaning, non response due to bad addresses were also removed for the calculation of response rate. For example, 136 of the emails were “bounced back” due to a bad email address and 19 were “returned to sender” by the recipient universities email server. Follow-up calls were made but respondents could not be located in these cases.

Model and measures

In this study we primarily concentrate on the effect of structural and content properties of individual's network on mobilized resources (Figure 2). We expect that individual differences and structural position will result in variations of personal networks and network properties, namely its structure, tie content and embedded resources will affect resources that an individual can mobilize. Specifically we develop and test the following model:

Mobilized network resources = f(network efficiency, network multiplexity, network resources, respondent structural position, respondent gender.)

Figure 2 Model of Network Effects on Mobilized Resources



Dependent variable - Mobilized Resources

We measure mobilized resources in four ways. First, we asked our respondents whether individuals they have named in their research discussion networks have reviewed their papers or proposals on which they were not collaborators prior submission to the journal or funding organizations. Second, we asked whether these individuals introduced our respondents to potential collaborators. Third, we asked whether they nominated them for an award or as an invited speaker. Those answers were coded as "1" if the answer was "yes" and "0" if the answer was "no". We then created measures of mean number of reviews, introductions and nominations from network as number of positive answers divided by the size of network that vary from 0 to 1.

Kadushin (1982) suggested that individuals who are connected to different circles are able to mobilize greater range of resources. Structural holes in individual network may mean that individual is connected to different groups. Therefore we created a measure of range of resources an individual receives from network. We summed the positive answers for each of her or his relationships and then calculating the mean of the range for the network that vary from 0 to 3.

Network Properties:

Structure – Network Efficiency (0-1); Multiplex Efficiency (0-1)

Content – Mean Multiplexity (0-4)

Resources – Mean Seniority (0-1)

Individual Characteristics: Male (0, 1)

Structural Position: Associate Professor (0, 1); Full Professor (0, 1)

Independent variables

The independent variables in the model include measures of the network properties, as well as the individual and network structural position of the respondents. First, regarding network structure, we measure structural holes with a **network efficiency** index introduced by Burt () and elaborated by Borggati (). [insert detailed discussion here]. **Strength of the ties** is measured as the sum of length of the relationship and frequency of meeting, and friendship. Typically, network literature measures **multiplexity** as the number of other networks in which people that are named in the focal network of interest are also named (Lakon, Ennett et al. 2006; van Emmerik 2006) among others). Here we follow the same logic and measure multiplexity of a tie as number of other role networks that individual is also named plus whether this person is also a friend. While friendship is often considered a measure of the strength of relationship, it is also a distinct role that a person in a work related network may play. Lazega and Pattison (Lazega and Pattison 1999) in their interviews with corporate law firm partners and associates found that friendships are seen as a form of resource, “a willingness to support in difficult situations, role-distance, emotional support, socialization, information and definition of the situation”. Furthermore, while cooperation can often be forced by the context, friendship is voluntary. Advice is often sought from more senior individuals while friendships are formed among individuals of the same status or from the same graduate school and remain through the careers (Lazega and Pattison 1999). Friendship serves important function of softening the effects of status competition and creation of context for advice seeking or talking about the important work related issues (Lazega and Pattison 1999).

Efficient multiplexity

We created index of multiplex efficiency by multiplying mean multiplexity of the network by the index of network efficiency. We expect efficiency of multiplexity index to be positive for all dependent variables and and stronger especially with respect to the nominations for awards or as invited speakers. Nominations for awards in the academic setting are competitive situation where all other equal individuals that are better connected with number of groups are more likely to have advantage over their peers. We coded gender as 0 for women and 1 for men. Therefore, if coefficient on the gender is positive, hypothesis 4a is supported, if negative – hypothesis 4b is supported.

FINDINGS

In our sample 899 scientists (66%) named at least one individual as someone with whom he or she discuss their research but never have collaborated. Average size of scientists' research discussion network is about 2.4 (see Figure 1).

Figure 1 Research Discussion Network Size

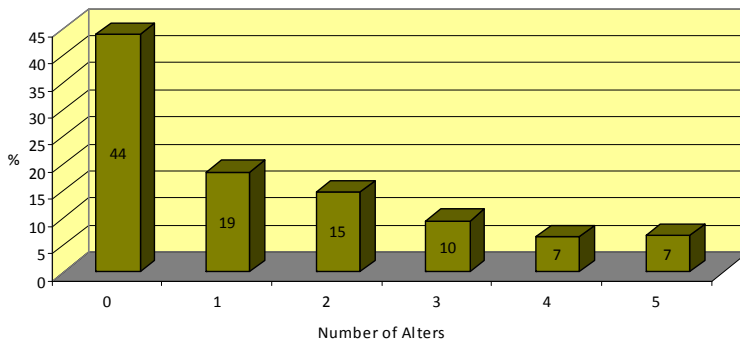


Table 1 reports means of selected measures of research discussion networks, and test of significance results for men and women.

Alters

Most alters in the research discussion networks are men. Alters are equally split by seniority – about one third of alters are more senior, third the same seniority as our respondents and about third are junior to our respondents. Not surprisingly, that more women than men name women alters in their discussion network. About one quarter of alters are also close friends of our respondents. About one fifth of them were met in conferences. Only 5% of named alters our respondents have known since their PhD studies, and only 1% were their students. Interestingly, that more women (23%) than men (18%) met their research discussion peers in conferences. Our results show that, on average, our respondents have better than working understanding of the expertise of individuals in their research discussion network. Men's (1.54) knowledge of their research discussion network alters expertise is higher than women's (1.64). On average our respondents have known their research discussion networks for about 3-6 years and they are in personal contact with those individuals about monthly or slightly more often.

Network properties

Results of significance test in the Table 1 suggest that there are no differences in structural network properties between men and women. Only about one out of ten individuals know each others. Mean multiplexity of network is about .6, which suggests that with most of the individuals named as someone our respondents talk about their research they have rather simple, or one dimensional relationships.

Interestingly, that while there is no differences mean multiplexity of relationships for men and women, for men at the level of individual ties this measure ranged from 0 to 4 and for women from 0 to 3. Which means that for men, there were alters with whom they talk about research, university related issues, seek advice from and also consider their mentors and good friends. However, research discussion networks of women are richer with strong relationships that are not connected between them. The same is true for associate professors.

Table 1 Research Discussion Properties Network, by Egoes Gender: Difference of Means				
	Male	Female	Diffence	Sig.
	n=391	n=356		
Network Size	2,32	2,49	0,17	
Efficiency	0,91	0,93	0,02	
Multiplexity	0,58	0,63	0,05	
Efficient Multiplexity				
	<i>All</i>	0,38	0,43	0,06 *
	<i>Associate</i>	0,35	0,50	0,15 *
Senior		0,36	0,40	0,04
The Same Seniority				
	<i>All</i>	0,30	0,27	-0,03
	<i>Full</i>	0,37	0,30	-0,07 *
Ability to Obtain Grant Funding	1,73	1,75	0,03	
In Governmnet	0,03	0,02	-0,01	
Female	0,08	0,18	0,10 ***	
Close Friend	0,24	0,23	-0,01	
Was on Respondents Dissertation Committee	0,02	0,02	-0,01	
Was Respondents PhD Student	0,01	0,01	0,00	
Were PhD Stdents Together	0,05	0,05	-0,01	
Met in Conference	0,18	0,23	0,05 *	
Extent to which Ego understands Alters Expertise	1,54	1,64	0,10 **	

*** p<0.001, ** p<0.01, * p<0.05, two tailed t-test

Table 2 presents mean values of resources that our respondents were able to mobilize from their networks. Range of resources that our respondents were able to mobilize from their research discussion networks varied from 0 to 3, and mean value is .59. Our results show no differences between men and women. The exception is group of assistant professors, where menwere nominated for awards or as invited speakers significantly less than women (0.07 for men and 0.16 for women).

	Male	Female	Diffence	Sig.
Range of Career Support Resources	0,57	0,62	0,05	
Paper and Proposal Reviews	0,22	0,24	0,02	
Introductions to Potential Collaborators	0,21	0,22	0,00	
Nominations for Award or as Invited Speaker	0,14	0,17	0,03	

*** p<0.001, ** p<0.01, * p<0.05, one tailed t-test

Table 3 reports linear regression results for four dependent variables – paper and grant proposals reviews, introductions to potential collaborations, nominations for awards and as invited speakers, and the range of mobilized resources. We report beta coefficients to be able to compare magnitudes of each effect.

Dependent variable	Reviews		Introductions		Nominations		Range		
	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	
Independent variables									
Individual Properties and Position:									
Male	-0,03	0,51	0,00	0,91	-0,02	0,55	-0,05	0,19	
Associate Professor	-0,06	0,20	0,06	0,19	0,10	0,03	0,00	0,97	
Full Professor	-0,12	0,02	0,08	0,12	0,22	0,00	-0,11	0,02	
Network Properties:									
Efficiency	-0,06	0,28	0,01	0,87	-0,02	0,68	-0,06	0,19	
Multiplexity	-0,30	0,33	-0,17	0,58	-0,59	0,06	0,00	1,00	
Efficient Multiplexity	0,47	0,12	0,21	0,49	0,75	0,01	0,43	0,12	
Status homophily	0,15	0,00	0,27	0,00	0,23	0,00	0,13	0,00	
Seniority	0,16	0,00	0,25	0,00	0,20	0,00	0,07	0,09	
Adjusted R Square	0,09		0,07		0,10		0,25		
N	602		602		602		602		

Effect of Structural Holes

Our regression results show negative sign on the efficiency variable. Even though, the results are not significant the direction of the relationship is as we expected in the models with reviews, nominations and range or resources as dependent variables. This means no support for the simple “structural hole” hypothesis with respect for these kinds of resources. We interpret this result as a support to our argument that it is not the openness of the network per se that is source of valued resources, but the rather the well developed relationships. The relationship is positive for introductions to potential collaborators. If it would be significant, we could speculate, that for the mobilization of this type of social capital denser networks might more beneficial. It is not however, therefore we can not tell and

have to further elaborate our model in the terms of number of observations and measures of control variables.

Effect of Multiplexity

In our multiplexity hypothesis we predicted that multiplexity will have positive effect on mobilized social capital as measured by the range of resources individual has been able to receive from her or his network. Even though not significant, the sign on multiplexity in the model with the range as dependent variable is positive. That at least partially supports our multiplexity hypothesis and calls for further elaboration. Multiplexity variable is negative and marginally significant in the model with number of nominations as dependent variable.

Efficient Multiplexity

Our efficient multiplexity hypothesis predicted positive effect on all four dependent variables. The sign is as expected, however it is significant on for the model with nomination nominations as dependent variable. Thus, our hypothesis is partially supported but asks for further elaboration. Interestingly, that multiplexity is marginally significant in this model and negative while the variable for strong relationships with unconnected individuals is significant, as expected positive, and its magnitude exceeds that of multiplexity. Thus the cumulative effect of this network property is positive.

To further understand the effects of network properties on resources our respondents were able to mobilize from their discussion networks, we examined these relationships by position. The results are presented in Table 4. Our results show, that efficient multiplexity matters for assistant professors in their efforts to mobilize support for their publishing and grant getting and multiplexity matters for their to mobilize broader range of support. For associate professors, efficient multiplexity matters for nominations. For the group of full professors none of the measures is significant.

Table 4 Linear Regression Results, By Position: Mobilized Resources

	Reviews		Introductions		Nominations		Range	
	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.
Assistant Professors								
Male	0,03	0,66	-0,10	0,20			-0,03	0,69
Efficiency	-0,12	0,28	0,07	0,53			-0,13	0,23
Multiplexity	-1,12	0,07	0,75	0,24			-0,45	0,42
Efficient Multiplexity	1,37	0,02	-0,72	0,25			0,93	0,09
Status homophily	0,08	0,38	0,21	0,03			-0,03	0,74
Seniority	0,18	0,05	0,15	0,13			0,07	0,39
Adjusted R Square	0,09		0,04				0,23	
N	166		166				166	
Associate Professors								
Male	-0,07	0,35	0,07	0,36	0,04	0,65	-0,06	0,42
Efficiency	0,00	0,97	-0,09	0,44	-0,01	0,91	-0,08	0,42
Multiplexity	0,66	0,26	-0,96	0,11	-1,10	0,07	0,14	0,80
Efficient Multiplexity	-0,49	0,40	0,90	0,13	1,27	0,03	0,27	0,62
Status homophily	0,30	0,00	0,30	0,00	0,18	0,04	0,22	0,01
Seniority	0,20	0,02	0,25	0,00	0,06	0,51	0,03	0,69
Adjusted R Square	0,11		0,11		0,07		0,21	
N	154		154		154		154	
Full Professors								
Male	-0,06	0,35	0,04	0,48	-0,02	0,78	-0,06	0,24
Efficiency	-0,06	0,43	0,03	0,67	-0,04	0,55	-0,03	0,68
Multiplexity	-0,41	0,40	-0,39	0,40	-0,29	0,51	0,09	0,83
Efficient Multiplexity	0,48	0,32	0,50	0,28	0,51	0,26	0,31	0,48
Status homophily	0,12	0,05	0,27	0,00	0,28	0,00	0,15	0,01
Seniority	0,12	0,07	0,24	0,00	0,22	0,00	0,06	0,29
Adjusted R Square	0,02		0,13		0,15		0,19	
N	280		280		280		280	

Discussion

First, our results suggests that there the measure of efficient multiplexity can be used to understand the entrepreneurial activities of academic scientists. Measure of efficient multiplexity refers to the percentage of unconnected individuals with whom our respondents have developed strong relationships. We have argued that such networks are entrepreneurial, because they allow not only reaching out to unconnected groups, but also ensure higher return from those relationships. In academic context it is more likely, that valued resources will be exchanged through the strong ties than weak.

Second, our results suggest that different network structures and properties of relationship may be beneficial for mobilization of different resources.

Third, we find that relationships within the individual research discussion networks differ by position. It seems that more entrepreneurial junior scientists are able to mobilize production support related resources, while more entrepreneurial associate professors – reputation related social capital.

Limitations and next steps

One of the limitations of our work is related to the small magnitude of our focal relationships. For example, mean multiplexity of the relationships within research discussion networks of our respondents is 0.6, which suggest, that simplex relationships prevail in this type of network. Therefore, we plan to expand our research and examine types of relationships, namely the collaborative ties within and outside of ones university.

Second, conceptually, we have argued for inclusion of friendship in the multiplexity measure. However, it could also be treated as a separate measure by itself. We plan to elaborate on this and to examine the differences of the results.

Next, our main argument was about the effect entrepreneurial networks. We defined entrepreneurial networks as those that consist of multiplex relationships that are not connected. Another way to approach the same idea of boundary spanning and access to greater variety of resources would be to look at the multiplex ties with individuals within ones university or outside of it. Higgins and Krams (2001) suggested that entrepreneurial networks are those that are rich with strong ties outside of individuals' organization. In our further analysis we plan to elaborate on this and to examine how measure of "multiplex relationship with unconnected individuals" performs in comparison to "multiplex relationships with individuals outside of ones university".

Finally, we used position of respondent to control for individuals own resources and seniority measures to control for resources embedded in the network and homophily of relationships. We acknowledge that better resource measures are necessary and plan to elaborate on this in our further analysis by adding resources measures based on ranking of respondents and alters institution. As for homophily measure, it could be used in constructing better measure of entrepreneurial network and we plan to elaborate also on that.

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