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Women's Social Capital in Academia: A Personal Network Analysis

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Abstract: Developmental networks are ego-centered networks, and were found to be beneficial for career success and advancement. Especially in academia, the benefits of developmental networks are critical due to limitations in career stability, and its up-or-out character. Overall, they facilitate career success and advancement by providing access to social capital, which is more or less attainable depending on certain structural network characteristics. Diverging access to social capital for women and men is well known, however, little is known about developmental networks of female and male academic staff. Therefore, this study investigated cohesion and brokerage as indicators for access to social capital to explore gender differences. The sample consisted of n = 594 ego-networks of PhDs and postdocs, working at German universities and research institutes. Cohesion was measured by density and degree; brokerage by effectiveness and constraint. Results revealed that based on Coleman's cohesion theory (1988, 1990), female researchers showed less access to social capital through less dense networks, but bigger ones implying more social capital. Moreover, based on Burt's brokerage theory (1992, 2005), female researchers showed, against our assumptions, more brokerage social capital by showing greater effectiveness, and less constraint. Results provide insight into men's and women's access to social capital.

Keywords: developmental networks, brokerage, cohesion, academia, gender

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In general, it is often assumed that men and women differ in rather unchangeable ways due to individual differences in attributes such as preferences, genetics, or socialization (Cabrera and Thomas-Hunt 2007). The social network approach softens this idea by assuming that individuals independently from gender can alter social interactions and their outcomes (Smith-Lovin and McPherson 1992). Meaning that the individual is in control of her social environment, and the social capital in terms of access to information, support, and opportunities (e.g., hiring and promotion chances) that comes along with it.

Nevertheless, as much as the social network might be a concept managed by individual action, the impact of external factors resulting from organizational and environmental structures (e.g., limitations in financial resources, duration of contracts, structural restrictions with regards to possible promotions) cannot be neglected. Academia illustrates how the structural landscape of a sector defined by rules and regulations can shape careers, the development of social networks, and thus the resources that might be accessible to men and women. In Germany, as well as in other countries, academia is a highly-competitive work environment with strong structural constraints (Kreckel and Zimmermann 2014). Completion of a PhD and postdoc each has to take place within six years, and the ones who sign up for the marathon of reaching a professorship mostly engage in employment situations with progressively less alternatives to the chosen route. Furthermore, researchers are usually not allowed to apply for professorships at their home university, and once they applied for a position, they are on average one applicant out of 40 (Deutscher Hochschulverband 2016). The majority of the ones dropping out from the race are women (Miller, Glick, and Cardinal 2005; European Commission 2013). A generic explanation for women not being that present in academia might be a lack of social capital and resources such as time and energy for progressing in their careers (Carre and Rayman 1999; Hüttges and Fay 2015; Addis and Joxhe 2016). Moreover, women tend to invest available personal resources like time and energy more in family planning or other non-work aspects compared to men (Carre and Rayman 1999).

Social capital in networks has proven to be a key career-related resource (Seibert, Kraimer, and Liden 2001). Specifically, developmental networks are increasingly researched with regards to social capital, as they can be associated with positive outcomes such as promotions, salary increases, career advancement, or career satisfaction (Kram, 1985; Whitley et al. 1991). However, the knowledge of the structure of developmental networks as explanation for access to social capital still needs to grow, even though studies found support for a relation between network structure and positive effects such as organizational assimilation (Sparrowe and Liden 1997), and promotions (Burt 1992).

Gender has been shown to affect the structure of networks (Moore 1990; Asmar 1999; Etzkowitz, Kemelgor, and Uzzi 2000), and hence the access to social capital (Forret and Dougherty 2004; van Emmerik 2006; Kegen 2013). Whereas successful men tend to build up their own social capital, successful women rather tend to borrow it (Burt 1998). Moreover, content and outcomes of social networks in terms of status, influence, career development, information and trust appear to be unequal for women and men (Campbell 1988; Krackhardt 1990; Ibarra 1992, 1997; Podolny and Baron 1997; van Emmerik 2006). Heretofore, it is important to follow the call of Gremmen, Akkerman, and Benschop (2013) to further explore gender differences in network structures and outcomes to advance the development in gender-sensitive approaches with regards to organizational network research. By analyzing gender-related differences in network structure, and by taking into consideration the career stage (i.e., PhD and postdoc), we get a deeper understanding of the social support environment of female researchers, which first provides an overview of the current situation, and might allow suggestions on how to structure the social environment or how to position oneself within it. To summarize, this study's objective is to research the access to social capital of male and female researchers in their early (i.e., PhD) to advanced (i.e., postdoc) career stages via an analysis of the structure of their developmental network.

This study is to our knowledge the first to examine the social capital of women in academia by means of cohesion and brokerage as structural characteristics of developmental networks. We therefore contribute to research on gender-related differences in access to social capital as a resource relevant for a career in academia. This is especially important since results concerning gender differences in social networks have been overlapping and contradictory at times (Cabrera and Thomas-Hunt 2007). Furthermore, academic staff is a special sample requiring attention, as trying to pursue a career in academia is very much a challenge due to the systems' structure itself. Moreover, we consider this research relevant to be executed first, to foster knowledge on the structural setup of developmental networks. By analyzing the structural setup of developmental networks based on two different approaches (i.e., cohesion and brokerage), we pave the way to gaining more insight in the entangled connection between structural setup and exchanged content such as information (i.e., brokerage) or support (i.e., cohesion). More knowledge on resources through social capital is largely relevant for academics, and hence the current knowledge society.

The next sections will describe social capital in developmental networks, the relation to network structure, and gender-related differences concerning social capital defined by cohesion and brokerage.

Social Capital and Developmental Networks

Throughout the paper, we will refer to *ego* as the owner of the ego-network and to *alter(s)* as the person named being part of the ego-network. Social capital is the access to tangible and intangible resources such as information or support acquired through direct or indirect contacts within a social network (Crossley et al. 2015). This study's social network concept - developmental networks - is defined by a set of people that have the other person's best interest regarding professional and private advancement in mind (Kram 1985). The social capital of developmental networks is expressed through career and psychosocial support given by the alters to the ego, and was found to be linked to career outcomes such as promotions, career satisfaction, perceived career success, or career-related self-efficacy during early career phases (Kram 1985; Whitley et al. 1991)(M. C. Higgins & Thomas, 2001), making them highly relevant career constructs.

In general, one can distinguish between social capital as cohesion (Coleman 1988, 1990), and as brokerage (Burt 1992, 2005). Social capital as cohesion is about strong, close relationships characterized by trust, cooperation, mutual support, or solidarity, and often is measured through the degree or density of a network (Crossley et al. 2015). Its assumption is that dense networks with strong connections result in social capital (Crossley et al. 2015). Social capital as brokerage is frequently captured by the observed brokerage positions, or the degree to which an actor is constrained by her social network (Crossly et al. 2015). It is defined by weak ties which allow movement in versatile social circles with access to non-redundant

information. In this study, we focus on social capital as cohesion and as brokerage because they together represent the complementary research directions of social capital that either focuses on strong ties resulting in support (Coleman 1988, 1990) or weak ties resulting in more information (Granovetter 1973; Burt 1992, 2005).

Gender specific knowledge on diverse network parameters indicating social capital in developmental networks in different academic career stages is rare (see van Emmerik 2006; Duberley and Cohen 2010; Sauer, Kauffeld, and Spurk 2014; Kegen 2013, 2015), for which reason, in the following section, we will illustrate gender-related literature on the cohesion and brokerage approach to social capital, and deduct our hypotheses accordingly.

Cohesion and Gender

According to the social capital as cohesion approach, dense networks are related to more trust, collaboration, and mutual support. Due to the intertwined relationships in the network, a strong incentive for support due to severe consequences when deviating from expected behavior, is facilitating opportunities that would not be present in sparse networks (Crossley et al. 2015). We first introduce generic, and second, gender relevant literature for density and degree as our indicators of cohesion.

Density. Density describes the number of connections between alters in relation to all possible connections between alters. Overall, developmental networks exist of rather strong and dense ties due to the support nature concerning professional and personal development (Coleman 1988, 1990; Cummings and Higgins 2006), which subsequently results in an increase of social capital (Crossley et al. 2015). Overall, dense networks are considered to be more beneficial for accessing resources, and in a group of scientists, who are dealing with similar research questions, density was found to provide social capital (Jungbauer-Gans and Gross 2013).

Some studies found that the average density of the women's social networks does not differ significantly from the average density of the men's social networks (Burt 1998; Bastani 2007; Gremmen et al. 2013). However, other research found that women lack social capital compared to men (Duberley and Cohen 2010; Addis and Joxhe 2016). Moreover, according to gender-role theories we expect that women invest less time and energy in career-related activities because of lower career-related goals and higher family orientations (Abele and Spurk 2011; Hall et al. 2013). In addition, women might be penalized through their social environment by putting too much effort in career-related activities, because they violate gender-role stereotypes by focusing too strongly on the life domain of careers (Eccles, Jacobs, and Harold 1990; Eagyl and Karau 2002). Hence, an active management of the strongly career-related developmental network is more difficult for women compared to men. In sum, therefore, a lower density for women's networks could be expected.

> **Hypothesis 1:** Female researchers' developmental networks are less dense than the ones of men.

Degree. Degree describes the number of supporters within the developmental network (Wasserman and Faust 1994). On average 5-6 people are named as supporters (Podolny and Baron 1997). Large networks have been found to be positively related to acquiring information and resources (Podolny and Baron 1997; Burt 1998), as well as more promotions and career satisfaction (Sauer et al. 2014).

When comparing the social networks of men and women, some research (Moore, 1990; McGuire, 2000; Ajruch, Blandon, and Antonucci, 2005) indicated that personal networks of men and women are equally big. Nevertheless, there are also general findings that women lack social capital for progressing in their careers (Duberley and Cohen 2010), or that they leave academia to due to missing resources for combining work and life (Carre and Rayman 1999). Again, based on gender-role and gender-role stereotype theories (Eccles et al. 1990; Eagyl and Karau 2002; Abele and Spurk 2011; Hall et al. 2013), we expect women to have smaller networks as an indicator of less access to social capital. Moreover, according to the homophily principle women tend to connect to female contacts within their networks (Ibarra 1993; Spurk et al. 2015a). Because a large part of the developmental networks consists of work-related contacts that are predominantly male in academia, women should have smaller networks. In sum, we therefore hypothesize that:

> **Hypothesis 2:** Female researchers' developmental networks have a lower degree than the ones of men.

Brokerage and Gender

Brokers connect unconnected parties with each other, and by means of that gain social leverage, access to resources transmitted between the parties, and hence social capital (Gabbay and Zuckerman 1998). Brokerage is theoretically and empirically associated with a competitive advantage, more likely resulting in promotions (Gabbay and

Zuckerman 1998). We again first introduce generic, and second gender-relevant literature for effectiveness and constraint.

Effectiveness. Effectiveness describes the redundancy or degree of overlap between contacts and the exchanged resources in a network. Supporters who are not connected to each other might tend to share diverse opinions and information with the ego, which is therefore not redundant. In networks with high effectiveness, most of the contacts do not know each other. If many of the direct contacts know each other, network effectiveness is low (Burt 1992). In networks with a high effectiveness, the ego has more the possibility to connect unconnected contacts, hence to broker, and to enjoy more social capital in terms of strategic use of information and/ or contacts.

Personality theories assume that women tend to be more agreeable and show lower levels of Machiavellianism compared to men (Paulhus and Williams 2002; Weisberg, DeYoung, and Hirsh 2011). Therefore, we assume that women tend to draw less strategic and sometimes manipulative use out of their network because they do not feel comfortable with it because of some of their dispositions. Moreover, research shows that women show less brokerage behavior (Brands and Kilduff 2013), and that women are underrepresented in positions of power (Ibarra 1993). Together with findings that women lack social capital for progressing in their careers (Duberley and Cohen 2010), or that they leave academia to due to missing resources, like social support, for combining work and life (Carre and Rayman 1999), we hypothesize that women in academia have less brokerage opportunities than their male colleagues in their networks:

> **Hypothesis 3**: Female researchers' developmental networks are less effective than the ones of men.

Constraint. Constraint is a summation of how much each alter constraints the ego in cooperating with all other network members. Thus, it measures the extent to which an individual is restricted by her social network, and hence, the extent to which her social capital is low. It taps the extent to which ego's connections are to others who are connected to one another. If the ego's potential cooperation partners all have one another as potential cooperation partners, the ego is highly constrained. If the ego's cooperation partners do not have other alternatives within their network, they cannot constrain ego's behavior in cooperating with each other.

With regards to gender differences in network constraint, we rely on the assumption that women in early career stages trade being constrained by high-status organizational sponsors through aligned tasks, or expected behaviors for social support from those high-status contacts (Burt 1998). By this mechanism, women may compensate for the lack of being in high-status positions themselves or having no powerful female supporters due to a lower frequency of women in high status positions in general and within academia (Ibarra 1993; Parker and Welch 2013). Moreover, similarly to the reasoning for effectiveness above, women may generally show less strategic and potentially manipulative behavior than men (Paulhus and Williams 2002; Weisberg et al. 2011), what might lead to a higher network constraint. Together with research from other employment fields that women in fact show less brokerage behavior (Brands and Kilduff 2013), we assume that:

> **Hypothesis 4**: Female researchers' developmental networks are more constraint than the ones of men.

Methods

Sample and Procedure

The data of this study were collected via a state-funded project aiming to detect factors that promote healthy and successful careers in academia. In total, 1011 participants registered at the website for the online-survey of which 798 (78.93%) actually started the questionnaire. Of those who started the questionnaire, 594 completed the part of the questionnaire that was solely about the participants' social network. This part of the questionnaire was the last one, and 259 participants did not even start this part, and were thereby being excluded in this study. We can thus report a response rate of 53%. Below, we will report the sample of the participants and the alters. The sample of the participants is relevant as they were the ones filling in the questionnaire. The sample of the alters were the supporters named by the participants as members of their developmental network. The unit of analysis is the network of each participant. The description of the alters is provided to give an indication of the composition of the participants' networks.

Developmental network questionnaire. Aligned to the concept of developmental networks by Dobrow and Higgins (2005), participants were asked to list up to 15 people (e.g., colleagues, friends, or kin) that support them in their career development by means of a name generator. We slightly extended the name generator applied by Dobrow and Higgins by providing more

example behaviors of possible supporters (e.g., providing information or creating career opportunities) to facilitate the name gathering for the participants. Afterwards, participants indicated in a matrix the relationships between the members of the developmental network (i.e., inter-alter relationships). At the end of the questionnaire, participants were presented a set of questions per person they had mentioned as member of their developmental network (i.e., alter-wise fashion).

Sample participants. This study's sample consists of 594 researchers working at state-owned and private research facilities as post-docs (58%) or PhD students (42%). Post-docs and PhD students working at German universities or research institutes are considered as regular employees responsible for teaching, administration, and research. Participants were on average 33 (*SD* = 5.09) years old and an equal number of men and women participated in the study (55% female). 30% percent of the participants were single, 32% married, and 33% in a relationship.

Sample alters. On average, 594 participants, named 6.33 alters (*SD* = 3.11) in their ego-networks. Alters were on average 41.84 (*SD* = 12.86) years old, and 53% of them were female. Two-third (65%) were employed at universities or research institutes, and 35% worked in the industry or were currently looking for a job.

Measures

Below, we will describe the measures applied, and how they are assessed and computed. This section gives additional information on how the metrics are computed to facilitate replication of this study. Information on metrics in the theoretical part is rather content-oriented.

Gender. Gender was measured by a closed question. Participants could either answer 0 when being a man and 1 when being a woman. The item was, "*Please indicate your gender*".

Density. Within ego-centered networks, the ego is naturally connected to all alters, which might impact the network density measure. The ego is hence excluded from the density measure. In general, this measure is assessing the proportion of all observed connection within the developmental network compared to all possible connections in a developmental network (Burt 1992). Density can take on values between 0 and 1.

Degree. The degree describes the total amount of alters named by the ego as members of the developmental network. If a participant named 6 alters to be part of the developmental network, then the degree is 6 (Wasserman and Faust 1994).

Effectiveness. Effective size of the network is the number of alters that ego has, minus the average number of ties that each alter has to other alters. Example: A has ties to five other actors. None of these five have ties to any of the others, resulting in a value of 0. The effective size of ego's network is five (5 − 0 = 5). Alternatively, suppose that A has ties to five others, and that all of the others are tied to one another. A's degree is five, but the ties are "redundant" because A can reach all five neighbors by reaching any one of them. The average degree of the others in this case is four, as each alter is tied to four other alters. Therefore, the effective size of the network is its actual size (5), reduced by its redundancy (4) to yield an effective size of 1 (Burt 1992).

Constraint. Constraint is a summary measure that taps the extent to which ego's connections are to others who are connected to one another. Technically, it is a combined measure of degree, density, and hierarchy (i.e., degree to which actors are connected to each other through a central actor). If ego's potential trading partners all have one another as potential trading partners, ego is highly constrained. If ego's partners do not have other alternatives in the network, they cannot constrain ego's behavior. The idea of constraint points out that actors who have many ties to others may actually lose freedom of action rather than gain it depending on the relationships among the other actors, and is thus an inverse measure of brokerage (Burt 1992). Values can range from 0 to 1.

Control variable. As the sample consisted of researchers in their PhD and postdoc phase, we included the career stage as control variable. Participants were asked to indicate whether they have finished their PhD or not. Participants who had not finished their PhD were assigned to the group of PhDs, and participants who indicated to have finished their PhD were assigned to the group of postdocs (0 = PhD, 1 = postdoc).

Data Analysis

Structural aspects of the developmental networks that will be investigated in this paper are density, degree, effectiveness, and constraint. Network parameters were calculated by means of RStudio 0.99.467. Only networks without any missings were included in the analysis. The applied packed is named EgoNet and developed by Sciandra, Gioachin, and Finos (2010). For being able to execute the data analysis, it was required to have the networks in matrix form. The group comparisons by means of ANCOVAs in which we controlled for career stage have been executed with SPSS 23.00.

Results

Preliminary Analysis

In the following section, we will report the differences in the network structure for male and female researchers. Before, we tested if career stage of the participants might have an impact on the results. Therefore, we conducted an analysis of variance (ANOVA). Career stage did not interact with gender for none of the investigated network parameters (density: F (1,590) = .86, p = .36; degree: F (1,590) = 1.18, p = .28; effectiveness: F (1,590) = 2.32, p = .10; constraint: F (1,590) = 1.53, p = .22). An overview of the means and standard deviations of the dependent variables, and according to gender can be found in Table 1. Results of the ANCOVA analysis, in which career stage was included as control variable are displayed in Table 2.

Cohesion and Gender

Density. In terms of density, we found a significant difference regarding gender in our data (F (1,590) = 23.04, p < .00). Female researchers (M = .61, SD = .17) report less dense networks than male researchers (M = .69, SD = .16). Our assumption of Hypothesis 1 that female researchers' network are less dense can therefore be supported.

Degree. Regarding the degree, we can identify significant differences between male and female researchers (F (1,590) = 15.40, p < .00). Female researchers reported on average 6.87 (SD = 3.13) alters and male researchers reported on average 5.65 (SD = 2.89) alters. Our assumption of Hypothesis 2 that female researchers' networks are smaller than the ones of their male colleagues can therefore not be supported.

Brokerage and Gender

Effectiveness. In terms of effective size, we can denote that men and women differ significantly (F (1,590) = 24.32, p < .00). With a mean of 3.32 (SD = 1.89) men appear to have less effective networks than women (M = 4.39, SD = 2.39). Our assumption of Hypothesis 3 that female researchers have a less effective developmental network in comparison to male researchers can therefore not be supported.

Constraint. In terms of constraint, we can report a significant difference between men and women (F (1,590) = 18.61, p < .00). Women (M = .47, SD = .19) seem to be less constrained by their reported social support system than men (M = .56, SD = .21). Our assumption of Hypothesis 4 that female researchers are more constrained by their developmental network than their male colleagues cannot be supported.

Discussion

Despite the knowledge that women lack resources such as social capital, and therefore are underrepresented in high positions in academia (Engels, Ruschenburg, and Zuber 2012), empirical contributions about the actual resources of female researchers in terms of social capital are still relatively scarce (van Emmerik 2006; Kegen 2013). Building on the theoretical approaches of Coleman (1988, 1990) and Burt (1992, 2005) concerning social capital, this study is to our knowledge the first to examine the social capital of women in academia by means of the structure of their developmental networks during the PhD and postdoc phase according to the cohesion and brokerage approach. It contributes to research on social capital as a factor related to women dropping out of academia. Overall, contrary to our expectations, the results of our study revealed that for the majority of our indicators for social

Table 2. Analysis of Covariance (ANCOVA) between network parameters and gender

	Gender			
	df	*F*	η	*p*
Density	1	**23.04**	.04	.00
Degree	1	**15.40**	.03	.00
Effectiveness	1	**24.32**	.04	.00
Constraint	1	**18.61**	.03	.00

Note. N = 594.

Table 1. Means and standard deviations of the dependent variables in general and according to gender

	Overall			Gender					
	n	*M*	*SD*	n_{male}	M_{male}	SD_{male}	n_{female}	M_{female}	SD_{female}
Density	594	.65	.18	249	.69	.17	287	.61	.17
Degree	594	6.33	3.11	249	5.65	2.89	287	6.87	3.13
Effectiveness	594	3.92	2.25	249	3.33	1.89	287	4.39	2.39
Constraint	594	.51	.21	249	.56	.21	287	.47	.19

capital (despite density), women seem to possess greater social capital than their male colleagues, during the PhD as well as postdoc phase. Below possible explanations for the results will be discussed.

Based on the theory of cohesion (Coleman 1988, 1990), which states that dense and bigger networks are related to access of social capital such as support with regards to personal and professional matters, we found that women have bigger networks and hence more social capital. Previous research also found support for women's networks to be bigger (Burt 1998; Sauer et al. 2014). An explanation for the bigger networks of women in this sample could be the broad-ranging initiative for supporting women in the workforce that has been initiated in Germany some years ago. The German state has for instance been promoting for a certain percentage of upper positions to be occupied by women. For helping women achieve those positions, gender-specific-mentoring or networking programs have been set up. The emphasis on networking and mentoring programs could have already made an impact visible in this sample. Furthermore, some first research has already revealed for bigger networks of female researchers to positively relate to social capital (Spurk et al. 2015a).

Concerning density, we found support for women to have less dense networks than men. Hence, women seem to possess less social capital due to less dense networks. Relatedly, Parker and Welch (2013) found that directors of research institutes reported strong and close relationships with each other as an advantage for cooperation in academia, and therefore indicating that dense support networks are possibly what it takes to advance in academia. The lower density in our female participants' networks might to some extent explain the still lower amount of resources reported by working women if dense networks are an important predictor of career success. On the other hand, dense teams were found specifically for women to hold disadvantages, which could only be reduced when they engaged in a more diverse social environment with a high information flow (Lutter 2015). Hence, women might want to keep the density low by preventing contact between certain contacts to reach a low constraint (i.e., low social pressure) and high effectiveness (i.e., high flow of information). Moreover, women have more non-work contacts in their network, which implies greater social pressure with regards to family plans or career pursuits (Moore 1990; Bastani 2007). To keep certain pressure of expectations or norms at distance, women might more consciously keep certain groups in the network apart. The latter would also explain the lower constraint and higher effectiveness resulting from women's networks found in this study.

Burt (1992) found that successful women borrow their social capital by positioning themselves less as brokers in their networks, hence implying more constraint. Less brokerage and greater network constraint let for women to an earlier promotion, however, later promotions were predicted by less constraint. He explained the finding about early promotions that women are making a trade-off between having contact to colleagues in high positions with more resources, which on the other side makes their network more constraint and hierarchical. The latter could explain why a lower network constraint in our female participants' networks might not necessarily be helpful for early objective career success unless they have powerful supporters. However, together with a bigger, less constrained and more effective developmental network, objectively interpreted, female researchers seem to possess more social capital such as diverse access to information, irrespectively from negative or positive future career outcomes.

Beside specific explanations why three of the four network parameters showed non-expected gender-differences, one overall explanation might be the type of analyzed network. Compared to past research that analyzed friendship (Haynie 2001) or solely work-related (Ibarra 1993, Spurk et al. 2015a) networks, the here analyzed developmental networks are different in nature (i.e., focused more on career support) and are comparatively more heterogeneous in composition (e.g., work and non-work, within organization, outside organization, young and old alters). Hence, it might be that a specific constellation of type of network (i.e., developmental) and type of employment field (i.e., academics in Germany) was responsible for the retrieved gender-differences.

To conclude, results indicate for women to have social capital beneficial network structures, but when looking at it in detail it is questionable to what extent the cohesion and brokerage approach is applicable to men and women in the same fashion. Overall, this study extends past research related to social capital based on cohesive networks or brokerage positions of women in academia by finding that women might possess greater social capital for professional and personal development than their male counterparts might. Our findings support previous research that was able to show an increase in social capital for women over the last decennia (Addis and Joxhe 2016). Moreover, we provided further insights into the resources (e.g., support and information) that women in academia have available, which is of importance, since women in academia are still underrepresented, and are dealing with gender discrimination (Duberley and Cohen 2010). Since

women seem to be more in brokerage positions, we can assume that they have more access to information, and since women also have bigger network, we can assume that they have more access to support. Beyond that, we can demonstrate that our findings apply for both career stages, the PhD as well as postdoc phase.

Implications for Future Research

In general, research found for female researchers to lack resources for career progress (Carre and Rayman 1999; Duberley and Cohen 2010). This study's sample is exactly in career and private-life critical stages, where higher resources for career progress, or personal-life objectives might be required. Possibly, the greater social capital is required by those women currently working in academia, and hence, a sign of adjustment to the higher requirements. Future research could investigate whether women and men with or without family responsibilities show greater access to social capital.

Relatedly, since a professional network has been shown to be of high importance (Poole and Bornholt 1998; Quinlan 1999), a general next step for research on social capital of women in academia is to further investigate the connection between the structure of relevant personal or social networks and outcome variables indicating success, satisfaction, or health. Parker and Welch (2013) researched certain structural aspects of social networks such as density and degree on different forms of leadership. But, only by connecting the structure of personal networks with career outcomes will we be able to provide a more distinct answer on whether the higher social capital for women in this study is actually resulting in better career outcomes, or whether it is needed to draw level with men in academia. To further broaden the amount of information on how career outcomes are related to the structure of the social environment, we suggest to focus on the link of different kinds of social capital resulting from the network structure with career outcomes.

Finally, with regard to the here applied distinction between the cohesion and brokerage approach to social capital, future research might not only further investigate gender differences in social capital but also moderating effects of gender. Specifically, it might be interesting to know if different types of social capital (i.e., cohesion or brokerage) are more helpful for either women or men. Such an analysis would deepen our understanding about what to recommend within gender-specific career development programs.

Practical Implications

Social capital is of great importance for career success, and women in academia seem to possess more than their male colleagues. Questionable is whether women are aware of the potential of their social network. Hence, awareness trainings or elements in trainings fostering awareness of the structure of women's social environment might be helpful. Especially, practical experience by means of role playing teaching how to strategically position oneself between departments by for instance becoming an expert in a certain field might foster awareness of how to create brokerage positions and its social capital. Structuring the social network can be achieved through networking by individuals modifying their social environment (Ibarra 1993; Gremmen, Akkerman, and Benschop 2013). In fact, people, who actively manage their social network have shown to be more successful (Burt and Ronchi 2007). Consequently, we recommend for graduate schools or institutions being involved in educating academic staff to integrate sections in trainings that inform about the effect of a wide and big network, and how a brokerage position between certain individuals can bring career opportunities along. By means of coaching (Gessnitzer and Kauffeld 2015), or a combination of networking training and coaching (Spurk et al. 2015b), female PhDs or postdocs could be trained in increasing their personal career resources, which might lead to the accumulation of social capital.

Limitations

Next to the strength of this study, we also would like to point out some improvement points. First, this study's results are based on cross-sectional data. However, social networks are dynamic, and might also be analyzed at several points in time. Nonetheless, for an analysis of gender differences, the here applied cross-sectional approach is suitable.

Second, this study had a purely structural perspective on networks, and did not consider relationship attributes (e.g., contact frequency) or alter attributes (e.g., age, gender). Ties might diverge in terms of contributing to men's and women's access to social capital, and hence their career success. Tie-level analysis would then imply a multilevel approach which would allow us to control for variance explained by the individual, department or university.

Third, we are limited in making deductions with regards to the impact of the network structure on career outcomes. Whether women in this study are actually

benefitting from the higher number of contacts, or whether they need a higher number of contacts to be equally successful or to catch up, could only be found looking into outcome variables such as subjective and objective career success.

Fourth, it is as much about who we know (i.e., social capital) as about skills, knowledge, and achievements (i.e., human capital). Therefore, including human capital as a control variable additional might shed additional light on careers for women and men in academia.

At last, we would like to mention that network parameters are usually interrelated. Well known is for instance that especially for large networks the density decreases with increasing network size (Jansen 2006), which can be ascribed to the power law distribution, according to which the degree distribution in empirical data is usually severely skewed (Barabasi and Albert 1999), with some parts of the network being highly and some parts loosely connected (Bar-Yam 2011). However, the latter is less applicable to personal networks, and only exemplifies the relations of network parameters for rather larger networks.

Conclusion

This study took an important step in gaining more insight into the social capital of female PhDs' and postdocs' developmental networks by assessing their developmental networks' structural setup. It is to our knowledge the first study to investigate the structure of developmental networks for academic staff by looking at two different social capital approaches - cohesion and brokerage. Our results indicate that female researchers within the PhD and postdoc career stage possess more social capital due to larger developmental networks, and greater brokerage potential within these networks. However, results also suggest that male researchers possess more social capital in terms of more dense networks. By means of knowledge on the structure, we contribute to paving the way to more insight about the connection between network structure and career outcomes in academia. Especially for academic staff, the social support system is of tremendous importance, and therefore should be developed throughout a longer period in the challenging career path.

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