BBR BRAZILIAN BUSINESS REVIEW

The Effect of Co-authorship Network Density on the Performance of Postgraduate Programs

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ABSTRACT

By focusing on the performance of research teams in the management area, this study analyzes the effect of the co-authorship of scientific publications on the performance of postgraduate programs (PPGs) in management. The data was collected from management researchers in Brazil. Along with this, scientific publications from 2013 to 2016 were collected to comprise the social network of each PPG. The evaluation of the PPG was used as the dependent variable. The effects of the density of the co-authorship networks on the programs' performance was verified. The results show that the density of the links between researchers follows a curvilinear trend of effect on organizational performance; that is, both highly dense and highly dispersed networks positively influence team performance. This study contributes to the literature on networks and team performance by providing evidence that the density of a network is not linearly related to performance.

KEYWORDS

Social network analysis (SNA), organizational performance, co-authorship, postgraduate programs (PPGs)

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Received: 15/04/2018.
Revised: 18/09/2018.
Accepted: 03/12/2018.
Published Online: 21/08/2019.
DOI: http://dx.doi.org/10.15728/bbr.2019.16.6.3

1. INTRODUCTION

The subject of academic co-authorship has been frequently addressed in scientific literature (Morrison, Dobbie, & McDonald, 2010). The theoretical and methodological basis for demonstrating the structure of this collaboration is social network analysis (SNA) (Forti, Franzoni, & Sobrero, 2013; Kumar, 2015; Newman, 2001, 2004; Toral et al., 2011). From this perspective, the relations among actors can be shown in a graph. One of the main reasons for using SNA is the ability to present different measures of the relationships among the actors, such as density, cohesion, geodesic distance, and centrality (Wasserman & Faust, 1994).

SNA has been used as a methodological resource to explore and describe the characteristics of the structure of these articulations or the types of relationships among actors (Marteleto, 2001; Tomaél & Marteleto, 2013). One of the most used structural measures is density, which is understood as the proportion of existing and possible links between actors (Hanneman & Riddle, 2011). Another measure is geodetic distance, which calculates the proximity among actors, indicating the speed of the relationships; that is, the closer the actors, the faster the communication. In association with this measure, diameter shows the size of the network or the cliques (subgroups), and cohesion shows the strength of the relationships (Hanneman & Riddle, 2011). When the analysis focuses on the relationships among actors; an important measure is centrality, which indicates the degree of a given actor's ability to connect other individuals to his or her network, differentiating himself or herself by the degree of centrality, proximity, and intermediation (Hanneman & Riddle, 2011).

In addition to the presentation of the social structure of co-authorship networks, several studies have shown the network's effect on the publication's impact and relevance (Andrade & Rêgo, 2015; Wanderley, Duarte, De Brito, As, & Prestes, 2014), on the author's status in the academic field (Machado-da-Silva, Guarido Filho, Rossoni, 2010), and on academic productivity (Yoshikane, Nozawa, Shibui, & Suzuki, 2009). The literature review revealed that while the centrality measure has been shown to be an important predictor of a publication's impact (Abbasi, Chung, & Hossain, 2012; Li, Liao, & Yen, 2013; Hoffmann & Meckel, 2014), the effects on the density measure are divergent and may indicate differences in access to resources, privileged information, trust, and resource sharing (Rossoni, 2013).

Density is an important measure used to verify the strength of a network (Hanneman & Riddle, 2005). However, the problematization of density in co-authorship networks for the publication of scientific articles becomes more complex when the intensity of information exchange is confronted with measures of organizational performance. From this, the study problematizes the effect of the density of co-authorship networks on the performance of the postgraduate programs (PPGs).

Studies in the organizational field about the effect of density on the performance of work teams have shown that high density can have a positive (Mullen & Copper, 1994; Beal et al., 2003) or negative effect (Hardy, Eys, & Carron, 2005). To avoid this debate, studies have followed the logic of the curvilinear effect of density on performance, considering a non-strictly positive effect of high density or low density on work group performance (Wise, 2014). In the same sense, Lechner, Frankerberguer, and Floyd (2010) found a curvilinear effect from density where strong ties create positive effects (e.g., efficient communication and ease of transfer of tactical knowledge); however, these ties can have negative repercussions by limiting research and creating unproductive reciprocity among the actors of the network, evidencing a dark side to high density.

At the theoretical level, this study follows the SNA trail with the intention to associate the analysis of the microrelation among researchers with organizational performance. To measure this effect, researchers are related to their co-authors to create a PPG network topology. This structure is then subjected to the most recent evaluation of the programs, conducted by the

Personnel Improvement Commission of Higher Education (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior [CAPES]).

The association between network configurations and PPG performance enables a discussion about the strategic choices these organizations make regarding the system that regulates Brazilian graduation. The logic of the institutionalization of practices is therefore an important aspect because strategic choices are immersed in the institutional framework and cannot be analyzed in isolation (Rossetto & Rossetto, 2005), especially considering the nature of these organizations whose reputation and social approval depends on the adequacy of the regulatory model (Alperstedt, Martignago, & Fiates, 2006). Evaluating the quality of the model, or the consequences of these strategic choices in so-called academic productivism, is not expected (Kuhlmann, 2015) although reflections can be made from the results found in this study. When analyzing the repercussions of co-authoring networks for the publication of academic research on the objective performance of an organization, the study intends to contribute to the broad discussion around the effects from network characteristics on performance evaluations.

The perspective of immersion (Granovetter, 1985) guides, therefore, the analysis of the strategies of the actors, which are considered the protagonists of network creation (Burt, 1992, 1997). Thus, researchers are considered agents that produce relationships, and the network is a result of this sharing action around a product – the publication – which will focus on an institutional result. This study defines the grade received in the evaluation of the four-year period as a performance criterion. In the Brazilian case, scientific production is the most relevant criterion for evaluating the performance of PPGs, making publication in scientific periodicals an important indicator of performance.

Thus, when proposing the analysis of the influence of density on performance from a curvilinear logic, the present study is expected to contribute to broadening the discussion regarding the divergent effect of this measure and increasing the understanding of the structure reflexes of the relations between actors' practices and institutional choices. Its innovation is to propose a nonlinear analysis of density in a very different context in which network actors institutionalize practices by considering the external regulatory environment that acts on this institutionality. In practical terms, co-authorship networks are constituted by observing the changes in the regulatory framework of the graduate program, by expanding the limits of the PPG to which the researchers are linked, or by strengthening internal reciprocity logics to improve organizational performance.

2. SOCIAL NETWORK ANALYSIS AND NETWORKS OF RESEARCHERS

SNA uses statistical resources and graphs to show topologies of the links between social actors, especially their structural and relational aspects, measured through factors such as density, centrality, distance, and diameter. The theoretical basis of this perspective began with Moreno's (1934) theory of networks and was taken from the 1970s onward by the analyses of many scholars (Borgatti, Everett, & Freeman, 2002; Borgatti, Everett, & Johnson, 2013; Burt, 1992; Burt, Kilduff, & Tasselli, 2013; Granovetter, 1973, 1985; Hanneman & Riddle, 2011; Uzzi, 1996; Watts, 2004).

Networks are considered socially rooted structures that articulate actors around common purposes, affecting the behavior of these agents (Granovetter, 1985). From this perspective, the term *network* has a dual capacity: first, as an analytical tool to define the dynamic contours of a given relational context, and, second, in its ability to characterize an institutional regulatory environment in terms of the actions of social actors. In short, the network concept would allow mediation between the poles of structure and agency, articulating the micro and macro levels of social analysis (Granovetter, 1973).

Also important to consider is that the network concept aspires to capture the movement of reality. In this sense, the concepts of Granovetter's (1973) "weak ties" and Burt's (1992) "structural holes" are widely referenced in the literature. For both, the open possibilities for innovation, from the connection of new actors in a diversified environment, represent the expansion of the network clique. Thus, entrepreneurship and innovation are linked to weak ties, whereas the density of strong ties indicates the network's internal cohesion and strength.

Studies on the curvilinear effect of density on team performance have shown that the effect of high density may not be positive insofar as it creates a relationship structure between actors that is closed to external logics, reducing innovation capacity and establishing unproductive reciprocal feedback from the confidence ties (Lechner et al., 2010). Wise (2014) also presented nonlinear density results by demonstrating that high density tends to increase information sharing and trust among actors, but this relationship can undermine the capacity for expansion and innovation, create costs for maintaining bonds, and decrease team productivity and performance.

In the field of co-authorship in research, studies have shown the importance of centrality and density to evaluate the impacts of scientific production, which is measured by the number of times an article is cited. The idea of centrality has been positively associated with the increase in the number of citations of an article because the privileged position in the network allows the articles to be divulged to a larger audience (Li, Liao, & Yen, 2013; Hoffmann & Meckel's, 2014; Acedo, Barroso, Casanueva, & Galan, 2006). In the same direction, the position of centrality implies the formation of egocentric networks because the same researcher's collaboration in several co-authored works allows him or her to increase the number of citations received and, consequently, enable a greater impact on his or her research (Abbasi et al., 2012).

Density has been associated with the capacity for innovation or the generation of trust. In the Forti et al. (2013) analysis of the positive effects of denser networks on innovation capacity, they concluded that denser networks may be associated with greater inventive capacity. Their explanation for the construction of networks with higher densities is that the networks use frequent and redundant exchanges to increase the circulation of specific information, establishing relations of greater trust, learning, and cooperation among the researchers in the networks.

Bordons, Aparicio, González-Albo, and Díaz-Faes (2015) analyzed the individual performance of researchers according to their positions in co-authored works and the relevance of the publications. Using the g-index as a performance indicator, the authors examined three areas of knowledge: nanoscience, pharmacology, and statistics. They concluded that, although the networks presented different densities, the number of co-authors (centrality) and the strength of their ties showed positive effects in the three areas. On the other hand, local cohesion presented a negative relation in denser networks (nanoscience and pharmacology) compared with fragmented networks (statistics), suggesting that openness and diversity bring benefits associated with the publication's relevance and impact.

Regarding density, studies on co-authorship networks have shown the positive influence of high density on resource sharing and low density on privileged information, confirming the double sense of density effect (Rossoni, 2013). Regarding the effect of density on productivity, Rossoni (2013) showed that, in low-density networks, productivity was higher but also decreased in networks with highly redundant relationships.

Following the logic that high-density networks exchange more information and therefore can respond more quickly to the stimuli of the social context to which they are immersed, the study by Mello, Crubellate & Rossoni (2010) analyzed the co-authorship networks in the area of administration in the periods 2001-2003 and 2004-2006. Among others propositions, the study proposed that denser programs are likely to respond more quickly to CAPES evaluation criteria than programs with lower densities.

Based on the previous evidence, deducing that there is a nonlinear effect from network density on organizational performance is plausible. Specifically, the hypothesis is that both high density and low density can produce positive effects on organizational performance; that is, while denser networks can generate good results from high sharing and trust generation among actors, low-density networks can produce innovations and stimulate entrepreneurship. Therefore, the two poles of density can be associated with performance, being configured as distinct institutional strategies and elaborated on from the confrontation between the conditions in each organization (PPG) and the requirements and expectations of the evaluation system (CAPES). It is important to note that there can exist a link between the strategic choices of the actors (researchers) in forming partnerships to meet the requirements of the evaluation system.

Based on the theoretical evidence presented in the introduction and review of the literature on the (a) divergence of density effect on the scientific impact of co-authorship networks, and (b) on the effects of the institutional environment on institutionalized strategic choices, this study proposes that the density of a research network has a curvilinear effect on the performance of PPGs. The option of not following a linear logic to describe the causality relationship between density and performance is therefore based on the results found in the literature on the divergent effects of density, suggesting the hypothesis of measuring its impact on organizational performance.

3. METHOD

For this research, an explicative approach was adopted, using a quantitative source, with a collection of secondary data. All publications (papers published in scientific journals) of students and teachers in the PPGs in administration were selected. The data were extracted from the Sucupira Platform (CAPES), considering the data validated by the institution referent to the period between 2013 and 2016. Specifically, we created a matrix for each PPG based on the data from papers published between 2013 and 2016 in co-authorship. We extracted the name of each paper's author and the links between authors to create each matrix. We connected the authors in the matrix through the indication of co-authorship available in the papers (an automatic script takes the authors' names from CAPES data sets and enters them into each matrix, establishing the relationships between the authors of each paper). Different names or abbreviations were analyzed and solved by the authors in each network. We do not consider the author position in the co-authorship; we only consider the relationship established by the co-authorship.

The data, including the names of the authors of each publication, were collected from June to July of 2018. The information collected involved 75 masters level or doctoral programs. All data referred to the academic programs. No data referring to professional programs was collected and used.

After the collection, the data was recorded in Microsoft Excel and converted into a matrix format, one for each PPG. Each matrix was symmetrical because it considered the relation among the authors of the same article.

Next, the matrices were exported to UCINET 6.0 for Windows, which allowed quantitative analysis of the collected networks with the aim of identifying their structural measures, mainly the density of each network, to investigate the central hypothesis of this study. From each PPG network, all the structural measures were extracted. The measures originated from another database, enabling us to verify the effects to test the hypothesis of this study. The visual analysis of the networks was performed through NetDraw 2.10, which was integrated into UCINET.

4. FINDINGS

The data from the 75 PPGs in management were compiled into a database comprising 75 networks, along with the degree of density of each network. On average, each network has 243 actors ($\sigma = 197$ actors). It is important to note that each network is composed of all the authors of the scientific papers linked to the PPG, so the actors are the authors linked to PPG, through the scientific publications, in the period between 2013 and 2016.

Considering at least two actors per component, on average, the networks have components ($\sigma = 10$ components). It is important to mention the large variation in the number of components, ranging from 1 to 59. A component is a group of actors (2 at minimum in this research) that have a relationship and do not have a relationship with other groups in the same network. The moderate correlation between the number of actors and the number of components ($r = .29$; $p < .05$) indicates that the programs with more actors in the network have more components. Moreover, it is important to highlight that programs with evaluation scores from 2 to 4 are within the same range of the number of components ($M = 8.00$), whereas programs with evaluation scores from 5 to 7 have significantly more components than the first group ($M = 14.79$; $F(1, 73) = 7.957$; $p < .01$).

The average fragmentation degree is 0.33 ($\sigma = .29$). There is an association between the degree of fragmentation and the number of actors ($r = -.39$; $p < .001$) and the evaluation of the program ($r = -.25$; $p < .05$). This analysis reveals a moderated fragmentation and that the higher the degree of fragmentation, the lower is the evaluation of the program.

The number of cliques in the networks ranges from 7 to 734; on average, 152 cliques ($\sigma = 135$) comprise the networks of the programs. In this study, each clique consists of at least two authors. Notably, the number of cliques represents the number of the groups of authors who are directly linked in the network. The higher the number of actors in the network, the higher is the number of cliques in the network ($r = .95$; $p < .001$). Similarly, the programs with evaluation scores from 2 to 4 have fewer cliques ($M = 112.16$) than the programs evaluated with scores of 5, 6, or 7 ($M = 236.96$; $F(1, 73) = 16.817$; $p < .01$). These findings are aligned with the Machado-da-Silva perspective, which indicates that the researchers' productivity is associated with their ability to establish collaborative links and to position themselves in the co-authorship network in order to maintain links with other researchers of greater scientific prominence. The evidence of the positive association between cliques and the program evaluation indicates that the higher the number of relations and groups, the better it is for the evaluation of the program.

Another verified indicator is the average distance between two actors within a network, measured by the geodesic distance. Specifically, the average distance between two actors in a network is 3.53 ($\sigma = 1.04$). The higher the number of actors in a network, the greater is the distance between two actors ($r = .47$; $p < .001$). However, there is a difference in the average distance between two actors in programs with evaluation scores from 2 to 4 ($M = 3.19$) and programs with higher evaluation scores ($M = 4.23$; $F(1, 73) = 20.445$; $p < .001$). This result indicated that programs with higher evaluations have a higher distance between the actors, which could indicate that each actor has more connections with his or her own group to produce, having external connections and increasing the potential for scientific production in the program.

Regarding the density of the networks (the number of links between the nodes that integrate the same environment) with parameters that vary from 0 to 1, the closer to 1 the parameter is, the greater the connectivity in the network (Wasserman & Faust, 1994), that is, the denser the presented network. Thus, a network would be completely dense if absolutely all the nodes that integrate it were linked to the rest of the nodes, which is practically impossible in real scenarios (Ferrer, 2010). In the networks, the average density is .02 ($\sigma = .02$), ranging from .004 to .094.

4.1. Effect of density on performance

To verify the main proposal of this paper or whether a network's density has a nonlinear effect (U-effect) on its performance, a linear regression with two independent variables was performed, one reflecting the density of each network and the other reflecting the quadratic term.

This analysis (graphically presented in Figure 1) shows that density has a negative linear effect on program performance ($\beta = -30.02$; $t = -4.89$; $p < .001$). However, the quadratic effect on program performance is positive ($\beta = 609.52$; $t = 2.95$; $p < .01$). These two findings indicate that both linear and quadratic terms of density can explain program performance. Specifically, only the linear term explains 24% of the program performance, while the inclusion of the quadratic term improves the explanation by 9% to 33%. Based on these results, the quadratic effect of density on program performance reveals that a lower or higher density of network can improve program performance, while a moderate density has a detrimental effect. The following equation explains this effect:

$$y = 5.69 + -82.16 \times x + 609.52 \times x \times x$$

Figure 2 presents three networks to illustrate the effect of density on program performance. Figure 2a shows the network of a program with the highest evaluation score of 7 and the lowest degree of density (.006). Figure 2b depicts a program with a moderate density (based on the mean of the distribution of density of the database) (.024) and an evaluation score of 4 for program performance. Figure 2c illustrates a program with the highest density (.94) and an evaluation score of 3 for program performance.

5. DISCUSSION

The results of SNA and its relation to program performance allow a discussion of the relationship between the network structure and PPG performance in two directions. The first is the identification

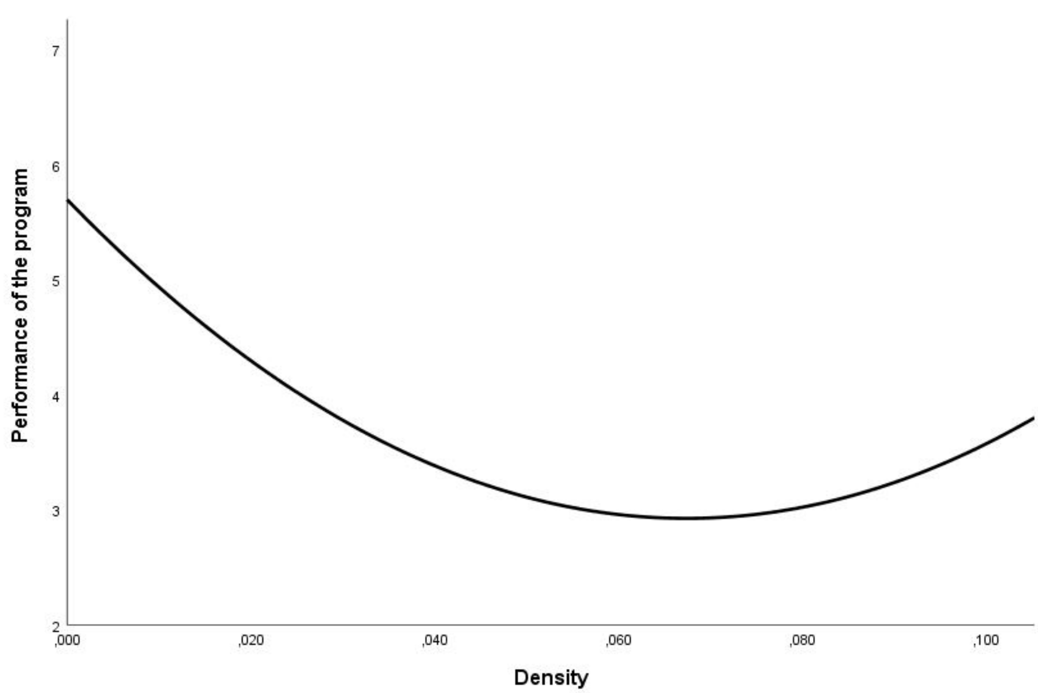

Figure 1. Quadratic effect of density on program performance.
Source: Data of the research (2017).

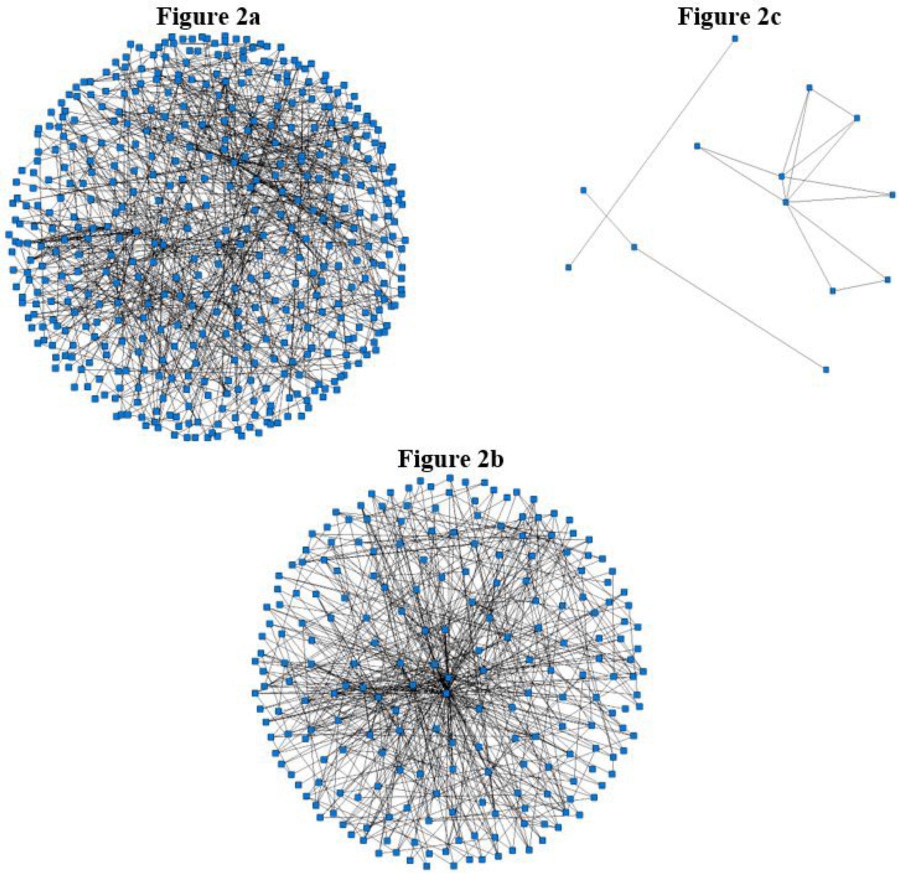

Figure 2. Models of networks according to density and performance.
Source: Data of the research (2017).

of the trends and consequences of the structural and relational measures evidenced in the analysis. The second sheds light on the theoretical reach of SNA to explain the organizational context in question.

Regarding the implications of the network's structural and relational model, despite the high fragmentation, the authors' positions in the network seem relevant, especially considering the number of relations established by the authors. Although this fragmentation has no effect on the PPG assessment, it reinforces Rossoni and Hocayen-da-Silva's (2008) findings on fragmentation in the academic field of management in Brazil. In fact, this high fragmentation has a positive aspect insofar as it indicates low cohesion and thus a greater opening for the expansion of the network. In practical terms, this expansion may mean more possibilities for co-authoring. The notion of field fragmentation is also important to prevent research networks from closing in on redundant links (Rossoni & Hocayen-da-Silva, 2008).

In this sense, this study's findings align with those of Bordons et al. (2015). Although the authors also reinforced the importance of density, their conclusions pointed to the limits of high density and suggested that more open networks bring greater benefits than academic productivity. As shown in the results, in addition to the significant relationship between network density and organizational performance, the PPG evaluation score tends to be higher in low- and high-density contexts.

Regarding the microsocial analysis among researchers, this study confirms Rossoni's (2014) findings on the relationship between a high number of ties and high productivity – the greater the density, the more the productivity decreases. This conclusion also supports the central argument proposed here by confirming that both high and low densities affect PPG performance, while a moderate density shows weak organizational performance. This curvilinear movement of density allows scholars to determine to what extent density influences organizational performance. Thus, the study confirms the hypothesis that the density has a curvilinear effect on the organizational performance, following a similar direction to the results found by Hardy et al. (2005), Lechner et al. (2010), and Wise (2014).

Thus, this study's results also point to a positive relationship between high-density networks and welfare programs. It is then consistent with the proposition of Forti et al. (2013) regarding the positive relationship between cohesion and inventiveness – the more redundant the relationships in the network, the greater the loyalty and trust. This type of relationship allows more important and more frequent information sharing, contributing to more inventive relationships. The present study therefore suggests that the positive relationship between high density and organizational performance is based on solid relationships among researchers. The results indicate that elements such as trust and loyalty are converted into academic productivity, in turn influencing PPG performance.

The results suggest that there are a high number of components per network, indicating the existence of empty spaces in this network and an isolation of the actors in relation to their peers. This empty space may even indicate little representation of some groups of actors within the networks, creating a problem of nodal and relational representativity.

Concerning the theoretical scope of SNA, which includes the analysis of the relationship between the network structure and PPG performance, the study deepens the notion of "structural holes" proposed by Burt (1992) and the concept of "weak ties" recommended by Granovetter (1973) by offering clues about the positive effects of a low-density network on organizational performance. Thus, the results indicate that co-authorship relationships with researchers from other PPGs prove to be effective for a higher evaluation score of a researcher's program. On the other hand, high cohesion suggests dense and productive relationships, pointing to consolidated and fruitful partnerships.

Finally, the network theory has proven to be a powerful tool for bringing together the individual strategies (micro level) with the organizational space (macro level) in which the researchers are inserted. This rich perspective elucidates relationships in the scientific field where the clash between individual strategies (agency) and organizational (structure) logic becomes evident in the nature of the individual-organization relationship in this context. Academic research is a venue where autonomy in defining relationships is high, but it is fairly common for these choices to conflict with program strategies.

FINAL REMARKS

Scientific output represents an important indicator of the quality of PPGs. In Brazil, the item that evaluates the intellectual production generated by the PPGs is a question that either limits or enhances the evaluation of the programs using the quality strata defined by CAPES (ranging from 3 to 7). By capturing the co-authorship networks of the PPGs in administration, this research has elucidated how the density of each network can influence, in different ways, the program performance evaluated by CAPES.

Specifically, this study contributes to the literature on networks and organizational performance by providing evidence that the density of a network is not linearly related to performance. Contrary to the linear relationship, this study proves that the quadratic effect of density best explains PPG performance in the administration field.

These results suggest that the adoption of less dense networks can promote better performance compared with moderately dense networks. However, such a strategy may require more resources because it involves the collaboration of the actors in an organization with their counterparts from other organizations. In the absence of such resources, the organization can prioritize the establishment of networks with a high degree of density for its segment, building high internal cohesion to increase organizational performance.

It is important to note that this research has only taken into account the *quantity* of scientific papers published by the PPG in scientific journals. The research does not consider the *quality* of these papers. In recent years, the discussion about Brazilian science has shifted from quantity to quality and how co-authorship is defined in the papers (Rossoni, 2018). Some areas of knowledge, such as management, have already adopted the quality of scientific production as an evaluation criterion. Based on this point, future studies can explore how the density of the PPG is related to the quality of scientific production.

REFERENCES

Abbasi, A., Chung, K. S. K., & Hossain, L. (2012). Egocentric analysis of co-authorship network structure, position and performance. *Information Processing and Management*, *48*(4), 671-679, 2w0.

Acedo, F. J., Barroso, C., Casanueva, C., & Galan, J. L. (2006). Co-authorship in management and organizational studies: An empirical and network analysis. *Journal of Management Studies*, *43*(5), 957-983.

Alperstedt, G. D., Martignago, G., & Fiates, G. G. S. (2006). O processo de adaptação estratégica de uma instituição de ensino superior sob a ótica da teoria institucional. *Revista de Ciências da Administração*, *8*(15), 1-24. Recuperado de https://doi.org/10.5007/%25x

Andrade, R. L., & Rego, L. C. (2015). A influência da rede de coautoria no nível das bolsas de produtividade da área de engenharia de produção. In Congresso da Sociedade Brasileira de Computação (CSBC), 35, 2015, São Paulo, *Anais do XXXV Congresso da Sociedade Brasileira de Computação*, São Paulo. Recuperado de: http://each.uspnet.usp.br/digiampietri/BraSNAM/2015/p21.pdf

Balancieri, R., Bovo, A., Kern, V., Pacheco, R., & Barcia, R. (2005). A análise de redes de colaboração científica sob as novas tecnologias de informação e comunicação: um estudo na Plataforma Lattes. *Ciência da Informação*, *34*(1), 64-77.

Beal, D. J., Cohen, R. R., Burke, M. J., & McLendon, C. L. (2003). Cohesion and performance in groups: A meta-analytic clarification of construct relations. *Journal of Applied Psychology*, *88*(6), 989. Recuperado de: http://dx.doi.org/10.1037/0021-9010.88.6.989

Bordons, M., Aparicio, J., González-Albo, B., & Díaz-Faes, A. A. (2015). The relationship between the research performance of scientists and their position in co-authorship networks in three fields. *Journal of Informetrics*, *9*(1), 135-144.

Borgatti, S. P., Everett, M. G., & Freeman, L. C. (2002).*UCINET for Windows: software for social network analysis*. Boston: Harvard Analytic Technologies.

Borgatti, S. P., Everett, M. G., & Johnson, J. C. (2013). *Analyzing social networks*. Thousand Oaks: Sage Publications Limited.

Bulgacov, S., & Verdu, F. C. (2001). Redes de pesquisadores da área de administração: um estudo exploratório. *Revista de Administração Contemporânea*, *5*(Edição Especial), 163-182.

Burt, R. S. (1992). *Structural hole*. Cambridge: Harvard Business School Press.

Burt, R. S. (1997). A note on social capital and network content. *Social Networks*, *19*, 355-373.

Burt, R. S., Kilduff, M., & Tasselli, S. (2013). Social networks analysis: Foundations and frontiers on advantage. *Annual Review of Psychology*, *64*, 527-547.

Dias, T. M. R., Moita, G. F., & Dias, P. M. (2016). Adoção da Plataforma Lattes como fonte de dados para caracterização de redes científicas. *Encontros Bibli: Revista Eletrônica de Biblioteconomia e Ciência da Informação*, *21*(47), 16-26.

Ferrer, M. L. (2010). Comparación en las estructuras de colaboración y pautas de citación entre áreas científicas a través del ARS. *REDES - Revista hispana para el análisis de redes sociales*, *19*, 39-63.

Forti, E., Franzoni, C., & Sobrero, M. (2013). Bridges or isolates? Investigating the social networks of academic inventors. *Research Policy*, *42*(8), 1378-1388.

Giddens, A. (1984). *The constitution of society: Outline of the theory of structuration*. Cambridge: Polity Press.

Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology*, *78*(6), 1360-1380.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, *91*(3), 481-510.

Hardy, J., Eys, M. A., & Carron, A. V. (2005). Exploring the potential disadvantages of high cohesion in sports teams. *Small group research*, *36*(2), 166-187.

Hanneman, R. A., & Riddle, M. (2011). Concepts and mesures for basic network analysis. In J. Scott & P. J. Carrington (Eds.), *The SAGE handbook of social network analysis* (pp. 340-369). London: Sage.

Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National academy of Sciences of the United States of America*, *102*(46), 16569-16572.

Hoffmann, C. P., Lutz, C., & Meckel, M. (2014). Impact factor 2.0: Applying social network analysis to scientific impact assessment. In 2014 47th Hawaii International Conference on System Science (HICSS), New York, 2014, *Anais do 47th Hawaii International Conference on System Science*, Hawaii, EUA. Recuperado de https://www.computer.org/csdl/proceedings/hicss/2014/2504/00/2504b576.pdf

Kuhlmann Jr., M. (2015). Produtivismo acadêmico, publicação em periódicos e qualidade das pesquisas. *Cadernos de Pesquisa*, *45*(158), 838-855. Recuperado de: https://dx.doi.org/10.1590/198053143597

Kumar, S. (2015). Co-authorship networks: a review of the literature. *Aslib Journal of Information Management*, *67*(1), 55-73.

Lechner, C., Frankenberger, K., & Floyd, S. W. (2010). Task contingencies in the curvilinear relationships between intergroup networks and initiative performance. *Academy of Management Journal*, *53*,(4) 865-889.

Li, E. Y., Liao, C. H., & Yen, H. R. (2013). Co-authorship networks and research impact: A social capital perspective. *Research Policy*, *42*,(9), 1515-1530, 2013.

Machado-da-Silva, C. L., Guarido Filho, E. R., & Rossoni, L. (2010). Campos organizacionais: seis diferentes leituras e a perspectiva de estruturação. *RAC-Revista de Administração Contemporânea*, *14*(Edição Especial), 159-196.

Marteleto, R. M. (2001). Análise de redes sociais: aplicação nos estudos de transferência da informação. *Ciência da Informação*, *30*(1), 71-81.

Mello, C. M., Crubellate, J. M., & Rossoni, L. (2010). Dinâmica de relacionamento e prováveis respostas estratégicas de programas brasileiros de pós-graduação em administração à avaliação da Capes: proposições institucionais a partir da análise de redes de co-autorias. *RAC-Revista de Administração Contemporânea*, *14*(3), 434-457. Recuperado de http://dx.doi.org/10.1590/S1415-65552010000300004

Moreno, J. L. (1934). *Who shall survive?*. Nova York: Beacon House.

Morrison, P. S., Dobbie, G., & McDonald, F. J. (2003). Research collaboration among university scientists. *Higher Education Research and Development*, *22*(3), 275-296.

Mullen, B., & Copper, C. (1994). The relation between group cohesiveness and performance: An integration. *Psychological Bulletin*, *115*(2), 210. Recuperado de http://dx.doi.org/10.1037/0033-2909.115.2.210

Neiva, E. R., & Corradi, A. A. (2010). A Psicologia organizacional e do trabalho no Brasil: uma análise a partir das redes sociais de pesquisadores da pós-graduação. *Revista Psicologia: Organizações e Trabalho, 10*(2), 67-84.

Neiva, E. R., Fussi, C. C., & Corradi, A. A. (2016). Relações entre produtividade acadêmica e redes sociais entre pesquisadores da Ciência Psicológica. *Estudos de Psicologia,* Campinas, *33*(1), 83-94.

Newman, M. E. (2001). Scientific collaboration networks. II. Shortest paths, weighted networks, and centrality. *Physical review E*, *64*, 1-7.

Newman, M. E. J. (2004). Co-authorship networks and patterns of scientific collaboration. *Proceedings of the National Academy of Sciences*, *101*(1), 5200-5205.

Pereira, J. C., Calabro, L., Teixeira, M. D. R. F., & De Souza, D. O. G. (2015). Redes de coautoria identificadas na produção científica em programa de pós-graduação da Universidade Federal do Rio Grande do Sul. *Revista Brasileira de Pós-Graduação*, *11*(25), 731-753.

Romano-Silva, M. A., Correa, H., Oliveira, M. C. L., Quirino, I. G., & Oliveira, E. A. (2013). Perfil e análise da produção científica dos pesquisadores brasileiros em neurociência clínica. *Revista Brasileira de Psiquiatria Clínica*, *40*(2), 53-58.

Rossetto, C. R., & Rossetto, A. M. (2005). Teoria institucional e dependência de recursos na adaptação organizacional: uma visão complementar. *RAE eletrônica*, *4*(1). Recuperado de https://dx.doi.org/10.1590/S1676-56482005000100010

Rossoni, L. (2013). Agência e redes mundos pequenos: uma análise multinível da produtividade acadêmica. *Revista de Administração Mackenzie*, *15*(1):200-235. Recuperado de http://dx.doi.org/10.1590/S1678-69712014000100009

Rossoni, L. (2014). Agência e redes mundos pequenos: uma análise multinível da produtividade acadêmica. *RAM. Revista de Administração Mackenzie*, *15*(1), 200-235.

Rossoni, L. (2018). Editorial: Produtivismo e Coautoria Cerimonial. *Revista Eletrônica de Ciência Administrativa (RECADM)*, Curitiba, *17*(2).

Rossoni, L., & Hocayen-da-Silva, A. J. (2008). Cooperação entre pesquisadores da área de administração da informação: evidências estruturais de fragmentação das relações no campo científico. *Revista de Administração*, *43*(2), 138-151.

Silva, A. K. A. (2014). A dinâmica das redes sociais e as redes de coautoria. *Perspectivas em Gestão e Conhecimento*, *4*(Edição Especial), 27-47.

Silva, P. M. (2015). Abordagem multinível em redes: análise da produção cientifica. *Revista de Administração FACES Journal*, *14*(1), 141-151.

Tomaél, M. I., & Marteleto, R. M. (2013). Redes sociais de dois modos: aspectos conceituais. *Transinformação*, *25*(3), 245-253.

Toral, S. L., Bessis, N., Martinez-Torres, M. D. R., Franc, F., Barrero, F., & Xhafa, F. (2011). An exploratory social network analysis of academic research networks. In 2011 Third International Conference Intelligent Networking and Collaborative Systems *(INCoS)*, *Anais do Third International Conference Intelligent Networking and Collaborative Systems (INCoS)*. Recuperado de https://idus.us.es/xmlui/bitstream/handle/11441/30801/an%20exploratory%20social.pdf?sequence=1

Uzzi, B. (1996). The sources and consequences of embeddedness for the economic performance of organizations: The network effect. *American Sociological Review*, *61*(4), 674-698.

Walter, S. A., & Bach, T. M. (2013). Inserção de pesquisadores entrantes na área de estratégia: análise das relações de autoria e temas estudados no período de 1997-2010. *Revista Eletrônica de Administração*, *19*(1), 165-191.

Wanderley, A. J., Duarte, A. N., De Brito, A. V., As, M., & Prestes, F. C. (2014). Identificando correlações entre métricas de Análise de Redes Sociais e o h-index de pesquisadores de Ciência da Computação. In Congresso da Sociedade Brasileira de Computação (CSBC), 34, *Anais do XXXV Congresso da Sociedade Brasileira de Computação*, São Paulo. Recuperado de http://www.each.usp.br/digiampietri/BraSNAM/2014/p04.pdf

Wasserman, S., & Faust, K. (1994). *Social network analysis: methods and applications*. Cambridge: Cambridge University Press.

Watts, D. J. (2004). The "new" science of networks. *Annual Review of Sociology*, *30*, 243-270.

Wise, Sean. (2014). Can a team have too much cohesion? The dark side to network density. *European Management Journal*, *32*(5), 703-711.

Yoshikane, F., Nozawa, T., Shibui, S., & Suzuki, T. (2009). An analysis of the connection between researchers' productivity and their co-authors' past attributions, including the importance in collaboration networks. *Scientometrics, 79*(2), 435-449.

Declaration of conflict of interests

The authors declare that there is no conflict of interests of any type in this paper.

Authors contribution

First Author: Main idea, theoretical development and discussions; Second Author: Method and data analysis; Third Author: Data collection and revision of the paper; Fourth Author: Data collection and revision of the paper.