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Informational status in intra-organizational networks: The role of knowledge sharing and structural holes

Status *informacional em redes intraorganizacionais: o papel do compartilhamento do conhecimento e das lacunas estruturais*

Estatus informativo en redes intraorganizacionales: el papel del intercambio de conocimiento y vacíos estructurales

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Abstract

The aim of this study was to evaluate to what extent the similarity of informational status of intra-organizational actors relates to behavioral (knowledge sharing) and structural antecedents (structural holes) in a knowledge-intensive organization. The study was operationalized through the analysis of 462 dyads ($22 * (22 - 1)$) that comprise social relationships in a development organization of technology for telemedicine. The results indicate that the similarity of independent variables was associated to similarity in informational status, but there is no interaction between them. It is concluded that the equal status can be achieved even when two actors have different bases for its construction, whether through knowledge sharing practices or through structural holes. This conclusion relativizes what is called Matthew effect in status research.

Keywords: Informational status; Knowledge; Structural holes; Intra-organizational relations; Social network analysis

Resumo

Neste estudo, o objetivo foi investigar se trabalhadores em uma empresa de conhecimento intensivo que compartilham conhecimento na mesma proporção e que possuem número similar de lacunas estruturais são avaliados como tendo status equivalente. O estudo foi operacionalizado por meio da análise de 462 díades ($22*(22-1)$) que compõem os relacionamentos sociais presentes em uma organização de desenvolvimento de tecnologia para telemedicina. Os resultados apontam que a similaridade nas variáveis independentes se associa a similaridade de *status* informacional, mas a interação entre elas não. Conclui-se que a igualdade de status pode ser alcançada mesmo quando dois atores possuem bases diferentes para sua construção, seja por meio de práticas de compartilhamento de conhecimento ou por meio de lacunas estruturais. Tal conclusão relativiza o que é denominado Efeito Mateus nas pesquisas sobre status.

Palavras-chave: Status informacional; Conhecimento; Lacunas estruturais; Relações intraorganizacionais; Análise de redes sociais

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Resumen

El objetivo en este estudio es analizar si existe similitud de estatus informativo entre los trabajadores de una organización intensiva en conocimiento que comparten conocimiento de manera proporcional y que tienen los mismos vacíos estructurales. Se ha llevado a cabo el estudio por medio del análisis de 462 pares (22*(22−1)) que componen las relaciones sociales en una organización de desarrollo de tecnología para telemedicina. Los resultados indican que la similitud en las variables independientes se relaciona con la similitud de estatus informativo, pero no hay interacción entre ellas. Se concluye que la situación de igualdad de estatus puede lograrse incluso cuando dos actores tienen diferentes bases para su construcción, ya sea por medio de prácticas de intercambio de conocimiento o de vacíos estructurales. Dicha conclusión relativiza el denominado Efecto Mateo en estudios sobre estatus.

Palabras clave: Estatus informativo; Conocimiento; Vacíos estructurales; Relaciones intraorganizacionales; Análisis de redes sociales

Introduction

This study defines the concept of informational status in organizations as an occupation of a hierarchical position resulting from the degree of deference (Podolny, 2005) received by a social actor from co-workers to gain knowledge and skills. Deference is a symbolic means of appreciation, conveyed from a sender to a particular recipient and which considers the recipient's attributes (e.g., knowledge at work) (Goffman, 1956). Sorokin (1927) originated this concept, but the present study focuses on the elements beyond formal education characteristics. Examining informational status allows us to highlight the similarities and dissimilarity among organizational actors related to the practical and conceptual understanding of work activities. These features give substance to one of the main informal bases for stratification operating in parallel with bureaucratic hierarchies, especially in the knowledge-intensive organizations that are typical of the *New Economy* (Makani & Marche, 2012; Phelps, Heidl, & Wadhwa, 2012).

The argument here favors an analysis of informational status based on established relationships between the various attributes of human capital and their effects on creativity and innovation. More specifically, the gestures of devotion or deference some colleagues to another employee based on that employee's ability to solve problems and to show divergent (creative) thinking distinguishes actors with high or low informational status. The more a person is judged as creative and as a problem solver by his or her colleagues, the greater is that person's informational status. Therefore, the variation in informational status, i.e., the position or rank of a social actor in the intra-organizational network, is a main factor influencing the results of the work, especially in knowledge-intensive organizations (Campos-Castillo & Ewoodzie, 2014). This type of status is also important in employee hiring decisions and in how the process of socializing new members proceeds (Guechtouli, Rouchier, & Orillard, 2013). On the other hand, occupying a high rank in knowledge is important for work can hinder the retention of employees treated as experts (Casimir, Lee, & Loon, 2012; Crane, 2012; Joe, Yoong, & Patel, 2013). This position can be even more harmful when actors with high informational status try to hide their knowledge from co-workers to maintain their appreciation (Peng, 2013). Together, these arguments illustrate the need for research on the elements related to informational status, and especially on their antecedents.

Among the traditional variables that affect the degree of any kind of status are inherited (e.g., race, gender) or achieved (e.g., formal education, employment, and income) characteristics (Piazza & Castellucci, 2014). More recent studies into status in organizations enrich the literature by accounting for context-specific behaviors and the properties of social network structures (Sauder, Lynn, & Podolny, 2012). The behavioral elements are actions by those in the organization worthy of deference from peers. In this sense, the literature about knowledge in organizations, even without specifically mentioning the concept of informational status, consistently points to knowledge sharing as the main activity that helps individuals attain the role of expert or creative (e.g. Crane, 2012; Durst & Edvardsson, 2012; Fullwood, Rowley, & Delbridge, 2012; Joe et al., 2013). On the other hand, the literature on social networks focuses only on the effects of relationship networks on knowledge flow, learning, idea generation, creativity, and innovation, neglecting the importance of informational status (e.g. Bell & Zaheer, 2007; Burt, 1987, 2004, 2007; Chiu, Hsu, & Wang, 2006). When researchers consider status, the concept is restricted to the idea that the greater the number of contacts with many relationships, the higher the status of those who control such contacts. This definition is often operationalized in social network analysis by extracting Bonacich's centrality (Hanneman & Riddle, 2011).

Therefore, considering the foremost importance of actions and structural features (i.e., features and positions in social networks) in determining the deference given to organizational actors in environments with technologies based on expert knowledge (Makani & Marche, 2012), this study aims to evaluate the extent to which similar knowledge sharing and non-redundant intra-organizational ties (i.e., structural holes) explain the similar informational statuses of intra-organizational actors in a knowledge-intensive organization.

This study defines informational status as a position resulting from the sum of the number of times that peers indicate that each actor is (i) a creative and (ii) a problem solver. Knowledge sharing was assessed by the extent to which each actor in the intra-organizational network is involved in exchanges of information and experiences during social interactions with peers (Casimir et al., 2012; Swift & Virick, 2013). The presence

of structural holes means that the central actor (*ego*) has non-redundant sources of information (contacts) to exploit. *Ego* (focal actor) can act in a broker position to increase information status in a given intra-organizational network by exploiting the control of information that only the broker can access. For example, this enables *ego* to have a greater probability of synthesizing his/her contact's ideas. This study measures the proportion of structural holes by their absence (using the constraint index). Because this study evaluates the similarity of structural holes, there are no limitations to using this variable.

In general, research on the relationship between the elements discussed above provides theoretical and methodological contributions to studies on knowledge in organizations. The first theoretical contribution is a conceptualization of informational status in knowledge-intensive environments as a hierarchical position attained from accumulated deference, specifically in terms of (i) generating ideas and (ii) solving problems. The second contribution is the establishment of nomological relationships between informational status (a measure of social assessment by peers) and behavioral and structural variables.

The relationships between these elements offer an explanation of how different kinds of social mechanisms operate, independently and in interaction, to contribute to the accumulation of a specific type of deference (i.e., creativity and problem-solving ability) that converge with the main meanings and values of knowledge-intensive organizations (Verburg & Andriessen, 2011; Whelan, Collings, & Donnellan, 2010).

The main methodological contribution is a demonstration of how a dyadic analysis through the MRQAP procedure is more appropriate means to study status than traditional techniques, such as OLS regressions. Since status is a hierarchical position that can only exist if social actors display deference inequalities, it is essential to consider how status differences are explained in a dyadic comparison (between pairs of actors in a network). Status inequalities are initially perceived by comparing one actor to the other; dyadic analysis becomes interesting exactly because of this comparative logic. It is important to emphasize that the discussion throughout this work, and the data processing techniques employed, resides specifically at the dyadic level of analysis (Rivera, Soderstrom, & Uzzi, 2010). This means that the study subject is not the strength of association, for example, between the status of a particular actor and his/her own knowledge-sharing level. This describes a traditional analysis. Dyad analysis uses comparisons between multiple pairs formed using players from within a group. If Joao, Carlos, and Augusto form a network, there are not three observation units to compare but rather several pairs. Measuring the status similarity between Joao and Carlos (first dyad) means that this can be compared to the degree of status similarity between Joao and Augusto (second dyad), and then with the degree of status similarity between Carlos and Augusto (third dyad), and so on.

Moreover, analytical method overcomes the difficulties in researching knowledge in small organizations by applying a more robust technique to extract data from small groups (Durst & Edvardsson, 2012). The MRQAP technique makes it possible to generate matrices with a large number of ties (e.g., $N = 462$) to use in a regression at the dyad level (Mizruchi & Marquis, 2006) even for small organizations, e.g., $n = 22$, as in the present study.

In the rest of this article, "Theoretical-empirical framework" section discusses the theoretical and empirical framework for the hypotheses regarding the similarity antecedents of the informational status. "Methodology" section describes the process, and "Data analysis and discussion" section presents the data analysis and discusses the results. Finally, "Conclusion" section concludes.

Theoretical-empirical framework

Similarity/dissimilarity in informational status

The growth in the number of studies on status in organizations is due to its importance for increased contacts, greater autonomy, creativity, innovation, promotion, and salary (e.g., Agneessens & Wittek, 2012; Benderski & Shah, 2013; Bitektine, 2011; Campos-Castillo & Ewoodzie, 2014; Lazega, Mounier, Snijders, & Tubaro, 2012; Mura, Lettieri, Radaelli, & Spiller, 2013; Peng, 2013; Torelli, Leslie, Stoner, & Puente, 2014; Turner, 1988). These earlier works found that the degree of status of a social actor results from systems of values and meanings that normatively select characteristics, behaviors, and affiliations to bestow distinction. Such systems can be analytically divided into four domains: (i) social, (ii) economic, (iii) political, and (iv) informational. Social status, the first of these domains, is a reflection of characteristics (e.g., race, age, formal education, behaviors) that promote honor, respect, and influence. Economic status comes from the control and use of property. Political status derives from occupying positions that confer authority (Riahi-Belkaoui, 2009; Turner, 1988). Informational status, in the organizational context, results from actions that demonstrate that a social actor has knowledge with value in these systems of values and meanings (Flynn, Reagans, Amanatullah, & Ames, 2006; Sorokin, 1927).

This study proposes that the degree of informational status of a member of a knowledge-intensive organization results from deference accumulated during events in which the actor generates new ideas and solves problems, acting as a expert in certain work domains (Crane, 2012; Guechtouli et al., 2013; Joe et al., 2013; Whelan et al., 2010). From this definition, it is important to note that a higher informational status depends on other members' lower status in terms of the ability to act creatively at work. This means that the measure of status is also a measure of social inequality (Sauder et al., 2012). Moreover, the distance between the informational status of one organizational member and another is always a measure that is first generated by comparing two organizational members (e.g., I vs. the other). In aggregate, these distances reveal which actors occupy which positions in the organizational strata in terms of knowledge, as one example. Thus, informational status is always a socially constructed position based on similarities/dissimilarities between dyads of social actors. This assertion highlights the fact that the similarity in the characteristics that knowledge-intensive organizations value influences the similarity of informational status at the dyad level.

Antecedents of informational status similarity

As in the argument above, similar informational statuses result mainly from similar behaviors valued in this context (i.e., knowledge sharing) and from the structural characteristics (i.e., structural holes) of social actors in their intra-organizational networks. Knowledge-sharing occurs through social interactions, which highlights its necessarily relational character (Casimir et al., 2012; Swift & Virick, 2013). Tsoukas (1996) states that organizations are distributed knowledge systems, and that the knowledge applied in work processes does not reside the hands of a single agent. That author adds that knowledge becomes tangible, at least in part, during the performance of social practices in which the implicit is realized, revealing its value to others. Thus, to share knowledge, an agent must become aware of it during an interaction that involves such knowledge (Crane, 2012). Moreover, as individuals display a similar frequency of interactions in which they share knowledge, they will accrue a similar degree of deference (i.e., informational status). Therefore, the following hypothesis is proposed:

H1. Dyads more similar in knowledge sharing are also more similar in informational status.

The presence of structural holes (Burt, 1992) is associated with informational status due to the effects of a focal actor's (i.e., *ego*) non-redundant ties on the generation of new ideas. When a focal actor has two or more contacts (i.e., *alters*) with no connection between them, then the focal actor acts as an intermediary in the information exchanges, which the actor can has an advantage. This position is referred to as *tertius gaudens* or "third party who benefits" (Burt, 1992, p. 30). Burt (1992) developed the concept of structural holes and classified the benefits of information resulting from three types: (i) access, (ii) timing, and (iii) referents. Access indicates receiving useful information, timing means receiving information earlier than others do, and referents are contacts with quality networks, that is, those who provide non-redundant ties for *ego*. According to Burt (2007), structural holes offer advantages from the potential to immediately use or synthesize information about new ideas. Burt (2004) examined managers of a large American electronics company and found that the degree of structural holes among these organizational members was related to performance, wages, and the evaluations of the ideas they proposed. Therefore, structural holes are related to the type of (non-redundant) information required to act creatively, produce new ideas, and solving problems. From this relationship, it is possible to deduce that the similarity of this type of property in the focal actor's network relates to the similarity of informational status.

H2. Dyads more similar in structural holes are also more similar in informational status.

Prior works indicated that both information sharing activity and the presence of structural holes are central elements to the role of expert (Burt, 2004; Crane, 2012; Guechtouli et al., 2013). Assuming a connection between these variables and the informational status, then there must be a relationship between structural holes and knowledge sharing. Knowledge sharing can vary depending on the proportion of non-redundant ties that a focal actor controls. Thus, those who can provide the best quality information in terms of generating ideas, ultimately have more to share. Therefore, a higher proportion of structural holes enable more knowledge sharing because it gives the focal actor that controls more non-redundant ties the benefits of (i) access, (ii) timing, and (iii) referent quality (Burt, 1992). Therefore, the similarity in structural holes moderates the effects of knowledge sharing similarity on the similarity of informational status.

H3. Dyads more similar in interactions between structural holes and knowledge sharing are also more similar in informational status.

Methodology

The organizational setting for this study is a knowledge-intensive organization. Its operating core consists of engineering professionals developing telemedicine technologies who employ mainly knowledge as their main production input (Joe et al., 2013; Whelan et al., 2010). The organization was founded in 2004 by engineering students on a university in the south of Brazil. Since then, the firm received numerous awards for innovation, such as the Prêmio Ozires Silva de Empreendedorismo (Ozires Silva Entrepreneurship Award), Prêmio Finep de Inovação da Região Sul (FINEP Southern Region Innovation Award), Prêmio CNI/FIEP (CNI/FIEP Award), Prêmio ANPROTEC (ANPROTEC Award), and Prêmio Idea Brasil Médico e Científico (Idea Brasil Medical and Scientific Award). During the course of this study, the firm had 22 members, and was starting a process of internationalization.

This study collected relational and composition data using the sociometric survey method (Babbie, 1998; Maciel & Machado-da-Silva, 2009; Wasserman & Faust, 2009). The questionnaire consisted of a list of names (relational data) and categorical and interval questions (composition data). As is common in sociometric studies, the network consisted of a small number of subjects ($N = 22$), allowing for a census, i.e., the collection of data from all members of the organization (Borgatti, Everett, & Johnson, 2013). The SPSS® version 23 and Smart-PLS software were used to analyze composition data; UCINET® 6.485 was used to calculate sociometric indicators, dyadic correlation, and regression analyses; and PAJEK® 3 was used to develop the sociogram.

Measurements

The dependent variable was informational status, formed by two sociometric indicators. Respondents marked the names of colleagues they considered as creative and those they considered as problem solvers in the questionnaire. The two measures were combined into a multiplex relation, resulting in a single sociometric status index (Langeheine & Andresen, 1982; Wasserman & Faust, 2009) through in-degree (the number of times each player of the network is mentioned in each question). From this status index, a square matrix was generated with the dissimilarities between each dyad. From the 22 observations, 462 dyadic

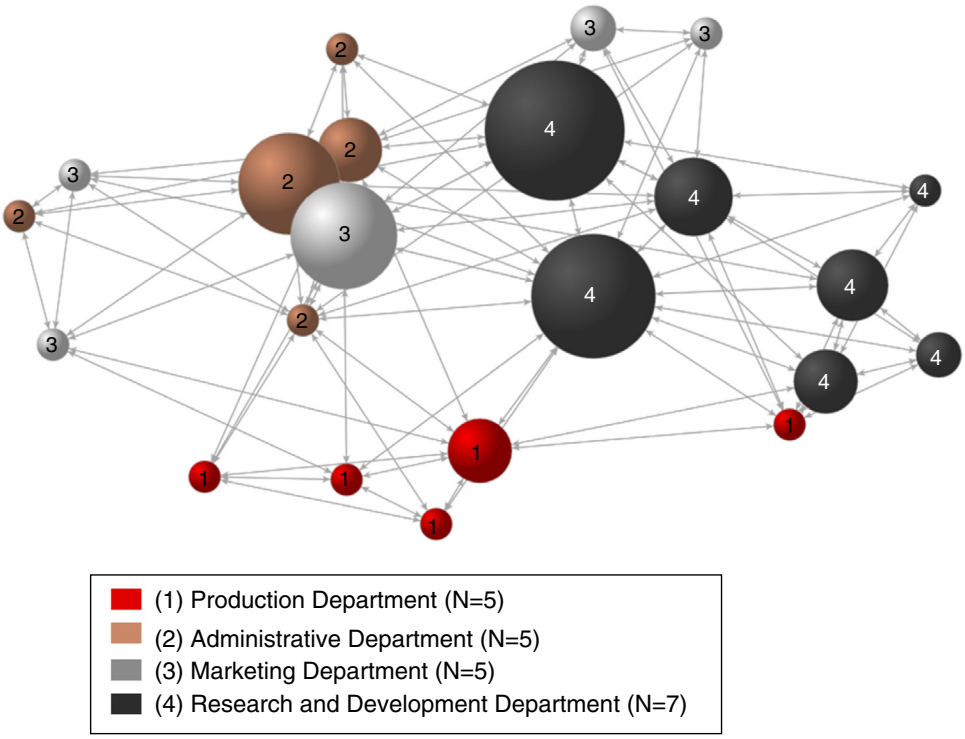

Fig. 1. Interaction patterns with the scale of actors' informational statuses. (■) (1) Production department ($n = 5$); (■) (2) Administrative department ($n = 5$); (■) (3) Marketing department ($n = 5$); (■) (4) Research and development department ($n = 7$).

relationships were generated, which were then analyzed with a regression. The size of the nodes in Fig. 1 shows the variations in informational status.

The independent variable knowledge sharing was measured on a 10-point Likert scale using five literature-based indicators reflected in the following statements: (i) I share my work experiences with those colleagues who need them; (ii) in group discussions, I do my utmost to share my experiences; (iii) I always offer the information that my colleagues may require to do their work; (iv) I tell my colleagues whenever I think of something that can improve their work; (v) I let colleagues know how I do things at work so they may learn. An exploratory factor analysis was performed on the indicators to check their dimensionality. The result of the KMO test to evaluate the adequacy of the data matrix for factor analysis was 0.771. The Bartlett sphericity test was significant: $\chi^{2[58,591]}$/degrees of freedom$^{[10]}$, p-value < 0.001. The cumulative variance was 65.085. All indicators showed a loading above 0.40. The consistency of the measure was assessed using Cronbach's alpha (0.85) and by a Guttman Split-Half Coefficient (0.85) to account for the sample size.

The researchers took additional care to assess the knowledge-sharing construct and validated this measurement model by estimating a partial least square (PLS) regression because there were few observations compared to the number of indicators. The PLS technique is appropriate even when the number of indicators is higher than the number of observations. To assess the validity of the construct via the Smart-PLS software it is necessary to have at least two related constructs in the same model. Thus, a perceived informational centrality measure, which was not used in this study, was collected in the same questionnaire that contained the knowledge sharing indicators. The centrality measure included the following indicators, also on a 10-point Likert scale: (i) I am considered someone well connected here in the company, with many contacts; (ii) because of my contacts, I am among the first to get information; (iii) I have many contacts with people from other departments of the company; (iv) information reaches me very fast, because I know many people here; (v) I have so many contacts in the company that I end up knowing things about almost everybody here. The two constructs were analyzed in the Smart-PLS software.

The convergent validity of the constructs was evaluated by loading the explicit variables and the average variance extracted values. One of the informational centrality indicators and two knowledge sharing indicators had loads below the desirable value (i.e., 0.70), but were kept since the values were above 0.50. Only indicators with values below 0.40 should be summarily deleted when testing new scales (Hair, Hult, Ringle, & Sarstedt, 2014). The average variance extracted for knowledge sharing was 0.60 and informational centrality was 0.70, both above the 0.50 reference. Discriminant validity was tested using the Fornel–Larcker criterion, a more stringent endpoint than cross-factor loading logic. According to this criterion, the squared correlation between the constructs may not exceed the average variance extracted (Hair et al., 2014). The fact that the correlation was not higher than the constructs' average variance extracted indicates discriminant validity. The constructs were also evaluated in terms of composite reliability (informational centrality = 0.92 and knowledge sharing = 0.88).

The independent variable, structural holes, was obtained from the network of interaction patterns displayed in the sociogram (Fig. 1). The respondents also had to indicate 3–5 colleagues with whom they interact more often at work. From this network, the structural holes for each *ego* were quantified. This was measured through the constraint index, a common measure that represents the absence of structural holes (e.g., Burt, 1992, 2004, 2007; Jensen, 2008). Because this study evaluates the similarity of structural holes, there are no limitations to the use of this variable. The means of the knowledge sharing indicators of the 22 observations, as well as their structural hole measurements, were transformed into square matrices with the differences between nodes pairs in the network. The variable interaction effect between structural holes and knowledge sharing was also obtained through this procedure to transform *ego* measures into dyadic measures. To avoid multicollinearity, the interaction was generated with the variable centered on the mean.

Some of the control variables were extracted from Santos, Rossoni, and Machado-da-Silva (2011) (department, hierarchical level, education level, age, and tenure), and others were employed specifically due to the context and research objectives: structural equivalence, physical proximity, sex, marital status, and skill in English language. Structural equivalence was generated through a square matrix of dyads that reveals how similar the position of a focal actor (ego) is compared to others in terms of the pattern of connections. If two social actors have the same pattern of connections, their roles in the social structure are equivalent, and therefore they may have similar informational statuses (Borgatti et al., 2013; Mizruchi, 1993). Physical proximity consisted of a square matrix with the distance in meters between each pair of organization member workstations or desks. The remaining variables also served to build new matrices to control for the similarities between other characteristics of the network actors. Age and tenure were subjected to dyad dissimilarities analysis and generated two more matrices. For gender, marital status, education, skill in English language, department, and hierarchical level, pairs with the same values were assigned a value of 1, and 0 otherwise. Therefore, 14 matrices were generated, each with 462 observations.

Data analysis and discussion

The dyadic data matrices were subjected to correlation and regression analysis. Table 1 shows the means and standard deviations for each continuous variable and their correlations through the quadratic assignment procedure (QAP). The results indicate an association between informational status similarity and other variables. Thus, these relationships were examined using Multiple Regression Quadratic Assignment Procedure – Double-Dekker Semi-Partialling (MRQAP) (Dekker, Krackhardt, & Snijders, 2007). This procedure is better at assessing relational data than the traditional ordinary least squares (OLS) estimation method, because it is a non-parametric technique that is less sensitive to collinearity issues and autocorrelation (Dekker et al., 2007; Kirschbaum, 2012; Reinert & Maciel, 2012; Santos et al., 2011).

The QAP multiple regression model is built from dyadic data in matrices. A network with 22 actors, for example, will have matrices generated for each variable. Therefore, each composite column of data (i.e., non-dyad), such as age, structural holes, or informational status, must be transformed into relational databases by assembling a square matrix with the names of the actors in the vertical column and the calculated dissimilarities for a given variable between each pair of actors, minus the diagonal ($n = 22$). For network data that are already dyadic, transformation is unnecessary because the array is already composed of dyadic relationships, such as structural equivalence. In this study, there are 13 variables that generated 13 matrices with 462 dyads each, for a total of 6006 dyads. The next step is to insert the 13 matrices rather than the variable columns, as in traditional analysis. Thus, the MRQAP model is a regression of matrices with matrices. The QAP procedure generates a distribution of coefficients through the permutation of rows and columns of matrices. Consequently, even without changing the network structure, the order of nodes changes randomly. The generated distribution allows for a calculation of the statistical significance of the coefficients (Dekker et al., 2007; Maciel, Taffarel, & Camargo, 2014). A more common example of the application of this technique is in the analysis of trade between countries. Because the unit of analysis is dyadic, it is necessary to use estimation procedures that consider the relational level.

Table 1
Results: QAP correlations.

	Mean	Standard deviation	1	2	3	4	5	6	7
1. Age (years)	27.81	10.62	1.00						
2. Tenure (years)	2.10	2.56	0.04	1.00					
3. Physical proximity (m)	6.52	4.30	0.00	0.00	1.00				
4. Structural equivalence	0.10	0.23	0.00	0.00	−0.18**	1.00			
5. Structural holes (SH)	0.488	0.135	0.08	−0.68***	0.00	0.00	1.00		
6. Knowledge sharing (KS)	8.12	1.07	0.22	−0.36**	0.00	0.00	0.09	1.00	
7. Interaction variable (SH) × (KS)	0.21	2.02	0.00	0.00	0.08*	0.13***	0.00	0.00	1.00
8. Informational status	3.95	5.15	0.07	0.60***	0.00	0.00	−0.67***	0.18	0.00

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table 2
Results: MRQAP models.

	Model 1	Model 2	Model 3	Model 4	Model 5
Sex	0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)	0.000 (0.000)
Age	0.050 (0.092)	0.106 (0.085)	0.062 (0.088)	−0.001 (0.087)	−0.001 (0.086)
Marital status	−0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)
Instruction	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)	0.000 (0.000)
English	0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)
Tenure	0.597 (0.479)**	0.514 (0.517)	0.774 (0.538)***	0.489 (0.578)**	0.489 (0.575)**
Department	0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)
Hierarchical level	0.000 (0.000)	−0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)
Physical proximity	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Structural equivalence	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)
Structural holes (SH)		0.506 (1.347)**		0.369 (1.294)**	0.369 (1.300)*
Knowledge sharing (KS)			0.473 (1.069)***	0.390 (1.064)**	0.390 (1.039)**
Interaction (SH) × (KS)					0.000 (0.000)
R^2	0.362**	0.495***	0.543***	0.609***	0.609***
Adjusted R^2	0.348**	0.483***	0.532***	0.599***	0.598***
Dyadic observations	462	462	462	462	462
Permutations	2000	2000	2000	2000	2000

Standard error in parentheses.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

To test the hypotheses, five models were developed (Table 1). Model 1 considers only the control variables and explained about 35% of the variation in the informational status similarity (Adjusted $R^2 = 0.348$, p-value < 0.05). Model 2 adds the structural holes variable and increased the explanatory power to 48% (Adjusted $R^2 = 0.483$, p-value < 0.01). Model 3 adds only the knowledge sharing variable to the control variables. This model had an adjusted $R^2 = 0.532$, p-value < 0.01. In Model 4, both the structural holes and knowledge sharing variables are added to the control variables. The result of this model indicated that the two main effect variables explain approximately 60% of the variation in the similarity of informational status. Model 5, in turn, considers all variables in the previous model and adds the interaction between structural holes and knowledge sharing. The interaction variable is formed by multiplying the matrices of both variables with values cantered on the mean to avoid multicolinearity. In this last model, the explanatory power of the variation in similarity of informational status did not increase (Adjusted $R^2 = 0.598$, p-value < 0.01). Overall, a comparison between the first 4 models showed that adding the main effect variables, whether separately or together, increased the explanation power of the variation in similarity of the informational status.

The results of the hypotheses are more specifically interpreted here from the last regression model in Table 1. The first hypothesis (H1) was confirmed ($\beta = 0.390$, p-value < 0.05), indicating that knowledge-sharing similarity contributes to the similarity in informational status. The second hypothesis (H2) was also confirmed ($\beta = 0.369$), but with p-value < 0.10, as indicated in Model 5. The confirmation of this hypothesis shows that the similarity in structural holes between two actors in the network, i.e., the proportion of non-redundant ties, gives them similar informational status. The third hypothesis (H3), which predicted that dyads with more similarity in interactions between structural holes and knowledge sharing would also have more similar informational statuses, was not confirmed. Rejecting this hypothesis implies that the ratio of non-redundant ties has no knowledge sharing moderating effects on informational status. Therefore, regardless of the proportion of structural holes, knowledge sharing can work, even in isolation, as a significant source of similarity in informational statuses among members of an organization (Table 2).

In general, the results for the hypotheses emphasize the significant influence of the similarity in behavioral and structural antecedents on the variation in informational status similarity. Both knowledge sharing behavior and the proportion of structural holes are significant predictors of similarity in a key type of status in knowledge-intensive organizations (i.e., informational status), which is often merely referred to as expertise (Crane, 2012). However, it is necessary to carefully consider the fact that the hypothesized relationship between the interaction of structural holes and knowledge sharing with the dependent variable was not confirmed. Even if statistical generalizations are not possible, an important analytical (theoretical) generalization is that structural holes and knowledge sharing behavior are alternative paths to construct informational status in knowledge-intensive organizations. This does not mean that it is impossible to add the isolated effects of these variables; the results show that the similarity in informational status between two organizational actors may result from knowledge sharing similarity and/or from the proportion of structural holes, but not necessarily from the moderation of one variable on the effects of the other.

The main implication of this finding relates to the informal stratification process (Ravlin & Thomas, 2005), which mainly occurs in this type of organization, and from symbolic deference (Podolny, 2005) toward the expertise of organizational members (Crane, 2012; Guechtouli et al., 2013; Makani & Marche, 2012; Phelps et al., 2012). In this sense, a knowledge status hierarchy

present insofar as there are significant inequalities between members of an organization, can be created and maintained through different elements (i.e., knowledge sharing practices and structural holes). The results show that both practices and the local structure of the focal actor's (*ego*) social networks are sources of social inequality in organizations. That is, they appear as advantages for the accumulation of deference related to knowledge. However, even if these inequalities and dissimilarities in position in the informal hierarchy are deemed unfair (Sauder et al., 2012), the practices and elements of the focal actor's social networking are characteristics that are won rather than inherited. This means that changing and even balancing such inequalities is, to some extent, within the scope of the organizational actors who are at the base of the informational status pyramid. Knowledge may be developed and shared by anyone, and structural holes can be deliberately built (Burt, 1992).

Anyhow, it is worth mentioning that efforts to achieve mobility or to balance the informational status dissimilarities tend to demand more effort than maintaining an almost unchanged social hierarchy. This is due to the so-called Matthew effect, named for the biblical passage Matthew 25:29, 'for whosoever hath, will be given, and he shall have abundance, but from him who has not, even what he has will be taken away', which is quoted in studies of status and refers to the fact that those who already have high status can more easily increase the basis of their social deference (Sauder et al., 2012, p. 270). This means that high informational status possibly allows an organizational actor to increase structural holes deliberately, and to be more sought for knowledge. Therefore, the dynamics of the stratification process in knowledge-intensive organizations, at least related to informational status, can be better understood by accounting for the effects of structural holes, knowledge sharing, and the fact that these variables do not interact to form a moderating effect.

Conclusions

This study evaluated the extent to which the similarity in informational status of intra-organizational actors relates to behavioral (i.e., knowledge sharing) and structural (i.e., structural holes) antecedents in knowledge-intensive organizations. Additionally, it tested whether the interaction between these antecedents could result in an additional effect from the (i) knowledge sharing and (ii) structural holes variables, when treated separately. This study used the dyad as the level of analysis (Mizruchi & Marquis, 2006), not only because the organization used as the context of this study had a small number of members in the organization, but also to reflect that institutions, standards, action logics, or system stratification results from the interactions that occur at the micro level. According to Granovetter (1973), investigating social networks allows a researcher to examine how interactions and relationships at the micro level can structure the behavioral patterns of a greater magnitude. This means that groups or even dyads (pairs of actors) operate as vectors of social order and stratification of higher social systems.

The results of this study provide conclusions that can contribute to research efforts on knowledge in organizations, especially when considering the embeddedness of organizations and their actors, as well as the hurdles to quantitative investigation in contexts with little structural complexity and fewer members. The first conclusion is that the informational status definition presented here, which considers multiplex relations of (i) idea generation and (ii) problem solving, has nomological validity (i.e., the variable relates to its antecedents as theoretically predicted). The second conclusion is that there is a statistically significant association between the informational and status variables of behavioral and structural nature. This finding underscores the need to recognize the influence of practices (e.g. knowledge sharing) as well as the embeddedness of organizational phenomena. The third conclusion is that knowledge sharing and structural holes are independent. Both variables relate to status, but there was no statistically significant association when examining their interaction. A network architecture with more structural holes is an alternative or perhaps even a replacement for knowledge sharing behavior. This may indicate that two organizational subjects with high informational status, for example, may have acquired their statuses through different routes: one through practice and the other via relational architecture. This does not exclude the potential to add the effects of the independent variables considered here (see results of the regression models).

The fourth and final conclusion concerns the main implication for research on status in organizations. Conceptualized as a position within a hierarchical categorization, informational status must also be considered in any discussion of stratification as a dynamic process. This type of status, as conceptually defined here, does not originate (directly) in inherited characteristics, because any organizational actor can cultivate structural holes and knowledge sharing, even making it possible to convert informational status in other types of status. Therefore, that this stratification imperative rests on less unequal opportunity bases compared to some characteristics of social status. However, the Matthew effect can also affect informational status, and that those who attained a high status have a lower cost to increase and maintain it.

Limitations and suggestions for future research

A focus on one type of relationship to the detriment of other types always requires caution when analyzing the results and conclusions of a study. This study investigated only interaction ties; other types of ties, such as friendship, also negative valence relationships, and may play a key role in the associations between the variables investigated herein. This limitation resulted from the use of the name generator method to compose the networks, which requires a lot of effort from the respondents and often compromises the quality of the data.

Future studies could use questionnaires with the names of all organizational members (roster–recall method) and request that respondents evaluate other members using than one criterion and relationship basis to compose the network. Additionally, future studies may explore potential mediators and moderators

between the variables structural holes, knowledge sharing, and tenure. The results showed a strong influence from tenure in all models tested.

Conflicts of interest

The authors declare no conflicts of interest.

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