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PSYCHOLOGICAL CONTRACTS AND KNOWLEDGE EXCHANGE IN VIRTUAL TEAMS

Contrats psychologiques et échange de connaissances au sein des équipes virtuelles

Completed Research Paper

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Abstract

This study examines the influence of psychological contracts on the relations between social ties and knowledge exchange in virtual teams. We empirically tested our model in a field study of virtual teams in a large, multinational R&D firm. Results of structural equation modeling suggest two important antecedents to psychological contracts of knowledge sharing: instrumental and relational embeddedness. Psychological contracts of knowledge sharing are positively associated with knowledge contribution and acquisition. Implications for research and practice are discussed with respect to emerging issues in contemporary psychological contracts.

Keywords: Psychological contracts, knowledge sharing, social networks, virtual teams

Résumé

Cette étude examine l’influence des contrats psychologiques sur les relations entre les liens sociaux et l’échange de connaissances au sein des équipes virtuelles. Les analyses empiriques montrent une relation positive entre les contrats psychologiques de partage de connaissances et le partage et l’acquisition des connaissances. Les implications académiques et pratiques de cette recherche sont discutées.
Introduction

Sharing expertise and innovative solutions is critical to competitive advantage for organizations. This allows firms to adapt and reinvent themselves in rapidly changing work environments (Ancona & Caldwell, 1992; Nahapiet & Ghoshal, 1998). However, knowledge sharing is difficult. It requires significant exchanges from individuals who carry knowledge as a powerful resource that they, rather than the organization, control (Davenport & Prusak, 1998). Individuals engaged in knowledge sharing behaviors have to sacrifice their time and effort to communicate knowledge to another. They can fear loss of control and exclusivity. Sharing may make their expertise less special and valued. Thus, organizations have to motivate individuals to share knowledge with their co-workers. Frequent interactions between individuals help firms to create and institutionalize knowledge beyond that held by any one individual (Nonaka & Takeuchi, 1995).

As knowledge sharing is essential to organizational flexibility, teams characterized by geographic dispersion and electronic interdependence (i.e., virtual teams) are formed to integrate the expertise of individuals who are not necessarily located near one another (Gibson & Gibbs, 2006; Hinds & Mortensen, 2005). Virtual teams often face difficulties in sharing knowledge successfully (Cramton, 2001). For example, knowledge sharing usually takes place through communication technologies that mask social cues, body language and other interpersonal aspects of traditional face-to-face teams (Daft & Lengel, 1986; DeSanctis & Poole, 1994; Siegel et al., 1986). Working from different geographical locations, team members have fewer opportunities for informal contact, an important factor in creating mutual understanding (Cramton, 2001). The availability of communication technologies is no guarantee that knowledge sharing will actually take place (Orlikowski, 2002). Moreover, norms of interpersonal support are difficult to enforce, especially at a distance. To address these challenges, past research has examined how interpersonal relationships can enhance knowledge sharing.

Previous studies examine social ties as conduits for the flow of interpersonal resources (Nahapiet & Ghoshal, 1998). The interconnectedness of individuals in social networks can be examined in terms of social embeddedness (Granovetter, 1985). Social embeddedness refers to the extent to which interactions are shaped by norms of social exchange (Uzzi, 1997). Embeddedness in strong social ties results in increased reciprocity and obligations (Granovetter, 1985; Uzzi, 1997). Several recent studies have linked social ties to knowledge sharing (e.g., Hansen, 1999; Borgatti & Cross, 2003). However, most of them focus on empirical observations regarding network ties (e.g., strength of tie, number of ties) and do not provide a theoretical explanation for the effects. Although interconnectedness can be examined from other perspectives (e.g., structural mechanisms), social embeddedness delineates relationships shaped by exchange norms, and reflects the interconnectedness of these relationships.

This study addresses an important explanation for individuals’ willingness to share knowledge - the set of knowledge sharing obligations that individuals are party to. Understanding the beliefs and obligations of individuals may help to open the "black box" between social ties and willingness of team members to share. It can provide insights into the motivation underlying knowledge sharing processes. The critical question is: Do the social ties of team members lead to different forms of knowledge sharing obligations? Do these obligations regulate and motivate knowledge sharing in different ways?

In this research, we examine knowledge sharing obligations by investigating psychological contracts as mediators between social embeddedness and knowledge exchange. A psychological contract of knowledge sharing refers to the obligations an individual has to share knowledge with others in the organization. It represents the individual’s belief about what he/she is entitled to receive and obligated to give in return (Rousseau, 1995). Psychological contracts focused upon knowledge sharing activities play a fundamental role in virtual teams where access to knowledge plays a central role in organizational performance (cf. Guest, 2004; Piccoli & Ives, 2003). They provide a mechanism for knowledge sharing by creating obligations in anticipation of future benefits. Although the importance of psychological contracts on knowledge sharing in virtual teams has been suggested by others (e.g., Guest, 2004; Piccoli & Ives, 2003), primary research in this area is still lacking.

Theoretical Foundations

Psychological contract theory provides an analytic framework for investigating and managing the employment relationship (Rousseau, 1995; Coyle-Shapiro & Kessler, 2000; Guest, 2004). Psychological contracts function as forms of schemas, i.e., cognitive structures that organize information (Morrison & Robinson, 1997; Rousseau, 1995). In the present case, psychological contracts refer to cognitive models regarding whether, when, and how to
seek and provide knowledge among co-workers. They incorporate implicit understandings and beliefs in obligations that go beyond explicit economic and legal aspects (Morrison & Robinson, 1997). A psychological contract perspective offers an inclusive view of knowledge sharing obligations by examining work relationships between all parties involved in the knowledge exchange.

The literature on psychological contracts offers a useful starting point for the investigation of knowledge exchange. First, it does so because breach of a psychological contract, such as violation of an agreement to exchange knowledge, has been empirically linked to lower levels of knowledge sharing (Omar, 2004). Employees who experienced a contract violation shared less knowledge with others than did those who perceived no violation. Second, in the context of virtual teams, the fulfillment of psychological contracts has been used to explain trust behaviors (Piccoli & Ives, 2003) and team formation (Galvin, McKinney & Chudoba, 2005). Third, psychological contracts provide a basis for identifying an array of knowledge sharing obligations that arise in social settings. The obligations can vary from simple discrete categories (e.g., sharing of a piece of information with the promise of rewards upon project completion) to complex categories (e.g., knowledge exchange relations consisting of interrelated obligations). These categories can run the gamut of obligations from those arising in limited social situations to those in highly embedded ones.

**Forms of Knowledge Sharing Obligations**

Since knowledge sharing is a form of social exchange, i.e., voluntary actions of individuals motivated by the returns anticipated from others (Blau, 1964; Homans, 1961), we infer that individuals establish and continue the exchange of expertise and resources in anticipation of some mutual benefit. Knowledge sharing obligations arise via social exchange (Chang & Rousseau, 2005). They can take two basic forms of social exchange (Flynn, 2005): explicit and implicit. These two forms differ in terms of the nature and timing of reciprocation. The explicit form of social exchange, a **negotiated exchange**, occurs when the nature and timing of reciprocation are openly discussed. In such a case, the benefits of giving and receiving knowledge resources are often immediate (Molm & Cook, 1995). Negotiated exchanges are defined by the voluntary actions of individuals motivated by the specific anticipated returns from these actions (Cardona et al., 2004).

**Negotiated local** obligations are built on explicit bargained-for exchanges between two members of the same team. For instance, in the knowledge sharing context, two team members may explicitly agree to exchange information (“I’ll give you the solutions next week if you give me your solutions for this week”). In this example, there are low costs of exchange to the contributor since the expectation of direct reciprocation is clear. **Negotiated global** obligations are built on negotiated exchanges among two or more people not part of the same team. These obligations include sharing knowledge with one person while anticipating reciprocity by a third party, not necessarily the recipient (Molm & Cook, 1995). Team members may engage in social exchange with unfamiliar or unaffiliated others. In this case, the contributor can anticipate subsequent exchanges, though not necessarily from any specific person.

The implicit form of social exchange, or **reciprocal exchange**, occurs when the nature and timing of reciprocity are not explicit, and the benefits of giving and receiving knowledge resources are not immediate (Emerson, 1976). Group norms to regulate exchange, in particular, the norms of reciprocity, reinforce tendencies towards balance inherent in social interactions (Blau, 1964). This balance ensures that the terms of each exchange are reciprocated in some fashion without bargaining for payback. Instead, exchange is sustained via norms of reciprocity.

**Reciprocal local** obligations are built on reciprocal exchanges between two parties who are members of the same team. For instance, two team members may develop the habit of acquiring knowledge from each other via favor exchange over time (Flynn 2005). Frequent reciprocal exchanges have been found to increase knowledge sharing (Chang & Rousseau, 2005). When members feel obligated to share knowledge as they perceive it will help another team member, they will offer to do so (e.g., providing a piece of critical information) without knowing when, whether, or to what extent the other members will reciprocate (Bordia et al., 2004). Benefits can be high as the increased frequency of exchange may foster stronger bonds of attachment and greater direct reciprocation over time.

**Reciprocal global** obligations are built on reciprocal exchanges among two or more people who are outside of the team. A person may provide a benefit to an external person who may reciprocate indirectly by benefiting another member in the community. In this case, the nature and timing of reciprocity is not explicit. Reciprocal obligations have been investigated primarily in terms of generalized forms of social exchange and found them to be associated with norms of sharing (e.g., Wasko & Faraj, 2005). The notion of generalized reciprocity suggests that individuals
help others as a result of a broad norm of reciprocity, where obtaining future returns from others is only one exchange benefit. Receiving payback can be less important than being a supportive member of the community.

**Model and Hypotheses**

**Instrumental Embeddedness and Psychological Contracts**

**Instrumental embeddedness** refers to the degree to which social exchanges take place through advice relationships using exchange protocols associated with task-oriented goals. It represents the work role of an individual, and captures task relationships such as advice seeking (Katz et al., 2004). In particular, individuals have greater accountability and more obligations when they shared more instrumental ties with team members. When many go to an individual for work-related advice, that individual is said to be prominent or high on instrumental embeddedness.

From a social exchange perspective, we would expect a co-worker whose advice is sought after by many other co-workers to adopt a more task-oriented view of knowledge exchange relationships with others. Strong instrumental advice ties between individuals generate social obligations to help members within the team (Umphress et al., 2003; Cardona et al., 2004). In a previous study, individuals with high expertise, i.e., many people come to them for advice, have reported greater obligations to provide useful knowledge (Constant et al., 1994). Conversely, individuals are less likely to share when they believe their own expertise is inadequate (Wasko & Faraj, 2005).

Earlier work on advice ties has focused on knowledge sharing obligations by examining local social exchanges (Brandes et al., 2004). A team member may develop negotiated local obligations as such obligations reduce risk and uncertainty in an exchange relation with a specific partner (Klein, 1993). Individuals who give advice often develop negotiated obligations to reduce the level of unreciprocated contribution involved in the exchange (Flynn, 2003). For example, a team member in a central advisory role is more likely to create explicit obligations to ensure the benefits of each transaction and to monitor the repayment of the exchanged resources. Thus, we predict:

**H1a:** *Instrumental embeddedness of a member will be positively associated with negotiated local obligations of knowledge sharing.*

Although communication technologies can be helpful to support knowledge exchange among virtual team members, issues of uncertainty and risk are difficult to address in knowledge exchange with other people in the organization (global target). Individuals who frequently provide advice to team members can hold more explicit expectations of exchanges with others outside the team. They perceive an obligation to share as they want to remain an instrumental person in the organizational network (Brandes et al., 2004). However, obligations to the global target are often negotiated to minimize risk (e.g., non-reciprocation or delayed payback) (Flynn, 2005). Previous studies have found that individuals with strong ties to local members also develop obligations to other organizational members as they expect the organization to recognize and reward their efforts (Eisenberger et al., 2001). Thus, we predict:

**H1b:** *Instrumental embeddedness of a member will be positively associated with negotiated global obligations of knowledge sharing.*

**Relational Embeddedness and Psychological Contracts**

**Relational embeddedness** refers to extent to which an individual has affective ties to other members within the team. It represents the quality of social ties within the network (Granovetter, 1985; Nahapet & Ghoshal, 1998). Unlike instrumental embeddedness, which focuses on self-interested or goal-oriented relationships among team members, relational embeddedness reflects the affective nature of ties, including a sense of trust and belongingness (Jones et al., 1997; Wasko & Faraj, 2005). Consequently, relational ties increase the level of trust between the parties, i.e., the “intention to accept vulnerability based upon positive expectations of the behavior of another” (Mayer et al., 1995; Rousseau et al., 1998).

Research evidence has highlighted the value of affective relationships between individuals in promoting knowledge exchange (e.g., Ardichvili et al., 2003; Piccoli & Ives, 2003; Constant et al., 1994; Cross & Cummings, 2004). Trust increases knowledge exchange and facilitates the exchange of valued resources through norms that encourage cooperation (Krackhardt, 1999). Becker et al. (1996) found that trust in a local group of individuals (e.g., between team members) was more important in influencing performance than trust in a global group (e.g., between non team members in an organization).

Extending this evidence to the knowledge sharing domain, strong relational ties between team members will be important in predicting one’s obligations to local co-workers (Chang, 2005). Individuals who have greater trust ties
with others are less likely to demand immediate repayment (Culnan & Armstrong, 1999). They trust their team members to reciprocate in future, even if the value and timing of the reciprocation are unclear (Jarvenpaa & Staples, 2001). Reciprocity exerts its influence via “feelings of obligations to return another’s favor, and these feelings occur automatically regardless of whether the favor is requested” (Paese & Gilin, 2000). Thus, we predict that an individual’s relational embeddedness is positively related to reciprocal obligations to local members.

**H2a: Relational embeddedness of a member will be positively associated with reciprocal local obligations of knowledge sharing.**

Conversely, reciprocal global obligation involves a norm of unilateral giving without direct reciprocation (Bearman, 1997). Prior work on global social exchange has focused on generalized exchanges (e.g., Flynn, 2005). Individuals who trust many others tend to provide more help, even to people outside the team (Leana & Van Buren, 1999). In electronic social networks, people with strong trust ties tend to contribute knowledge due to the perceived obligation to repay the benefits they had received (Wasko & Faraj, 2005). The social exchange theory postulates that if support is received from others then they must be compensated, and that the greater the support received the greater the subsequent compensation (Gouldner, 1960). This need to reciprocate is like a moral obligation (Greenberg, 1980). It may be extended to a larger community, such as other groups of individuals in the organization. Thus, we predict:

**H2b: Relational embeddedness of a member will be positively associated with reciprocal global obligations of knowledge sharing.**

**Psychological Contracts and Knowledge Exchange**

Knowledge exchange is defined here as the contribution and acquisition of task information and know-how regarding a procedure or product (Wathne, Roos and von Krogh, 1996). It consists of activities carried out between team members to obtain and process information that will enable them to learn and improve their work (Cummins, 2004), e.g., sharing feedback and discussing problems (Cross & Cummings, 2004). Although individuals incur tangible costs (e.g., time and effort to share information), perceived obligations (i.e. psychological contracts) help them interpret actions and respond accordingly (Paese & Gilin, 2000).

Both negotiated local and negotiated global obligations involve social exchanges with expectations of future extrinsic benefits to the contributor (Molm et al., 1999). Hence, negotiated knowledge sharing can occur because it benefits each party in doing their job (Culnan & Armstrong, 1999). Moreover, team members with negotiated obligations experience less risk of unreciprocated contributions (Chang & Rousseau, 2005). Thus, we hypothesize:

**H3a: Negotiated local obligations of knowledge sharing will be positively associated with (i) knowledge contribution and (ii) knowledge acquisition.**

**H3b: Negotiated global obligations of knowledge sharing will be positively associated with (i) knowledge contribution and (ii) knowledge acquisition.**

In previous studies on psychological contracts, researchers have found that employees reciprocate what they receive from the organization (e.g., salary, support) with their contributions (e.g., commitment and job performance), depending on how well they perceive the organization was meeting its contractual obligations to them (Morrison & Robinson, 1997). Among co-workers, greater reciprocal obligations increase knowledge sharing between the contributor and the recipients (Bordia et al., 2004). When an individual feels that a co-worker has failed to meet the obligations, this feeling of violation of psychological contract may lead the employee to withhold individual knowledge and not engage in knowledge exchange. Thus, we suggest that employees not only differentiate between different kinds of obligations, but also share knowledge to different extent when reciprocating difference sources of support. Reciprocal obligations of individuals to both the local and global targets drive actual knowledge exchange because they form intent, create personal goals, and generate commitments that can be enforced based on norms of reciprocity (Settoon et al., 1996).

**H3c: Reciprocal local obligations of knowledge sharing will be positively associated with (i) knowledge contribution and (ii) knowledge acquisition.**

**H3d: Reciprocal global obligations of knowledge sharing will be positively associated with (i) knowledge contribution and (ii) knowledge acquisition.**
Research Methodology

Sample
An R&D unit in a large global high-technology firm served as the research site. This firm developed integrated software solutions (e.g., commercial printing and imaging software) for other divisions of the firm and external clients. The site involved software development teams with a total of 275 individuals. The R&D unit comprised of 36 time-limited cross-functional project teams in different geographical regions, including San Diego, Vancouver, Bristol, Haifa, and Bangalore. The teams were made up of software developers, technical leaders, supervisors and project managers. The majority of team members were software engineers and computer scientists, holding university degrees. Knowledge sharing was critical for project success because the teams were created to generate integrated solutions based on an array of individual expertise. The study was approved by senior management, and the firm was willing to participate in this research to obtain feedback on how well their teams were working.

Procedures
First, in semi-structured interviews, key managers provided information on their team’s goals, tasks and names of members, the activities that members carried out with people within and outside the team, how the team organized its work, and the challenges it faced. The general questions provided factual descriptions and examples of knowledge sharing behavior. These included sharing best practices, transferring know-how of product tools, and exchanging organizational resources.

Next, a web-based survey was developed incorporating information from these interviews. It was piloted tested on twenty-three employees from the R&D organization who were not included in the actual survey. Minor changes were made to the wording of some obligations so that they were applicable to all employees.

The formal study was then conducted using the web-based survey administered to the remaining 252 members. The response rate was 87.7%. A follow-up web-based survey containing the same items was administered one month after the first survey. We also collected additional archival information such as messages on electronic forums and documents in online repositories that were contributed and retrieved by the respondents for the entire month after the administration of the first survey. Given the importance of contextualization, the knowledge sharing obligations reflect the types of activities characteristic of the organization being studied (Rousseau & Tijoriwala, 1999).

Measures
To assure that the instrument was valid both in this setting and on a broader scale, we used a combination of the results of the interviews and pre-existing standardized scales to derive the measures. The online questionnaire combined structured and open-ended questions to measure respondents’ perceptions on knowledge exchange, obligations and social networks. The survey items included measures at the network level (instrumental network, relational network, knowledge contribution, and knowledge acquisition) and at the individual level (knowledge sharing obligations, demographic information).

Network variables. Each participant was presented with a list of members from their own team in the web-based survey, and asked to indicate their work relationships with each person. We used two items as measures of instrumental and relational networks respectively. For each of these networks, we constructed individual-level measures of instrumental and relational embeddedness.

Instrumental embeddedness was operationalized as the ratio of actual individual advice ties to others within the team to total possible ties. Participants indicated the extent to which they went to each team member for advice or help concerning the project on a 5-point Likert scale (1=not at all, 5=to a great extent). We computed the in-degree score for each individual, i.e., advice relations that other team members reported with that individual. Instrumental embeddedness reflects the ratio of in-degree score to total possible ties. A high score indicated that an individual was instrumentally embedded in the overall network. Out-degree scores, i.e., relations that an individual reported with other team members were also computed for additional comparisons with the in-degree scores.

Relational embeddedness was operationalized as the ratio of actual individual relational ties others within the team to total possible ties. Participants indicated the extent to which they trusted each member with matters that were important to them on a 5-point Likert scale (1=not at all, 5=to a great extent). We computed the out-degree score for each individual. Relational embeddedness reflects the ratio of out-degree score to total possible ties. A high score indicated that an individual was relationally embedded in the overall network. Similarly, in-degree scores were also computed for additional comparative analyses.
Psychological contracts of knowledge sharing. Four aspects of knowledge sharing obligations were adapted from the interviews and from previous studies (Chang & Rousseau, 2005). Reciprocal local obligations describe the extent to which members make implicit commitments or obligations to share knowledge with their team members (e.g., “I feel obligated to contribute information beneficial to the team because I believe my team members will contribute in the same manner”). Reciprocal global obligations describe the extent to which members make implicit commitments or obligations to share knowledge with people outside their team (e.g., “I feel obligated to contribute information beneficial to people outside my team because I believe they will contribute in the same manner”). Negotiated local obligations describe the extent to which members make explicit commitments or obligations to share knowledge with their team members (e.g., “I feel obligated to contribute information to my team because we have explicitly agreed upon sharing the information that I need in return”). Negotiated global obligations describe the extent to which members make explicit commitments or obligations to share knowledge with people outside their team (e.g., “I feel obligated to contribute information to people outside my team because they have explicitly agreed upon sharing information I need in return”).

Knowledge exchange. Measures created by Borgatti and Cross (2003) and Cross and Cummings (2004) were adapted to assess knowledge contribution and knowledge acquisition. Since knowledge can be intangible and hard to observe or measure (Ancona & Caldwell, 1992), an individual’s perception of whether he/she has acquired knowledge from or contributed knowledge to others is a relevant indicator of knowledge exchange. For knowledge contribution, we asked the respondents to rate the extent to which they contributed knowledge to each member that enabled him/her to perform tasks and develop new insights (1=not at all; 5=to a great extent). For knowledge acquisition, we asked the respondents to rate the extent to which they acquired knowledge from each member that enabled them to perform tasks and develop new insights (1=not at all; 5=to a great extent).

Objective measures of knowledge exchange were collected for corroboration of findings. First, we examined the volume of messages retrieved and contributed by each respondent in the organizational electronic forums (i.e., a centralized computer system where each employee can post work-related messages and retrieve messages contributed by other employees). We recorded the total number of archived messages within a month from the day of administering the first survey that was posted and retrieved by each respondent respectively. These messages contained work solutions such as software programming codes and pointers to resources useful for software development. Second, we examined the number of documents that each employee retrieved and contributed via the online repositories (i.e., a shared computer folder that each employee has access to). We computed from the organization’s archived log files the total number of documents that were posted and retrieved by each employee, respectively, for the whole month following the administration of the first survey. These documents contained task-related information and work flow processes of the teams.

Control variables. To control for possible alternative explanations of observed effects, seven control variables were taken into account: gender, age, organizational tenure, prior work experience, employment status, task interdependence and geographical distance. Demographic characteristics such as gender and age were controlled because previous research has shown that males and females differ in communication patterns that could generate a different mechanism by which psychological contracts would affect perceptions and behavior of individuals. Gender was included as a dummy variable (“0” = female; “1” = male). Age was operationalized in terms of years.

Organizational tenure was operationalized as the actual number of years with this organization. Prior work experience was operationalized as the actual number of years worked prior to joining the organization. Employment status (e.g., part-time vs. full-time) can impact perceived obligations and was controlled. This control variable was dichotomized as “0” where team members were part-time and “1” where team members were full time.

We also controlled for the possibility that task interdependence and geographical distance might affect relationship between social ties and obligations. Knowledge exchange might occur as a result of work interdependence as individuals rely on other team members for knowledge based on formal work structures. Task interdependence was measured by adapting scales from Campion et al. (1993). Similarly, individuals who were located in close proximity might exchange knowledge more frequently than those who are separated by geographical zones. Geographical distance between an individual and other people was measured using the distance index (Cross & Cummings, 2004).
Analyses

In the exploratory data analyses, network correlations were used to examine dyadic relationships between each social network. As network data observations are not independent, the Quadratic Assignment Procedure (QAP) (Baker & Hubert, 1981; Krackhardt, 1988) was used to run the correlations and multiple regressions. QAP analyses have been shown to remain unbiased as compared with ordinary least squares (e.g., Krackhardt, 1988).

To analyze the hypotheses, partial least squares (Chin, 1998), a structural equation modeling technique, was used. This consists of the measurement model, which assesses reliability and validity of the measures in the research model, and the structural model, which examines path coefficients and hypothesized relationships between the variables. In testing the theoretical model, we fitted several nested models to the data, each model incorporating different assumptions regarding model parameters. Comparisons with alternative models were conducted to show whether a hypothesized model is the best representation of the data, an important part of assessing the model fit.

Results

Preliminary Analyses

The descriptive statistics and correlations of the individual-level and control variables are reported in Table 1. To ensure that the instrumental and relational embeddedness measures are reliable and valid, we conducted a principal components analysis with varimax rotation using the social embeddedness indices for instrumental and relational network measures. Two factors, explaining 88% of the variance in the network measures, had eigenvalues greater than 1.0. The instrumental and relational items indicated high loadings on each factor, therefore demonstrating convergent and discriminant validity (see Table 2).

Measurement Model

In analyzing the measurement model, a table of internal consistency values for each construct in the research model is generated using a formula by Fornell and Larcker (1981). A value of 0.7 would indicate that the construct is reliable. In addition, the square root of the average variance for each construct is verified to determine if it is larger than any of the intercorrelations between the latent variables. To ensure that discriminant validity exists, the loadings of each individual item are examined. The results of the measurement model (Factor Loadings, Internal Consistency, Cronbach Alpha and Average Variance Extracted) are presented in Table 2.

Structural Model

After evaluating the adequacy of the measurement model, we analyzed the strength of the hypothesized relationships between the constructs, and assessed the predictive power of the model for each group by looking at the R-square values on the endogenous variables. We calculated the path coefficients and t-values for each path obtained through bootstrapping. The t-values would indicate the significance of the direct or mediating effect as described in the hypotheses. The path coefficients and t-values for the hypothesized relation are presented in Table 3.

Comparisons with Alternative Models

The hypothesized model has good statistical fit ($\chi^2=190.33, p<.01$, root mean square error of approximation RMSEA=.05, adjusted goodness-of-fit index AGFI=.91, normed fit index NFI=.93 and comparative fit index CFI=.94). Next, it was compared with a series of nested models using the change in chi-square test. In the first comparison, the alternative model specified only the direct paths from the control variables to the knowledge exchange variables. The results showed that the hypothesized model provided a significantly better fit than did the control-variables-only model ($\Delta \chi^2=479.25, p<.01$). In the second comparison, the hypothesized model was compared with the partially mediated model, which specified paths in the hypothesized model as well as the direct paths from the social embeddedness constructs (instrumental and relational) to the knowledge exchange constructs. The change in chi-square test showed that this alternative model was significantly better than the hypothesized model ($\Delta \chi^2=27.34, p<.01$). We also compared the hypothesized model with the non-mediated model. In the non-mediated model, the paths from psychological contract obligations (reciprocal and negotiated) to knowledge exchange were constrained to zero, but the paths from social embeddedness to knowledge exchange were freely estimated. As the non-mediated model was nested within the partially mediated model, it was compared to the
partially mediated model. This alternative model was not significantly better than the partially mediated model ($\Delta \chi^2 = 142.67, p < .01$).

The nested model comparisons indicated that the model including the hypothesized effects and direct effects from social embeddedness to knowledge exchange (partially mediated model) was the best fitting and most parsimonious model ($\chi^2 = 168.63, p < .01$, RMSEA = .05, AGFI = .92, NFI = .91 and CFI = .95). Thus, we retained this model as the best-fitting model and interpret it in order to examine the hypothesized relationships.

**Hypothesized Model**

Examining the standardized parameter estimates indicated that 11 of the 12 hypothesized relationships were significant and in the predicted directions when the control variables were accounted for (see Table 3). First, Hypotheses 1a and 1b positively relate instrumental embeddedness to negotiated local and negotiated global obligations respectively. A statistically significant parameter estimate ("b") was found for the path between instrumental embeddedness and negotiated local obligation (b = .27, p < .01). The estimated path between instrumental embeddedness and negotiated global obligation was not significant. Thus, support was indicated for Hypothesis 1a but not for Hypothesis 1b.

Hypotheses 2a and 2b positively associate relational embeddedness and reciprocal local and reciprocal global obligations respectively. A statistically significant parameter estimate was found for the path from relational embeddedness to reciprocal local obligation (b = .33, p < .01), and for the path from relational embeddedness to reciprocal global obligation (b = .26, p < .01). The results indicated support for both hypotheses associating relational embeddedness and reciprocal obligations.

Hypotheses 3a and 3b positively relate negotiated local and global obligations to knowledge exchange. Respondents who indicated greater negotiated local obligations had greater knowledge contribution (b = .28, p < .01) and knowledge acquisition (b = .25, p < .01). Respondents who indicated greater negotiated global obligations had greater knowledge contribution (b = .30, p < .01) and knowledge acquisition (b = .26, p < .01). Hypotheses 3c and 3d positively relate reciprocal local and global obligations to knowledge exchange. Respondents who indicated greater reciprocal local obligations had greater knowledge contribution (b = .24, p < .01) and knowledge acquisition (b = .29, p < .01). All the parameter estimates were statistically significant.

Although not hypothesized, there were four other significant path estimates pertaining to social embeddedness and knowledge exchange in the partially mediated model. Significant positive parameter estimates were found for the path from instrumental embeddedness to knowledge contribution (b = .23, p < .01), and for the path from relational embeddedness to knowledge acquisition (b = .15, p < .05). A significant, positive parameter estimate was found for the path from instrumental embeddedness to reciprocal global obligation. Respondents with greater instrumental embeddedness reported greater reciprocal global obligation (b = .25, p < .01). A significant, negative parameter estimate was found for the path from relational embeddedness and negotiated local obligation. Respondents with greater relational embeddedness reported lower negotiated local obligations (b = -.21, p < .01).

Supplementary analyses were conducted where additional team and task variables were added in the analyses. Instrumental embeddedness was predicted by task interdependence (b = .14, p < .05) and team diversity (b = .16, p < .05). However, psychological contract obligations and knowledge exchange were not significantly predicted by task interdependence and team diversity. Other team variables (team size, team efficacy) and task routineness were not significantly related with relational embeddedness, psychological contract obligations and knowledge exchange. This suggests that social embeddedness has a more central influence on obligations and knowledge exchange than overall team and task structures. The social embeddedness and control variables together explained 48% of the variance in knowledge contribution and 40% of the variance in knowledge acquisition. The explained variance in the knowledge exchange outcomes was greater in the partially mediated model than in the control-variables-only model, with the latter explaining 28% of knowledge contribution and 16% of knowledge acquisition.
### Table 1. Descriptive Statistics and Correlation Matrix

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*p < 0.05; ** p < 0.01; N=221
Table 2. The Measurement Model – Factor Loadings, Internal Consistency, and Discriminant Validity

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Table 3. Summary of Path Analyses and Hypotheses

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Relationships that were not hypothesized

- Instrumental Embeddedness to Knowledge Contribution: .23, 18.13**, Yes
- Relational Embeddedness to Knowledge Acquision: .15, 12.96*, Yes
- Instrumental Embeddedness to Reciprocal Local Obligation: -.09, 8.95, No
- Instrumental Embeddedness to Reciprocal Global Obligation: .25, 19.42**, Yes
- Relational Embeddedness to Negotiated Local Obligation: -.21, 19.63**, Yes
- Relational Embeddedness to Negotiated Global Obligation: -.06, 10.11, No

R² values for Negotiated Local = .908, Negotiated Global = .882, Reciprocal Local = .891, Reciprocal Global = .869, Knowledge Contribution = .953, and Knowledge Acquisition = .946

Discussion

This study posited that psychological contracts of knowledge sharing are central to understanding knowledge exchange. These psychological contracts provide an important frame of reference in guiding exchange behaviors (Chang & Rousseau, 2005). The current findings identify the nature and role of psychological contracts in knowledge exchange relationships that are often taken for granted. They demonstrate the importance of specific obligations in driving knowledge exchange based on norms of reciprocity and instrumental negotiation.

By examining knowledge exchange from the perspective of psychological contracts, the current research provides further evidence that knowledge exchange can be a voluntary or discretionary behavior that is not formally rewarded. The results reported in this study were surprisingly strong when further analyses were conducted. First, when psychological contracts were examined with reports of knowledge exchange one month after the first survey, obligations were positively associated with both contribution (b=.24, p<.01) and acquisition (b=.21, p<.01). Thus, the effects of psychological contracts may be enduring. Second, the respondents reported their knowledge contribution in the same survey that they reported organizational tenure, work experience and pay/promotions. Despite the fact that these factors are central motivators of knowledge contribution, they did not explain as much variance in contribution as did psychological contracts.

The results were further reinforced when psychological contract obligations were examined with actual amount of contribution to knowledge repositories. Respondents with greater negotiated global obligation posted a greater volume of messages containing work solutions on organizational electronic forums (b=.26, p<.01) and contributed more documents in online repositories (b=.22, p<.01). Similarly, respondents with greater reciprocal global obligation also posted a greater volume of messages on organizational electronic forums (b=.28, p<.01) and contributed more documents in online repositories (b=.27, p<.01). On the other hand, both negotiated and reciprocal local obligations were not significantly related to volume of messages and contribution of documents in online repositories. These findings contradict prior research that suggests knowledge exchange is reduced in electronically-mediated work environments due to lack of common ground (Nahapiet & Ghoshal, 1998; Cramton, 2001).
Knowledge contribution, both perceived and in actual amount, increases when obligations to share with the global target increases, even when individuals do not explicitly negotiate for reciprocation. One possible explanation is that direct reciprocity is expected for personal exchanges between individuals (local target), whereas generalized reciprocity, i.e., reciprocation in other forms by another party other than the recipient of the exchange (Wasko & Faraj, 2005), is the key to sustaining knowledge exchange in virtual teams.

The current study shows that two measures of social embeddedness, instrumental and relational, positively relate to each form of psychological contract obligations. Existing theories maintain that what matters in virtual teams is the impact of distance, face-to-face interactions, and use of communication technologies (Sproull & Kiesler, 1991; Cramton, 2001; Cross & Cummings, 2004). While having some explanatory power, along with other individual and team factors such as familiarity and identity (Henry et al., 1999; Espinosa et al., 2002), this study found that distance and technology effects can be overshadowed by the impact of social relationships on knowledge exchange.

**Theoretical Implications**

The above results on the mediating role of psychological contracts have several important theoretical implications. The social networks literature has repeatedly stated two assumptions: (1) that obligation to share is the critical ingredient in the relationship between social networks and knowledge exchange, and (2) that the impact of social networks comes from something more than just the expectations of rewards and benefits. This study empirically supports these previously untested assumptions, and this is important for two reasons. First, it demonstrates, for the first time, why social ties have the effect on knowledge exchange in virtual teams, because it identifies the crucial mediating variables, i.e. different forms of obligations. Second, it validates prior studies on the effects of social ties. Until now, it was impossible to determine whether prior work on the effects of social networks in virtual teams were demonstrating anything new beyond what is already known about the effects of reciprocity. Even though it has been argued in the contract literature that the effects of psychological contract obligations were something more than just the effects of reciprocity, there were no empirical data to support these claims. The results of this study show that social ties generate reciprocal obligations, but that reciprocal obligations alone cannot account for these effects of different social ties. The results also suggest that although the constructs of instrumental and relational ties are related to psychological contract obligations, they are in fact distinct.

Research on virtual teams can benefit from these findings. While face-to-face interactions during the course of a project are important, alternative means of communication should be employed to develop instrumental and relational components of social ties that facilitate the development of psychological contract obligations. As in evidence-based management (Rousseau, 2006), identifying such ties and obligations reveal the cause-effect connections in virtual work practices, and translate them into practices that promote desired knowledge exchange.

**Practical Implications**

Managers face the challenge of motivating employees to actively and willingly engage in knowledge sharing. The current findings provide further evidence that psychological contract theory provides not just a framework to understand knowledge exchange, but also practical directions on how to facilitate knowledge exchange. Specifically, they showed that team members with greater obligations to share were more likely to exchange knowledge. Interestingly, different types of social ties were associated with different forms of obligations. Thus, organizations initiating a knowledge management strategy should consider the kind of knowledge sharing processes to promote.

The strategy to promote knowledge exchange directed at the local target, e.g., personalized knowledge between team members, will differ from the strategy to promote knowledge exchange directed at the global target, e.g., codification of knowledge in repositories to benefit other organizational members. Managers who want to increase knowledge sharing directed at the local target can provide opportunities to develop trust relationships that promote feelings of reciprocal obligations between co-workers, or advice networks that promote instrumental negotiation. The findings suggest that trust relationships allow team members to establish a sense of reciprocity and obligations to share. Managers who want to increase knowledge sharing directed at the global target can promote contributions to knowledge repositories or among organizational members by establishing strong task-oriented structures. These structures can increase situational cues that are often lacking in virtual work contexts, by clarifying individual expectations, and guiding behavior through making knowledge sharing less discretionary (Dirks & Ferrin, 2001).

**Conclusion**

In conclusion, this study contributes by increasing the theoretical and empirical understanding of the antecedents and consequences of psychological contracts of knowledge sharing in virtual teams. Specifically, instrumental and
relational embeddedness were found to be associated with negotiated and reciprocal obligations. The more an individual is instrumentally embedded, the greater negotiated obligations they have towards their exchange partners. The more an individual is relationally embedded, the greater reciprocal obligations they have towards their exchange partners. The results also showed that these obligations, both to local and global targets, have positive relationships with knowledge contribution and knowledge acquisition. These findings illustrate the role of psychological contracts in virtual environments, and calls for contextualized views of psychological contract obligations in the evaluation of knowledge sharing processes.

References


