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Examining the antecedents of knowledge sharing in facilitating team innovativeness from a multilevel perspective

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ABSTRACT

This paper examines how transformational leadership (TFL) climate influences employees' team identity and their intentions to share knowledge and how team knowledge sharing intention subsequently influences team innovativeness. Data was collected from 301 employees comprising 52 R&D teams. Hypotheses were tested with both hierarchical linear modeling (HLM) and regression analyses. Results indicated that TFL climate was related to employees' intention to share knowledge through team identity. At the group level, results supported the relationships between team knowledge sharing intention and team innovativeness. The results also indicated that team knowledge sharing intention mediated the relationship between TFL climate and team innovativeness.

1. Introduction

Innovativeness, the flexibility and willingness to accept new ways to create knowledge-based solutions, is an increasingly indispensable tool for corporations attempting to cope with the complexity of today's competitive environments. As more and more sectors of the global economy become knowledge-based, the importance of understanding the relationships that logically exist among the social capital of an organization (Nahapiet & Ghoshal, 1998; Yli-Renko, Autio, & Sapienza, 2001), the knowledge management mechanisms utilized by the organization, and their effects on both individual and team-level creativity and innovation become paramount. While scholars and practitioners have acknowledged the critical role that knowledge sharing plays in creating and maintaining firm effectiveness (e.g. Alavi & Leidner, 2001; Kogut & Zander, 1996; Spender & Grant, 1996; Tsai, 2001), surprisingly few empirical studies have concomitantly examined both the antecedents of knowledge sharing as well as its relationship to organizational innovativeness within this broader context.

At an organizational level, the extant literature has emphasized the effects of managerial practices and organizational culture on knowledge sharing (e.g., Bartol & Srivastava, 2002; Chen & Huang, 2007; Floyd & Lane, 2000). Prior research with more of an individual team member perspective has, in comparison, focused on employees' personalities and dispositions and their relationships with knowledge sharing (Cabrera, Collins, & Salgado, 2006; Mooradian, Renzl, & Matzler, 2006; Szulanski, 1996; Yang & Farn, 2009). While both of these streams of research have yielded interesting and useful information, very little attention has been given to the antecedents and consequences of knowledge sharing from a multilevel perspective, despite the acknowledged importance of adopting a cross-level conceptual and analytical perspective on social interactions that involve knowledge sharing in organizational settings (Brass, Galaskiewicz, Greve, & Tsai, 2004; Siemsen, Balasubramanian, & Roth, 2007). The purpose of the present investigation was, therefore, to help provide this multilevel perspective on an issue that remains a critical one for both theory and practice. The fundamental question that we address in the present study is whether a climate of transformational leadership (TFL) can facilitate team innovativeness. Although research has frequently examined the effects of leadership on teams, a substantial portion of the prior research has been conducted within a single-level analytical framework. Unfortunately, examining one level at a time prevents one from knowing the relationships involving predictors at two or more levels and an outcome at a single level (Kozlowski & Klein, 2000); thus, we adopted a multilevel approach in this study to test our proposed model.

We believe that the present study will make an important contribution to the leadership, innovativeness and knowledge sharing literatures by providing a more comprehensive, multilevel analysis of several of the potentially important underlying variables. Specifically, as represented in Fig. 1, we examine whether TFL climate influences team members' knowledge sharing intention through team identity perceptions via hierarchical linear model-

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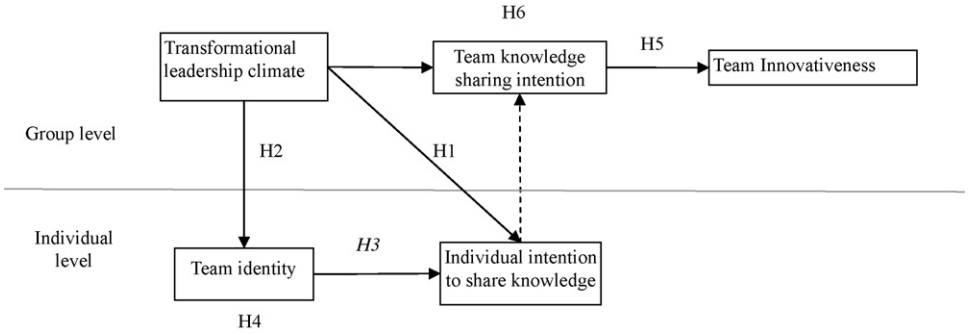

Fig. 1. An integrated multilevel research model. *Note*: Dashed lines represent additive processes through which individual-level phenomena are compiled to form group-level phenomena.

ing (HLM; Raudenbush & Bryk, 2002); and subsequently whether these enhanced team knowledge sharing intentions can explain the relationship between leadership climate and team innovativeness.

2. Theoretical background and hypothesis development

2.1. TFL climate and intention to share knowledge

Over 40 years ago Katz and Kahn (1966) suggested that the ability to evoke "performance beyond role requirements" was a critical element for organizations attempting to optimize their functioning. One perspective on this kind of performance enhancement that has proven quite informative is the body of knowledge related to transformational leadership (TFL). TFL develops between the leader and the followers in the form of a climate shared among team members. Under a TFL climate, members may internalize team attributes as their own and in turn, this internalization can lead to a strong sense of team identity which in turn should facilitate extra-role behaviors, such as knowledge sharing behavior (Bryant, 2003).

Transformational leadership presumably has positive effects on individual and work group productivity when a leader successfully utilizes the 4 "I's" of leadership (Avolio, 1994). By enacting leader influence through the use of idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration, transformational leaders are able to realign employees' values and norms, and inspire employees to achieve higher levels of innovation and effectiveness.

The potential effects of transformational leadership on knowledge sharing are especially compelling given the focus of this leadership perspective on organizational values and norms; it has often been argued that knowledge sharing will be positively related to individual attitudes and to organizationally shared values (culture) (e.g., Bock, Zumd, Kim, & Lee, 2005). Quite logically, therefore, leadership styles that enhance knowledge sharing organizational-cultural beliefs will stimulate an environment in which employees have the desire to share. This desire to share is a critical aspect of knowledge sharing's effects on innovativeness since "Knowledge sharing does not happen automatically in a team, and the team's leader has an important role to play in making it come about." (Srivastava, Bartol, & Locke, 2006, p. 1241) Moreover, there is evidence to suggest that intrinsically motivated knowledge sharing intentions are more effective than attempts to enhance knowledge sharing through extrinsic factors such as organizational rewards (Lin, 2007). Developing a common perspective and mutual understanding (a key aspect of an organization's repository of social capital) is posited to stem from a number of sources including citizenship behaviors which typically are assumed to be derived from intrinsic-motivation (Bolino, Turnley, & Bloodgood, 2002). As such, leadership styles such as transformational leadership that foster a culture of shared beliefs, vision, organizational commitment, and knowledge sharing should be especially useful.

A belief that TFL may be a critical precursor to knowledge sharing is also conceptually quite consistent with a more comprehensive social capital perspective on organizational effectiveness. As Nahapiet and Ghoshal (1998) have carefully articulated, social capital is critical for maintaining organizational competitive advantage because it forms the bases for trust and cooperation among and between work groups. This trust and cooperation is essential for effective knowledge-sharing to occur. Moreover, research has demonstrated that psychological safety (Edmondson, 1999) is an important antecedent to knowledge sharing (Siemsen, Roth, Balasubramanian, & Anand, 2009). Team members must possess shared beliefs that the team environment is trustworthy and that interpersonal risk will be rewarded rather than punished. Logically, the team leader plays an integral role in facilitating high levels of psychological safety and more importantly, the fundamental nature of transformational leadership should effectively foster this sense of trust.

Liao and Chuang (2007) proposed that the concept of "work unit transformational leadership" refers to the overall pattern of leadership behaviors displayed to the entire work unit; it can be viewed as a type of 'ambient stimulus' that pervades the work unit and is shared among unit members" (p. 1007). In the context of knowledge management research, it has been noted that TFL is linked to a follower's motivation to perform beyond standard expectations and may have a positive influence on knowledge management (e.g., Bryant, 2003; Huang, Davison, Liu, & Gu, 2008). However, the posited relationship between TFL and knowledge sharing has never been tested from the multilevel perspective. Logically, however, TFL should be beneficial to effective social interaction (Avolio, 1999; Bass, 1998) and therefore, a transformational climate might arouse the affiliation motive among group members, which ultimately could result in increased intention to share knowledge, especially when the overall leadership climate of the group supports the interpersonal risks that are inherent with knowledge sharing. Thus, we hypothesized:

Hypothesis 1. TFL climate is positively related to employees' intention to share knowledge.

2.2. TFL climate, team identity and intention to share knowledge

Team identity refers to the individual perceptions that team members have regarding the feeling of oneness with or belongingness to the group of which they are members. Bass and Avolio (1990) argued that TFL motivates followers to exert extra effort by getting them to transcend their own self-interests for the good of the group. They also contended that transformational leaders empower subordinates by promoting a strong identification

with the workgroup as well as a commitment to the organization and its goals and values (Shamir, House, & Arthur, 1993). In other words, employees' motivational states under transformational leaders shift from self-interests to collective interests; employees are more likely to develop a sense of team identity with this shift in focus. Given the strong positive group climate developed in groups by transformational leaders (Shamir et al., 1993), members are more likely to share a stronger collective identity within such groups (Jung & Sosik, 2002; Jung & Avolio, 1999). As a result:

Hypothesis 2. TFL climate is positively related to members' team identity.

Other literature provides theoretical and empirical justification for the expectation that team identification may contribute to extra-role behavior (e.g. Liden, Wayne, Kraimer, & Sparrowe, 2003; Shore & Wayne, 1993). In an environment where the group and the organization's interests transcend the individuals' own self-interests, an atmosphere conducive to knowledge sharing should exist. Moreover, as members develop a stronger sense of identity with the team, their inherent trust with other members should increase along with their desire to cooperate for the good of the team. Together, these conditions should also contribute to the team's psychological safety which, as previously mentioned, will logically mitigate the interpersonal risks associated with sharing knowledge and expertise with other team members, especially in a climate where individual needs are not primary. Thus, we propose that team identity would contribute to team members' intention to share knowledge.

Hypothesis 3. Team identity is positively related to intention to share knowledge.

It has been argued that transformational leaders energize a higher level of group performance at least in part by elevating the needs of group members from self- to collective interests and inspiring higher levels of commitment to a common mission and/or vision (Bass, 1985; Jung & Sosik, 2002; Shamir et al., 1993). In view of the previous arguments that team identity elevates intention to share knowledge, we expect that TFL climate helps promote individual intention to share knowledge through the effects of employees' identity with their team.

Hypothesis 4. Team identity mediates the relationship between TFL climate and intention to share knowledge.

2.3. Team knowledge sharing intention and team innovativeness

A fundamental premise of collaboration at work is that teams whose members work together will be more productive than teams whose members are self-focused and, therefore, more concerned about their individual outcomes than the group's outcomes. Teams are groups of individuals with experiences and knowledge both different from and complementary to those responsible for a work process or goal (Zárraga & Bonache, 2003). When the complementariness of team members' knowledge is shared and transferred from one to another within a team, a synergy then occurs. Knowledge sharing is likely to contribute to enhanced collective knowledge (Cabrera et al., 2006; Grant, 1996; Nahapiet & Ghoshal, 1998) through which the integration of the individuals' knowledge will surpass the sum of what each of members can do on his or her own. In any interdependent work process, no single individual can carry out all the activities necessary to produce improvements and innovations. Only by combining individuals with different and complementary skills and perspectives, and by achieving cooperation among them, can this process be carried out to its fullest potential (Swan, Newell, Scarbrough, & Hislop, 1999; Zárraga & Bonache, 2003).

Srivastava et al. (2006) suggested that knowledge sharing in teams improves team performance because of its beneficial effect on team coordination. Knowledge sharing may lead to improved coordination because of the development of transactive memory, defined as the knowledge of "who knows what" in a team (Oshri, van Fenema, & Kotlarski, 2008; Srivastava et al., 2006; Wegner, 1987). With the formation of transactive memory, the team will be more likely to obtain the resources needed for innovations such as new product development, with timely prototype development and with the commitment of appropriate personnel all of which should result in getting a product to market that is innovative, timely and cost-efficient. Moreover, team innovation is tied closely to the ability for team members to share the work group's vision (Pearce & Ensley, 2004). Thus, the above arguments suggest that knowledge sharing is likely to lead to higher team innovativeness. We, therefore, hypothesized:

Hypothesis 5. Team knowledge sharing intention is positively related to team innovativeness.

In view of the above arguments that TFL climate creates an atmosphere of knowledge sharing and that team knowledge sharing intention positively influences team innovativeness, we expect that TFL climate will facilitate a team's innovativeness through the effect of team knowledge sharing intention. Although there may be some direct effects of TFL climate on innovativeness, prior similar conceptualizations of the role that leadership plays in producing desired team outcomes has suggested that the direct effect may be an oversimplification of the relationship (Srivastava et al., 2006). These authors found evidence for the existence of several key intermediate (mediating) mechanisms; their focus was on knowledge sharing and team efficacy. Although our focus is on knowledge sharing and team identity, the shared conceptualizations are apparent, especially if one presumes that team efficacy is potentially enhanced by a strong team identity. Certainly, one might expect that many of the same leadership qualities than foster team efficacy (e.g., creating a shared vision, seeking opinion and input, access to team-level information) would likewise foster team identity as we have noted. As a result, we share a common assertion with Srivastava et al. (2006), namely that transformational leadership's effects on team outcomes (innovativeness) will occur through group and individual-level processes. Thus, our final hypothesis is:

Hypothesis 6. Team knowledge sharing intention mediates the relationship between TFL climate and team innovativeness.

3. Method

3.1. Participants and procedures

An invitation to participate in the research was sent to 84 companies in Taiwan. The 84 companies were obtained from multiple sources including EMBA program alumni lists and researchers' personal contacts. Fifty-six companies accepted the request. Survey packages were sent out to each R&D team that was working on a specific project when the data collection was conducted. Each package contained copies of team member questionnaires and one copy of the leader questionnaire. To ensure the anonymity of employee responses, we instructed an employee representative in each team to collect sealed surveys from employees. Employees were also provided the option of sending their responses directly to the researchers via mail or email. A translation-back translation procedure (Brislin, 1980) was followed to translate the English-based measures into Chinese. One of the authors who was fluent in

Chinese translated the original scales and then asked another colleague to back translate the Chinese version into English. Based on this iterative process, the Chinese version was again revised by the authors to create the final version of the surveys.

The estimates for Hierarchical Linear Modeling (HLM) in this study required at least 5 respondents per group. After excluding four teams with an insufficient number of respondents, the final sample consisted of 301 surveys representing membership in 52 teams which were from 52 different companies. The sample consists of 5 companies in semiconductor industry, 6 companies in information technology, 9 companies in electronics, 9 companies in photonics, 5 companies in petrochemicals, 3 companies in biochemistry, and 15 companies in manufacturing.

Approximately 70% of the team members in the final sample were male while about 77% of team leaders were male. A majority of the group members (71%) were between the ages of 30–49. About 60% of leaders' ages range from 40–49. Sixty percent of the members had a college degree and 40% of the members had a Master's or Doctoral degree. Forty-two percent of the team leaders had a college degree and 58% of the team leaders had a Master's or Doctoral degree. Most of the group members' tenure (68.8%) was from 1 to 6 years; about 35% of the team leaders' tenure was in this same time period. Team members were working face to face on a daily basis.

As with any large-scale organizational study where participation is voluntary, the potential for a nonresponse bias may exist and, therefore, the interpretation of relationships between independent and dependent variables can be tenuous. Given that our responses were collected by the team leader or the employee representative at the same time in each team, we were not able to conduct a wave analysis comparing early to late respondents on the measures. However, we collected additional demographic information on the entire cohort of R&D teams we investigated to conduct an archival analysis suggested by Rogelberg and Stanton (2007). Proportions of respondents were quite similar to the entire cohort of R&D teams we investigated in terms of gender (male: 70.1% vs. 70.9%), tenure (5.12 vs. 5.09), and age (33.1 vs. 33.3). These results reduce the concern that there are significant differences between respondents and nonrespondents.

3.2. Measures

Transformational leadership climate. Team members were asked to rate their team leader using the rater form of the Multifactor Leadership Questionnaire (MLQ, Form 5X; Avolio & Bass, 1995). The MLQ includes several dimensions of TFL: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. Sample items by dimension include (a) idealized influence ("Talks to us about his or her most important values and beliefs"), (b) inspirational motivation ("Articulates a compelling vision of the future"), (c) intellectual stimulation ("Re-examines critical assumptions to question whether they are appropriate"), and (d) individualized consideration ("Spends time teaching and coaching me"). Responses were made on five-point scales ranging from 1 (never) to 5 (always). Since TFL climate was conceptualized as an overall indicator of work group climate, the analyses were conducted with a TFL composite that combined the four subscales ($\alpha = .95$) which is consistent with recent empirical studies (e.g. Barling, Weber, & Kelloway, 1996; Bono & Anderson, 2005; Hofmann & Jones, 2005).

The transformational leadership climate scores were derived by averaging individual TFL scores within each team. The viability of creating an aggregated measure of TFL climate was checked following the method by James, Demaree, and Wolf (1984) and Kozlowski and Hults (1987). The within group agreement (r_{wg}), intraclass correlation (ICC1), and reliability of the mean (ICC2) were computed. The mean value of r_{wg} computed for TFL was .87. The computed ICC(1) and ICC(2) values for TFL were .46 and .85, respectively. The mean r_{wg} value and ICC(1) value were well above the acceptable levels (0.12 for ICC(1), 0.6 for ICC(2), e.g. Bliese, 2000; James, 1982). Thus, TFL climate was justified for aggregation to a group level variable.

Team identity. We assessed team identity with Mael and Ashforth's (1992) six item identification measure ($\alpha = .85$). Team members were asked to respond on five-point scales ranging from 1 (strongly disagree) to 5 (strongly agree) to items such as "When someone criticizes my team, it feels like a personal insult".

Intention to share knowledge. Five items adapted from Bock et al. (2005) with responses ranging from 1 (extremely unlikely) to 5 (extremely likely) were used to assess an individual's intention to share knowledge ($\alpha = .88$). An example item is "I try to share my expertise from my education or training with other group members in a more effective way".

Team knowledge sharing intention. To assess the overall team knowledge sharing across a group, we averaged team members' evaluation of their individual intention to share knowledge to form the team knowledge sharing intention score, following the method by James et al. (1984) and Kozlowski and Hults (1987). The mean value of r_{wg} computed for intention to share knowledge was .91. The computed ICC(1) and ICC(2) values for intention to share knowledge were .35 and .75, respectively. The mean r_{wg} values and ICC values were well above acceptable levels (e.g. Bliese, 2000). Thus, the aggregated measure of team knowledge sharing intention was justified.

Team innovativeness. Four items adopted from Lovelace, Shapiro, and Weingart (2001) were used to measure team innovativeness ($\alpha = .80$). Survey packages were sent out to each R&D project team in the companies where the team was working on a specific project when the data collection was conducted. Therefore, the project was still ongoing while we measured team innovativeness. Team leaders were the person who most logically could closely observe his/her team innovativeness, and were therefore, asked to provide the information necessary for measuring their team innovativeness. Team leaders were asked to respond on seven-point scales ranging from 1 (much lower than average) to 7 (much higher than average). A sample item is "the number of innovations or new ideas introduced by the team".

Control variables. We controlled team age and size in testing group-level hypotheses, Hypotheses 5 and 6, since these two variables often demonstrate relationships to group processes such as innovativeness (e.g., Hoegl & Parboteeah, 2006; Wiersema & Bantel, 1992). Team age was operationalized as the number of years that the group had been in operation. Team size was operationalized as the number of employees in the work group. Both of these were obtained from team leaders' self-reports. We also controlled for a number of individual characteristics, including employees' gender, age, education, and team tenure in testing individual-level hypotheses.

In the present study, two key variables of interest, namely team identity and individual intention to share knowledge were both self-report measures. A reliance on these self-reports could, therefore, introduce common method error variance into the data. To mitigate these concerns, we examined the data using Harman's one-factor test (Podsakof & Organ, 1986): items at the individual level including team identity and individual intention to share knowledge were considered in a factor analysis to determine whether the majority of the variance could be accounted for by one general factor. The results of the principal component factor analysis revealed two factors with Eigenvalues greater than one explaining 62.6% of the total variance. The first factor accounted for 31.3% (less than 50%) of the variance, which did not account for a majority of the variance (Podsakof & Organ, 1986). Therefore, we

Table 1
Means, standard deviations, and correlations.

	M	SD	1	2	3	4	5	6
Individual level variables								
Gender								
Age	33.10	6.71	−.04					
Education	3.05	.64	−.09	−.05				
Team tenure	3.69	4.00	.05	.40**	−.17*			
Team identity	3.73	.61	−.04	.19*	−.02	.08	.77	
Intention to share knowledge	3.91	.55	−.09	.14*	.08	−.05	.60**	.83
Group level variables								
Team age	13.69	12.54						
Team size	5.75	.93	−.13					
TFL climate	3.77	.42	−.03	.22				
Team knowledge sharing intention	3.91	.34	.10	.11*	.59**			
Team innovativeness	5.11	.94	−.12	.42**	.45**	.47*	.64	

Note. The square root of average variance extracted for each construct is underlined and shown in the diagonal. Gender was coded as 1 for female and 2 for male.
* $p < .05$ (two-tailed significance).
** $p < .01$ (two-tailed significance).

concluded that our data did not suffer from unacceptable degrees of common method bias.

3.3. Analyses

Hierarchical linear modeling was used to test Hypotheses 1, 2 and 3 because it provides an appropriate estimate of standard errors that is better than those provided by other analytic methods when data are nested within groups. HLM can simultaneously estimate the impact of factors at different levels on individual-level outcomes while maintaining appropriate levels of analysis for the predictors (Bryk & Raudenbush, 1992). In conducting the analyses, we controlled for a number of variables, including employees' gender, age, education, and team tenure. No significant effects for these control variables were found in the analyses. All variables examined in the HLM analysis were grand-mean centered as this reduces possible multicollinearity and helps address the interpretation of intercepts, and the variance of random intercepts across groups (Hofmann & Gavin, 1998). Kenny, Kashy, and Bolger's (1998) approach and Sobel's tests (1982) guided our examination of the mediation effects.

4. Results

The means, standard deviations and correlations for the study variables are shown in Table 1. Discriminant validity of each construct was assessed by testing whether or not the square root of the average variance extracted for each construct was greater than the correlations between the construct and other constructs (Fornell & Larcker, 1981). Table 1 shows that the constructs meet this criterion. We calculated the variance inflation factor after mean centering and prior to the calculation of the interaction terms. Convergent validity was assessed by testing the item-to-total correlations of the constructs. The examination of convergent validity was provided in Appendix B. The results show that the specific items have a stronger correlation with the construct than with other items.

4.1. HLM results

The means, standard deviations and correlations for the study variables are shown in Table 1. In order to test the hypotheses, we estimated a null model in which no predictors were specified for either the level 1 or level 2 function to test the significance level of the level 2 residual variance of the intercept. The result

Table 2
Results of HLM analyses.

Variable	Intention to share knowledge				Team identity
	Model 1	Model 2	Model 3	Model 4	Model 5
Level 1					
Intercept	3.91** (0.07**)	3.91**	4.04**	3.64*	4.14**
Gender		−0.06	−0.08	−0.06	0.00
Age		0.00	0.00	0.00	−0.04
Education		0.04	−0.00	0.04	−0.07
Team tenure		−0.01	−0.01	−0.01	0.00
Team identity		0.55**		0.52**	
Level 2					
Team age			0.01	0.04	0.00
Team size			−0.01	0.00	−0.07
TFL climate			0.49**	0.22*	0.52**
Within-group residual variance	0.23	0.17	0.23	0.17	0.28
$R^2_{\text{within-group}}$ [a]		0.26			
Deviance	473.6	373.7	482.3	381.2	524.44

Note. Entries are estimations of fixed effects (γs) with robust standard errors. Estimations of the random variance components (τs) are in parentheses. The τs for the intercepts represented the between-groups variance in intention to share knowledge.
[a] Explained within-group variances in intention to share knowledge by level 1 predictors.
* $p < .05$.
** $p < .01$.

Table 3
Regression analyses at group level.

Variable	TKSI	Team innovativeness			Collinearity statistics	
	Model 1	Model 2	Model 3	Model 4	Tolerance	VIF
Team age	.13	−.08	−.13	−.12	.93	1.06
Team size	.06	.35**	.36**	.33**	.96	1.04
TFL climate	.58**	.34**		.16	.61	1.62
Team knowledge sharing intention			.40**	.30*	.62	1.59
R^2	.38	.33	.38	.39		
Adjusted R^2		.28	.33	.34		
ΔR^2				.06		

Note. TKSI = team knowledge sharing intention.
* $p < .05$.
** $p < .01$.

($\hat{\tau}_{00} = .07$, $p < .01$) indicated a significant between-group variance in knowledge sharing.

The results of tests of the hypotheses appear in Table 2. Hypothesis 1 postulated that TFL climate would be positively related to intention to share knowledge. As can be seen in Model 3, work unit TFL had a significantly positive relationship with intention to share knowledge ($\widehat{\gamma} = .49$, $p < .01$). As predicted in Hypothesis 2, TFL climate had a significantly positive relationship with team identity ($\widehat{\gamma} = .52$, $p < .01$; Model 5). Hypothesis 3 postulated that team identity would be positively related to intention to share knowledge. As can be seen in Model 2, team identity had a significantly positive relationship with intention to share knowledge ($\widehat{\gamma} = .55$, $p < .01$). Thus, Hypotheses 1, 2 and 3 were supported.

4.2. Testing cross-level mediation

Hypothesis 4 proposed that team identity would mediate the relationship between TFL climate and intention to share knowledge. In order to test the mediation hypothesis, the approach suggested by Kenny et al. (1998) was used. In the first step, TFL climate needs to be related to intention to share knowledge which was supported in our testing of Hypothesis 1. Second, TFL climate needs to be related to team identity and this proposition was supported by the results of analyses related to Hypothesis 2. Third, team identity has to relate to intention to share knowledge and this aspect of a meditational model was also supported in Model 2.

Analytically, full mediation exists when the relationship between the predictor and the outcome variable is reduced to non-significant levels when both the predictor and mediator are included in the regression equation. If the relationship between the predictor and outcome variable remains significant but to a lesser degree after controlling the mediator, then partial mediation can be claimed.

The results in Model 4 indicated that the relationship between TFL climate and intention to share knowledge remained significant ($\widehat{\gamma} = .22$, $p < .05$), but to a lesser degree compared to the effect in Model 3 ($\widehat{\gamma} = .49$, $p < .01$) once the proposed mediator, team identity, was controlled in the prediction equation. This means that TFL climate promoted employees' intention to share knowledge partially through increasing employees' team identity. As such, Hypothesis 4 was partially supported. In addition, Sobel's test (1982) was conducted to further examine Hypothesis 4. The results of the Sobel's test further supported Hypothesis 4 for partial mediation ($z = 3.64$, $p < .001$).

4.3. Testing group-level hypotheses

The results of group-level hypotheses are shown in Table 3. Hypothesis 5 postulated that team knowledge sharing intention would be positively related to team innovativeness. The results showed that group size had influence on team innovativeness. After we controlled the influences of team age and size, the results in Models 3 indicated that team knowledge sharing intention had a significantly positive relationship with team innovativeness ($\beta = .40$, $p < .01$). Thus, Hypothesis 5 was supported.

Hypothesis 6 proposed that team knowledge sharing intentions mediated the relationship between TFL climate and team innovativeness. Kenny et al. (1998) was again used in testing mediation effect. First, the results in Table 3 showed that TFL climate has a positive relationship with team innovativeness ($\beta = .34$, Model 2). Second, the results showed that TFL climate had a positive relationship with team knowledge sharing intention ($\beta = .58$, Model 1). Then, TFL climate was related to team knowledge sharing intention which was supported in our testing of Hypothesis 5. The results in Model 4 showed that the relationship between TFL climate and team innovativeness was insignificant ($\beta = .16$), suggesting that the effects of TFL climate on team innovativeness was fully mediated by team knowledge sharing intention. Therefore, Hypothesis 6 was supported.

5. Discussion

It has become nearly axiomatic that knowledge sharing among team members, especially those who are performing complex, interdependent tasks such as R&D work is essential for maintaining high levels of group and organizational productivity (Haas & Hansen, 2007; Liao, 2008). As such, there is a growing need for research to explore both the antecedents and the consequences of knowledge sharing intentions. Clearly, however, since both intragroup and intergroup communications are embedded in a larger, socially rich context, no one study can fully capture all of the antecedents and consequences of knowledge sharing at one, let alone multiple levels of analysis. Nonetheless, the overall pattern of results that already exists in the organizational literature suggested to us that a workgroup climate characterized by high levels of transformational leadership (TFL) should have positive effects on team members' knowledge sharing intention through a meditational effect on team identity. This proposition was tested among 52 intact work teams in Taiwanese organizations and the results of our investigation were generally supportive. Using multilevel analytic techniques we found that TFL climate was indeed positively related to knowledge sharing intentions and this effect could be in part explained by the strength of members' identification with the team. Moreover, we found that TFL climate was positively related to team innovativeness through a meditational effect of team knowledge sharing intention.

What implications does this study have for researchers and practitioners? Based on our results, we would first suggest that the role that our proposed antecedents to knowledge sharing play on team innovativeness is more thoroughly understood when

it is viewed from a multilevel perspective. Although there are undoubtedly a number of important single-level inputs, the complex interactive nature of individual, group, and organizational processes cannot be fully appreciated without this multilevel approach. In other words, although the decision to share knowledge may occur at an individual level, we simply cannot ignore the potentially powerful influences of team or organizational level variables on employees' intention to share knowledge. To our knowledge, the present research is the first to study the effect of knowledge sharing on team innovativeness from both individual and group level perspectives. As such, this study will hopefully allow researchers and practitioners alike to adopt a more comprehensive model for enhancing knowledge sharing intentions among work group members.

Taken as a whole, the results of the present investigation were consistent with prior research on leadership, knowledge sharing, and group productivity. While we can only speculate at this time, it is nonetheless interesting to consider the possibility that the positive effects of knowledge sharing that occurred in our sample were attributable to a transformational leadership climate's unique capacity to align team members' individual goals with the team's goals in a way that more traditional transactional leadership climates simply cannot.

It is also interesting to speculate about other potential mechanisms through which transformational leadership might positively influence knowledge sharing despite our not having the luxury and/or capability to measure all such mechanisms. Of special interest, given our focus on leadership processes is the potential effect that transformational styles might have on workgroup members' perceptions of psychological safety (Edmondson, 1999). Since sharing information with colleagues does have inherent risk to one's own standing in an organization (especially if group and individual rewards are not properly aligned), the workgroup's overall sense of trust and cooperation are logically critical to their willingness to share job-relevant knowledge (Siemsen et al., 2007, 2009). Likewise, group efficacy also influences knowledge sharing intentions (Srivastava et al., 2006) and it is also conceptually closely aligned with team identity. Given the focus of transformational leadership styles, it seems quite reasonable to posit that such leadership will have a significantly more positive effect on psychological safety while enhancing team efficacy than would more transactional styles. As such, we would encourage future research to attempt to simultaneously measure all of these conceptually related aspects of a workgroup's climate and its effects on knowledge sharing intentions.

The notion that TFL might be an effective way to align team members' and team's goals, thereby facilitating members' intentions to share knowledge is especially pertinent in light of the recent work of Haas and Hansen (2007). Their results indicate that more knowledge per se should not necessarily be the actual purpose underlying an organization's desire to increase members' intention to share information with one another. To the contrary, if an organization wishes to enhance innovativeness through knowledge sharing, it must do so by ensuring that the "correct" type and source of information is disseminated. It is here where TFL climate might play a crucial role, especially in non-routine environments. Without the alignment of members' and team's goals, knowledge sharing may have little or no positive effect on team innovativeness. This notion reflects the importance of examining the antecedents of knowledge sharing while exploring the effects of knowledge sharing on team innovativeness or productivity.

Similarly, in the present study we did not attempt to measure whether knowledge sharing among team members involved primarily explicit, job-relevant information or more implicit or tacit information. In addition to Haas and Hansen's (2007) focus, there clearly could be different psychological climates that foster knowledge sharing depending on what kind of information needs distributed. In an R&D environment, substantial information that may positively influence task performance is, logically, more of a tacit nature. Interestingly, however, one might argue that it is precisely this form of information about which more personal risk is assumed. As we have suggested elsewhere, an organization's reward structures definitely need to align with these knowledge sharing needs if transformational leadership (or any other style for that matter) is going to facilitate the process. Therefore, future research may need to more carefully articulate between both amounts and types of information to gain a thorough understanding of TFL's role in facilitating knowledge sharing among team members.

6. Limitations and future research

Although we believe that the results of the present study are a useful addition to the literature, they must be interpreted within the study's methodological limitations. First, an objective measure of team innovativeness was not available to us. Our measure of team innovativeness was obtained from team leaders. We, therefore, do not have data to show that the measure of team innovativeness is related to more "objective" measures of innovativeness (e.g. Lovelace et al., 2001). In an R&D environment, this would necessarily include criteria such as patents; in a new product development environment it would also include measures such as speed-to-market and ultimately, product sales. Clearly, future longitudinal research could improve the study by including these or other objective performance measures.

Second, our participating organizations were all from Taiwan and similar to any uni-cultural study, potential differences related to culture and nationality might limit the generalization of the results of the study. As an example, we simply do not know whether the same relationships between transformational leadership and team identity would be found in more individualistic cultures. Obviously, therefore, future cross-cultural studies would prove to be very informative.

Third, it was somewhat notable that none of the individual-level control variables that we included in the study were significantly related to the substantive variables of primary interest. This lack of significance may simply be due to the fairly homogenous nature of the sample; virtually all participants were male, of similar age, and generally were highly educated. As such, it would be premature to suggest that TFL can foster knowledge sharing irrespective of team members' demographics. Within less educated samples or within samples manifesting more diversity, the results could be quite different.

In conclusion, the present study adds to the growing body of research that suggests that leadership plays an important role in the creation of knowledge sharing intentions among members of intact work teams. We believe that we have added a meaningful piece to this overall research agenda by demonstrating with a multilevel perspective that TFL climate was positively related to such intentions in a robust sample of work groups and that these effects were at least partially mediated by an intervening effect on team identity perceptions. Finally, support was also found for the important mediating role that team knowledge sharing intention played in explaining the relationship between TFL climate and team innovativeness. As such, the results of the study have, we believe, contributed to both the leadership and the knowledge sharing literatures. We encourage future research to continue expanding and clarifying these organizationally crucial relationships.

Appendix A.

Constructs and measures

Transformational leadership (MLQ, Form 5X; Avolio & Bass, 1995)

1. The team leader instills pride in me for being associated with him/her.
2. The team leader goes beyond self-interest for the good of the group.
3. The team leader acts in ways that builds my respect.
4. The team leader displays a sense of power and confidence.
5. The team leader talks about his/her most important values and beliefs.
6. The team leader specifies the importance of having a strong sense of purpose.
7. The team leader considers the oral and ethical consequences of decisions.
8. The team leader emphasizes the importance of having a collective sense of mission.
9. The team leader talks optimistically about the future.
10. The team leader talks enthusiastically about what needs to be accomplished.
11. The team leader articulates a compelling vision of the future.
12. The team leader expresses confidence that goals will be achieved.
13. The team leader re-examines critical assumptions to question whether they are appropriate.
14. The team leader seeks differing perspectives when solving problems.
15. The team leader gets me to look at problems from many different angles.
16. The team leader suggests new ways of looking at how to complete assignments.
17. The team leader spends time teaching and coaching.
18. The team leader treats me as an individual rather than just as a member of a group.
19. The team leader considers me as having different needs, abilities, and aspirations from others.
20. The team leader helps me to develop my strengths.

Team identity (Mael & Ashforth's, 1992)

1. When someone criticizes my team, it feels like a personal insult.
2. I am very interested in what others think about my team.
3. When I talk about this team, I usually say 'we' rather than 'they'.
4. This team's successes are my successes.
5. When someone praises this team, it feels like a personal compliment.
6. If a story in the media criticized the team, I would feel embarrassed.

Intention to share knowledge (Bock et al., 2005)

1. I will share my work reports and official documents with members of my organization more frequently in the future.
2. I will always provide my manuals, methodologies and models for members of my organization.
3. I intend to share my experience or know-how from work with other organizational members more frequently in the future.
4. I will always provide my know-where or know-whom at the request of other organizational members.
5. I will try to share my expertise from my education or training with other organizational members in a more effective way.

Team innovativeness (Lovelace et al., 2001)

1. Innovativeness of the team's product.
2. The number of innovations or new ideas introduced by the team.
3. The team's overall technical performance.
4. The team's adaptability to changes.

Appendix B.

Results of exploratory factor analysis.

Construct	Item	Loading		Eigenvalues
		Component 1	Component 2	
Individual level Intention to share knowledge	ISK1	0.735	0.319	5.56
	ISK2	0.847	0.167	
	ISK3	0.817	0.346	
	ISK4	0.768	0.313	
	ISK5	0.742	0.226	
Team identity	TI1	0.164	0.742	1.31
	TI2	0.225	0.605	
	TI3	0.205	0.646	
	TI4	0.267	0.761	
	TI5	0.345	0.751	
	TI6	0.273	0.75	
Group level Team innovativeness	INN1	0.847		
	INN2	0.842		
	INN3	0.784		
	INN4	0.716		

Appendix C.

Measurement model estimation and basic statistics.

Construct	Item	Item loading	*t*-Value	Error variance	CR	AVE
Team identity	TI1	0.74	0.89	0.45	0.89	0.60
	TI2	0.65	0.76	0.58		
	TI3	0.67	0.71	0.55		
	TI4	0.81	0.78	0.34		
	TI5	0.83	0.79	0.30		
	TI6	0.80	0.75	0.36		
Intention to share knowledge	ISK1	0.81	0.71	0.35	0.92	0.69
	ISK2	0.84	0.66	0.29		
	ISK3	0.89	0.66	0.21		
	ISK4	0.83	0.61	0.30		
	ISK5	0.77	0.69	0.41		
Team innovativeness	INN1	0.85	1.27	0.28	0.88	0.80
	INN2	0.84	1.18	0.29		
	INN3	0.78	1.07	0.38		
	INN4	0.72	1.18	0.49		

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