Group Dynamics: Theory, Research, and Practice
2001, Vol. 5, No. 2, 111–123

1089-2699/01/$5.00 DOI: 10.1037//1089-2699.5.2.111

Understanding Team Innovation: The Role of Team Processes and Structures

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The present study focused on innovation of teams, examining the contributions of team interaction processes (exchanging information, learning, motivating, and negotiating) and structures (functional heterogeneity and frequency of meetings) to innovation. Specifically, it was hypothesized that (a) team structures will be positively related to team innovation, (b) team heterogeneity will be positively related to team interaction processes, (c) team interaction processes will be positively related to team innovation, and (d) team interaction processes will mediate the relationship between team heterogeneity and team innovation. Results from a sample of 48 intact teams in elementary and secondary schools supported the main hypotheses. These results imply that the development of mutual interaction processes is a crucial mechanism for translating team heterogeneity into innovation.

As working under changing circumstances becomes an essential feature of organizations (Van Offenbeek & Koopman, 1996), and teams become the common work unit for managing change (Jackson, 1996), investigating team innovation and its underlying formative processes is essential. Earlier research on innovation focused primarily on the adoption of innovation by organizations and was largely restricted to top-down innovations, namely those introduced by the highest level of management. There has been little research on emergent innovation or the introduction of new and improved ways of working introduced by teams at the lower levels of organizations (Agrell & Gustafson, 1996; West & Wallace, 1991).

This study focused on team innovation: "the intentional introduction and application within a team, of ideas, processes, products or procedures new to the team, designed to significantly benefit the individual, the team, the organization, or wider society" (West & Wallace, 1991, p. 303). This definition emphasizes that innovation is related to intentional attempts of team members to arrive at anticipated benefits for the individual, the team, the organization, or the surrounding society, in contrast to top-down change. Furthermore, the definition is applicable to innovations across a variety of organizations: industrial and high technology as well as service and educational. Finally, the definition requires an application component, which will almost always imply a social element of the innovation process (Agrell & Gustafson, 1996).

A review of the relevant literature revealed that innovation is no longer viewed as solely stimulated through a burst of creativity by a talented individual. It is defined as an interactive process among people, structures, and interaction processes (Agrell & Gustafson, 1996; Van Offenbeek & Koopman, 1996; West, 1990). For example, Van Offenbeek and Koopman (1996) argued that innovation is a continuous process that consists of the participation of people and the interaction among them. According to Agrell and Gustafson (1996), although the innovation process begins with the production of ideas from individuals, often the innovation will be unfairly abandoned or defeated if these ideas are not properly discussed in a dialogue that involves the whole team. West (1990) outlined the innovation cycle as containing four phases: recognition of an opportunity for innovation, initiation of a process within the team to foster implementation, implementation of the innovation, and stabilization of the innovation. Hence, although at the recognition phase

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the enterprising disposition of an individual might be relatively dominant, the initiation, implementation, and stabilization phases of the innovation depend critically on team processes and structures, which serve as innovation carriers and ensure that an individual's ideas are checked, processed, and executed.

The main purpose of this study was to investigate process and structure variables that foster innovation in teams and to integrate the findings into a comprehensive model. On the process level we chose to focus on team interaction processes (Van Offenbeek & Koopman, 1996), whereas on the structural level we emphasized the team's frequency of meetings and functional heterogeneity (Jackson, 1996). These groups of variables, the postulated relationships between them, and their impact on innovation are discussed subsequently.

Team Interaction Processes and Innovation

As mentioned, on the process level, we chose to focus on team interaction processes (Van Offenbeek & Koopman, 1996). Almost all models addressing the issue of promoting team outcomes such as team innovation have emphasized the important role of team interaction processes as key antecedent variables (Hackman, 1990; Tannenbaum, Salas, & Cannon-Bowers, 1996). In the specific context of promoting team innovation, empirical results have identified the roles of developing a team climate of trust and openness (West, 1990), vision and shared objectives (West, 1990), team collaboration (West & Wallace, 1991), and the team's belief in its potency to perform well and attain its goals (Farr & Ford, 1990).

Influenced by research concerning learning organizations (Argyris, 1992), authors have recently shown interest in the cognitive and learning benefits of teams. These conceptualizations have usually focused on one specific cognitive component, such as variety of members' responses (Pearce & Ravlin, 1987), reflexivity (West, 1996), or constructive conflict (Tjosvold, 1990), and have fallen short of depicting the overall cognitive contribution of team members to team effectiveness and innovation.

Recently, Van Offenbeek and Koopman (1996) suggested four interaction processes in teams that promote team innovation: exchanging information, learning, motivating, and negotiating. Exchanging information refers to the accumulated individual inputs of information, knowledge, and experience necessary for team functioning. Exchange of information expands knowledge and experience resources available to team members, improves the analysis of the problem, and allows better assessment of the usefulness of potential solutions (Jackson, 1996; Nemeth & Owens, 1996), all of which are important in regard to innovation. In implementing innovation, information exchange leads to a more complete and accurate specification of the needs of the different parties, to interventions and solutions that suit the characteristics of the organization, and to more realistic expectations (Ives & Olson, 1984). Nevertheless, information exchange is not sufficient for innovation, because it does not ensure changes in subsequent behavior (Van Offenbeek & Koopman, 1996).

The learning function is defined as the extent to which team members overtly reflect on the team's objectives, strategies, and processes for the purpose of creating a team-level intellectual product that initiates change (Larson & Christensen, 1993; Swieringa & Wierdsma, 1992; West, 1996). Empirical evidence indicates that organizational and collective learning is a prerequisite for the development and adoption of innovation at the organizational level (Argyris, 1993). Although not directly investigating innovation, research has revealed that team learning results in improvements in detecting and identifying problems (Hirokawa, 1990), scanning the environment (Ancona & Caldwell, 1992), and producing creative solutions (Maier & Solem, 1962), all of which might be crucial to team innovation.

Motivating in Van Offenbeek and Koopman's (1996) model focused on the cognitive processes whereby team members become committed to their innovative goals. The issue of motivating innovation is complex. Empirical research has indicated that external rewards can often serve to diminish creativity (Amabile, 1988; Nemeth & Owens, 1996). Hence, in describing the motivation of those involved in an innovation process, process-oriented motivation theories offer more support than those that are mostly based on reinforcement or oriented to the content of motivation (Van Offenbeek & Koopman, 1996). This approach led researchers

to focus more on the cognitive motivating processes that foster innovation, as suggested by Locke and Latham's (1990) goal-setting theory. In the context of innovation, research findings have emphasized the role of team participation in goal setting to establish a high level of acceptance of goals, to overcome resistance, and to generate commitment to team projects (Erez, Earley, & Hulin, 1985).

Finally, although an innovation process demands cooperative relations, it involves, in the case of high conflict potential, political components as well. The negotiating function constitutes the political dimension of team interaction and is evident when team members strive to express their opinions, which allows mutual influence (Van Offenbeek & Koopman, 1996). Although not directly examining the negotiating process, research has shown that teams exposed to minority views prove to be more original and use a greater variety of strategies to invent novel solutions (Nemeth & Owens, 1996; Vroom & Yago, 1988). In addition, Tjosvold (1990) showed that allowing opposing opinions within teams promoted mutual influence of team members and, consequently, team effectiveness and innovation.

As a whole, the literature is wanting in regard to the effects of exchanging information, learning, motivating, and negotiating on team innovation. To our knowledge, no study has examined the four team interaction processes combined, to offer empirical support for Van Offenbeek and Koopman's (1996) model. On the basis of the related results described here, we posited that team interaction processes—namely, exchanging information, learning, motivating, and negotiating—would be positively related to team innovation.

Team Structures and Innovation

In this article, we refer to a team's structures as institutionalized structural arrangements that serve as innovation carriers. We chose to focus on two structural variables: frequency of team meetings and team functional heterogeneity (Jackson, 1996).

Team meetings constitute the basic prerequisite for collaboration (McGrath, 1991). Although not addressing innovation in particular, the literature has demonstrated close relationships between frequency of meetings and team performance. For example, results from studies addressing teams such as boards, councils, and college trustees have indicated a positive relationship between frequency of meetings and success of the team (Brewer & Kramer, 1986). It seems that the more the team meets, the more teammates are motivated and committed to the team's mission and hence contribute to the team's success in achieving its goals (Brewer & Kramer, 1986). In another study, Hofner (1996) found that members of productive global business teams met and communicated more often than members of less productive teams. Moreover, members of the former also disagreed more frequently, which contributed to critical analysis of work-related issues at meetings. On the basis of these related results, it seemed logical to suggest that frequent meetings would enable team members to interact and hence provide greater opportunity for members to develop the four team interaction processes suggested by Van Offenbeek and Koopman (1996).

Functional heterogeneity is described as the diversity of organizational roles embodied in the team (Jackson, 1996). Research on team innovation often depicts tension between the desire for heterogeneous teams, which foster creativity and innovation (Ancona & Caldwell, 1992; Bantel & Jackson, 1989; Zenger & Lawrence, 1989), and the desire for more homogeneous teams, which promote cohesiveness, commitment, and member satisfaction and, therefore, implementation of innovation (Tsui, Egan, & O'Reilly, 1992). Rather than drawing general conclusions, research should focus on the inhibiting and facilitating variables that help translate team heterogeneity into team innovation. We suggest that the aforementioned set of four team interaction processes (Van Offenbeek & Koopman, 1996) might serve as such a mediating construct. We go on to review preliminary empirical evidence of how functional heterogeneity might facilitate exchanging information, learning, motivating, and negotiating and how this could lead to team innovation.

Exchanging Information

Functional heterogeneity might affect amount of information exchange, because teammates with different organizational roles possess different skills and expertise and, hence, broader informational resources and knowl-

edge. Although not directly examining this issue, Ancona and Caldwell (1992) found that when a team recruited a new member from a certain functional area in an organization, communication increased dramatically in that area. This in turn might favor innovation through the introduction of additional and different ideas and models (Agrell & Gustafson, 1996). Similarly, Zenger and Lawrence (1989) suggested that functional heterogeneity might influence team performance through the higher rate of communication outside the work team's boundaries.

Learning

Functionally heterogeneous teams do not carry only diverse knowledge and information but also different vocabularies, cognitive patterns, and styles. Hence, as the team considers wider sources of information, the diverse perspectives will presumably increase team learning. No empirical evidence has been adduced to support this assertion directly. A few authors have emphasized the role of team discussion of information and reflection on it as a prerequisite for a team's ability to convert an individual's information into team knowledge (Argyris, 1993). Empirical results have indicated that when team members discuss alternative views, the team improves its ability to foresee all possible costs, benefits, and side effects (Pearce & Ravlin, 1987).

Motivating

Heterogeneity in general may well harm motivation and commitment to team goals, because the diversity in opinions and perspectives may spark conflict and resentment (Jackson, 1996). Tentatively confirming this logic, several studies have indicated that team heterogeneity is associated with deficient social integration within teams (Jackson, 1996) as well as less attachment and member satisfaction (Tsui et al., 1992). On the other hand, in functionally heterogeneous teams in particular, each member has a unique contribution to make to the team's mission and therefore might be more accountable, committed, and motivated toward attaining team goals (Harkins & Petty, 1982; Weldon & Gargano, 1988). Therefore, we expected that team functional heterogeneity would be positively related to team motivation.

Negotiating

Functional heterogeneity might foster negotiating, because team members with different organizational roles probably make unique contributions to the team and hence may strive to express their unique opinions. Pfeffer (1981) showed that individuals with diverse functional roles were less power oriented and less inclined to perceive their attainment of personal success as being in competition with the success of other team members. Hence, individuals with diverse functional roles might be more open to mutual influence. In another study, Pelled, Eisenhardt, and Xin (1999) demonstrated that members of functionally heterogeneous teams expressed more opposing opinions about task issues, including goals, key decision areas, procedures, and the appropriate choice for action, than members of more homogeneous teams, which contributed to mutual influence and enhanced team performance.

In summary, a review of the relevant literature demonstrated primary support for the effects of team functional heterogeneity on the four team interaction processes and on team innovation. However, no research so far has aimed at integrating these findings into a comprehensive model. We suggest a mediating model in which the four interaction processes serve as mediators in the relationship between team structures (frequency of meeting and functional heterogeneity) and team innovation. In line with the preceding discussion, we propose the following hypotheses:

1. Exchanging information, learning, motivating, and negotiating will emerge as distinctive facets of team interaction processes.
2. The team's frequency of meetings and functional heterogeneity will be positively related to team innovation.
3. The team's frequency of meetings and functional heterogeneity will be positively related to the four team interaction processes.
4. The four team interaction processes will be positively related to team innovation.
5. Team interaction processes will serve as mediators in the relationship between team structures (frequency of meetings and functional heterogeneity) and team innovation.

Method

Participants and Procedure

Fifty-two self-managing teams were recruited randomly among a list of elementary and secondary schools that enrolled for educational training programs in northern Israel administered by the Ministry of Education. School settings were chosen because commentators (Henkin & Wanat, 1994) have suggested that educational teams have arisen because of the necessity to yoke together separate but interlinked professional skills in response to growth of services, expansion of knowledge, and increases in specialization. In addition, school staff teams offer a continuum of functional heterogeneity, with homogeneous disciplinary teams at one end and interdisciplinary heterogeneous teams at the other and with different degrees of heterogeneity along the continuum. Following the definitional work of Hackman (1987), teams were identified as intact work teams in that they had responsibilities and resources, had worked together at least 9 months before data collection, depended on one another for knowledge and effort, and had interdependent tasks. Of the original 52 teams, 1 had a policy of not participating in research, 1 was a new team and thus did not meet our criteria, and 2 had to be dropped from the analysis because the principal did not rate the team's innovation. Hence, 48 teams comprising 321 school staff members (258 women and 63 men) were covered by the survey. The average number of members per team was 6.23 (SD = 2.11).

Data were collected through questionnaires during a training program. Research assistants were present and answered questions if necessary. In addition, the team innovation measure was distributed by research assistants personally to the teams' principals during their breaks.

Level of Analysis

The hypotheses identified the team as the unit of analysis. Researchers can measure team-level phenomena using individual members' data in several ways (Kirkman & Rosen, 1999). Teams can provide consensus survey ratings (Kirkman & Rosen, 1999), or team members can rate themselves or their team on different attributes, and researchers can then aggregate these data to the team level (Campion, Papper, & Medsker, 1996). Following the recommendations of the authors just listed, we averaged individual responses across all team members who completed the questionnaires and used the mean team indexes (both for team functions of interaction and team appraisal of innovation) as measures for analysis. We tested the efficacy of these aggregations through the interrater agreement procedure (James, Demaree, & Wolf, 1993).

Measures

Team functional heterogeneity. Team functional heterogeneity was defined as the diversity of organizational roles embodied in the team (Jackson, 1996). Information for this measure was obtained from a demographic questionnaire. Functional heterogeneity was measured by Blau's (1977) heterogeneity index, defined as $1 - \Sigma \pi^2$, in which π is the proportion of the total team that each function category represents. The function categories used were homeroom teacher, professional teacher, principal, educational counselor, organizational counselor, psychologist, and school nurse.

Frequency of meetings. The frequency of meeting scale was a self-report measure, adopted from West (1994), designed to assess the extent of formal and informal interaction within the team. The scale contains four items rated on a 5-point Likert-type scale indicating extent of agreement (1 = *strongly disagree,* 5 = *strongly agree*). The Cronbach alpha reliability value was .89.

Team interaction processes. Team interaction processes reflected the degree to which team members engaged in exchanging information, learning, motivating, and negotiating (Van Offenbeek & Koopman, 1996). To develop this scale, we distributed a pool of 40 items adopted from West's (1994) effective teamwork questionnaire to three doctoral students in the field of teamwork and leadership. They were then asked to select, by the Q-sort procedure, those items that best reflected Van Offenbeek and Koopman's (1996) conceptualizations of exchanging information, learning, motivating, and negotiating. Items judged irrelevant or on which the judges disagreed were excluded.

The final questionnaire consisted of four sub-

scales based on factor analysis (see Table 1): (a) a four-item exchanging-information scale with a reliability (alpha) level of .79, (b) a four-item learning scale with a reliability level of .85, (c) a four-item motivating scale with a reliability level of .83, and (d) a two-item negotiating scale with a reliability level of .68. Each subscale was measured by the mean responses to the relevant items rated on a 5-point Likert-type scale (1 = *strongly disagree*, 5 = *strongly agree*).

Team innovation. A four-item scale modified from West and Wallace (1991) for use with teachers measured team innovation (see Appendix). The items reflected the extent to which, in the previous 6 months, the team had initiated changes in each of four job areas: work objectives, working methods, teaching methods, and development of skills. To measure team innovation, we used both the principal's rating and the team's own evaluation. (Cronbach alpha reliability coefficients were .89 for principal's ratings and .90 for team's ratings.) This procedure was adopted for three reasons. First, as with other team research in organizations (Alper, Tjosvold, & Law, 1998), obtaining objective work outcome measures proved impossible, because schools usually do not collect team-level innovation data. Second, when a team was assessed by its organization, it was by means of the organization's own measurement systems, so comparability across organizations was limited (Kirkman & Rosen, 1999). Third, we surveyed both principals and team members to avoid the same-source bias that would have arisen if we had used team members' data only (Podsakoff & Organ, 1986).

Table 1
Factor Analysis of the Four Team Interaction Processes

Item	Exchanging information	Learning	Motivating	Negotiating
Usually we share information in the team and do not keep information to ourselves	.79	.06	.20	.09
We inform each other on different work issues	.66	.32	.08	.11
We really try to exchange information and knowledge	.76	.34	.17	.19
My teammates always look for different interpretations and perspectives to confront a problem	.66	.27	.13	.12
My teammates and I criticize each other's work in order to improve teaching	.18	.69	.12	.26
My teammates are prepared to reflect on the way we act	.23	.73	.27	.18
My teammates and I engage in evaluating our weak points in attaining effectiveness	.26	.78	.17	.02
The team often utilizes the different opinions for the sake of obtaining optimal outcomes	.26	.72	.17	.24
The team's goals are specific and unambiguous	.20	.10	.73	.14
The team usually discusses its goals and attains the agreement of team members	.13	.19	.86	.17
The team's goals are realistic and attainable	.03	.17	.89	.13
To what extent do you believe that team members are committed to the team goals?	.21	.16	.61	−.04
In our team, we all influence each other	.29	.17	.09	.77
Everybody in our team strives to express his/her opinion	.07	.24	.18	.79

Control variables. Team size was treated as a control variable in our study because the literature on teams has noted that size is a key variable influencing team effectiveness (Brewer & Kramer, 1986) and because larger teams have more potential for heterogeneity (Bantel & Jackson, 1989). Team size was measured as total number of team members.

Results

The hypotheses identified the team as the unit of analysis, so team-level variables were used in all analyses. Table 2 presents means, standard deviations, and intercorrelations for all key variables included in the analysis. Table 2 shows acceptable interrater reliabilities for the aggregated variables averaged across all of the teams (James et al., 1993). All teams met Glick's (1985) heuristic, whereby values of at least .6 suggest that aggregating individual responses is warranted.

As shown in Table 2, there was a consistent pattern of correlation among heterogeneity, frequency of meetings, and team interaction process variables and the two measures of team innovation (by the team and by the principal). This finding imparted more force to our predictions, especially because the two innovation variables were assessed by two different sources (the team and the principal). In addition, the correlation between the innovation scores obtained by the team and those obtained by the principal was considerably high ($r = .61$, $p < .001$). Because of these consistencies, and to avoid same-source bias, we used the principal's appraisal measure for further analysis.

To test the first hypothesis, we performed a factor analysis using the maximum-likelihood rotation varimax method (see Table 1). From a varimax rotation, four factors with eigenvalues greater than 1.0, $\chi^2(3, N = 321) = 63.44$, $p > .1$, emerged, corresponding to our original theoretical expectation. Factor 1 appeared to represent team members' behaviors directed at acknowledging teammates concerning work issues and sharing information, knowledge, and experience necessary for the team's functioning. This dimension referred to the exchanging information function of team interaction and consisted of four items. Factor 2 pertained to a more intense form of dealing with information that ensured changes in subsequent behavior. These behaviors were directed toward critical appraisal of the information gathered in the team, drawing lessons from failure, and continuous learning. This factor referred to the learning function of team interaction and consisted of four items. Factor 3 seemed to capture the team's perception of specific attainable and meaningful goals, as well as committing to those goals. This dimension referred to the motivating function of team interaction and consisted of four items. Finally, Factor 4 appeared to represent behaviors directed at mutual influence in the team. This factor referred to the negotiating function of team interaction and consisted of two items.

Taken together, the factor analysis results supported Hypothesis 1. To obtain further sup-

Table 2
Descriptive Statistics, Reliabilities, and Intercorrelation Matrix for the Study Variables

Variable	*M*	*SD*	r_{wg}	1	2	3	4	5	6	7	8	9
1. Team size	6.60	4.20		—								
2. Frequency of meeting	3.60	0.49	.82	.06	—							
3. Team's functional heterogeneity	0.43	0.49		.28*	.36**	—						
4. Exchanging information	3.86	0.45	.80	.09	.65***	.36**	—					
5. Learning	3.60	0.47	.80	.07	.52**	.40**	.85**	—				
6. Motivating	4.10	0.39	.81	−.10	.50**	−.01	.50**	.41**	—			
7. Negotiating	3.92	0.53	.77	.07	.40**	.30*	.58***	.57***	.45**	—		
8. Team innovation: principal	3.69	0.82		−.15	.46**	.30*	.48**	.62***	.37**	.55***	—	
9. Team innovation: team members	3.70	0.35	.86	.02	.54***	.27*	.76***	.79***	.31*	.51**	.61***	—

Note. The statistic r_{wg} represents the reliability within groups averaged across all teams (James et al., 1993). Reliability score ranges were as follows: .78–.91 for frequency of meetings, .70–.92 for exchanging information, .69–.88 for learning, .71–.90 for motivating, .65–.89 for negotiating, and .80–.92 for innovation. $N = 48$.
* $p < .05$. ** $p < .01$. *** $p < .001$.

port, we examined the correlations between the dimensions, which, contrary to our expectations, were moderate to high (ranging from .41 for motivating and learning to .85 for exchanging information and learning; see Table 2). This finding suggested that although the different interaction processes had common variance, each contained a unique aspect of team support. However, the moderate to high correlations between the dimensions did not provide sufficient evidence for discriminant validity, and overall Hypothesis 1 received only mixed support.

To test the second hypothesis, we conducted a hierarchical regression analysis. The control variable of team size was entered into the regression equation in Step 1, followed by the structural predictors of team functional heterogeneity and frequency of meeting in Step 2. The results of the hierarchical regression analysis are presented in Table 3. As shown in Table 3, team size accounted for 2% of the variance in team innovation (team innovation, Equation 1). The complete model accounted for 18% of the variance in team innovation (team innovation, Equation 2). Concerning the structural predicting variables, our results demonstrated that, in support of our hypothesis, functional heterogeneity and frequency of meetings significantly predicted team innovation.

As a means of testing the third hypothesis, four hierarchical regression analyses were conducted for each of the four team interaction processes. As in the analysis of the first hypothesis, the control variable of team size was entered in the regression equation in Step 1, followed by the structural predictors of functional heterogeneity and frequency of meeting in Step 2. As shown in Table 3, team size accounted for a negligible percentage of the variance in all four interaction processes (Equation 1). However, examination of the effects of the structural predictors on the four interaction processes gave general support to the hypothesis, as follows. The complete model accounted for 29% of the variance in exchanging information (exchanging information, Equation 2). Our results indicated that frequency of meetings and functional heterogeneity significantly predicted exchanging information. In regard to the learning function, the complete model accounted for 25% of the variance in learning (learning, Equation 2). Functional heterogeneity and frequency of meetings significantly predicted team learning. In regard to motivating, the complete

Table 3
Results of Hierarchical Regression Analysis Predicting Team Innovation and Team Interaction Processes From Team Structures

Variable	Negotiating		Motivating		Learning		Information exchange		Team innovation	
	Equation 1	Equation 2	Equation 1	Equation 2	Equation 1	Equation 2	Equation 1	Equation 2	Equation 1	Equation 2
Team size (β)	.05	−.03	−.13	−.18	.03	−.07	.05	−.03	−.15	−.24
Frequency of meeting (β)		.31*		.42**		.34*		.44**		.28*
Heterogeneity (β)		.34*		.18		.38**		.30*		.32*
R^2	.02	.17	.01	.26	.01	.30	.03	.33	.03	.23
Adjusted R^2	.01	.12	−.00	.20	.01	.25	.03	.29	.02	.18
F	0.12	2.94*	0.71	4.8**	0.05	5.98**	0.14	7.13**	1.10	4.25**
df	1	3	1	3	1	3	1	3	1	3
ΔR^2		.11		.20		.24		.26		.16

* $p < .05$. ** $p < .01$.

model accounted for 20% of the variance (motivating, Equation 2), with frequency of meetings as the sole significant predictor of motivating. Finally, concerning the negotiating function, the complete model accounted for 12% of the variance (negotiating, Equation 2). Functional heterogeneity and frequency of meetings significantly predicted team negotiating. In summary, the preceding results supported the third hypothesis.

To test the fourth hypothesis, we conducted a hierarchical regression analysis in which the control variable of team size was entered in the regression equation in Step 1, followed by the four interaction process indexes in Step 2. The results of the hierarchical regression analysis (see Table 4, Equations 1 and 2) demonstrated that team size accounted for 2% of the variance in team innovation (team innovation, Equation 1). The complete model accounted for 38% of the variance in team innovation (team innovation, Equation 2). Concerning the interaction processes, our results demonstrated that learning was the sole significant (albeit potent) predictor of team innovation, thus providing only partial support for our predictions.

Finally, the fifth hypothesis concerned the mediating effects of team interaction processes in the relationship of team heterogeneity and frequency of meetings (antecedent variables) with team innovation (consequence). Mediation can be demonstrated by showing that (a) the antecedents are related to the consequence (this assertion was supported in Hypothesis 2); (b) the mediator is related to the consequence (this assertion was supported in Hypothesis 4); and (c) the relation between the antecedent and the consequence is eliminated when the mediator is controlled (James & Brett, 1984). To test this, we used a hierarchical regression analysis. As in the preceding analyses, we entered the control variable of team size in the first step (team innovation, Equation 1). To control for the effects of team interaction processes, we entered the four interaction processes in the second step (team innovation, Equation 2). In the third step, we entered the team structural variables, functional heterogeneity and frequency of meetings, to assess their residual variance. The results indicated that, after the effects of team interaction processes had been controlled, team heterogeneity and frequency of meetings did not contribute significantly to the explained variance of team innovation. Thus, team interaction processes mediated the relationship of team heterogeneity and frequency of meetings with team innovation.

Discussion

The present study explored the issue of innovation at the team level of analysis. This is important because although teams are increasingly becoming a significant work unit in modern organizations and are required to develop innovative products and services, most research on innovation so far has focused on the individual or organizational level (Agrell & Gustafson,

Table 4
Hierarchical Regression Analyses Testing the Mediating Effect of Team Interaction Processes in the Team Structures–Team Innovation Relationship

	Team innovation		
Dependent variable	Equation 1	Equation 2	Equation 3
Mean team members (β)	−.15	−.19	−.20
Exchanging information (β)		.05	−.00
Learning (β)		.47*	.45*
Motivating (β)		−.01	.01
Negotiating (β)		.22	.18
Frequency of interaction (β)			.08
Functional heterogeneity (β)			.09
R^2	.03	.45	.46
Adjusted R^2	.02	.38	.36
F	1.10	6.42**	4.57**
df	1	5	7
ΔR^2		.36	.02

* $p < .05$. ** $p < .01$.

1996). Investigating innovation at the individual level, particularly individual characteristics such as creativity, self-efficacy, and cognitive fluency that foster innovation, seemed to fall short of fully capturing the innovation phenomenon, in that innovation is not restricted to a burst of creativeness in individual inventive thinking (Agrell & Gustafson, 1996; West & Wallace, 1991). On the other hand, focusing mainly on institutionalized structural and process arrangements at the organizational level might miss the inquiry into emergent innovation by team members working on the shop floor of the organization. Hence, we chose, in the present study, to address the innovation issue by investigating at the team level. Our results highlight the importance of structural and process arrangements within the team, which serve as innovation carriers, and thereby contribute to the innovation literature in several aspects.

First, at the structural level, our results emphasized the role of formal and informal meetings as a basic prerequisite for team innovation. Our results also confirmed both long-standing theory (Maier, 1971) and more recent empirical evidence (Bantel & Jackson, 1989; Hambrick, Cho, & Chen, 1996; Jackson, 1996) indicating that team innovation depends greatly on team heterogeneity. A mix of organizational roles can contribute to increased environmental scanning, generation of alternatives, and multiple interpretations of information (Hambrick et al., 1996), all of which are relevant to innovation.

Second, this study complemented previous work emphasizing the structural determinants of team innovation by incorporating the interaction processes of the team as an important influence. Our results indicated that although heterogeneity is important, the interaction processes the team used outweighed heterogeneity in predicting innovation (team heterogeneity predicted 16% of the explained variance in innovation, whereas team interaction processes and, especially, team learning predicted 36% of the explained variance). These results indicated that teams seem more than merely a structure for individuals who work together. Team members must exchange information, learn, negotiate, and motivate each other so that they can use their heterogeneity properly and work effectively and innovatively. Unless team members learn to work together, their aggregate cognitive endowment can become a net liability, with team performance and innovation suffering (Hambrick et al., 1996).

Moreover, team learning was found to be the most potent carrier of innovation in teams. This finding supports both theoretical arguments (Argyris, 1993; Larson & Christensen, 1993; Swieringa & Wierdsma, 1992) and recent empirical evidence (West & Wallace, 1991) highlighting the importance of learning and reflecting at the organizational level. Our findings underline the importance of reflection on the team's objectives, strategies, and processes for the purpose of creating a team-level intellectual product that initiates change at the team level. However, in considering the four interaction processes, a word of caution is warranted. Although the present study emphasized the important role of exchanging information, learning, motivating, and negotiating in the innovation process, our findings provided only partial support for the distinctive nature of these processes. More studies are needed to explore the detailed interrelationships as well as causal relations among exchanging information, learning, motivating, and negotiating.

Third, we found that team functional heterogeneity influenced three of the four team interaction processes. Specifically, the more heterogeneous the team, the more its members engaged in exchanging information, learning, and negotiating. If successfully replicated, this finding supports former research indicating that team functional heterogeneity does not necessarily mean potential problems for teamwork and helps to identify the specific beneficial effects of functional heterogeneity. Concerning team motivation, the results of the present study could not resolve the tension detected in previous studies between the inhibiting and the beneficial effects of team heterogeneity on team motivation and commitment. Some studies emphasized the deficient social integration within teams and indicated motivational decline (Tsui et al., 1992). Others argued that, in functionally heterogeneous teams, team members might believe that they make a unique contribution to the team mission and are accountable for attaining team goals; thus, these studies indicated motivational increment (Weldon & Gargano, 1988).

More research is needed in this area to better our understanding of the nature of motivation in teams, specifically as to whether an individual's motivation can automatically be aggregated into a team-motivation characteristic. For example,

Manz (1993) suggested that granting teams more empowerment might in fact detract from individual levels of motivation. An individual may actually perceive less autonomy on a team in which decision making and responsibilities have to be shared among its members (Manz, 1993). Perhaps what is needed most now in team motivation research is an examination of motivation at the team level and individual level simultaneously (Kirkman & Rosen, 1999), along with clarification of their interrelations.

Fourth, our findings demonstrated that team interaction processes mediated the team heterogeneity–team innovation relationship. More specifically, team heterogeneity affected team innovation through its effects on team processes, especially team learning. This finding can contribute to an understanding of the conflicting evidence concerning the relative importance of team heterogeneity at all stages of team innovation (Ancona & Caldwell, 1992; Bantel & Jackson, 1989; Zenger & Lawrence, 1989). As our findings imply, the development of mutual work processes emphasizing learning and reflection is a crucial mechanism for translating team heterogeneity into team innovation. On the other hand, our findings also shed light on the drawbacks of more homogeneous teams. Team homogeneity apparently did not stimulate team members to engage in mutual learning, which impaired the innovation of these teams. Homogeneous teams, more than heterogeneous teams, must seemingly make deliberate efforts and engage in team building and training interventions to learn how to work together and foster creativity.

The results of this study are, of course, limited by its operations. The data were largely self-reported and subject to biases, although recent research suggests that self-reported data are not as limited as commonly believed and that people often accurately perceive their social environment (Alper et al., 1998). However, common method variance may not be a serious problem in our data, because we included an independent rating of innovation by principals that evinced a strong relationship with the team's rating.

In addition, the cross-sectional design of the present study raises the issue of causality. It is difficult to determine the nature of the relationship between the team processes we observed and team innovation. Do teams that introduce innovation also introduce innovative ways of working together? Are these different team procedures and interactions a determinant or a consequence of innovation? Nor could the data provide direct evidence of causal links between the structural variables of heterogeneity and frequency of meeting. It may well be that teams that function well together and generate positive process norms will attract and maintain a more heterogeneous membership and will be inspired to meet more often. Longitudinal studies involving more objective criteria are clearly required to further explore the nature of these relationships.

Conclusion

The present study focused on emergent innovation at the team level and explored the structural and process arrangements embodied by teams that serve as innovation carriers: team functional heterogeneity, frequency of team meetings, and team interaction processes. Our results help to incorporate the structural and process aspects of teamwork into a comprehensive model that contributes to the prediction of team innovation. The results of the present study demonstrated that team interaction processes, and especially team learning, mediated the team heterogeneity–team innovation relationship. These results have several theoretical and practical implications for improving team innovation.

First, our results support a social psychological perspective of innovation. The innovation process can be seen to consist of people's participation in the innovation and the nature of the interaction among them.

Second, our findings emphasize the importance of integrating team heterogeneity considerations into the devices for selection of individuals for teams. Existing devices rely at best on individual characteristics such as how to identify the best person for the job or who will be more innovative (Tannenbaum et al., 1996). Our results imply that team-level considerations should include enhancing functional diversity. Moreover, such improvements in selection interventions will promote team information exchange, team learning, and team negotiating as well as team innovation.

Third, our findings highlight the importance of dialogue as a carrier of the creative process. In a team, opportunities exist for genuine dialogue, but they are endangered by individuals'

fear of exposing themselves and of rejection by the other team members. Managers should assimilate institutionalized structural and process frameworks to facilitate dialogue and to enable team members to learn and reflect on themselves.

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Appendix

Team Innovation Scale

Directions. Please think of the teamwork in the last 6 months, and try to review performance data. For each of the following sentences, please indicate the extent to which the team had initiated the following innovations.

1. The team initiated new procedures and methods.
2. The team developed innovative ways of accomplishing work targets/objectives.
3. The team developed new skills in order to foster innovations.
4. The team initiated improved teaching strategies and methods.