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Structural Versus Individual Perspectives on the Dynamics of Group Performance: Theoretical Exploration and Empirical Investigation[†]

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This study contrasts the structural perspective with the individual perspective in explaining group performance in a dynamic setting. The authors argue that these perspectives are not mutually exclusive but have different predictive powers at different group stages. Results from 45 project groups show (a) group structures provide stronger performance predictions at the later stage, whereas individual-based attributes do so at the earlier stage, and (b) different group structures and individual-based attributes provide distinctive insights at respective stages. This indicates the need to explore the potential bridge between the two perspectives in advancing group studies.

Keywords: *individual perspective; structural perspective; individual-based attributes; group structures; group dynamics; group performance*

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Research on groups has primarily been conducted in the fields of social psychology (e.g., Levine & Moreland, 1990; Martell & Leavitt, 2003) and organizational behavior (e.g., Gersick & Hackman, 1990; Thoms, Moore, & Scott, 1996). Studies from these streams have typically adopted the individual perspective, also called the individualist perspective (Mayhew, 1980), which focuses on individual traits or their aggregates at the group level. Although this line of research has made significant contributions to our knowledge of group behavior, some scholars suggest that such an individualistic approach has failed to position individuals in a structural context (Salancik, 1995), which can be vital to capturing the dynamic process of groups (Marks, Mathieu, & Zaccaro, 2001). On the other hand, the structural perspective, also termed the *structuralist perspective* (Mayhew, 1980), emphasizes that the pattern of relationships among actors can explain outcomes over and above the attributes of either individuals or the aggregated set (Wasserman & Faust, 1994).

In this study, we contrast the two seemingly distinctive perspectives and explore their potential boundaries and bridges by examining group performance in a dynamic process. Our main concern is not in judging the relative merit of one perspective over the other but in finding the conditions that may provide a better understanding of group dynamics and their effects on group performance, which has been severely lacking in group studies (Cohen & Bailey, 1997). Specifically, we examine not only the role of individual attributes but also the relational context reflected through group structures, in which group behavior and processes are truly embedded (Salancik, 1995). Such a systematic exploration, we believe, can allow us to unearth the potential linkage between the individual and structural perspectives and move the field of group research to the next level.

Two Main Perspectives on Group Performance

The Individual Perspective on Group Performance

Studies from the individual perspective generally contend that individual characteristics or their aggregates affect group performance (e.g., Barry & Stewart, 1997). Numerous studies have examined the impact of various individual-based attributes including demographic characteristics, personal traits, goal commitment, and efficacy (e.g., Brockner & Adsit, 1986; Klein & Mulvey, 1995). Despite the fact that some recent group studies have started to recognize the importance of moving beyond individual attributes, this line of research, in essence, has been dominated by the perspective of individualism (Baugh & Graen, 1997; Meyer, Tsui,

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& Hinings, 1993; Reagans & Zuckerman, 2001). As a result, according to some scholars (Salancik, 1995; Sparrowe, Liden, Wayne, & Kraimer, 2001), previous research on groups may not have fully addressed some of the important questions related to the actual interactions of internal network relationships and their effects on group performance. Indeed, some researchers from the organizational behavior field have also recognized the need to move toward a more process- and structure-oriented approach (Baugh & Graen, 1997; Meyer et al., 1993; Reagans & Zuckerman, 2001).

The Structural Perspective on Group Performance

The structural perspective provides a sharp contrast, both philosophically and methodologically, to the individual perspective (Mayhew, 1980; Pfeffer, 1982). The structural perspective suggests that emerging structural properties of groups, which are different from attributes of individuals and their aggregates, come into effect in the process of interactions (Salancik, 1995). Often represented by the social network approach, the structural perspective has several distinctive principles. First, behaviors are interpreted in terms of structural constraints rather than inner forces within individuals. Second, analyses focus on relations among all individuals. Third, the central consideration is how the pattern of relationships among individuals jointly affects network members' behaviors (Galaskiewicz & Wasserman, 1994; Wellman, 1988).

Since the recognition of the importance of social embeddedness (Granovetter, 1985), researchers have started to introduce the concept of social networks into group studies. For instance, Baldwin, Bedell, and Johnson (1997) found that the centrality of MBA students was positively associated with their grades. Similarly, Sparrowe et al. (2001) examined the effects of social networks on the performance of both individuals and groups. All these efforts demonstrate that the structural context in which group members interact could have a significant impact on group outcomes.

The structural perspective, however, has its own critics. Besides some of the methodological difficulties, one of the main criticisms has been its neglect of the dynamic aspect of individual attributes, which may affect the evolution of structural relationships (e.g., Salancik, 1995).

Theoretic Framework and Hypotheses Development

Despite substantial contributions to our understanding of groups from these two perspectives, much less effort has been spent to contrast the two streams of research and explore their boundary conditions. We believe that the separation of these two streams of research may hinder our further understanding of groups, which have become increasingly multilevel, dynamic, and complex (Meyer et al., 1993). A limited number of studies from both perspectives have tried to bridge the two. For example, Baugh and Graen (1997) conducted research that implied network relations in leadership by focusing on the vertical dyadic level. Reagans and Zuckerman (2001) introduced network concepts such as density and heterogeneity into the diversity study on team productivity, relying on seminetwork data. Mehra, Kilduff, and

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Brass (2001) started to consider networks composed of members with different individual attributes.

A Dynamic Comparison

For this study, we propose a conceptual framework (see Figure 1), within which the effects of two sets of variables, individual attributes and group structures, on group performance are contrasted in the same dynamic setting, as we believe they can play different roles at different stages (Adler & Kwon, 2002; Earley & Mosakowski, 2000). For working purposes, we focus on two stages of groups: Stage 1, or the earlier stage, and Stage 2, or the later stage. We follow the general conceptualization from prior group studies and regard Stage 1 as the earlier period of group development when forming, storming, and norming can be dominant and Stage 2 as the later period of group development when performing and adjourning can be dominant (Tuckman & Jensen, 1977).

From such a dynamic view of groups, once the structure comes into existence, stable interaction patterns may either contribute to or constrain group performance in conjunction with other individual attributes (Labianca, Brass, & Gray, 1998). Interaction will lead to multiple types of interpersonal relationships, and a group's distinctive network patterns will emerge and evolve. Such patterns would further influence the behavior of group members. A large body of social psychology literature, inspired by Festinger's (1957) work on social comparison, indicates that social interaction affects perceptions and attitudes of group members. Others have also observed that interaction within both formal and informal work groups leads to common perceptions of the job (Homans, 1950).

Group interaction is a process of selection and evolution (Harrison & Carroll, 1991). Through communication and interaction, group members gradually become familiar with each other. Individual members can take different roles and positions in the process. This emerging structure is strengthened by experiences derived from the group process. Doreian and Stokman's statement provides us with good guidance for studying dynamic group processes: "We will draw the following distinction and view a 'course of events' as having some coherence. Events at one point in time are conditioned, in part, by the events that went before them: networks evolve" (1997: 3).

With the development of interpersonal relationships and group structural patterns, the effects arising from network characteristics may increase their influence on group performance (Abrahamson & Rosenkopf, 1997; Friedkin & Cook, 1990). Group structures essentially consist of behavior patterns of group members, which in turn constrain and shape members' behaviors. As suggested by studies concerned with behavioral patterns, such as those on the institutionalization effect (Zucker, 1986), structure will exert a bigger impact on group members' behavior once the pattern is formed. In turn, the pattern will be strengthened by group behaviors. In other words, structural inertia comes into play. Consequently, members will, more or less, act on the pattern consciously and unconsciously. Once interpersonal relationships are established, members tend to interact more with those they already know.

The mechanism through which structure constrains members' behavior is similar to the influence of routines (Coleman, 1990), which have a lasting effect on group processes. Over

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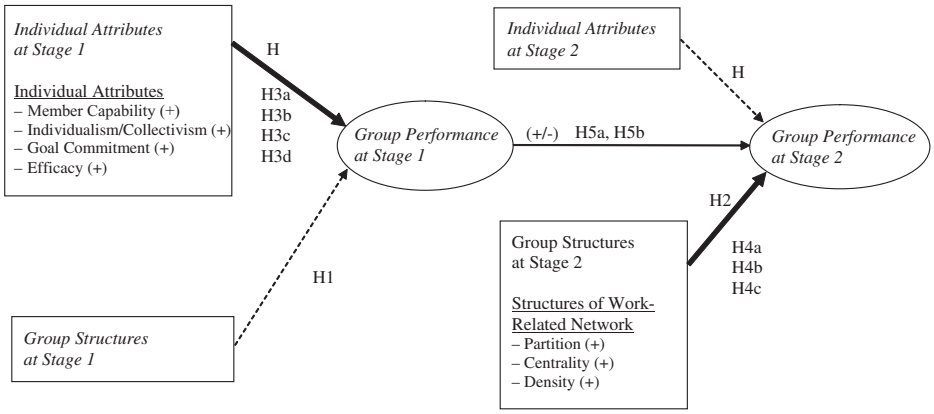
Figure 1
An Illustration of the Conceptual Framework



The proposed explanatory power of variables is represented by respective lines, with the following descending order:

time, the initial individual differences existing among group members will give way to the structural constraints through the social integration and interaction process. With the intensified embeddedness of every group member in the overall group structures, individuals also tend to amplify the perceived importance of social norms (Simsek, Lubatkin, & Floyd, 2003) and act accordingly under the structural constraints. Thus, although we argue that individual-based attributes have an important effect on group performance, the impact may be more meaningful during the earlier stage, whereas a group's structures play a more important role during the later stage.

Hypothesis 1: Individual attributes, compared with group structures, will have more impact on group performance at Stage 1 rather than at Stage 2.

Hypothesis 2: Group structures, compared with individual attributes, will have more impact on group performance at Stage 2 rather than at Stage 1.

Specifically, we intend to examine the respective predictive power of some important individual attributes and group structures.

Individual Attributes

In the long tradition of group research, numerous individual attributes or their aggregates have been suggested to affect group performance. For this study, we focus on some of the most studied ones from the individual perspective, which have been suggested to play important

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roles for a group to be effective (Ambrose & Kulik, 1999; Barry & Stewart, 1997). These individual-based attributes include individual capability, individualism-collectivism orientation, goal commitment, and group efficacy. In this framework, we do not consider gender diversity as prior studies have often found its effect on group performance to be inconsistent or even nonexistent (Harrison, Price, Gavin, & Florey, 2002; Webber & Donahue, 2001). Our pilot study also showed no significant effect of gender diversity.

Member capability. It has been found in social psychology and organizational behavior that an individual's ability serves as one of the basic foundations for his or her performance (Brodbeck & Greitemeyer, 2000). Studies have also shown that a group composed of members with a higher level of capability tends to increase their performance of group tasks (Barry & Stewart, 1997; Devine & Philips, 2001; Schweiger & Sandberg, 1989). Thus,

Hypothesis 3a: At Stage 1, a higher level of member capability will enhance group performance.

Individualism-collectivism orientation. We examine members' cultural values in terms of individualism and collectivism, which captures the aspect of an individual's relation to his or her social group (Hofstede, 1980; Triandis, 1994). Studies have shown that groups with collectivistic members or groups with strong member preference for teamwork, given the interdependent nature of the task, tend to be associated with higher group performance (Campion, Medsker, & Higgs, 1993; Cox, Lobel, & McLeod, 1991; Earley, 1993). This may be more critical at the earlier stage of group development when group norms have not been fully established. Hence,

Hypothesis 3b: At Stage 1, a higher level of collectivism will improve group performance.

Goal commitment. Another important attribute to be considered is goal commitment, which is regarded as an individual's acceptance of a goal and the determination to reach that goal (Klein, Wesson, Hollenbeck, Wright, & DeShon, 2001; Locke & Latham, 1990). Studies have shown that a group can be highly effective when individual members' goals are linked to the group goal (Campion et al., 1993; O'Leary-Kelly, Martocchio, & Frink, 1994). Although there is a general consensus on the importance of goal commitment on task performance (Ambrose & Kulik, 1999; Locke & Latham, 1990), some scholars have cautioned that whether goal commitment influences group performance can also depend on other factors such as group cohesiveness and goal difficulty (Klein & Mulvey, 1995; Podsakoff, Mackenzie, & Ahearne, 1997). In general, given the motivational effects of goal commitment, we would expect goal commitment to play a positive role in group success. Therefore,

Hypothesis 3c: At Stage 1, a higher level of goal commitment will enhance group performance.

Efficacy. In addition, we consider group efficacy, that is, a group's shared belief by members that it can be effective (Gist & Mitchell, 1992; Guzzo, Yost, Campbell, & Shea, 1993; Thoms et al., 1996). Research suggests that although efficacy stems from the individual level, it can rise to the group level as a result of members' abilities to consider entities larger than

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themselves (Lindsley, Brass, & Thomas, 1995). Studies have shown that a high level of efficacy can positively influence a group's performance (Campion et al., 1993; Campion, Papper, & Medsker, 1996; Gibson, Randel, & Earley, 2000; Shea & Guzzo, 1987). Gully, Incalcaterra, Joshi, and Beaubien (2002) also noted that groups can exhibit a high level of perseverance in the face of adversity or uncertainty when they have a great sense of confidence generated by group efficacy. As a result, we would expect group efficacy to play an important role at the earlier stage of group development. Thus,

Hypothesis 3d: At Stage 1, a higher level of group efficacy will improve group performance.

Group Structures

While the individual perspective has contributed significantly to our understanding of the foundations of group behavior, it is limited by its overreliance on individual-based attributes or their aggregates, with little exploration of the roles of group structures, especially in a dynamic setting (Barry & Stewart, 1997). Many studies from the individual perspective have failed to explain the performance variance across groups even after controlling for these individual attributes. Their findings suggest that other factors need to be taken into consideration. For example, Murnighan and Conlon's (1991) study of British string quartet groups found that the performance variance was accounted for less by quartet players' skills and more by their interaction and coordination. Similarly, Earley and Mosakowski (2000) demonstrated that teams of moderately heterogeneous nationality performed poorly partially because these teams failed to develop an efficient interaction pattern, or group structure. Thus, incorporating reviews and reasoning stated earlier, we argue that a group's structures may play a more important and lasting role during later stages.

From such a structural perspective, we examine the work-related network because such work relations are the most important dimension in network structures and can offer insights into the effect of group structures on group performance (Ibarra & Andrews, 1993). For this study, we do not simultaneously consider the friendship network as it can be highly correlated with the work-related network due to the relatively small group size. We also wish to maintain an acceptable sample-size-to-predictor ratio (Kerlinger & Lee, 2000; Stevens, 2002).

For the work-related network, we focus on peer-rating relationships. Through peer-rating relationships, individuals perceive the contributions of other group members in terms of valuable ideas, coordinative activities, and the completion of each member's fair share of work (Farh, Cannella, & Bedeian, 1991). This network acts as a proxy for group members' inclination to exchange work-related information with the right person. Those individuals whose ideas are treated as valuable for the work will be consulted more frequently and will gain more trust. This network, therefore, reflects the actual work-related information flow and can help us better understand work relations among group members working toward the same group goals.

Scholars have identified several interesting features such as centrality, density, cohesion, core/periphery positions, structural equivalence, and so on, among which some are group-level measures and others are individual-level measures, and some could be applied at both

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levels (Burt, 1984; Erickson, 1988; Freeman, 1977; Friedkin, 1984). Drawing on the findings from social network studies (Burt, 1984; Freeman, 1977; Reagans & Zuckerman, 2001), we focus on three structural features—group partition, group centrality, and group density—with the group as the unit of analysis.

Group partition refers to the existence of subgroups, substructures, or subcultures within a group (Wasserman & Faust, 1994). The degree of partition is reflected in the number of structurally equivalent blocks that divides a group into subgroup structures (Burt, 1984; Friedkin, 1984). Social network scholars generally regard partition as a form of segregation that may force networks to emerge into hierarchies (DiMaggio, 1986; Gerlach, 1992). Such group partition may not help deal with tasks of a simple and homogeneous nature or build informal personal relationships. However, it can be beneficial for a group to tackle complex tasks, which require both division of labor and structural coordination, as are being examined in this study (Arrow, McGrath, & Berdahl, 2000; Simon, 1962). Group partition can also help mitigate the negative impact of "slackers" or poor performers on the overall performance of the group, because it tends to force members to have more specialized responsibilities (Lin & Hui, 1999; Pugh, Hickson, Hinings, MacDonald, Turner, & Lupton, 1963). Therefore,

Hypothesis 4a: At Stage 2, a higher degree of group partition in a work-related network will enhance group performance.

Group centrality measures the group-level variability or heterogeneity of individuals' centrality within a group (Freeman, 1977). It records the extent to which a single actor has high-point centrality, and the others, low-point centrality. It can also be viewed as a measure of variability, dispersion, or spread of individual centrality within a group (Faucheux & Moscovici, 1960; Leavitt, 1951; Wasserman & Faust, 1994).

Few studies have examined the relationship between group centrality and group performance. Most researchers, drawing on the social network theory, have only studied how actors' centrality affects individual performance by contending that central actors have access to more resources (Knoke & Burt, 1983). We believe that group centrality, which takes into account all individual actors' centrality, is an important group structural feature for understanding group performance.

Findings from group research suggest that a successful and effective work group should involve members of different expertise, especially when the group project has multiple parts and is at least moderately complex (Schmitt & Klimoski, 1991). Although division of labor may help achieve better specialization, concerted coordination is required to transform such specialization into group-level outcomes. High group centrality in the work-related network reflects the existence of uneven leadership roles or hierarchies, which can help to coordinate the activities of group members and ensure that a group's resources are effectively used. Low group centrality in a work-related network implies the existence of multiple centers or leaders of similar status, which may cause unnecessary conflicts and make it difficult to achieve concerted efforts (Galaskiewicz 1979; Gloria, Bazzoli, Chan, Shortell, & D'Aunno, 2000). Therefore, we argue that high group centrality in a work-related network is beneficial for group performance. Hence,

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Hypothesis 4b: At Stage 2, a higher level of group centrality in a work-related network will improve group performance.

Group density refers to the average strength of relationships between group members (Reagans & Zuckerman, 2001). It is defined as the ratio of the number of dyadic relationships that exist in the network to the total number of possible dyadic relationships (Wasserman & Faust, 1994: 101). When each member in a group is connected directly with every other member, the group is said to have the maximum degree of density.

An increase in group density helps norm building in the group as "the more tightly that individuals are tied into a network, the more they are affected by group standards" (Collins, 1988: 416). A dense network benefits groups through the enhanced capacity for a team to coordinate its actions, especially when facing complex tasks (Reagans & Zuckerman, 2001). Intensified communication and information sharing, as a result of increased group density, can also enhance group cohesiveness and improve decision making, leading to improved group performance (Sparrowe et al., 2001). Thus,

Hypothesis 4c: At Stage 2, a higher level of group density in a work-related network will enhance group performance.

Historical Effect

Prior performance. Finally, we believe that in a dynamic setting, it is important to consider prior performance as groups can potentially learn from their past experience and improve their future performance (Thibaut & Kelley, 1959; Watson & Merritt, 1998). The literature, however, has been scarce regarding whether groups that have performed better at the earlier stage will have their performance carried over to the later stage. Some scholars have suggested that high-performing groups should perform better on future tasks as they can achieve better efficiency with their high interpersonal trust (Peterson & Behfar, 2003) and low process conflict (Jehn & Mannix, 2001). Others have found the opposite pattern. For example, Mesch, Farh, and Podsakoff (1994) examined the effect of positive and negative feedback on group goal setting and performance and found that groups that received negative feedback on their prior performance performed at higher levels than groups that received positive feedback, as they were more motivated and set higher goals for the future project. As result, we have the following two competing hypotheses,

Hypothesis 5a: Higher group performance at Stage 1 can have a positive impact on group performance at Stage 2.

Hypothesis 5b: Lower group performance at Stage 1 can have a positive impact on group performance at Stage 2.

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Method

Sample

Our study used a sample of 45 project groups consisting of 293 2nd-year students enrolled in an organizational behavior course at a university in Hong Kong, during a span of 15 weeks. The data were originally collected by research assistants for another study (Farh, Lee, & Lin, 1996). We use this data set for three reasons. First, our study attempts to explore some general group behavior patterns, including interpersonal relations, which can be found in the student population (Greenberg, 1987). Second, even though the data were collected from student groups, such groups were formed for dealing with real problems rather than hypothetical scenarios and can be used to examine many of the group processes exhibited by other types of organizational groups (Chang, Bordia, & Duck, 2003; Smith, Locke, & Barry, 1990). Third, a pilot study of our data showed that Hong Kong students' values do not exhibit significant cultural differences when compared with Western values (Farh et al., 1996). We hope that our exploratory study will provide new insights for future research in this area.

Although a 15-week life cycle may not be considered long for some types of group projects, we have identified important stages during which significant events could influence a group's development (Chang et al., 2003). This length is also reflective of the competitive business environment of today's world, as more and more work teams and task forces have much shorter time frames in order to be more responsive to the market (Smith et al., 1990).

The average age of the students was 21, and 38% of the students were male. As a part of course requirements, students were assigned to groups of 6 to 8 members to complete two group projects during a 15-week semester. Students then were randomly assigned to groups, with some consideration for gender composition. As a result, among these 45 groups, 8 were all-male groups, 17 were all-female groups, and 20 were mixed-gender groups. However, due to reasons explained earlier, the role of gender diversity has been excluded from further analyses.

At the beginning of the semester and before the groups were assigned, we administered a questionnaire to collect demographic and other individual information such as gender, grade point average (GPA) (the self-reported information was further verified by referring to their individual student academic record at the university), goal commitment, and team readiness including individualism and collectivism orientation. Completion of the surveys was part of participation, which could affect their performance in the course.

All the students in the sample were from six sections of an undergraduate organizational behavior course, taught by two instructors in English, with each instructor covering three sections. All sections were fully coordinated according to university guidelines to ensure that they covered similar content and shared same requirements. Two group projects representing two stages in the 15-week semester were conducted. For Project 1, each instructor provided a set of 10 cases to each of the three sections that he or she taught. Each group could then choose one case from that set. There were about 20 unique cases in total for 45 groups, but no 2 groups from the same section shared the same case. For Project 2, groups were asked to find a real-life company in Hong Kong of their choice and write a six- to eight-page report or research pro-

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posal. To reflect today's business world, all group projects had multiple components and required coordination.

After completing the first project (about the 7th week of the semester), and before the instructor's grade on the project was given to the groups, students were asked to fill out the surveys describing their group process and evaluating the contributions of each member to the project. The summary results of the peer evaluation were tallied by research assistants and returned to each team member. After students reviewed the feedback, they were asked to complete a questionnaire in which their perceptions of equity and satisfaction with the peer rating were assessed. This period for Project 1 is called Stage 1. The same procedure was carried out for Project 2, which is called Stage 2.

Measurements—Dependent Variable

Group performance was based on the rating of the group project by the instructor teaching that section, who had also outlined grading criteria in the syllabus, covering both the content and format of the project. Ample communication between the two instructors was ensured for a consistent evaluation criterion. Although the two instructors shared the same requirements, they used slightly different scales for measuring the group projects. For the first instructor, a scale of 100 was used for both projects. For the second instructor, a 10-point score scale was used for the first project and a 20-point scale for the second project. Both were then rescaled to a 100-point scale. Furthermore, all performance scores were standardized to eliminate the influence of disparate scoring scales. Standardized Group Performance 1 and Group Performance 2 were used for the performance in Stage 1 and Stage 2, respectively.

Due to the standardization, no significant effect was found due to different instructors. As a result, no dummy variable of instructor was created for this study, which should also help improve the stability of the models (Stevens, 2002).

Measurements—Independent Variables

There are two sets of independent variables used in this study: one based on individual attributes and their group aggregates and the other based on group structures. They involve two stages through the time span of a 15-week semester. Among the individual attributes, member capability and individualism/collectivism were considered unchanged across both stages as they reflect stable individual characteristics and personal beliefs. On the other hand, goal commitment was measured for Stage 1 and Stage 2, respectively, as it was considered task related and dynamic in nature. Efficacy was only measured for Stage 1 as it can also be considered as an estimation of group performance by members when no prior performance feedback is available. All the group structure variables were measured for Stage1 and Stage 2, respectively.

Finally, common factor analyses were conducted for each variable to uncover the most closely related questionnaire items based on the highest factor loadings. In the appendix, we have listed the questions used in this study along with the factor loading for each item and the Cronbach's value for each variable across both stages.

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Individual attributes. *Member capability* was measured by each member's cumulative GPA at the university on a scale of 1 to 10. To get the group-level value, a simple group average was computed as used in previous research (Pfeffer, 1982).

Individualism/collectivism was measured by asking respondents eight questions adopted from Earley (1993, 1994) on a 5-point Likert-type scale from *strongly disagree* to *strongly agree*, with a higher value indicating a higher level of collectivism. To obtain the group-level value, each member's response to the eight questions was averaged. These values were further aggregated across all group members.

Goal commitment was measured using four core items developed from Hollenbeck, Klein, O'Leary, and Wright (1989) on a 5-point scale ranging from *strongly disagree* to *strongly agree*. All four questions were with regard to each member's self-set goal captured by the following question: "What grade (A, B, C, D, E/F) will you realistically try for in this course?" To obtain the group-level value, each member's responses to the four questions were averaged. These values were further aggregated across all members.

Efficacy was measured by asking group members about their assessment on their group's capability in achieving various grades on group projects, as was similarly conducted in Gist and Mitchell (1992) and Thoms et al. (1996). Five items were employed, indicating increasing levels of efficacy from Item 5 to Item 1. Due to the particular design of the questionnaire that allows a higher level of efficacy to include all lower levels of efficacy, a group member could answer "1" ("yes") for multiple items. Efficacy was calculated using the weighted sum of all selected items, with Item 1 having the highest weight of 5 and Item 5 having the lowest weight of 1. Finally, a simple average across all members was used to get the group-level measure.

To justify the aggregations from the individual level to the group level, we followed the work by Gibson (1999) and Chen and Klimoski (2003), and calculated the within-group agreement/consensus (R_{wg}) on a uniform expected variance distribution (James, Demaree, & Wolf, 1984). We also measured two intraclass correlations (ICCs): (a) ICC(1), which indicates whether raters/group members are replaceable, or the amount of variance in ratings accounted for by group membership, and (b) ICC(2), which provides an estimate of the reliability of the group means and indicates the stability of aggregate variables (Bliese, 2000; James, 1982). Furthermore, we conducted an *F* test for ICC(1), which captures within-group reliability/consistency (Bliese, 2000). Average within-group agreements were all at or higher than .82, well above the .70 benchmark proposed by James et al. (1984). ICC(1) and ICC(2) values were also consistent with those usually obtained in team research settings (Bliese, 2000) (see Table 1).

Group structures. Three social network constructs, group centrality, partition, and density, were used to measure evolving group structures for both stages (see appendix). They are representatives of the commonly used structural variables at the group level and are also suitable for the characteristics of our sample (Wasserman & Faust, 1994).

Group partition was measured on the basis of the work-related network, which should give us sufficient information to understand the internal structures of the groups (Freeman, 1977). The network was measured by five items rated on the scale ranging from 1 to 5, with 1 as *strongly disagree* and 5 as *strongly agree*. Each group member was asked to evaluate his or her work-related ties with other members within the same group. After each group member was

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Table 1
Aggregation Validity Measures for Individual-Based Attributes

	Aggregation Validity Measures		
Variable	Average R_{wg}	ICC(1)	ICC(2)
Member capability	.77	.06 ($F = 1.39$, $p = .06$)	.28
Individualism/collectivism	.88	.08 ($F = 1.56$, $p = .02$)	.36
Goal Commitment 1	.88	.07 ($F = 1.45$, $p = .04$)	.31
Goal Commitment 2	.89	.07 ($F = 1.45$, $p = .04$)	.31
Efficacy	.82	.18 ($F = 2.38$, $p = .00$)	.58

Note: $N = 45$. R_{wg} = within-group agreement/consensus; ICC = intraclass correlation.

asked, a matrix of data was created, with each cell containing the results of the five items from one member to another member.

Questions regarding the work-related network are largely based on those from Borman, White, and Dorsey (1995). The data for each member were put into a matrix, in which each cell represents the averaged evaluation based on the five items from another member.

We used the number of structurally equivalent blocks to measure the degree of partition in each group, with the help of the CONCOR procedure in UCInet 5.0 (Borgatti, Everett, & Freeman, 1999), which generates a tree diagram indicating which members are in the same block or structurally equivalent (Wasserman & Faust, 1994).

Group centrality was measured based on the same work-related network as with partition. It was calculated separately for each group using UCInet 5.0. Because our data are valued instead of binary, the group centrality was calculated based on the following graph centrality formula recommended by Freeman (1978-1979: 228):

$$C_D = \frac{\sum_{i=1}^{n} \left[C_D(p^*) - C_D(p_i) \right]}{\max \sum_{i=1}^{n} \left[C_D(p^*) - C_D(p_i) \right]}, \quad (1)$$

where $C_D(p_i)$ is the point centrality of node i and $C_D(p^*)$ is the maximum point centrality in a network. As a result, our definition of group centrality of a network, C_D, measures the relative degree of the concentration.

Group density was also measured for each group, again using UCInet 5.0 based on the same work-related network data.

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Measurements—Control Variable

Group size is simply the number of members in each group.

Results

Table 2 presents the means, standard deviations, and correlations for all variables at the two stages of the group process.

To test our hypotheses, we first use hierarchical regression analysis at two periods of time, Stage 1 and Stage 2, to examine the overall effects of individual attributes and group structures on group performance. After the control variable of size, individual attributes were first introduced into the equation to test the traditional argument of their effects on group performance. Then, group partition, centrality, and density for the work-related network were added to see whether the structural variables add explanatory power to group performance. At Stage 2, the historical effect of prior group performance was considered before introducing group structures.

To further demonstrate the unique effect of each variable, we have followed other studies and conducted usefulness analysis to see if that variable is significantly related to group performance, above and beyond all other variables in the final model (Darlington, 1968; Robbins, Summers, Miller, & Hendrix, 2000; Tremblay, Sire, & Balkin, 2000). The unique contribution of a variable is determined by the squared semipartial correlation (Stevens, 2002).

In Model 2 of Stage 1 (see Table 3), the model with the addition of individual attributes greatly increased the explanatory power for group performance ($\Delta R^2 = .30$, $p < .01$). However, in Model 3 of Stage 1, the addition of group structures added no significant explanatory power to the model. This supports Hypothesis 1.

A further analysis also revealed the significant impact of individual attributes such as goal commitment and group efficacy on group performance during the first stage. In the usefulness analysis, both Goal Commitment 1 and Efficacy were uniquely related to group performance. However, the impact of Goal Commitment 1 was negative, which is contrary to Hypothesis 3c. This result may not be too surprising, as studies have shown that whether goal commitment has a positive impact on group performance can also depend on the difficulty of the goal and the cohesion of the group (Klein et al., 2001; Podsakoff et al., 1997). The significant and positive impact of efficacy confirms Hypothesis 3d. It shows that groups composed of members who have a strong belief in themselves can indeed help group performance.

We did not find statistical significance for other individual attributes including member capability. This could be due to the fact that students were generally randomly assigned to groups, which may have minimized the variability of group member capability at the group level. This result does not support Hypothesis 3a. The nonsignificance of individualism/collectivism also fails to show the direct impact of such general cultural values on group performance. This result, therefore, does not support Hypotheses 3b.

At Stage 2, a contrasting picture emerges (see Table 4). In Model 2 of Stage 2, individual attributes lost their explanatory power. In Model 4, none of the individual attributes were statistically significant. However, the addition of group structural variables greatly enhanced the

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Table 2
Descriptive Statistics and Correlations

Stage 1

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
1. Group Performance 1	1.00	0.08								
2. Group size	6.51	0.69	–.07							
3. Member capability	5.15	0.88	–.07	–.05						
4. Individualism/collectivism	2.91	0.18	–.10	.31*	–.21					
5. Goal Commitment 1	3.88	0.30	–.23	–.41**	–.06	–.35*				
6. Efficacy	13.17	1.42	.48**	–.19	.03	–.14	–.06			
7. Group Partition 1	3.62	0.49	–.10	.25	.12	.26	–.23	–.14		
8. Group Density 1	0.81	0.06	.16	.04	.06	.12	.03	.24	.05	
9. Group Centrality 1	40.40	18.67	–.03	.05	–.13	–.19	.08	.17	–.13	–.25

Stage 2

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
1. Group Performance 2	1.00	0.09								
2. Group size	6.50	0.69	.15							
3. Member capability	5.10	0.88	.04	–.05						
4. Individualism/collectivism	2.90	0.18	–.11	.31*	–.21					
5. Goal Commitment 2	3.05	0.14	.09	–.22	–.14	–.28				
6. Prior group performance	1.00	0.08	.06	–.07	–.07	–.10	.18			
7. Group Partition 2	3.50	0.55	.29	.43**	–.26	.12	.10	–.35*		
8. Group Density 2	0.79	0.07	.31*	.20	.13	.06	.18	.08	–.03	
9. Group Centrality 2	42.70	21.6	.03	–.21	.11	–.07	.04	–.08	–.06	–.59**

Note: $N = 45$. * Correlation is significant at the .05 level (two-tailed). ** Correlation is significant at the .01 level (two-tailed).

Table 3
Hierarchical Regression Analysis for Stage 1 Group Performance

Variable	Model 1		Model 2		Model 3		Usefulness Analysis
	β	*t*	β	*t*	β	*t*	
Step 1: Control variable							
Group size	–.07	–.43	–.06	–0.38	–.04	–0.23	.00
Step 2: Individual-based attributes							
Member capability			–.13	–0.94	–.15	–1.02	.02
Individualism/collectivism			–.15	–1.00	–.18	–1.12	.02
Goal Commitment 1			–.29	–1.84†	–.30	–1.81†	.06*
Efficacy			.43	3.12**	.43	2.77**	.14**
Step 3: Group structures							
Group Partition 1					–.06	–0.38	.00
Group Density 1					.07	0.45	.00
Group Centrality 1					–.12	–.79	.01
N	45		45		45		
Model R^2	.00		.30		.33		
ΔR^2			.30**		.02		

Note: For the usefulness analysis, the statistics reported in the table are squared, semipartial correlations, indicating the incremental change in R^2 for a given variable beyond all other variables in the final model.
†$p < .10$
*$p < .05$
**$p < .01$

overall model fit from .06 to .35. The R^2 change is significant at the .01 level. These results support Hypothesis 2, which states that compared with individual attributes, group structures can play a more significant role in group performance at the later stage. No significant effect was found for prior group performance. This was also confirmed by the nonsignificant Pearson correlation (two-tailed) of .06 between prior group performance (Group Performance 1) and Group Performance 2. This result, along with the others, indicates that group performance at the later stage depends more on emerging group structures than on past performance alone. As a result, Hypotheses 5a and 5b are not supported.

We found from Model 4 of Stage 2 that all three group structures had significant impacts on group performance, as was also confirmed by the usefulness analysis. Specifically, we found a significant and positive effect of Group Partition 2, which supports Hypothesis 4a. This, to some extent, demonstrates that the existence of group substructures can be beneficial to group performance when dealing with complex tasks as in this study.

We also found that Group Centrality 2 had a significant and positive impact. This supports Hypothesis 4b, which argues for the beneficial effects of work-related group centrality as a mechanism for control and coordination to improve group performance.

As to the density variable, Group Density 2 based on the work-related network again had a significant and positive effect on group performance. Therefore, Hypothesis 4c is supported. This positive effect indicates that density in the work-related network can help groups achieve more synergy, while maintaining effective group structures for dealing with complex tasks.

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Table 4
Hierarchical Regression Analysis for Stage 2 Group Performance

Variable	Model 1 β	Model 1 *t*	Model 2 β	Model 2 *t*	Model 3 β	Model 3 *t*	Model 4 β	Model 4 *t*	Usefulnes Analysis
Step 1: Control variable	.15	.97	.21	1.30	.21	1.29	–.08	–.44	.00
Group size									
Step 2: Individual-based attributes									
Member capability			.04	0.22	.04	0.23	–.02	–.10	.00
Individualism/collectivism			–.14	–0.79	–.13	–0.76	–.19	–1.22	.03
Goal Commitment 2			.10	0.62	.10	0.57	–.20	–1.21	.03
Step 3: Historical effect									
Prior group performance					.04	0.27	.22	1.42	.04
Step 4: Group structures									
Group Partition 2							.48	2.70*	.13*
Group Density 2							.62	3.31**	.20*
Group Centrality 2							.42	2.37*	.10*
N	45		45		45		45		
Model R^2	.02		.06		.06		.35		
ΔR^2			.04		.00		.29**		

Note: For the usefulness analysis, the statistics reported in the table are squared, semipartial correlations, indicating the incremental change in R^2 for a given variable beyond all other variables in the final model.
*$p < .05$
**$p < .01$

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Discussion

This study has provided a conceptual framework and an exploratory analysis for contrasting the individual and structural perspectives for the study of group performance in a dynamic setting. We have not only examined the boundary conditions of individual attributes and group structures but also explored their distinctive effects on group performance at different stages. By revealing how group performance can be affected by factors other than prior performance, our study has demonstrated the importance of group dynamics in addressing group effectiveness, as also echoed by other scholars (Cohen & Bailey, 1997; Marks et al., 2001).

The finding that individual attributes and group structures play distinctive roles at different stages of groups confirms our thesis and suggests that there may be a potential bridge between these two perspectives, which may be best explored in a dynamic setting as the formation of group structures may be partly influenced by individual attributes. Some recent studies have also started to uncover the potential of exploring such linkages, although their focus has mainly been on the individual level within a group (e.g., Ahuja, Galletta, & Carley, 2003). Different effects of individual attributes at the earlier stage also suggest that attributes that are more directly related to group tasks, rather than general cultural values or personal characteristics, may have a more direct impact on group performance, as was also observed in some other studies (Robins & Lin, 2000).

The finding that group partition in the work-related network is positively associated with group performance may need some further explanation. It suggests that at the group level, partition in the work-related network may reflect how members choose to "divide and conquer" their tasks, which, like in our study, are complex and require distributed expertise (Arrow et al., 2000). As such, a high degree of group partition may help the group become more efficient and effective when facing such a task that requires strong coordination (Lin & Hui, 1999; Pugh et al., 1963). Gibson and Vermeulen (2003) found similar results, although they focused on team learning outcomes and did not explore the potential bridge between the individual and structural perspectives.

The finding that groups benefit from work-related group centrality is interesting in two main aspects. First, it suggests that when groups face tasks that need effective and efficient coordination, it may be more beneficial to have some degree of hierarchy within the group (Gloria et al., 2000; Schmitt & Klimoski, 1991). Second, although prior studies have typically focused on the effect of individual-based centrality on an individual's behavior and argued for the positive role of such centrality (Ahuja et al., 2003; Brass, 1992), our study shows that when measured at the group level, whether or not centrality helps group performance may depend on it being work related. This has also been noticed in some recent studies, in which centrality measures based on non-work-related informal relationships such as friendship ties were found to be negatively associated with group performance (Cummings & Cross, 2003; Sparrowe et al., 2001).

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Contributions

Our study makes several important contributions. First, it has systematically integrated group structures into the study of group performance, while considering the comparative role of individual attributes. This goes beyond prior research that tends to treat individual and structural perspectives as mutually exclusive (Barry & Stewart, 1997; Mayhew, 1980). Our findings confirm and disconfirm the determinant roles of individual attributes advocated by traditional individualists. Furthermore, our study points out conditions under which the role of group structures may predominate. This comparative examination has enabled us to lay the foundation for future explorations of the potential bridge between structural and individual perspectives and provide more systematic and comprehensive insights into group performance (Arrow et al., 2000; Salancik, 1995).

Second, our study has adopted a dynamic approach that better illustrates group processes (Gersick, 1988). We have successfully shown that, to truly understand the causes of group performance and explore the potential linkage between individual and structural perspectives, it is necessary to consider the context of group dynamics. Through these efforts, we have demonstrated both the necessity and feasibility to address calls to advance group research from a dynamic angle (Cohen & Bailey, 1997; Marks et al., 2001).

Third, our study has also complemented the literature of group studies by developing new measures of group-level characteristics. This methodological development has allowed us to move beyond general critiques of prior group research with regard to its overreliance on individual-level attributes or their aggregations (Salancik, 1995). We not only have demonstrated how to empirically derive measures of group structures using social network techniques but also have shown their respective effects on group performance. Such effort has also been advocated by other scholars (Cummings & Cross, 2003; Sparrowe et al., 2001).

Limitations and Future Directions

Despite the contributions of this study, several limitations are noticeable. First, we only examined one network, although there can exist other types of network relationships (Ibarra & Andrews, 1993; Knoke & Kuklinski, 1982). Many studies have found that the existence of multiple relations for a set of social actors is common (Doreian & Stokman, 1997; Homans, 1950). Some or all of these relations put constraints on actors' behaviors, which makes it critical to identify the pertinent relations among group members. Although it may be better to consider multirelationship networks to more closely measure group structures, we also have to be aware of the trade-offs. When group sizes are relatively small, there is an increasing chance of high correlation among multiple network relationships.

Second, due to the nature of the data sample, there is a limit to which the results may be generalized. Although a Chow test showed that the models were fairly stable and not sample sensitive, the sample-size-to-predictor ratio in our study only ranged from 6 to 11. Even though this may be considered acceptable in most group studies and social network research (Chang et al., 2003; Gersick & Hackman, 1990; Kerlinger & Lee, 2000; Sparrowe et al., 2001), it still falls short of the ideal ratio of 15 (Stevens, 2002). We also need to be aware of the differences

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that exist in a student sample when generalizing our findings to other real-world settings (Ward, 1993), which provides both opportunities and challenges for future research.

Third, because we have adopted a dynamic perspective, it is better to observe groups over a longer term to let the influence of group structure fully unfold. As Doreian and Stokman (1997) have suggested, two periods of time are the minimal requirement for dynamic studies. Although our study has met this minimal requirement by observing two group project periods during one semester, future studies are encouraged to investigate a longer period to test the time effect on group structures.

Fourth, the groups examined in this study are not predesigned in their structures (Gersick, 1988). Instead, results are largely drawn from the natural group evolution processes. As a result, questions such as how formal organizational authority structures and informal social network relationships interact to affect the group processes and outcome have not been explored. Research in this direction can have great implications for organizations.

Finally, the list of exploratory variables in our study of groups is not exhaustive. Other factors such as the level of extraversion (Barry & Stewart, 1997) and average level of conscientiousness (Waung & Brice, 1998) should provide new insights. Many studies claim that work groups are becoming increasingly diverse in terms of race, gender, functional background, education, and culture (Earley & Mosakowski, 2000). Some of these factors are shown to affect not only individuals' perceptions but also how they choose interaction partners (Ibarra & Andrews, 1993). It would be fruitful to consider these additional factors in future studies so that we can learn how they may, or may not, alter the relationships that we have found in this study.

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APPENDIX
Description of Measures: Questionnaires and Reliabilities

Variable	Questions in Surveys	Factor Analysis: Loading Level, Stage 1	Factor Analysis: Loading Level, Stage 2	Reliability Analysis: Cronbach's α, Stage 1	Reliability Analysis: Cronbach's α, Stage 2
Control variable					
Size	(from roster information)	—	—	—	—
Individual attributes					
Member capability	(GPA: from roster information)	—	—	—	—
Individualism/collectivism	(on a Likert-type scale of 1 [*strongly disagree*] to 5 [*strongly agree*])				
	People like to work in a group rather than by themselves.	.92	—	.97	—
	If a group is slowing me down, it is better to leave it and work alone. (R)	.87			
	To be superior, a person must stand alone. (R)	.93			
	One does better work working alone than in a group. (R)	.92			
	I would rather struggle through a personal problem by myself than discuss it with my friends. (R)	.91			
	A person should accept the group's decision even when personally he or she has a different opinion.	.85			
	Problem solving by groups gives better results than problems solving by individuals.	.86			
	The needs of people close to me should take priority over my personal needs.	.92			
Goal commitment	(on a Likert-type scale of 1 [*strongly disagree*] to 5 [*strongly agree*])				
	Quite frankly, I don't care if I achieve this goal or not. (R)	.93	.83	.95	.90
	I think this goal is a good goal to shoot for.	.93	.88		
	I am willing to put forth a great deal of effort.	.94	.86		
	There is not much to be gained by trying to achieve this goal. (R)	.91	.82		
Efficacy	(yes = 1, no = 0)				
	My group will get an A in the next group project.	—		—	
	My group will get at least a high B in the next group project.				
	My group will get at least a B in the next group project.				
	My group will get at least a low B in the next group project.				
	My group will get at least a C in the next group project.				

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Group structures					
Group centrality, group partition, and group density	(on a Likert-type scale of 1 [*strongly disagree*] to 5 [*strongly agree*])				
	This group member offered valuable ideas or suggestions to the project.	.78	.89	.88	.95
	This group member completed the fair share of work.	.75	.87		
	This group member coordinated group activities.	.73	.87		
	This group member actively participated in group activities.	.79	.91		
	Overall, this group member contributed a great deal to the group project.	.79	.91		

Note: (R) denotes reversed scales. GPA = grade poiint average.

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