THE RECIPROCAL EFFECTS OF TOP MANAGEMENT COGNITIVE DIVERSITY AND FIRM PERFORMANCE: OPENING THE BLACK BOX

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THE RECIPROCAL EFFECTS OF TOP MANAGEMENT TEAM COGNITIVE DIVERSITY AND FIRM PERFORMANCE: OPENING THE BLACK BOX

Demography research rarely examines the black box within which the cognitive diversity of the top management team is assumed to affect firm performance. Using data from 35 simulated firms run by a total of 159 managers attending executive education programs, the current research tested several hypotheses concerned with: a) the relationship between demographic and cognitive team diversity; and b) reciprocal influence processes between team cognitive diversity and firm performance. Results showed that members of high-performing teams tended to preserve multiple interpretations early in the team's life cycle, but moved toward greater clarity near the end of the life cycle. These high-performing teams, therefore, exhibited both early interpretative ambiguity and late heedful interrelating. Further, teams that improved firm performance early in the game tended to show increased diversity concerning perceptions of team decision making and structure over the course of the simulation. Thus, cognitive diversity in teams both affected and was affected by changes in firm performance. Finally, there was a marginally significant tendency for teams heterogenous in terms of nationality and functional background to show increases in market share over the course of the simulation. Surprisingly, there was no evidence of any effect of demographic diversity on measures of cognitive diversity.

Commenting at the fifth game of the National Basketball Association (NBA) championship series in Seattle, basketball legend, Julius Erving, remarked that the 1996 Chicago Bulls offered a glimpse of what the team of the future would look like: the 1996 Chicago Bulls were one of the most nationally and ethnically diverse teams ever assembled in the NBA. The Bulls' lineup consisted of the best white and African American players from three continents: Europe, Australia, and America.

The increasing diversity of teams in the NBA is only one instance of a larger trend. The work force throughout the developed world is becoming more diverse, reflecting changing demographics within nation states (Johnston and Packer 1987) and migrations of peoples across national borders (Hambrick, Korn, Fredrickson and Ferry 1989, p. 33).

The growing diversity of the workforce underscores three questions of theoretical and practical importance concerning the makeup and functioning of teams in organizations. First, how does team demographic diversity affect cognitive diversity? Second, what are the effects of team cognitive diversity on performance? Third, is there a reciprocal effect of team performance on team cognitive diversity? We explored these questions in a simulation of top management team decision making.

LITERATURE REVIEW

The victory of the Chicago Bulls in the NBA championships notwithstanding, the relationship between team diversity and outcomes remains unclear. Researchers have pointed to both the costs and benefits of increased diversity in teams. Top management team demographic diversity has been shown to predict turnover rates (Jackson, Brett, Sessa, Cooper, Julin and Peyronnin 1991, Wiersema and Bird 1993); increased levels of work group diversity have been associated with lower psychological attachment to the organization (Tsui, Egan and O'Reilly 1992) and less frequent communication (Zenger and Lawrence 1989). But diversity has also been hailed as a competitive advantage because minority views "can stimulate consideration of non-obvious alternatives in task groups" (Cox and Blake 1991, p. 50); and heterogenous teams have been shown to be more creative than homogenous teams (Triandis, Hall and Ewen 1965, Hambrick, Cho and Chen 1996).

The discrepancy in the research literature concerning the effects of team diversity on organizational functioning reflects two different approaches. The demographic approach studies

diversity in terms of gender, age, organizational tenure, ethnicity and nationality (see Pfeffer 1983, for a review). The emphasis is on directly measurable attributes of individuals. The cognitive approach studies diversity in terms of attitudinal and normative differences between individuals who may be homogenous on demographic indicators (e.g., Nemeth 1986). Thus, cognitive diversity in this literature refers to variability concerning relatively unobservable attributes such as attitudes, values and beliefs.

According to demography researchers, the reason to gather demographic rather than cognitive data when examining the consequences of diversity is that, "mental processes... are more difficult to access and reliably measure" (Pfeffer 1983, p. 351). Demographic variables are argued to be more objective, to yield more parsimonious explanations of organizational phenomenon, and to be more easily submitted to testing than cognitive variables (Pfeffer 1983, p. 352, Hambrick and Mason 1984, Wiersema and Bantel 1992, p. 94).

Although the demographic approach seems to offer a short-cut to studying the effects of diversity on organizational outcomes, a careful reading of the demography literature reveals a disjunction between theory and research. As noted by Lawrence (1997, p. 2), organizational demographers hypothesize "various subjective concepts that explain significant association between demographic predictors and outcomes....However,...,researchers usually leave the concepts unmeasured and the hypotheses untested. As a result, subjective concepts and their relationships within research models have become the 'black box' of organizational demography." Demographic variables are often treated as convenient proxies for cognitive ones in predicting team outcomes.

The use of demographic variables as surrogates for cognitive ones is premised on the assumption that demographic variables predict and explain variation in intervening cognitive variables (Pfeffer 1983, p. 350, Hambrick and Mason 1984). Thus, for example, Michel and Hambrick (1992) suggested that a common background in terms of tenure in the top

management team or functional specialization "contributes to the development of common schemata among team members" (p. 18). Similarly, Tsui, Egan and O'Reilly (1992) argued that individuals use demographic categories such as age and race to define psychological groups that reinforce self-identity; and Wiersema and Bantel (1992, p. 112) argued that demographic categories reflect individuals' cognitive bases. Team demographic diversity, measured over such visibly salient variables as age, gender and race, has been assumed to be an accurate reflection of how much the team shares a common set of attitudes, values and norms.

Researchers have tended to avoid specifying precise relationships between diversity on particular demographic variables and diversity on particular cognitive variables in favor of general assertions that the more demographically diverse the team, the more members will tend to see the world differently, with this increased cognitive diversity affecting individual and firm performance (see the discussion in Lawrence 1997, p. 4). Research results on outcome variables have thrown this assumed general correspondence between demographic and cognitive diversity into some doubt, however. For example, one study found that team heterogeneity had opposite effects on performance depending on the measure of heterogeneity selected (Smith, Smith, Olian, Sims, O'Bannon and Scully 1994), whereas another study reported that top management team tenure heterogeneity had results directly contrary to those hypothesized (Michel and Hambrick 1992). Similarly, Tsui, Egan and O'Reilly (1992) found, contrary to their predictions, that the larger the difference between the individual and the group on measures of organizational tenure and education, the higher the individual's intent to stay with the firm. Wiersema and Bantel (1992, p. 14) reported that: "Very little support for the heterogeneity argument emerged... heterogeneity on age, organizational tenure, and team tenure were not significantly associated with strategic change."

That these outcomes turned out to be different from predictions suggests that the link between demographic and cognitive diversity may be more complex than generally assumed by

demographers. Homogeneity along demographic markers does not necessarily engender homogeneity in attitudes, beliefs or values. People homogenous on demographic indicators may exhibit a wide array of cognitions. For example, a study of third-year elementary education majors (all females under the age of 30) from the same university revealed a strikingly wide range of attitudes toward potential job interviews. The authors suggested that idiosyncratic preferences and personality traits could produce such individual cognitive differences (Rynes & Lawler 1983). Other research has found little support for the effects of top management team demographics on firm performance, but some effects of social process variables such as communication frequency (Smith et al 1994) that may be related to cognitive variables.

THEORY AND HYPOTHESES

In the current research we examined the links between demographic diversity and cognitive diversity, and also examined how these different kinds of diversity influenced team performance. We looked at three aspects of demographic diversity: functional specialization (e.g., marketing, research and development, etc.), national origin (i.e., French, German, etc.) and age. Previous demography research has suggested that teams with high variability on these kinds of markers tend to have different schemata or ways of seeing the world (e.g., Michel and Hambrick 1992). For example, executives from different functional areas may view organizational problems from different perspectives (Dearborn and Simon 1958, Waller, Huber and Glick 1995; but see Walsh 1988, for a dissenting view). Further, managers from different countries tend to have different frameworks for approaching a wide range of issues (Hofstede 1980, Laurent 1983, 1986). Similarly, research suggests that people of similar age tend to view the world in general in similar terms, reflecting shared experiences and socialization (cf. Tsui, Egan and O'Reilly 1992, Wagner, Pfeffer and O'Reilly 1984). Thus, based on prior research and theory, we predicted that demographic diversity on important indicators such as functional

affiliation, national origin and age would predict diversity over a wide range of attitudes, beliefs and values relevant to team decision-making.

Hypothesis 1: The higher the demographic diversity of the top management team, the higher the cognitive diversity of the team's decision-making processes.

Despite their differences over how best to examine the impact of diversity on team outcomes, both the proponents of the demographic approach and those of the cognitive approach agree that cognitive diversity is related to performance. There is less agreement, however, on what the precise form of this relationship may be. We draw on a sensemaking perspective (Weick 1979, 1995) to argue that cognitive diversity can be either a blessing or a curse, depending upon the specific type of cognition involved. Three aspects of cognition in teams appear especially relevant based upon a review of the sensemaking literature (Weick 1993a): Attributions concerning performance, decision making agreement, and perceptions of organizational structure.

First, from a sensemaking perspective (Weick 1979, 1995), the preservation of multiple interpretations in teams is critical for registering complex environments. Weick reasons that for the detailed registering necessary for successfully coping with a complex, equivocal environment, the variety within the organization must match the variety outside it (1979, p. 190; cf. Ashby 1952). Interpretive ambiguity within the top management team preserves the requisite variety needed to sense and regulate the variety facing the organization (cf. Schweiger, Sandberg and Ragan 1986).

Strong norms concerning the interpretation of the environment tend to restrict the variety in a team's repertory of beliefs. Janis (1972) chose the Orwellian label "groupthink" to describe the phenomenon characterized by strong normative pressures on members to interpret the world in the same way. If members interpret the world in the same way, this means they perceive the same causal connections between actions and outcomes. They are less able to make rich sense of

the environment they face. This is because we see what we believe and we cannot see that for which we have no beliefs (Weick 1995, p. 87). Strong norms shrink the team's repertory of beliefs, and, consequently, restrict the ability of the team to make sense of ambiguity.

The interpretative ambiguity valued by Weick should be distinguished from disorganization on the one hand (i.e., teams in which everyone explicitly disagrees with everyone else) and unanimity or groupthink on the other (i.e., teams in which everyone agrees with everyone else). Interpretative ambiguity resembles most closely that state of equivocality in which both agreement and disagreement concerning causality are simultaneously possible. As Weick (1995, p. 120) pointed out, in organizations characterized by strategic ambiguity (a concept originated by Eisenberg 1984), "people are not pressed to articulate their individual understanding" of causal connections. Thus, people act effectively together without the team as a whole ever clarifying how much interpretative ambiguity actually exists.

Hypothesis 2: The higher the interpretative ambiguity within the top management team, the higher the firm's subsequent performance.

A completely separate issue concerns not how the team members interpret the causal connections in the environment, but how smoothly procedures for decision making have been implemented within the team. Some teams are characterized by relative unanimity concerning the processes by which decisions should be made. These teams tend to have worked out decision making and discussion norms, and these norms facilitate decision making (Lodahl and Gordon 1972, Bettenhausen and Murnighan 1985). Other teams tend to engage in conflict over how decisions should be made and this conflict can retard decision making, implementation and performance (Murnighan and Conlon 1991). Controlled conflict can, of course, be built into the decision making process and can aid decision making by expanding perspectives, but only to the extent that conflict remains affect-free and focused on how best to achieve objectives (Amason 1996). Executives in for-profit firms report finding conflict generally unpleasant and leading to

low-quality decisions (Schwenk 1990), suggesting that affect-free cognitive conflict in top management teams is rare. Conflict over decision making processes can consume resources, such as time (March and Simon 1958, pp. 149-151) and thus adversely affect performance. From a sense-making perspective, in fast moving environments, speed of decision making is critical in allowing the top management team to influence events as they are developing (Weick 1993b). On balance, the research suggests a generally negative effect of disagreement over decision making norms on organizational performance.

Hypothesis 3: The higher the disagreement within the top management team concerning decision making norms, the lower the firm performance.

The sensemaking perspective also suggests that agreement among top management team members concerning role and power relations is a prerequisite for effective performance, especially in fast-moving environments in which coordination is important. The interlocking behaviors that Weick (1979) described as forming the structure of the team depend on mutually understood roles and statuses (cf. Merton 1957). As consensus with regards to role and power relations disintegrates, so does structure. And as structure disintegrates, so does the team. One consequence of team disintegration is that members can no longer draw on others to help register the environment. Things suddenly make a lot less sense. This is one of the lessons Weick draws from his study of the death of 13 smokejumpers in the Mann Gulch disaster: "As their group disintegrated, the smokejumpers became more frightened, stopped thinking sooner, pulled apart even more, and in doing so... lost access to the novel ideas of other people... [and] reverted to primitive tendencies of flight. Unfortunately, this response was too simple to match the complexity of the Mann Gulch fire" (Weick 1993b, p. 638). When the structure embodied in role systems unravels, so does the ability of the organization to make sense.

Structure exists not just on the organization chart but also in the minds of organizational members (Kilduff and Krackhardt 1994). To the extent that structure is institutionalized, then

perceptions concerning structural relations will tend to converge (cf., Romney, Weller and Batchelder 1992). Diversity with respect to perceptions of structure suggests that the group is disorganized. This disorganization, because it prevents the group from adequately registering and making sense of its environment, is a recipe for disaster.

Hypothesis 4: The higher the diversity of perceptions among top management team members concerning structural relations among team members, the lower the subsequent firm performance.

In focusing on the effects of cognitive diversity on performance, we should not lose sight of the possibility of a dynamic relationship between performance and cognition. From an enactment perspective, feedback from the environment is expected to trigger changes in cognition which in turn affect actions that help determine subsequent performance (Weick 1979). The emphasis is on reciprocal relationships between cognitive change and performance change. From an enactment perspective, top management teams help create environmental outcomes (such as successful or unsuccessful product launches) that have consequences for team cognition and functioning. Members of top management teams that see their firms failing in the competitive marketplace may become increasingly rigid in their belief systems, according to the threat-rigidity perspective (Staw, Sandelands and Dutton 1981). Failing performance tends to freeze belief systems in place whereas success tends to free team members up to consider different possibilities. Thus, we might expect that increases in firm performance would subsequently result in increased cognitive diversity.

Hypothesis 5: Increases in firm performance will increase top management team cognitive diversity.

Previous research has confirmed that team cognitive diversity does change over time, even if team membership remains stable (Jacobs and Campbell 1961; Weick and Gilfillan 1971). How might this changing cognitive diversity affect performance? We were unable to find any

discussion explicitly focused on the effects of such changing cognition on changes in performance, although such research has been called for (e.g, Thomas, Clark and Gioia 1993). Consequently, we decided to conduct exploratory analyses on this important topic.

RESEARCH SETTING

We chose a setting in which it was possible to study the demographic and cognitive diversity of top management teams and relate measures of diversity to performance outcomes: a business simulation involving teams of experienced managers. Organizational simulation has emerged as a valuable tool for studying complex organizational processes (e.g., Cohen, March and Olsen 1972; Masuch and LaPotin 1989). The MARKSTRAT simulation (Larreche and Gatignon 1977), in particular, is widely used for studying decision making (e.g., Hogarth and Makridakis 1981; Lant and Montgomery 1987; Walsh, Henderson and Deighton 1988). Managers from different industries have reported that MARKSTRAT reflects the competitive environment they are familiar with and that they take real actions in their own organizations based on their experiences in MARKSTRAT (Kinnear and Klammer 1987). The realism of the simulation has been widely recognized (e.g., Dodgson 1987, Remus 1978) and has been attributed to the game's ability to capture long-term market mechanisms (Gatignon 1987, p. 469). Further, involvement by managers and others in the MARKSTRAT simulation is typically high (Hogarth and Makridakis 1981).

What is MARKSTRAT? Briefly, it is a game in which teams of players compete with each other in a consumer entertainment market. There are five teams, each team representing the overall strategic marketing orientation of a company. Each team, in other words, represents the top management of a company and is responsible not only for strategic marketing, but also for coordinating production, inventory control, and research and development. The top management team plans and implements the marketing strategy of the company in the context of competition

from four other companies in the same industry. Each player on each team typically has a MARKSTRAT manual (Larreche and Gatignon 1984) that describes the characteristics of the MARKSTRAT world, the ways in which to design and implement strategy in this world, and the operating instructions specific to this simulated environment.

At the beginning of the simulation, each team is responsible for marketing two brands, but part of the strategy involves modifying, withdrawing and introducing brands. For each decision period (equivalent to one year), teams must make decisions concerning the number and types of brands, how much research and development to fund, how much production to plan for, the advertising budget, recommended retail prices, number of salespeople and so on. These decisions are entered into a computer which simulates the competitive environment and produces updated performance reports for each team showing units sold for each branded good, gross marketing contribution, market share and other performance indicators.

In the current research, after a practice run designed to increase familiarity with the simulation, each team received a computer printout detailing the initial position of the organization. In the MARKSTRAT simulation, teams take over companies that are already established. The simulation was then run for 6 decision periods (each period is the equivalent of one organizational year), with each decision period lasting about two-and-a-half hours. At the end of each period, teams made alterations to the marketing mix (including pricing, sales force size, advertising budget, research and development budget and production volume). These decisions were based on prior results and marketing research studies that were available for purchase (see Cook 1987, for more details of MARKSRAT as a research tool).

METHOD

Sample

The sample consisted of all 159 managers (divided into 35 teams) attending selected executive development programs at a European management institute. The average age was 41 (sd = 6), with the range extending from 25 to 56. Fourteen countries were represented including 30 or more people from France, Germany and Switzerland. Because only 3 of the participants were women, gender diversity was not measured in this study. The managers occupied a variety of functions in European firms, including over 20 people in each of the following functions: marketing, research and development, manufacturing, and general management.

Unit of Analysis

The unit of analysis was the simulated Markstrat team to which managers were assigned. All variables were calculated at the team level. There were 35 Markstrat teams.

Measures

Questionnaires were distributed at two points in time: early in the game (at the end of the second decision period), and late in the game (at the end of the second from last decision period). These questionnaires were prepared in three languages (English, French and German) corresponding to the language of instruction being used in the executive education programs of which the MARKSTRAT simulation formed a part. Following Hofstede's (1980, p. 34) recommendations, translations from the original English version of the questionnaire were accomplished by a person fluent in all three languages and familiar with the content matter of the document. This method avoids the often clumsy phrasing that results from back translation. The response rate for the questionnaire was 91.5% and 95% for the early and late administrations respectively.

Performance

Because MARKSTRAT is a marketing simulation, the focus of team effort is on improving marketing performance. The measures of performance, therefore, relate to the results of decision making by the top management of the marketing department, which is responsible for the overall orientation of the company to its markets (Larreche and Gatignon 1977, p. 5).

Two measures of performance were monitored by the teams throughout the game -- net marketing contribution (in dollars) and market share (percent). The net marketing contribution was the basic measure of profitability and was defined as total revenues from sales minus expenses, with expenses including cost of goods sold, research and development, inventory holding costs, etc. The market share was expressed as a percentage of the total market captured by the focal firm in competition with the other 4 firms in its industry. Recall that each team competed with 4 other teams for market share.

In the analyses we look at these two measures of performance in different ways. To assess how well firms were doing early in the simulation, we assessed **Early Net Marketing Contribution Change** as the net marketing contribution at the start of the second period divided by the net marketing contribution at the start of the game. This measure was greater than one for firms that improved their performance during the first period and less than one for firms that suffered performances decreases as a result of decisions made during the first period. We also examined **Final Market Share** and the **Cumulative Net Marketing Contribution** for each firm. These were the market share and profitability results at the end of the simulation. To measure performance increase and decrease over the course of the game, we looked at **Overall Market Share Change**, measured as the percent change in market share for each firm from early in the game (end of second period) until the end of the game.

Control variables

In MARKSTRAT, teams take over existing firms and these firms have different starting profiles. Five firms make up each MARKSTRAT world and of these five in the current simulation two firms had relatively disadvantaged starting positions whereas the other three firms had relatively advantaged starting positions. Thus, we controlled for whether the team took over an advantaged or disadvantaged firm by classifying firms into two groups: advantaged and disadvantaged.

We also controlled for size because the size of teams varied between 3 and 5 people.

Cognitive diversity

Six questionnaire items comprised the raw data for composite team-level cognitive diversity measures. These single-item questionnaire measures were based on the questions used by Zucker (1977) to measure cognitive variability in an institutionalization context. Like Zucker, we asked the managers to indicate (on 7 point scales) their perceptions of group processes. We recognize that these one-item measures violate arguments concerning the importance of reliable, multimethod measurements of individual dispositions and cognitions (e.g., Block 1977). Because of this methodological shortcoming, this study's assessments of the effects of cognitive diversity are likely to comprise very conservative tests of the hypotheses. We grouped the cognitive diversity measures into three categories (based on exploratory factor analyses) to reduce the number of variables in the regressions.

Factor analysis. The team-level coefficient of variation scores on these six variables represented our measures of cognitive diversity. Because of the relatively large number of cognitive diversity variables relative to the number of teams in our sample, we used an exploratory factor analysis applied to the variation scores derived from the initial questionnaire responses to see if the six cognitive variation scores could be reduced in number. The results showed three factors with eigen values greater than 1. A varimax rotation suggested grouping

two decision making variation scores together (factor loadings of .80 and .73 on the first rotated factor for the decision difficulty and decision agreement scores, respectively). The loadings on the second rotated factor suggested grouping three structural scores together (factor loadings of .57, .63 and .73 for the role specialization, power, and effectiveness scores respectively). The loadings on the third rotated factor suggested that the attribution of agreement score stand alone (factor loading of .90; no other loadings above .13). Thus, this factor analysis suggested that our items measured three separate aspects of cognitive diversity.

To investigate cognitive diversity, therefore, we used three scores. The **interpretative ambiguity** score consisted of the coefficient of variation for attributional agreement. A **decision making diversity** score was created by adding together the two coefficient of variation scores related to decision making. A **structural diversity** score was created by adding together the three coefficient of variation scores related to structural effectiveness.[1]

Interpretative ambiguity. To measure agreement about the causes of performance, we asked team members the following question: "How much agreement was there in your MARKSTRAT organization about the causes of your market share results during the last decision period?" The scale was anchored with the phrases "Everybody stuck to a different explanation" and "All members agreed." The greater the variation in members' responses to this question, the more interpretative ambiguity the team was assumed to exhibit with respect to attributions about past performance. If everybody in the team responded identically, then this was taken as evidence of team consensus about the level of agreement in the team.

Decision making diversity. Three items measured different aspects of the taken-for-grantedness of team decision making processes. First, we assessed the degree to which each participant perceived team decision making to be an habitual, routine, activity. Berger and Luckmann (1967, p. 54) have pointed out that "Habitualization makes it unnecessary for each situation to be defined anew, step by step." To the extent that decision making in the team was

perceived by a participant to be part of a high consensus, institutionalized process, then the participant should perceive the decision making process as relatively easy rather than difficult. Participants were requested to: "Think about how difficult or easy it is for your MARKSTRAT organization to make decisions." The scale was anchored with the phrases "Very difficult to make decisions" and "Very easy to make decisions."

The second item concerned each individual's agreement with team decision making. The more consensus in the team over decisions, the more each individual should feel normative pressure to agree with the team decision (Zucker 1977, p. 737). We asked participants to "Think about your participation in the organization's decisions in the last session. Did you feel you should agree with the decisions reached by your MARKSTRAT organization?" The scale was anchored with the phrases "No -- I felt that I could disagree" and "Yes -- I felt that I should agree."

Third, we assessed perceptions of role specialization in the team. As Berger and Luckmann (1967, p. 74) have emphasized, "the construction of role typologies is a necessary correlate of the institutionalization of conduct." Before team members can function as an organization, it may be necessary to agree among themselves on a division of labor. Managers were asked to indicate approximately how specialized the members of the MARKSTRAT organization were, with the scale anchored with the phrases "No person has a specialized role to play" and "Each person has a specialized role to play."

Structural diversity. Two questions assessed perceptions of team structure. The first item related to the distribution of power in the organization. An important aspect of consensus in organizations concerns the taken-for-grantedness of authority relations. The higher the consensus, the more difficult it becomes to challenge the existing order of things (cf. Garfinkel 1967). Managers were asked to estimate how easy it would be to challenge the decision making power of the dominant members. The scale was anchored with the phrases "Very easy to

challenge decision making power of dominant members" and "Very hard to challenge decision making power of dominant members."

Second, increasing consensus was expected to increase the taken-for-grantedness of organizational procedures, thus making it more difficult to imagine ways to improve effectiveness. Each manager was asked whether there were some obvious ways in which the MARKSTRAT organization could be run more effectively, with the end points of the 7 point scale anchored with the phrases: "Yes -- there are many ways to increase effectiveness" and "No -- there are few ways to increase effectiveness."

Demographic diversity

We measured three demographic diversity variables -- national heterogeneity, functional heterogeneity and age heterogeneity -- that prior literature suggested as important.

ANALYSIS

All variables were measured at the team level of analysis. The performance variables were measures of how well each team had performed. The diversity variables were calculated as heterogeneity within each organizational team as follows.

For the two categorical demographic variables (nationality heterogeneity and functional heterogeneity), Blau's (1970) index of heterogeneity was computed (see Jackson et al, 1991, for the formula and a recent example of its use). This index can vary from 0 (indicating all team members are the same) to a high of 1 (indicating all team members are different).

The other diversity measures (including age heterogeneity and the cognitive diversity measures) were calculated for each team as the coefficient of variation (i.e., standard deviation divided by the mean). This is a scale-invariant measure judged to be superior in its psychometric properties to other measures such as the standard deviation (Allison 1978).

The effects of diversity on performance were investigated using ordinary least squares multiple regression.

Validity of cognitive diversity measures

For the cognitive diversity measures we investigated the validity of the composite variables we constructed on the basis of exploratory factor analysis. Validity refers to whether the constructs measure what they are intended to. In particular, construct validity can be established by showing that the measures relate to "other measures consistent with theoretically derived hypotheses concerning the concepts (or constructs) that are being measured" (Carmines and Zeller 1979, p. 23). In the current research, we expected differences in cognitive diversity in the early stages of the MARKSTRAT simulation between those teams that took over firms with advantageous starting positions compared to those teams that took over firms with disadvantageous starting positions.

First, we expected more decision making conflict (and therefore more decision making diversity) in teams that found themselves running relatively poorly performing firms. A team that takes over a relatively poorly performing firm faces a more difficult decision making situation than a team that takes over a relatively well-performing firm. The poorly performing firm must consider more alternatives in the same amount of time and this more difficult decision process will tend to lead to conflict between individuals with differing viewpoints and perceptions (March and Simon 1958).

Second, we expected that teams taking over poorly performing firms would experience more structural conflict than teams taking over relatively high performing firms. In poorly performing firms, we can expect a more unsettled internal environment concerning power relations and roles. As Thompson (1967) suggested, increased performance pressures from the environment tend to cause increased conflict within the decision making team concerning roles and power relations.

Third, we expected that teams taking over poorly performing firms would tend to engage in more explicit discussions concerning performance results, thus revealing to the team the diversity of perceptions concerning interpretations of these results and producing more consensus than in high performing firms. In high performing firms, "people are not pressed to articulate their individual understanding" of performance results and thus retain more interpretative ambiguity (Weick 1995, p. 120).

Table 1 about here

Table 1 shows the effects of advantageous and disadvantageous starting position on the performance and cognitive diversity measures. First, note that the firms we labelled as advantaged achieved significantly higher performance than firms we labelled as disadvantaged. The effects of an advantageous starting position significantly influenced early net marketing contribution change ($t = -5.734$, $p < .001$), cumulative net marketing contribution ($t = -4.897$, $p < .001$) and final market share ($t = -3.456$, $p < .05$). There was no significant difference between advantaged and disadvantaged firms in how well they improved their market share over the course of the game.

Second, for the cognitive diversity measures, Table 3 shows that advantaged firms early in the game had, as expected, significantly lower decision diversity ($t = 2.772$, $p < .01$) and significantly higher interpretative ambiguity ($t = -2.002$, $p < .06$). The perception of structural diversity mean was higher in the disadvantaged firm, as predicted, but the difference did not reach significance. Looking at the three cognitive diversity measures as a set, firm starting position had a significant overall effect in a MANOVA analysis, controlling for firm size (Wilks'

Lambda = 3.57, $p < .05$). The cognitive diversity measures, therefore, appear to have acceptable construct validity.

Table 2 about here

RESULTS

Table 2 shows the descriptive statistics for the variables in this study, including minimum and maximum values. This table shows that teams differed greatly both with respect to how much market share was gained and lost, as well with respect to final success or failure in the industry. The diversity measures show considerable variance across teams.

Table 3 about here

Table 3 presents the correlations between the variables. Of interest is the significant negative correlation between team size and national heterogeneity, reflecting the fact that some of the most heterogenous groups happened to contain the least people. None of the demographic diversity measures were significantly correlated with the cognitive diversity measures.

Table 4 about here

Table 4 addresses the first hypothesis, which suggested that demographic diversity would predict cognitive diversity. Looking first at the three models showing the effects on early cognitive diversity, we find no support for this hypothesis: There were no significant

relationships between the demographic diversity variables and cognitive diversity. Evidently teams that were heterogenous on age, functional background, or national origin were no more cognitively diverse early in the game than teams less heterogenous on these demographic indicators.

The last three columns of Table 4 show the situation near the end of the simulation. None of the models were significant and therefore there is no support for the hypothesized relationship between demographic and cognitive diversity.

Table 5 about here

Hypotheses 2, 3 and 4 stated that aspects of top management team cognitive diversity would relate to firm performance. Table 5 shows the results of cognitive diversity on performance early in the life of the team, whereas Table 6 shows the parallel results of cognitive diversity on the final outcomes of the simulation. We controlled for possible effects of top management team size, firm starting position and demographic diversity.

Looking first at Table 5, as expected, in this early stage of the game (the second round), firm starting position was the most significant predictor of how well the firms did. Looking at model 3 in Table 5, where all the diversity variables are entered together, we see that the only diversity variable to explain significant variance was structural dissensus: the more dissensus, the worse the performance of the firm (beta = -.246, $p < .05$). Thus, Table 5 offers support to hypothesis 4, but no support to hypotheses 2 and 3.

Table 5 also shows that a marginally significant effect of functional heterogeneity disappeared when the cognitive diversity variables were entered into the regression. Evidently, the cognitive diversity variables (and in particular decision diversity) picked up some of the variance explained by functional heterogeneity. What is striking about the model 3 results in

Table 5 is that the demographic diversity variables had no significant effects on early firm performance. It didn't matter whether teams were composed of diverse kinds of people or not.

Table 6 about here

Table 6 details the effects of diversity on the final performance of firms in the simulation. All of the models explained significant amounts of variance, with adjusted r-squares ranging from 25 to 54 percent. Immediately apparent is the continued importance of starting position: Firms that started advantageously concluded the game with significantly higher market share and revenues than firms that started the game in disadvantageous positions. For the demographic diversity measures, only age heterogeneity affected overall performance: the greater the age diversity of the team, the greater the market share (beta = .457, $p < .05$) and the greater the profitability (beta = 533.187, $p < .05$).

Hypotheses 2, 3 and 4 concerned the effects of cognitive diversity on performance. Only hypothesis 2 was supported: As Table 6 shows, the greater the interpretative ambiguity of the team early in the game, the higher the final performance in terms of both market share (beta = .286, $p < .05$) and profits (beta = 376.588, $p < .05$).

Although the two measures of final performance considered in Table 6 are conceptually distinct, Table 3 shows that they were highly correlated in this study. The question arises, therefore, whether interpretative ambiguity and age heterogeneity had overall effects on the two final performance measures considered as a set. Using a MANOVA multivariate test (SAS Institute 1989) that reported Wilks' Lambda, we found that both interpretative ambiguity ($F = 3.53$, $p < .05$) and age heterogeneity ($F = 2.71$, $p < .10$) significantly affected the set of two dependent performance variables.

Table 7 about here

Hypothesis 5 suggested that top management team cognitive diversity would be positively affected by increases in firm performance. Table 7 shows support for this prediction for two of the three cognitive diversity measures. Teams that improved their performance early in the game tended to show increased diversity concerning perceptions of team decision making and structure over the course of the game, but there was a non-significant negative effect of performance change on change in interpretative ambiguity. A Manova multivariate test using the Wilks' Lambda criterion showed an overall effect of performance change on cognitive diversity change ($F = 5.30$, $df = 3, 29$, $p < .01$). (Note that for this analysis, focused on the effects of performance change on cognitive diversity change, to preserve the power of the analyses, we included other variables as controls only if they were significant at $p < .25$ in at least one of the regressions.)

Table 8 about here

Table 8 shows the effects of demographic diversity and changing cognitive diversity on the degree to which firms improved their overall market share during the course of the simulation. This was an exploratory analysis for which we formulated no hypotheses. Looking at model 3, in which all variables are entered, we see that demographic diversity did have marginally significant effects: Teams that were more heterogenous with respect to functional backgrounds and national origins tended to show bigger market share gains ($p < .10$). Looking at the cognitive diversity measures, we see that increasing interpretative ambiguity was associated with loss of market share over the course of the game (beta = -.204, $p < .01$). A closer

investigation of this result showed that all 6 firms with market share changes 1 standard deviation below the mean showed increases in interpretative ambiguity over the course of the simulation. For those 19 firms that showed positive market share gains, 13 of them showed a reduction in interpretative ambiguity.

DISCUSSION

The results cast doubt on the thesis that teams composed of people of diverse nationality, functional background, or age (relative to more homogenous teams) are likely to be more diverse in terms of their cognitive processes. There was no evidence for an effect of demographic diversity on measures of cognitive diversity in these decision making teams.

One possible reason why demographic diversity may have failed to affect measures of cognitive diversity relates to the competitive nature of the MARKSTRAT business simulation. To the extent that people within a team are driven by the goal of maximizing performance relative to other teams, the social group origins of team members may fade in importance. A team, such as the 1996 Chicago Bulls basketball team, characterized by national, ethnic and age heterogeneity, may be held together in part by the fierce inter-team rivalry of professional sports. Previous research and theory has suggested that superordinate goals can bring people from diverse social groups together (Sherif, Harvey, White, Hood and Sherif 1961; see the discussion in Coser 1956). Thus team members may have focused on their competitive goals rather than on their national, functional, or age differences. This suggests that the effects of demographic diversity on cognitive diversity may be minimized for teams facing external competition.

It is also possible that the effects of demographic diversity on cognitive diversity may take more time to appear than was available in this simulation. People may initially strive to harmonize their thinking with that of their new teammates. But after this initial honeymoon period, people may become more comfortable relying on thought-patterns characteristic of

particular age-cohorts, national cultures, or functional specialties. (See, however, a contrary argument in Pelled 1996, p. 623.)

The hypotheses concerning the effects of cognitive diversity on firm performance received mixed support. There was no evidence that diversity concerning decision making norms had any effect on firm performance. Dissensus concerning how the team was structured, however, tended to be associated with low firm performance early in the simulation, but such dissensus had no lasting effects on overall firm performance.

Interpretative ambiguity emerged as the key cognitive diversity measure that differentiated successful versus unsuccessful teams. Interpretative ambiguity among team members early in the game predicted overall performance of the firms. An exploratory analysis showed that teams that ended the simulation with high performance tended to reduce the degree of ambiguity over the course of the simulation, even though they tended to start out with high interpretative ambiguity. Exactly the opposite pattern was observed for low-performing teams. Thus, successful and unsuccessful teams showed quite different patterns of ambiguity management over the course of the simulation.

Gersick (1990, p. 103), in her qualitative analysis of two project groups, suggested that the successful team tended in the early meetings to operate with implicit understandings that were not openly discussed or challenged. In our terms, this absence of explicit discussion tends to preserve high levels of interpretative ambiguity. Her observations of a less successful group showed the members spending considerable time during the early meetings to explicitly outline their varying positions on important issues, thus, in our terms, reducing interpretative ambiguity. Gersick suggested that all groups tend to undergo predictable transitions in the course of their life-cycles, but that groups' trajectories can vary. Our research suggests that the team's management of interpretative ambiguity over the course of the life-cycle can be a major factor affecting performance outcomes.

Further, the current research suggests that diversity variables important for early performance were different from those important for final performance, strongly implying that different types of diversity may come into play at different stages in the life cycle of the team. Certainly, future work should examine in greater detail the time-related effects of team diversity.

The only demographic diversity measure to affect overall performance was age heterogeneity. Paradoxically, the greater the diversity of team members' ages, the better the teams performed. This result is strikingly different from previous research that has reported generally negative effects of age diversity in groups (see the review in Milliken and Martins 1996), although there have been few if any direct tests of top management age diversity on firm performance. Recent research by Hambrick, Cho and Chen (1996) found positive results of top management team heterogeneity on firm performance, although they did not measure age heterogeneity. Their results from the real world paralleled the results from this simulation in showing that top management team heterogeneity had significantly positive effects both on growth in market share and growth in profits. According to Hambrick et al (1996, p. 665), the heterogenous team has a broad potential behavioral repertoire and is able to "conceive and launch actions on many fronts." From this perspective, demographic heterogeneity may well complement rather than determine cognitive heterogeneity. In other words, teams heterogenous on demographic variables may be better able to build on the diverse experience base of the team to validate diverse cognitions and thus take advantage of innovative suggestions. Compatible with the Hambrick et al (1996) suggestion is the evidence in Table 6 that the greater the national and functional heterogeneity of the team, the more likely the team was to improve its market share over the course of the simulation.

Not only did diversity affect performance; as predicted, there was a reciprocal effect of performance outcomes on changes in team cognitive diversity. Teams with improving performance tended to exhibit increasing diversity concerning perceptions of team decision

making and team structuring, suggesting a certain creative ferment and flexibility in the micro-environments of high-performing teams.

The current research is limited in looking at a relatively small number of highly competitive teams engaged in a simulation of real-world decision making. Fortunately, the realism of the MARKSTRAT world is high (Dodgson 1987, Remus 1978) and the players in the current research were all practicing managers from the private sector familiar with decision processes in competitive firms. Future research can extend the preliminary results in this study by examining decision making teams in the field rather than in the laboratory. One arena for which both demographic and performance data is readily available is professional sports.

In using the results in this paper as a basis for further research, attention should be paid to the relatively small number of teams relative to the large number of regressors. The statistical tests, in particular, may be unstable given the low power of the study. We have tried to overcome possible instability by using composite variables and by testing hypotheses with several different dependent variables. Thus, the significant effects of interpretative ambiguity on performance show up whether the performance dependent variable is market share, profitability, or change in market share.

Top decision makers face environments rich with ambiguity, but operate in organizations that are typically in thrall to purpose, consistency and rationality (Cohen and March 1986). Keeping alive possibilities for diverse and contrary thinking becomes, therefore, a difficult challenge. The current research suggests that simply assembling a demographically diverse team will not, in itself, assure cognitive diversity. We saw that successful teams tended to manage themselves so as to allow interpretative ambiguity to flourish in the early stages of project life-cycles, moving toward more interpretative clarity in the later stages. This cycle of ambiguity and clarity may represent one dynamic solution to the twin problems of impoverished sensemaking on the one hand and uncoordinated activity on the other.

One of the major tasks of management is to manage cognitive diversity so as to maintain within teams rich possibilities for sensemaking while at the same time promoting coordinated work. How can teams foster both equivocality and mutual understanding? The answer from the present research is to take advantage of the natural cycle of work: in the beginning let ambiguity flourish; in the end, strive for heedful interrelating.

FOOTNOTE

[1] We also checked to ensure that the results of hypothesis tests were not artifacts of the particular factor analysis technique we used. We ran all tests on the complete set of variables (including all 6 cognitive diversity measures) using a forward selection procedure that included in the regression models only those variables that met a significance level of $p < .5$. The forward selection procedure preserved the power of the analyses (just as the factor analysis did) by reducing the number of variables. The results of the analyses based on forward selection closely matched those that included composite variables derived from factor analysis. In particular, the pattern of results concerning the demographic diversity variables (such as age diversity) and cognitive diversity variables (such as interpretative ambiguity) were remarkably similar irrespective of whether factor analytic or forward selection variable reduction techniques were used. For clarity of presentation, we preferred to present results based on composite variables rather than forward selection.

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TABLE 1

Effects of Firm Starting Position

Variables	Starting Position: Advantageous	Starting Position: Disadvantageous	t
Performance Means (and Standard Deviations)			
Early Net Marketing Contribution	2.03 (.271)	1.54 (.231)	-5.734***
Market Share	0.234 (.100)	.149 (.044)	-3.456**
Cumulative Net Marketing Contrib.	339.086 (122.684)	159.764 (73.765)	-4.897***
Overall Market Share Change	-.012 (.087)	-.016 (.041)	1.312
Early Cognitive Diversity Means (and Standard Deviations)			
Decision	.516 (.274)	.768 (.248)	2.772*
Structure	1.146 (.337)	1.211 (.482)	.476
Ambiguity	.193 (.144)	.118 (.077)	-2.002+

Note: N = 35 firms.

+ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

TABLE 2

Descriptive Statistics

Variables	Mean	S.D.	Median	Minimum	Maximum
1. Market Share Change	-.00	.07	.01	-.18	.23
2. Early NMC Change[a]	1.84	.35	1.92	1.23	2.93
3. Final Market Share	.20	.09	.20	.04	.50
4. CNMC[b]	267.36	137.40	242.40	56.60	606.000
5. Size	4.23	.73	4	3	5
6. Starting Position				1	2
Demographic Diversity					
7. National	.37	.28	.38	0	.75
8. Functional	.63	.12	.64	.32	.80
9. Age	.13	.07	.10	.03	.35
Early Cognitive Diversity					
10. Decision	.62	.29	.67	.01	1.17
11. Structure	1.17	.40	1.21	.34	1.99
12. Ambiguity	.16	.13	.14	0	.49
Late Cognitive Diversity					
13. Decision	.68	.27	.69	.11	1.28
14. Structure	1.08	.39	1.07	.19	2.07
15. Ambiguity	.19	.13	.16	0	.45

Note: N = 35 firms.

[a] Net marketing contribution change.

[b] Cumulative net marketing contribution.

TABLE 3

Intercorrelations Among Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Market Share Change														
2. Early NMC Change[a]	-.21													
3. Final Market Share	.67***	.38*												
4. CNMC[b]	.37*	.56***	.88***											
5. Size	-.00	-.21	-.04	-.15										
6. Starting Position	-.31	.72***	.53**	.67***	.06									
7. National	.34*	-.05	.16	.15	-.40*	-.10								
8. Functional	.07	-.30	-.01	-.15	.31	-.05	-.24							
9. Age	.30	-.17	.25	.16	-.08	-.07	.21	-.09						
Early Cognitive Diversity														
10. Decision	.16	-.34*	-.19	-.38*	.28	-.42*	.06	.22	.22					
11. Structure	.26	-.35*	.13	.10	-.07	- .08	.28	.13	.20	.04				
12. Ambiguity	.25	.27	.44**	.50**	-.22	.26	.18	-.28	-.07	-.11	-.02			
Late Cognitive Diversity														
13. Decision	-.08	.09	.05	.02	.13	.00	-.21	.31	-.15	.26	.25	-.09		
14. Structure	.04	.05	.04	.06	.07	.13	.26	.14	-.08	.09	.41*	-.16	.39*	
15. Ambiguity	-.42*	-.13	-.42*	-.31	-.18	-.01	.04	.24	-.28	.02	-.08	-.15	.03	.24

Note: N = 35 firms; [a] Net marketing contribution change; [b] Cumulative net marketing contribution.

* $p < .05$; ** $p < .01$; *** $p < .001$.

TABLE 4

Effects of Demographic Diversity on Cognitive Diversity

	Cognitive Diversity					
	Early			Late		
	Decision	Structure	Ambiguity	Decision	Structure	Ambiguity
Size	.105	-.002	-.014	-.006	.095	-.050
	(.068)	(.105)	(.032)	(.073)	(.100)	(.034)
Start. Pos	.213*	.005	-.074+	.010	-.154	.014
	(.092)	(.141)	(.043)	(.098)	(.134)	(.046)
Demographic Diversity						
National	.113	.411	.069	-.128	.587*	.025
	(.177)	(.271)	(.084)	(.189)	(.258)	(.088)
Functional	.386	.684	-.212	.597	.609	
	(.383)	(.589)	(.182)	(.409)	(.560)	(.191)
Age	.734	.903	-.150	-.400	-.623	-.558+
	(.650)	(.999)	(.308)	(.694)	(.949)	(.324)
Model F	2.70*	.97	1.40	.82	1.35	1.51
Adj. R^2	.20	.00	.06	.00	.05	.07
Root MSE	.26	.40	.12	.28	.38	.13
DF	5,29	5,29	5,29	5,29	5,29	5,29

Note: n = 35 firms; the table shows unstandardized betas (with standard errors in parentheses).

+ $p < .10$

** $p < .05$

TABLE 5

Effects of Diversity on Early Net Marketing Contribution Change

Variable	Model 1	Model 2	Model 3
Size	-.054	-.088	-.063
	(.065)	(.060)	(.066)
Starting Position	-.462**	-.459**	-.482**
	(.088)	(.096)	(.097)
Demographic Diversity			
National	-.056		.043
	(.169)		(.172)
Functional	-.742+		-.618
	(.367)		(.379)
Age	-.475		-.316
	(.622)		(.627)
Early Cognitive Diversity			
Decision		-.009	.071
		(.165)	(.174)
Structure		-.276*	-.246*
		(.104)	(.112)
Ambiguity		.094	-.078
		(.348)	(.364)
Overall Model F	7.91**	8.96**	5.97**
Adj R^2	.50	.54	.54
Root MSE	.25	.24	.24
Degrees of Freedom	5,29	5,29	8,26

Note: N = 35 firms; the table shows unstandardized betas (with standard errors in parentheses).

+ $p < .10$; * $p < .05$; ** $p < .01$.

TABLE 6

Effects of Diversity on Final Organizational Performance

	Market Share			Cum. Net Marketing Contrib.		
	Model			Model		
Variable	1	2	3	1	2	3
Size	.011	.010	.020	.742	-.047	16.916
	(.021)	(.020)	(.021)	(27.023)	(28.864)	(25.822)
Starting	-.101**	-.068*	-.070*	-195.448**	-139.804**	-145.623**
Position	(.028)	(.032)	(.031)	(36.216)	(39.675)	(38.093)
Demographic Diversity						
National	.075		.056	97.809		74.731
	(.054)		(.054)	(69.767)		(67.339)
Functional	.050		.122	-54.125		50.751
	(.118)		(.119)	(151.458)		(148.058)
Age	.388+		.457*	420.255		533.187*
	(.200)		(.120)	(256.797)		(244.950)
Early Cognitive Diversity						
Decision		-.008	-.050		-60.110	-103.287
		(.055)	(.054)		(68.107)	(67.722)
Structure		.041	-.012		53.821	21.580
		(.035)	(.035)		(42.970)	(43.696)
Ambiguity		.260*	.286*		371.000*	376.588*
		(.117)	(.114)		144.168)	(142.318)
Model F	3.30*	3.19*	3.18*	6.55**	7.43**	6.01**
Adj. R^2	.25	.24	.34	.45	.49	.54
Root MSE	.08	.08	.07	101.96	98.52	93.07
DF	5,29	5,29	8,26	5,29	5,29	8,26

Note: N = 35 firms; the table shows unstandardized betas.

+ $p < .10$; * $p < .05$; ** $p < .01$.

TABLE 7

EFFECTS OF ORGANIZATIONAL PERFORMANCE CHANGE ON

TEAM COGNITIVE DIVERSITY CHANGE

	Cognitive Diversity Change		
	Decision	Structure	Ambiguity
Functional Diversity	.414	.396	.418
	(.472)	(.589)	(.279)
Age Diversity	-1.124	-1.165	-.443
	(.798)	(.995)	(.471)
Performance Change	.357*	.459*	-.117
(ENMCC)[a]	(.167)	(.208)	(.049)
Overall Model F	2.74+	2.53+	2.05
Adjusted R^2	.13	.12	.09
Root MSE	.32	.40	.19
Degrees of Freedom	3,31	3,31	3,31

Note. N = 35 firms. The table shows unstandardized betas (with standard errors in parentheses). Variables were included if they were significant at $p < .25$ in at least one of the regressions. Manova test for no overall Performance Change effect (Wilks' Lamda): $F = 5.30$, $df = 3, 29$, $p < .01$.

[a] Early Net Marketing Contribution Change

+ $p < .10$, * $p < .05$.