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RESEARCH NOTES AND COMMENTARIES

ENVIRONMENTAL DYNAMISM AND STRATEGIC DECISION-MAKING RATIONALITY: AN EXAMINATION AT THE DECISION LEVEL

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Several approaches have been used to explore environmental dynamism as a contingent predictor of the relationship between rational-comprehensive strategic decision-making and firm-level performance. At the decision level of analysis, however, small sample sizes, low statistical power, and statistical dependence have plagued the research. Through the use of a simulated decision-making environment and multilevel analysis, this study examined 400 decisions from 54 executive teams. Consistent with much of the existing firm-level research, the results indicated that environmental dynamism may moderate the relationship between rational-comprehensive decision making and decision quality. Surprisingly, the form of the relationship differed from much of the firm-level research.

Using the firm as the unit of analysis, researchers have explored environmental dynamism as a contingent predictor of the relationship between rational-comprehensive strategic decision-making (SDM) processes and firm performance (see review by Priem, Rasheed and Kotulic, 1995; Goll and Rasheed, 1997). However, relating decision processes directly to firm performance is problematic since the causal ordering is ambiguous, the relationship is likely to be confounded, and firm-level analyses often ask questions concerning the extent to which an organization uses rational decision processes (e.g., Glick, Miller and Huber, 1993; Goll and Rasheed, 1997; Priem *et al.*, 1995), thereby ignoring the possibility that decision-makers may vary their use of processes among specific decisions (Hickson *et al.*, 1986).

Examination at the decision level of analysis diminishes these concerns. First, causal ambiguity is not an issue since the decision-making process clearly precedes any evaluation of decision outcomes. Second, the relationship between process and outcome is more direct and therefore less likely to be confounded by exogenous factors. Third, decision-level analysis allows different processes for each decision, thereby eliminating assumptions that decision-makers consistently use specific processes across decisions or time. Therefore, this paper explores the contingent relationship between rationality and performance through examination of SDM at the decision level of analysis.

Key words: strategic decision-making; environmental dynamism; rationality; multilevel analysis
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THEORETICAL AND EMPIRICAL BACKGROUND

Rationality is the use of information for the purpose of selecting a sensible alternative in the pursuit of one's goals (Dean and Sharfman, 1993; Fredrickson, 1984). However, instead of focusing on the *choice* that maximizes expected utility, decision rationality focuses on the decision-making *process* (Simon, 1955). Derived from the synoptic (Lindblom, 1959), planning (Mintzberg, 1973), and rational (Miller and Friesen, 1984) schools of strategy making, decision rationality emphasizes the importance of analysis (Ansoff, 1965), the need for systematic scanning (Aguilar, 1967), and methodical planning and unification of strategies (Ansoff, 1965).

Rational decision-making research stresses analytic and integrative comprehensiveness. Analytic comprehensiveness is a decision-level concept that emphasizes systematic scanning and analysis of environments (Miller, 1987) in the process of making a particular decision. Integrative comprehensiveness, on the other hand, refers to the overall decision-making process and encourages the integration of decisions that compose the overall strategy (Fredrickson and Mitchell, 1984) through the use of formal planning efforts and precise conceptualization of overall strategies that facilitate the making of specific decisions (Miller, 1987). When overall processes are examined, both analytical and integrative comprehensiveness are included. Studies at the decision level of analysis, however, emphasize the scanning and analysis aspects of rationality associated with analytical comprehensiveness. Thus, Dean and Sharfman (1993: 1071) defined decision-level rationality as the 'extent to which the decision process involves the collection of information relevant to the decision and the reliance upon analysis of this information in making the choice.'

Firm-level research

Firm-level research on the relationship between rationality and performance in dynamic environments has produced conflicting results (Priem *et al.*, 1995). Studies by Fredrickson and colleagues suggest that rationality leads to lower levels of performance in dynamic environments (Fredrickson and Iaquinto, 1989; Fredrickson and Mitchell, 1984) yet supports higher performance in more stable environments (Fredrickson, 1984). The opposing perspective suggests that decision-makers faced with dynamic environments increase rationality by accelerating information collection and analysis so that decisions can be responsive to rapidly changing circumstances (Eisenhardt, 1989). In addition to evidence that rationality is associated with higher performance in dynamic environments, there is growing evidence that the relationship does not hold in moderate and stable environments (Glick *et al.*, 1993; Goll and Rasheed, 1997; Priem *et al.*, 1995).

Decision-level research

Only three studies have addressed the contingent effect of the environment on the relationship between rational-comprehensive processes and decision-level outcomes. Eisenhardt (1989) and Judge and Miller (1991) examined decision speed, while Dean and Sharfman (1996) studied decision effectiveness. Eisenhardt's examination of 10 decisions from eight firms concluded that simultaneous consideration of alternatives leads to speedier decisions in high-velocity environments. Extending these results to other environments, Judge and Miller argued that decision speed would be less important in the slower pace of the stable environment but found support for an overall positive relationship between alternative generation and decision speed that did not differ in form or strength across environments. Although they did not offer any explanation for the failure to support the hypothesized moderation, the sample size of 32 decisions provided limited power to detect such effects (Aguinis and Stone-Romero, 1997).

Dean and Sharfman (1996: 372) examined decision effectiveness or 'the extent to which a decision achieves the objectives established by management.' In a sample of 52 decisions from 24 firms, an overall significant effect between rationality and decision effectiveness was detected, while the moderating effect of environmental instability was not supported. Again, no explanations were offered for the discrepancy between these results and the hypothesized relationship, yet the small sample size rendered detection of a moderating effect unlikely. Furthermore, no provision was made for the statistical dependence of decisions made by the same firm.

Understanding how *decision-level* rational-comprehensive processes in different environmental contexts influences SDM quality remains elusive. Yet, the theoretical literature suggests that firm-level arguments connecting rationality to performance will transfer to the decision level of analysis. In particular, the use of rational processes in dynamic environments assists managers in identifying relevant opportunities and devising successful responses. In more stable environments, managers use existing information and mental models to formulate effective decisions.

Hypothesis: The environment will moderate the relationship between rationality and decision quality such that there will be a positive and significant relationship in dynamic environments and a nonsignificant relationship otherwise.

METHODS

The nonroutine nature of strategic decisions makes it difficult to generate large samples from field studies. Indeed, the largest sample size reported in a decision-level study of environmental moderation was 52 decisions. Yet, small sample sizes provide low power for the detection of moderating effects (Aguinis and Stone-Romero, 1997), perhaps contributing to the discrepancy between firm- and decision-level studies. Thus, methods that facilitate larger sample sizes and provide greater control are required to help untangle conflicting results.

Behavioral simulations offer a viable solution by controlling many potentially confounding variables while maintaining contextual relevance. Furthermore, simulations can be administered repeatedly to increase sample sizes and when conducted in the context of executive development programs produce samples from the population of interest. Simulations are designed to reproduce the behaviors of the real world (Dutton and Stumpf, 1991) and 'achieve parity in relevance' with studies conducted in natural contexts altered by the introduction of survey instruments (Gist, Hopper and Daniels, 1998: 259). Thus, behavioral simulations balance concerns of external and internal validity.

The Looking Glass Incorporated (LGI) behavioral simulation, designed by the Center for Creative Leadership as a SDM research environment (McCall and Lombardo, 1982), controls variables such as environment, size, structure, information availability, and decision content. The simulated organization is a $600 million, privately held glass manufacturer composed of three strategic business units (SBUs), each led by a top management team consisting of a Vice President, Director of Sales and Marketing, Director of Manufacturing, and Director of Product Development.

The 216 participants in this study were members of a *Fortune* 100, diversified technology company that generates approximately 50 percent of its revenue from the defense sector. The firm sent senior managers and executives to one of 18 executive development programs, which included participation in the LGI simulation. Following an LGI briefing, participants self-selected positions and received reports and memos pertaining to their job.[1] They were asked to spend at least 2 hours that evening preparing for a bimonthly, day-long staff meeting among managers of each SBU. Participants arrived the next morning to find offices available for their use as they analyzed information, conducted meetings, and made decisions to move the organization forward strategically. Ranging from the security of confidential information to the potential sale of a plant,[2] the embedded issues were designed by a panel of organization researchers and industry experts to meet the strategic decision descriptors of 'important,' 'ambiguous,' and 'complex' (cf. Mason and Mitroff, 1981; Mintzberg, Raisinghani and Theoret, 1976). Although participants were free to act upon all issues embedded within their division, they were constrained by the day-long meeting. Overall, 400 usable decisions were provided by the 18 replications.

Measures

In contrast to survey measures that ask for managers' perceptions, the measures in this study are based on factors designed into the simulation. Objective measures avoid the potential bias of retrospective accounts, while eliminating the need for decision-makers to project actions to future decisions.

[1] There was no evidence of systematic bias in the positions selected when participant age, occupational experience, and educational level were examined across simulated environments and simulated positions.

[2] For more detail regarding LGI, see McCall and Lombardo (1982). Chatman and Barsade (1995), Chatman *et al.* (1998), and Gibson (1999) used the scaled-down, University Edition of LGI for OB research.

Environmental context

While it has been argued that the environment is enacted by the firm's decision-makers (Weick, 1979) and thus should be measured as a managerial perception, others have shown convergence between perceptual and objective measures of environmental dynamism (Sharfman and Dean, 1991). Indeed, many studies of the contingent relationship between rationality and performance have defined the environment using objective criteria (e.g., Dean and Sharfman, 1996; Eisenhardt, 1989; Fredrickson, 1984; Fredrickson and Mitchell, 1984; Glick *et al*., 1993).

The external environments of the LGI SBUs were designed using Duncan's (1972) conceptualization of dynamic vs. static environments, which is consistent with objective measures of environmental instability uncovered by Dess and Beard (1984). LGI designers used customers, technology, markets, and competition to clearly differentiate SBU dynamism. Unpredictable markets, rapidly changing technology, and shifting competition characterize the dynamic environment of Advanced Products, which produces optical fibers, capacitors, and liquid crystal displays. In contrast, the stable environment of Commercial Glass has predictable markets, stable technology, and well-established competitive relationships in the market for incandescent and florescent lighting. The moderate environment of Industrial Glass, which produces automobile glass and specialty items such as insulated glass, exhibits a mixture of the factors from the other two environments (McCall and Lombardo, 1982).

Rational-comprehensive decision making

Unlike traditional field studies, simulated decision environments allow for the control of information where each participant begins with a known set of information, based on his or her position. At the conclusion of the simulation, participants indicate what information was known and what action, if any, was taken relative to *each* issue. While this discussion of the simulation refers to 'information,' it is important to understand the richness of the simulated context. Over 227 memos and reports provide internal and external data, identify alternative solutions to many issues, and analyze various problems and opportunities. Thus, a participant's 'knowledge' at the end of the simulation represents information known, alternatives recognized, and facts derived from analysis, which are indicative of analytical comprehensiveness.

Two different measures of decision-level rational-comprehensive decision making were examined: availability and pervasiveness. Availability captures the degree to which the available cues were known by the team when they made their decision. High availability indicates that the team had a great deal of knowledge about the issue. The level of availability is diminished when knowledge that was embedded in the start-up material goes undetected and/or when the team fails to seek knowledge that was only available from interaction with managers from another division or 'phantom' corporate support staff, who were available via phone during the course of the simulation. Availability was calculated as:

$$\text{Availability} = \frac{\text{Number of unique knowledge bits for this issue known within the team}}{\text{Number of knowledge bits available within the simulation for this issue}} * 100$$

The second measure of rational-comprehensive decision making was derived from Hollenbeck *et al.* (1995) to assess how widely knowledge is held within the team—in other words, to what extent were *all* team members informed of the available information. Since participants received memos and reports pertinent to their position within the division, team members began with different pieces of knowledge, which may or may not have overlapped with other team members. The measure was calculated as:

$$\text{Pervasiveness} = \frac{\text{Sum of the knowledge bits known by all team members}}{\text{Number of team members} * \text{Number of knowledge bits available}} * 100$$

Note that pervasiveness could be low while availability is high. This would occur if each member held a small, but unique, amount of the overall knowledge and would indicate the team's failure to engage in interactional processes such as dialectical inquiry and devil's advocacy that produce cognitive conflict and ultimately leads to higher-quality decisions (Schweiger and Sandberg, 1989). The two measures would be equivalent under two conditions: (1) no knowledge is held by any team member, and (2) the same knowledge is held by all team members. Condition one can not occur in the context of the simulated environment and condition two is unlikely.

Decision quality

Each LGI issue raises several possible alternatives with the selection of one or more alternatives constituting a decision. When the simulation was developed, LGI designers asked a panel of industry and academic experts to rate the quality of each potential alternative. Having an expert panel evaluate quality prior to the administration of the simulation reduced concerns of consistency and subjectivity. Discussing each issue to consensus, the panel identified each alternative as good, poor, or indifferent. Raters assigned values ranging from 1 to 10 indicating the extent to which the alternative was 'good' or 'poor,' with 10 representing the best or worst possible score and 0 representing indifference. Summing the number of good and poor points across alternatives for a given decision yields:

$$\text{Decision quality} = \frac{\begin{array}{c}(\text{Number of good points}-\\ \text{Number of poor points})\end{array}}{\text{Total possible good points}} * 100$$

For a decision where *all good* alternatives are selected, quality equals 100. When the number of poor points exceeds the number of good points, quality is negative.

Analysis

With 54 teams making 400 decisions, the observations are not independent, thereby suggesting the use of multilevel analysis. However, the data do not follow a strict nested structure. Instead the design is cross-classified (Goldstein, 1995) where decisions occur within teams and within issues. That is, each decision was made by one of 54 teams and represents one of the 37 issues embedded in the simulation. Thus, teams and issues are treated as random effects so that between-team and between-decision variation can be controlled. Decision quality and both measures of rationality occur at the decision level and are treated as fixed effects. MLwiN software was used to fit the cross-classified, multilevel model.

RESULTS

The unconditional means model (i.e., a one-way analysis of variance model partitioning outcome variance into within and between components) indicates that the between-team variation is not significant ($\tau = 28.87$, $p = 0.13$). Yet the significant between issue (i.e., decision) variance ($\tau = 168.52$, $p = 0.002$) confirms the need for multilevel analysis (Pollack, 1998). With a residual variance of 713.22, the proportion of total variance occurring between issues is $\rho = 0.19$ $[168.52/(28.87 + 168.52 + 713.22)]$.[3]

The interaction hypothesis was examined by allowing teams and issues to vary randomly while specifying the main effects for rationality, the environment, and the associated interactions as fixed effects (Table 1). Comparing the residual variance from the unconditional model to the residual variance of the full model indicates that the level 1 variance in decision quality accounted for by rational-comprehensive decision making, the environment, and the interactions is 0.033 (i.e., (713.22 -689.81)/713.22). While small, this effect size is not inconsistent with firm-level studies (e.g., $R^2 = 0.00$ to 0.09, Glick *et al.*, 1993; $R^2 = 0.07$ to 0.15, Priem *et al.*, 1995).[4]

The coefficients for the interaction between availability and the dynamic and moderate environments are not significant. This indicates that the slope of availability in the dynamic environment given pervasiveness does not differ from the slope in the stable environment ($p = 0.80$), nor do the slopes differ between the moderate and stable environments ($p = 0.73$). Further analysis indicates that the slopes do not differ between the dynamic and moderate environments ($p = 0.54$). However, the pervasiveness by dynamic interaction was significant ($p =$

[3] Correlation between: decision quality ($\mu = 33.0$, S.D. = 30.2) and availability ($\mu = 89.6$, S.D. = 14.5) $r = 0.01$ ($p = 0.8$); decision quality and pervasiveness ($\mu = 51.6$, S.D. = 14.4) $r = 0.04$ ($p = 0.4$); availability and pervasiveness $r = 0.66$ ($p < 0.001$).

[4] Studies reporting larger effect sizes have included other predictors beyond rationality and environmental dynamism (e.g., political behavior, favorability, and quality of implementation, Dean and Sharfman, 1996).

Table 1. Multilevel analysis of decision quality

Fixed effects	Coefficient	S.E.	t-ratio	p-value
Intercept	25.29	4.55	5.56	<0.0001**
Availability[a]	0.06	0.27	0.21	0.834
Pervasiveness[a]	0.58	0.30	1.90	0.058†
Dynamic environment[b]	3.81	6.42	0.59	0.556
Moderate environment[b]	14.07	6.23	2.26	0.031*
Availability × Dynamic	−0.09	0.38	0.25	0.803
Availability × Moderate	0.13	0.37	0.35	0.727
Pervasiveness × Dynamic	−0.77	0.41	1.87	0.062†
Pervasiveness × Moderate	−0.31	0.40	0.78	0.436
Random effects	Variance component	S.E.	Z-value	p-value
Team	21.42	23.71	0.90	0.184
Issue	152.45	52.49	2.90	0.002**
Error	689.81			

† $p \le 0.10$; * $p \le 0.05$; ** $p \le 0.01$.
[a] Variables were group mean centered by team.
[b] Dummy variables were used to denote environments. When both the dynamic and moderate environment dummies were zero, the environment was stable.

0.06), suggesting that the slope for pervasiveness given availability does differ between the dynamic and stable environments. The simple slope for pervasiveness in the stable environment is positive ($b = 0.58$, $p = 0.06$), indicating that decision quality increases as pervasiveness increases. In both the dynamic ($b = -0.19$, $p = 0.49$) and moderate environments ($b = 0.26$, $p = 0.31$), however, decision quality is not significantly related to pervasiveness.

Thus, controlling for the pervasiveness of information, the relationship between availability and decision quality is not contingent on the environment (Figure 1a). However, controlling for availability, the relationship between pervasiveness and decision quality is moderated by the environment (Figure 1b). In particular, controlling for the amount of unique knowledge held by decision-makers in stable environments, higher-quality decisions result from ensuring that all decision-makers are well informed. In moderate and dynamic environments, however, pervasiveness is not related to decision quality when controlling for availability. This pattern of results differs from the predicted positive relationship in the dynamic environment and nonsignificant relationship in moderate and stable environments.

To avoid criticisms of accepting the null, Frick (1995) suggested that researchers demonstrate that (a) the hypothesized predictor explains the hypothesized outcome in a related situation, or (b) the hypothesized predictor explains a different outcome. In this study, the observed null effect in the dynamic and moderate environments is strengthened by significance in the stable environment, which is consistent with the original theory proposed by Fredrickson (1984). Furthermore, the increased power of this study improved the chances of detecting moderating effects. The null effects find further support through examination of rationality's effect on a different, but related outcome: whether a decision is actually made. Decision-makers were presented with a number of issues, many of which had to be ignored due to time constraints. Since quality could be measured only for those issues that were acted upon, only those observations could be included in the main study. However, measures of rationality were available for the 'nondecisions.' Therefore, a logistic regression model using rationality to predict decision vs. nondecision was tested, resulting in 63 percent of the issues being correctly classified ($\chi^2 = 68.7$, d.f. $= 8$, $p < 0.0001$). Thus, using the suggestions of Frick (1995), the conclusion of no effects in the dynamic and moderate environments seems plausible.

DISCUSSION AND CONCLUSIONS

Although these results are inconsistent with recent studies of firm-level effects, they are consistent with the theoretical development and empirical evidence of Fredrickson (1984) and Fredrickson and Iaquinto (1989), who argued that rational processes cannot change the uncertainty of the dynamic environment. By definition, factors within the dynamic environment are in a state of change, relationships are ambiguous, and the future is unpredictable (Duncan, 1972). Because of this inherent uncertainty, rational processes provide little assistance to decision-makers. Indeed, new but contradictory information may actually slow the decision-making process and negatively impact performance (Eisenhardt, 1989). Furthermore, the frequent opportunities provided by the rapid pace of the dynamic environment may diminish the need to ensure that each decision is fully rational. In more stable environments, however,

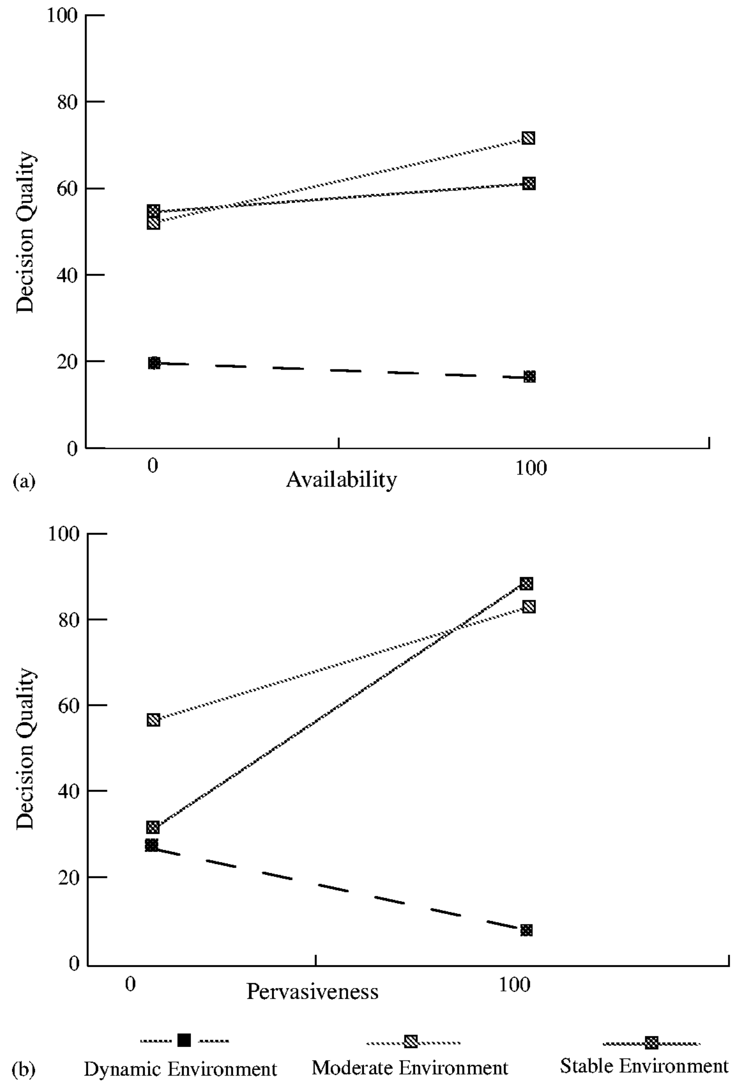

Figure 1. Moderating effects of environment at average levels of (a) pervasiveness and (b) availability

decision-makers can identify the critical variables. As a result, rational processes are used to gather information, facilitate cognitive conflict within the team, update cognitive schemas, and ultimately to increase decision quality (Schweiger and Sandberg, 1989). The slower pace of change causes each decision to be critical in maintaining strategic position.

In addition to these findings, this study highlights the benefit of using an alternative research context and analyzing the data using a methodology that acknowledges the multilevel nature of SDM data structures. The use of a behavioral simulation offered a unique opportunity to examine strategic decision-making at the decision level of analysis, thereby (a) diminishing firm-level concerns of causal ambiguity between process and outcome, (b) controlling potentially confounding variables such as environment, organization, and decision contexts, (c) allowing decision processes to vary from decision to decision, and (d) providing an opportunity to gather larger sample sizes and increase the power of detecting moderating effects.

By using multilevel techniques to accurately account for the statistical dependence of different decisions made by the same team, this research suggests that 19 percent of the variation in decision quality is explained by the differences between decisions. Thus, conflicting results in the existing literature may be the result of assuming that organizations have central tendencies with respect to rational-comprehensive decision processes (e.g., Glick *et al.*, 1993; Goll and Rasheed, 1997; Miller and Friesen, 1983; Priem *et al.*, 1995).[5] Instead, differences may exist based on factors such as decision criticality, complexity, decision motive, urgency, frequency, information source, and problem classification (Hickson *et al.*, 1986; Papadakis, Lioukas, and Chambers, 1998; Rajagopalan *et al.*, 1998). Similarly, decisions within the same general environmental context may not be subject to precisely the same conditions. For example, the customers within the manufacturing subenvironment may be relatively stable, while technology is dynamic.

Yet, SDM research should be expanded beyond the linear, contextual view. Examining decision processes in light of contextual factors such as environmental dynamism provides an incomplete, and perhaps inaccurate, picture of SDM. Integrative models such as Rajagopalan *et al.*'s (1998) multitheoretic model of SDM should be used to simultaneously examine the effects of the context, managerial actions, and manager cognitions. Such approaches allow for the explicit consideration of the cognitive schemas used by managers in strategic decision-making processes and may be the key to understanding why decision processes differ between environmental contexts. Behavioral simulations in conjunction with multilevel analysis techniques offer one avenue for researchers to explore these more complex models.

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[5] Although Fredrickson and Mitchell (1984) did demonstrate a significant correlation between the process used on a decision scenario and responses to questions concerning how the participant's firm *usually* makes decisions, others have found that decision processes do differ based on the decision context (Hickson *et al.*, 1986; Papadakis *et al.*, 1998).

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