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Research Articles

Examining the Implications of Process and Choice for Strategic Decision Making Effectiveness

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ABSTRACT

Most strategic decision-making (SDM) approaches advocate the importance of decision-making processes and response choices for obtaining effective outcomes. Modern decision-making support system (DMSS) technology is often also needed for complex SDM, with recent research calling for more integrative DMSS approaches. However, scholars tend to take disintegrated approaches and disagree on whether rational or political decision-making processes result in more effective decision outcomes. In this study, the authors examine these issues by first exploring some of the competing theoretical arguments for the process-choice-effectiveness relationship, and then test these relationships empirically using data from a crisis response training exercise using an intelligent agent-based DMSS. In contrast to prior research, findings indicate that rational decision processes are not effective in crisis contexts, and that political decision processes may negatively influence both response choice and decision effectiveness. These results offer empirical evidence to confirm prior unsupported arguments that response choice is an important mediating factor between the decision-making process and its effectiveness. The authors conclude with a discussion of the implications of these findings and the application of agent-based simulation DMSS technologies for academic research and practice.

Keywords: *Agent Software, Agent Technology, Decision Support Systems (DSS), Distributed Decision-Making Systems, Knowledge Management, Security Management, Strategic Planning*

INTRODUCTION

Strategic decision-making (SDM) involves the methods and practices organizations use to interpret opportunities and threats in the environment and then make response decisions (Shrivastava & Grant, 1985). Modern decision-making support system (DMSS) technology is often also needed for complex SDM, with recent research calling for more integrative DMSS approaches (Mora, Forgionne, Cervantes, Garrido, Gupta, & Gelman, 2005; Phillips-Wren, Mora, Forgionne, & Gupta, 2009). Such DMSS technologies offer the type of rich and powerful research technology platforms with a high degree of external and internal validity as well as reliability required for integrated decision support (Mora et al., 2005; Liu, Duffy, Whit-

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field, Boyle, & McKenna, 2009; Linebarger, De Spain, McDonald, Spencer, & Cloutier, 2009; Mostashari & Sussman, 2009; Phillips-Wren et al., 2009).

Conditions of uncertainty in highly turbulent environments (e.g., crisis response), by nature, further complicate the SDM process, and may limit decision making effectiveness (Ramirez-Marquez & Farr, 2009). At issue is the presumed need for speed of response where logic dictates that a satisfactory decision that is made quickly is superior to an optimal decision made too late. Two of the most commonly accepted, and widely employed decision making processes in these contexts are political behavior and procedural rationality (Fredrickson & Mitchell, 1984; Hart, 1992; Eisenhardt & Zbaracki, 1992; Dean & Sharfman, 1993; Hart & Banbury, 1994; Radner, 2000; Hough & White, 2003; Elbana & Child, 2007). Prior research advocates that 'political' processes will be more effective in these contexts, and that 'rational' decision processes will be less effective in unstable environments (Fredrickson & Mitchell, 1984). Subsequent research considered the effectiveness of processes in 'high velocity' environments and advocated that rational decision-making processes will allow for faster response and will be more effective than political decision-making processes in these contexts (Bourgeois & Eisenhardt, 1988; Eisenhardt, 1989). Hart (1992) later expanded on these arguments to develop a framework for decision-making processes involving a variety of forms stemming from political or rational bases, and also argued that 'rational' approaches should relate positively to effectiveness, while more 'political' approaches should not.

Collectively, the literature on the effectiveness of these SDM processes across a variety of settings is in conflict as some studies suggest that rational decision-making processes will be positively related to effectiveness (Bourgeois & Eisenhardt, 1988; Eisenhardt, 1989; Hart, 1992) and political decision-making processes will not be effective (Hart, 1992), while others advocate for political decision-making processes and against rational decision-making processes (Fredrickson & Mitchell, 1984). Given this conflict, and the fact that these differences are largely unresolved empirically, one contribution of this study is that we examine the effectiveness implications of political and rational SDM processes. Through doing so, we offer some clarification and resolution of the conflicting predictions and findings of Fredrickson and Mitchell (1984), Bourgeois and Eisenhardt (1988), and Hart (1992). Further, while the inclusion of a mediating role for response choice is well theorized, it is also largely untested empirically in prior work. Therefore a further contribution of this study is that we also seek to take into account this mediating role of choice on decision effectiveness.

In this study we address several specific research questions: 1) Does variation in the decision-making process result in variation in response choice; 2) Does variation in response choice result in variation in decision effectiveness; and 3) Can we also trace the effectiveness of different SDM processes as mediated through particular response choices? Since management can influence the SDM processes, question three is likely to be of more interest than question two. However, if we only look at the direct relationship between SDM processes and effectiveness (i.e., Dean & Sharfman, 1996), we might be attributing differences in effectiveness to process variation when these variations did not actually influence choices. Thus, we need to adequately discern which SDM processes are more effective in these situations and produce the most effective outcomes. Addressing these questions helps to clarify the integrated influences of process and choice on strategic decision-making effectiveness.

This paper proceeds as follows: 1) We review related research on SDM, and leverage prior theory to develop hypotheses for an integrated process-choice-effectiveness SDM model; 2) We examine the model and hypotheses through empirical analysis of data from a crisis response training exercise using an agent-based simulation decision support system technology; 3) We present and discuss the results of our analyses in relation to the model and hypotheses;

and 4) We conclude with a discussion of our findings along with implications for practitioners and future academic research.

THEORY DEVELOPMENT

Prior work by Dean and Sharfman (1993, 1996) offers an integrated decision-making model, for framing this study of SDM process-choice-effectiveness. Their work examines the assumptions underlying the relationship between decision-making processes, response choices, and SDM effectiveness. The model proposes that ***variation in decision-making process*** (political or rational) will produce different ***response choices***, which result in ***variation in SDM effectiveness***. However, empirical testing of their model is limited to the relationship between political and rational ***decision-making processes*** and ***variation in effectiveness*** alone, excluding the intermediate ***response choice*** variable. As the potential mediating implications of the ***response choice*** intermediate variable are thereby unexamined, we extend and examine Dean and Sharfman's (1996) model to clarify the conflicting arguments in the prior SDM literature. We do this through examining the full model with the inclusion of the mediating relationship of ***response choice*** through our application to an extreme decision-making context (crisis response). Our approach is as follows: 1) We extend Dean and Sharfman's (1996) strategic decision-making relationship and effectiveness model of variation in process, response choice, and effectiveness by expanding their effectiveness model to include the potential mediating effects of intermediate choices; and 2) We then examine the competing arguments for process effectiveness in this context from Fredrickson and Mitchell (1984), Bourgeois and Eisenhardt (1988), and Hart (1992).

In Dean and Sharfman's (1996) model variation in the strategic decision-making process (e.g., Political or Rational approaches) produce variation in response choice, resulting in variation in effectiveness. The effectiveness outcomes therefore depend on the following: 1) The strategic decision-making process utilized, and 2) The response strategy choices implemented. In order to clarify the conflicting dominant arguments in the literature for process effectiveness under uncertainty, as well as test the theorized mediating role of choice, we develop several base-line hypotheses to be roughly consistent with the previous literature.

Replicating Dean and Sharfman's (1996) model:

Hypothesis 1: Variation in strategic decision-making process will be related to variation in effectiveness.

Examining the sub elements of the implied Dean and Sharfman (1996) model:

Hypothesis 2: Variation in strategic decision-making process will be related to variation in response choice.

Hypothesis 3: Variation in response choice will be related to variation in effectiveness.

To examine the full model as proposed by Dean and Sharfman (1996), which proposes a mediating relationship but only examines the direct relationship, we distinguish between the direct effect of SDM process on effectiveness (H1) and a mediating relationship acting through response choice. Whereas, Dean and Sharfman's (1996) original model has choice as endogenous to the strategic decision-making and effectiveness relationship, we model response choice as an intermediate step and consider this as an expansion of the strategy decision-making and effectiveness relationship. We therefore derive hypothesis 4 to examine whether response choice has both a mediating and direct effect on decision effectiveness.

Examining the full Dean and Sharfman (1996) model:

Hypothesis 4: Variation in strategic decision-making process and variation in response choice will be related to variation in effectiveness.

To examine the conflict in the literature regarding the inconsistency among the Fred-

rickson and Mitchell (1984) and Bourgeois and Eisenhardt (1988) propositions for uncertain and high velocity environments, as well as the Hart (1992) propositions for effectiveness by type of decision-making process, we develop hypotheses 5a and 5b:

Hypothesis 5a: In highly turbulent environments, Rational decision-making processes should be positively related to effectiveness, while Political decision-making processes should not have a positive relationship with effectiveness (Bourgeois & Eisenhardt, 1988; Hart, 1992).

Hypothesis 5b: In highly turbulent environments, Rational decision-making processes should be negatively related to effectiveness, while Political decision-making processes should have a positive relationship with effectiveness (Fredrickson & Mitchell, 1984).

ANALYTICAL CONSIDERATIONS

Study Context

Crisis events (i.e., natural disasters, terrorism, etc.) are environments characterized by varying levels of turbulence and ambiguity (National Commission on Terrorist Attacks, 2004). While government organizations differ from those in the private sector, research in the management field on SDM may be applicable to government organizations dealing with crisis events. For example, the core task of organizations is the creation and/or maintenance of a fit between the organizations' internal strengths and capabilities and the demands placed on them by their environments. Government organizations must also draw upon unique resources and capabilities across various departments and levels of government to respond to challenges in their environments.

Similarly, the levels of turbulence and ambiguity present in a government agency's operating environment may also be direct contributors to the difficulties inherent to SDM in these contexts. The nature of the environmental pressure, turbidity, and outcome implications make this a unique and challenging operating environment. Prior related work on this topic from other fields includes the development of homeland defense strategy for the White House (USDHS, 2004), the modeling of disease outbreaks (Rvachev & Longini, 1985; Kuhr & Hauer, 2001; Kaplan, Craft, & Wein, 2002, 2003; Eubank, Guclu, Kumar, Marathe, Srinivasan, Toroczal, & Wang, 2004; Craft, Wein, & Wilkins, 2005). Further uses have included numerous academic, government, and practitioner publications on epidemiological, terrorism response, and homeland security and defense strategies (Deutsch, 1963; Hoffman, 1981; Waugh & Sylves, 2002; Ramirez-Marquez & Farr, 2009).

Sample Data

We test our model and hypotheses using data collected from a multi-step approach consisting of an experiment (a U.S. Department of Homeland Security training exercise called Measured Response (MR)) in conjunction with an intelligent agent-based simulation. We use this data to examine the extended Dean and Sharfman (1996) model and the associated hypotheses for variation in SDM process, choice, and effectiveness. We use a computational experimentation methodological approach to do this. This approach consists of two steps: 1) Using a validated survey instrument to collect data on strategy process and choice from a lab experiment with actual practitioners grouped into several response teams; and 2) An intelligent agent-based simulation utilized in the exercise to produce data on the effectiveness of the groups' SDM processes and response choices. We test our model and its hypotheses through empirical analysis of a sub sample of 268 combined observations from the survey and simulation data collected from the exercise.

Measured Response Exercise. The MR Homeland Security training exercise consisted

of nine teams of human agents comprised of three to five individuals each (representing their actual functional responsibilities in most cases) to play the roles of the Departments of Homeland Security (DHS), Health and Human Services (DHHS), and Transportation (DT) at the local, state, and federal levels. These human agents operated in a "Joint Operations Center" environment where they were able to execute a variety of decisions and respond interactively to changes in the simulated environment throughout the exercise.

Simulation Model. The Measured Response training exercise utilizes a synthetic environment as the decision support system technology for the exercise. This system uses a dynamic virtual computer simulation environment to simulate the outbreak and dispersion of a biological agent on a mid-sized city in the United States. This outbreak affects tens of thousands of computer-based intelligent agents. These agents approximate the diversity of behavioral characteristics and demographics of the actual modeled population for the city. Additionally, we utilized pathogen-specific data from the Centers for Disease Control (CDC) in the simulation model to ensure the attack takes place in a realistic manner on the virtual population of intelligent agents. Further, the organizational aspects of the simulation model incorporate data from actual DHS and CDC response plans. The simulated scenario therefore replicates the actual characteristics of a real-world attack in which the decision-making process and response strategy choice can significantly affect outcomes in terms of infection rate, contagion spread, population death rate, and public mood.

Given these factors, these types of decision support system technologies offer a rich and dynamic simulation environment, which largely alleviates the common concerns previously associated with using simplistic homegrown or off-the-shelf simulation tools in academic research (Linebarger et al., 2009; Mostashari & Sussman, 2009). Specifically, our training exercise utilizes thousands of different participant decisions on a variety of teams, at multiple levels, which affect thousands of computer-based agents who respond dynamically to the collective participant inputs, as well as each agent's response behavior to the inputs (See Chaturvedi, Mehta, & Drnevich, 2005; Harrison, Lin, Carroll, & Carley, 2007 for more detail on simulation modeling). Additionally, conflicting criteria prevent exercise participants from "gaming" the system and drive the multiple measures of effectiveness. Thus these types of decision support system technologies offer the type of rich and powerful research technology platforms with a high degree of external and internal validity as well as reliability required for integrated decision support (Liu et al., 2009; Linebarger et al., 2009; Mostashari & Sussman, 2009).

Measures

Dependent variables. The dependent variable in our study consists of an integrated composite measure for decision effectiveness. This approach is consistent with recent research advocating integrated process and outcome measures for decision-making support system evaluation (Mora et al., 2005; Phillips-Wren et al., 2009). While the decision objective is to contain or control the outbreak and minimize fatalities, the need to maintain acceptable levels of public mood complicates this objective. Therefore the decision makers must consider the outcome of their decisions choices in terms of containing the outbreak and impact on public mood. We represent these effectiveness implications through an integrated dependent variable in the model, which consists of a standardized weighted composite decision effectiveness measure of the total number of lives saved (termed "**TLS**") and the public mood improvement (termed "**PMI**"), to capture the trade-off in decision-making. We label this dependent variable decision effectiveness (termed "**DE**"). We construct the measure for decision effectiveness through comparing the simulation output generated during the exercise, with the base line measures of the simulation produced under conditions of no intervention after the

attack to calculate TLS and PMI. Specifically, we measure the effectiveness of the responders as the difference between their performance and the worst-case scenario (no response). We then construct our measure for decision effectiveness (DE) from a weighted composite (based on responder biases towards health or political issues) of the standardized values of the TLS and PMI measures. We do this to capture the trade-off in decision-making inherent in responses to bio-terrorism (outbreak containment versus public mood). The weighting for the composite measure is determined through survey measures, which asked the participants their decision-making priorities in terms of consideration of health and political issues in the decision-making process. We measure these issues relative to the decision maker's team and level, and weight the importance of the respective standardized values of TLS and PMI to determine a value for the decision effectiveness measure (DE) relative to each level.

Independent variables. The independent variables in our study consist of the strategic decision-making process, and the quarantine strategy choice. The strategy process variables consisted of measures of the decision-making process designed to discern procedural rationality (termed "**PR**") and political behavior (termed "**PB**") decision processes. We measure these variables through questions on a survey instrument which were based on the original Dean and Sharfman (1993, 1996) questions leveraging their approach (measured through several validated questions on a survey instrument using Likert scales, see appendix and Dean and Sharfman 1993 and 1996 for further detail). The response choices in the exercise consist of options for quarantine strategies. Quarantine strategy response choices include no quarantine (termed "**NQ**"), a passive quarantine approach by city block (termed "**CBQ**"), and deploying the military for a more extreme quarantine approach (termed "**EQ**"). We measure these response choices as an input decision to the simulation on measures for quarantine strategy response choice (termed "**SC**"). We code these variables from simulation input data on a five point Likert scale, which ranged from least restrictive (1) to most restrictive (5). We collected the survey measures through a paper instrument administered at five equal time periods before, during, and after the five rounds of the exercise.

Control variables. The control variables in our study include measures to control for potential government level and department affiliation affects, as well as a participants prior disposition to health and political issues. We include these control variables in the event commonalities in SDM processes or response choice preferences may exist among certain levels of government or among specific government agencies. We further controlled for a participant's prior disposition to health and political issues to check to see if alternate factors may be driving the decision processes or choice preferences. We depict the variables utilized in the study and their measures in Table 1.

ANALYTICAL PROCEDURES

Following the coding and compilation of our sample data, we conducted checks for missing data, face validity, and multicolinearity. These checks confirmed that the sample appeared usable and that the data were within expected parameters. Further, checks for multicolinearity revealed some minor correlation among variables, as we expected, which relate to the nature of the variables under study and their measures. We list the descriptive statistics and correlations of these measures in Table 2.

Next, to test our hypotheses, given the potential for autocorrelation with pooled data, we use a mixed models repeated measures design. Since our dependent variable measure originated as continuous data with a normal distribution (which we then standardized prior to analysis), we conducted our analysis using the MIXED procedure with control for covariance in SAS. Since some of our independent variables also involve Likert-scale measures, generalized linear mixed models (e.g., the NLMIXED or GLIMMIX procedures in SAS) were also considered (supplemental analysis

Table 1. Study Variables and Measures

Variable	Description	Measure
Process Variables		
PR	Procedural Rationality	Likert scale measured survey data*
PB	Political Behavior	Likert scale measured survey data*
Choice Variable		
SC	Quarantine Strategy Choice	Scaled simulation input data
Effectiveness Variables		
TLS	Total Lives Saved	Raw # simulation output vs. baseline #
PMI	Public Mood Improvement	Raw # simulation output vs. baseline #
DE	Decision Effectiveness composite of TLS and PMI	HI and PI weighted composite of standardized TLS and PMI measures
Control Variables		
HI	Importance of Health Issues	Likert scale measured survey data**
PI	Importance of Political Issues	Likert scale measured survey data**
LEVEL	Level of Government	1=Federal; 2=State; 3=Local
DEPT	Department of Government	1=DHS; 2=DHHS; 3=EM; 4=DT

* see Questionnaire in Appendix as well as Dean and Sharfman (1993, 1996) for more detail on the measures of these variables.

** see Questionnaire in Appendix for more detail on the measures of these variables.

Table 2. Summary Statistics and Correlation Matrix of the Raw Data

Variable	Mean	S.D.	Min	Max	DE	SC	PR	PB	Time	Level	Dept.	HI
Decision Effectiveness (DE)	305	311	12	1159	1.00							
Strategy Choice (SC)	2.24	0.96	1	4	0.24**	1.00						
Procedural Rationality (PR)	3.44	0.87	1	5	0.05	0.19*	1.00					
Political Behavior (PB)	2.65	0.70	1	4	0.02	-0.01	0.54**	1.00				
Time	2.5	1.12	1	4	0.74**	0.59**	0.18*	0.06	1.00			
Level	2.08	0.81	1	3	-0.52**	0.34**	0.09	0.02	-0.01	1.00		
Department (Dept)	2.52	1.13	1	4	0.01	0.01	-0.07	-0.18*	0.0	-0.02	1.00	
Health Issues (HI)	3.91	1.13	1	5	0.04	0.16*	0.50**	0.23**	0.14*	0.13*	-0.22*	1.00
Political Issues (PI)	2.27	1.17	1	5	0.10	0.01	0.03	0.26**	0.11	-0.04	0.15*	-0.01

† $p \leq .10$, * $p \leq .05$, ** $p \leq .001$

with this procedure did not reveal significantly different results among the procedures). Mixed procedures in SAS allow for true repeated measures analysis to address the potential for autocorrelation. In doing so, we use the level of government as a fixed effect which allows us to more rigorously assess the models as well as compare the levels of fit between the direct and mediated models. In doing so, after first testing our control variables (models 1 and 3), in model 4 we test whether effectiveness is a function of strategic decision-making process (Hypothesis 1). Next, in model 2, we test whether response choices are a function of strategic decision-making process (Hypothesis 2), and in model 5, whether effectiveness is a function of response choice (Hypothesis 3). Following the regression testing for these hypotheses, we utilized the results of models to test for the potential direct versus mediating role of decision process on choice and effectiveness. We then made comparisons between the direct relationships of process on effectiveness, and choice on effectiveness, and the mediating relationship of process, working through choice, on decision effectiveness. Through hypothesis 4 we test the full path model to determine if response choice provides a mediating relationship between SDM processes and effectiveness, or if the direct effect of SDM process on effectiveness is sufficient without the mediating relationship. Finally, we sought to clarify the conflict in the prior literature regarding effectiveness expectations of rational or political SDM processes in our current context. We examine this conflict through hypotheses 5a and 5b. We provide an overview of the results of this analysis in Table 3, and discuss these results in the following section.

DISCUSSION OF RESULTS

Overall, when we analyze the direct paths of the full model (Process on Effectiveness) against the indirect path (Process through Choice on Effectiveness) we observe that effectiveness does indeed appear to mediate process through choice. We discuss these results in specific detail, in relation to our hypotheses below.

Hypotheses Testing

In **Hypothesis 1**, we examined whether variation in SDM process relates directly to variation in effectiveness. We observe *support for Hypothesis 1* in model 4; as the coefficient for political behavior is negative and significant (see Table 3). Next, in **Hypothesis 2**, we examined the sub-elements of the model in terms of whether variation in SDM process relates to variation in response choice. We observe only *marginal support for Hypothesis 2* in model 2, as the coefficient for political behavior is negative and marginally significant, while the coefficient for procedural rationality is positive and marginally significant (see Table 3). Further, in **Hypothesis 3**, we examined whether response choices are significant in explaining effectiveness. We *fail to observe support for hypotheses 3* in model 5, as the coefficient for strategic response choice is negative and not significant (see Table 3). In **Hypothesis 4** we examined the full path (model 6), to determine if response choice provides a mediating relationship between SDM processes and effectiveness, or if the direct effect of SDM process on effectiveness (model 4) is sufficient without the mediating relationship. We observe *partial support for Hypothesis 4* as model 6 shows a negative, but marginally significant coefficient for choice, as well as a negative and significant coefficient for political behavior. Additionally, we observe an improved goodness of fit in model 6, which offers some additional support for Hypothesis 4 in addition to the marginally significant coefficient for choice in the model (see Table 3).

Further, to test effectively the apparent mediating role of response choice on the relationship between SDM process and effectiveness, Baron and Kenny (1986) indicate that to establish mediation, several conditions must hold. These conditions correspond to finding significant relationships in models 4, and 6. Since we have significant or margin-

Table 3. Results of Strategy Process, Choice, and Effectiveness Model Testing

Model	1	2	3	4	5	6
Hypothesis	**Controls**	**H2**	**Controls**	**H1, 5a, 5b**	**H3**	**H4**
Variable	**Strategy Choice**	**Strategy Choice**	**Decision Effectiveness**	**Decision Effectiveness**	**Decision Effectiveness**	**Decision Effectiveness**
Procedural Rationality		0.10†		0.01		0.01
Political Behavior		-0.10†		-0.03**		-0.03**
Strategy Choice					-0.01	-0.02†
Level	0.34*	0.34*	-0.51†	-0.51†	-0.51†	-0.51†
Department	0.02	0.01	0.01	-0.01	0.01	0.01
Health Issues	0.02	-0.01	0.01	0.01	0.01	0.01
Political Issues	-0.06	-0.04	-0.01	0.01	-0.01	-0.01
Df	257	255	257	255	256	254
X^2	129.18**	124.22**	1044.28**	1061.86**	963.7**	983.58**
-2 Log	593.8	590.4	-376.7	-395.8	-378.2	-398.2
AIC	611.8	612.8	-358.7	-373.8	-358.2	-374.2

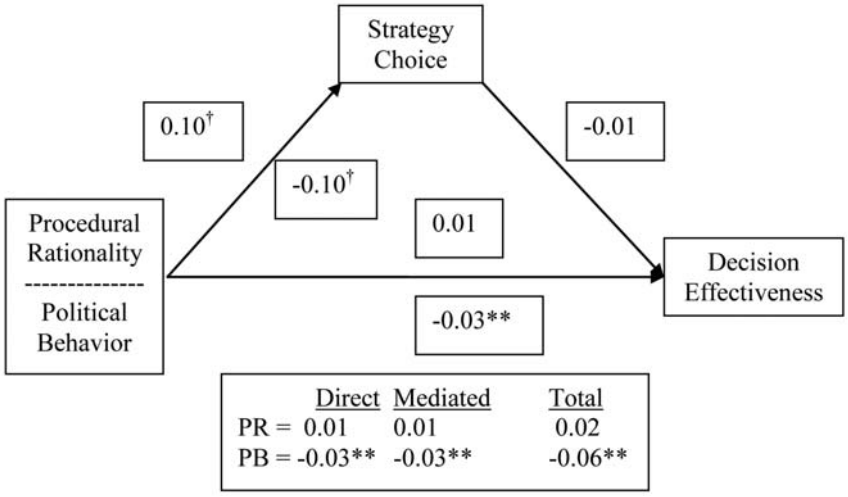
† $p \leq .10$, * $p \leq .05$, ** $p \leq .001$

ally significant relationships in these models, we conclude that response choice mediates the relationship between SDM process and effectiveness. Additionally, when we analyze the direct and indirect paths, the indirect path through response choice is significant and less negative for political behavior (see Figure 1). Therefore as response choice mediates the relationship, this means that response choice has a role in influencing SDM effectiveness. This finding supports including the response choice variable in the model and appears to offer an extension of, and empirical support for the work of Dean and Sharfman (1993, 1996).

†$p \leq .10$, * $p \leq .05$, ** $p \leq .001$

Next, through **Hypotheses 5a and 5b**, we seek to clarify the conflict in the prior literature regarding the competing expectations of rational or political decision-making processes effectiveness in our current context. In **Hypothesis 5a** we argued that rational decision-making processes would relate positively to SDM effectiveness (Bourgeois & Eisenhardt, 1988), and expected a non-positive effect for political decision-making processes (Hart, 1992). In model 4, the coefficient for procedural rationality is positive, but not significant, and the coefficient for political behavior is negative and significant (see Table 3). Likewise, in model 6, the coefficient for procedural rationality positive, but not significant, and the coefficient for political behavior is negative and significant. Further, in the path analysis (Figure 1), the meditated effectiveness of political behavior is significant, and the effect of the mediated path is positive when compared to the direct path. Thus, we conclude that we *fail to observe support for Hypothesis 5a*. Therefore, our results appear consistent with the arguments of Hart (1992) who said political behavior would not be positive, while they appear to conflict with the arguments of Bourgeois and Eisenhardt

Figure 1 Direct versus mediating effects of SDM process and choice



(1988), who advocated that rational processes would be positive and significant.

In **Hypothesis 5b** we argued that rational decision-making processes would relate negatively to SDM effectiveness, and expected a positive effect for political decision-making processes (Frederickson & Mitchell, 1984). However, in models 4 and 6, we observe a positive but not significant coefficient for procedural rationality. Further, we also observe a negative and significant coefficient for political behavior in models 4 and 6 (see Table 3). We therefore also *fail to observe support for Hypothesis 5b*, conflicting with the arguments of Frederickson and Mitchell (1984) who advocated the use of political-type processes in these contexts, and that rational decision processes would have a negative association with effectiveness in unstable environments.

CONCLUSION

In this paper we examined the implications of competing arguments for the effectiveness of decision-making processes, with the inclusion of a theorized, but under-examined mediating role for response choice, in the context of public sector decision-making under conditions of uncertainty (i.e., crisis response). In doing so, we utilized a DMSS technology to develop an extension of a prior decision model (Dean & Sharfman, 1993, 1996) with associated hypotheses for SDM process, choice, and effectiveness. We examined the extended model using data collected through a computational experimentation approach involving an experiment with actual decision makers (federal, state, and local government personnel), and an established and validated agent-based simulation decision support system (Chaturvedi et al., 2005; Harrison et al., 2007).

Research Implications

One research implication of this study involves the expansion and extension of the Dean and Sharfman's (1993, 1996) work as well as the clarification of competing predictions for the effectiveness of SDM processes. Our finding of empirical support for the expanded Dean and Sharfman (1996) model indicates that response choice may play an important mediating role in the relationship between SDM processes and effectiveness. This finding is important because if we only look at the effect of decision processes on effectiveness, as prior research does (Dean & Sharfman, 1993, 1996), we might be

attributing differences in SDM effectiveness to process variation that did not actually influence response choice and is therefore not directly driving effectiveness. Secondly, our extension of Dean and Sharfman's (1996) model to complex, turbulent environments indicates the applicability of the model to extreme contexts, beyond the more stable context in which it was originally developed. This observation indicates further support for the robustness and applicability for Dean and Sharfman's (1993, 1996) arguments and model.

Further, we clarified unresolved conflict in the literature on the effectiveness of SDM processes in turbulent environments, echoing calls in recent research for more integrative DMSS approaches (Mora et al., 2005; Phillips-Wren et al., 2009). The results of our analysis appear to support Hart (1992) who advocated the negative effects of political behavioral processes in such contexts. However, our observations conflict with the work of Bourgeois and Eisenhardt (1988), who advocated rational processes, as well as those of Frederickson and Mitchell (1984) who advocated political-type processes in these contexts. Based on our current study, while we can't advocate the benefits of utilizing rational decision-making processes (Bourgeois & Eisenhardt, 1988), we conclude that political decision-making processes do clearly appear to undermine SDM effectiveness (Hart, 1992). This finding may hold interesting managerial implications for practice in crisis response and potentially other analogous contexts.

Managerial Implications

In terms of managerial implications, we sought to discern which response choices are most effective in these contexts and which decision-making processes produce more effective responses. Given the critical nature of decision-making under the high uncertainty and risk in our context, we harbored concerns that currently observed SDM processes in practice (often political) may be sub-optimal and even detrimental to effectiveness. For example, we expected that as quarantine measures become more restrictive, we would save more lives, but that we would adversely affect public mood so decision makers would be hesitant to make these choices. However, we found that in the context and duration of this exercise, more restrictive quarantine measures may actually adversely affect both the total number of lives saved as well public mood. Further examination of this finding reveals that this observation may be due to the short-term localized effects of aggressive quarantine strategies, which are highly restrictive, and may potentially constrain healthy subjects to contaminated areas thereby subjecting them to infection. In the short-run, this would decrease the number of lives saved and public mood in comparison to less restrictive quarantine strategies. However, over longer time periods, highly restrictive quarantine strategies theoretically should still be more effective than less restrictive ones in terms of total lives saved at the state and national levels, as they should help to prevent a localized event from becoming a widespread epidemic. Finally, this observation provides insight into the complexity of SDM in this context, in that it is likely important to implement screening and evacuation responses, in conjunction with quarantine responses, to attempt to reduce the adverse impacts of quarantine strategies to healthy subjects within the containment zones.

Limitations and Future Research

Limitations. This study is subject to a number of potential limitations, which should be considered when interpreting our findings and observations. The first potential limitation is sample size (268 observations from one experiment). Future research on these constructs and their relationships in these contexts may wish to utilize larger samples over longer periods of time. Second, given the need to maintain the realism of a homeland security training exercise and to utilize decision-makers in their real-life roles, we could not randomly assign our treatment groups. Third, while we attempted to control for the prior disposition of the experiment's participants towards political or health issues, it

is still possible that such factors may influence in the SDM processes, response choices, and their effectiveness. Fourth, there is also the possibility of other alternative explanations to the observations of this study, which could also be a plausible explanation for some of the results.

Future Research. This study raises several important questions that may hold numerous implications for research in the management and public policy areas. Some of these questions are: How can political processes be discouraged, and how can we mitigate their detrimental effects; and to what extent might predisposition towards a decision-making process impact response choice and/or SDM effectiveness? In particular, we suggest further research into both the impact of decision-making process, and the mediating role of response choice, in both public and private sector settings under conditions of high risk and uncertainty.

CONCLUSION

Through this paper, we demonstrated the importance of response choice as a mediating factor in the SDM process - effectiveness relationship. Further, we have illustrated that the theory, models, and methods developed through research in the field of management may apply to other, more turbulent contexts such as public sector crisis response (Hoffman, 1981; Green & Kolesar, 2004). We hope our work may provide some motivation for further research on SDM effectiveness as well as the application of management research and models to unconventional settings such as terrorism and crisis response.

In terms of which SDM processes appear most effective, we conclude that overall, while we fail to find support for rational decision-making processes, the effects of political approaches are significantly more negative on effectiveness in our current context. Further, the key finding that response choice may mediate some relationships between SDM processes and effectiveness is potentially quite important. This finding indicates that process alone may not be sufficient to explain effectiveness, but rather it is the compound effect of the decision-making process and response choice that is important for response effectiveness. We hope that these findings may provide some insight for future research and practice to improve SDM effectiveness, and demonstrate the usefulness of DMSS technologies for such environments (Mora et al., 2005; Phillips-Wren et al., 2009; Ramirez-Marquez & Farr, 2009), while hopefully increasing the likelihood of an effective response to an actual event.

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APPENDIX 1 - SELECTED MEASUREMENT ITEMS FROM EXERCISE QUESTIONNAIRE

Table 4.

Survey Question	Not at All		Moderate		Extreme
Measures for Procedural Rationality:					
How extensively did the ***team look for information*** in making a decision?	1	2	3	4	5
How extensively did the team ***analyze information*** before making a decision?	1	2	3	4	5
How important was the analysis (if any) in making the decision?	1	2	3	4	5
How ***effective*** was the team ***at focusing*** attention on relevant information?	1	2	3	4	5
Were team members primarily concerned with the situation's needs?	1	2	3	4	5
Measures for Political Behavior:					
Were team members primarily concerned with their organization's needs?	1	2	3	4	5
Were team members open about their interests and preferences?	1	2	3	4	5
Were team decisions arrived at through power and coercion?	1	2	3	4	5
Were team decisions arrived at through negotiations?	1	2	3	4	5
Measures for weighting Decision Effectiveness:					
Were ***Political Issues*** a factor in the team's response strategy?	1	2	3	4	5
Were ***Health Issues*** a factor in the team's response strategy?	1	2	3	4	5