

# ENHANCING MENTAL MODELS, ANALOGICAL TRANSFER, AND PERFORMANCE IN STRATEGIC DECISION MAKING

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*Recent research suggests that managers often make strategic decisions in novel situations by utilizing past experiences to reason by analogy. However, there is substantial evidence that decision makers often fail to identify and apply knowledge about one situation to a similarly structured situation. Two experimental studies investigated the mechanisms impacting knowledge transfer from one managerial situation (the source) to an analogous situation. The results show that exposure to variation in the source situation improves transfer performance. Variation decreases performance in the short term but improves learning and increases analogical transfer. Higher performance on and systematic search of the source situation also increase transfer performance. These results yield important implications for enhancing analogical transfer in strategic decision making and for future research on reasoning by analogy. Copyright © 2012 John Wiley & Sons, Ltd.*

## INTRODUCTION

The process by which managers make sense of new or changing environments to determine strategic decisions is a central topic in strategy. Managers may face novel contexts as a result of corporate diversification into new areas, extensive change in the competitive environment, or because the managers themselves move to new firms and/or industries. Recent research suggests that managers often make strategic choices in novel situations by utilizing their knowledge derived from past learning and experiences—their mental models—to reason by analogy (Gavetti, Levinthal, and Rivkin, 2005; Gavetti and Rivkin, 2005).

There is substantial evidence that mental models influence decision making through managers' efforts to match strategic choices to their understanding of the business environment (Gary and Wood, 2011; Hodgkinson *et al.*, 1999; Kaplan, 2008; Porac *et al.*, 1995; Reger and Palmer, 1996; Tripsas and Gavetti, 2000). However, there has been very little attention given thus far to understanding how and when managers can make effective use of analogies drawn from their existing mental models when faced with new or changing contexts. Prior strategy research suggests that the application of analogies from a familiar problem to a novel situation can shape strategic problem definitions, reduce complexity and uncertainty, and produce fresh insights (Duhaime and Schwenk, 1985; Gavetti *et al.*, 2005). While highlighting the potential benefits of analogical reasoning, strategy scholars have also acknowledged that transferring existing knowledge through analogical reasoning processes can mislead decision makers into an

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overly simplistic or incorrect view of new strategic problems (Schwenk, 1984).

The basic psychological processes involved in analogical transfer—including encoding, retrieval, and adaption—are well established in psychology (Gentner, Holyoak, and Kokinov, 2001; Gentner, Loewenstein, and Thompson, 2003; Lee and Holyoak, 2008). In this research tradition, analogical transfer refers to the transfer of knowledge between problems or situations that share the exact same structural relations. The key feature of analogical transfer is making use of the structural alignment between problems or situations to identify important similarities (Blanchette and Dunbar, 2000; Gentner *et al.*, 2001; Holyoak and Thagard, 1997; Kolodner, 1997). Although analogical transfer can be a very powerful source of strategic insights, there is substantial evidence from both laboratory and field studies that show decision makers typically have great difficulty drawing appropriate analogies (Gick and Holyoak, 1983; Markman and Gentner, 1993). The findings show that decision makers generally focus on superficial, surface features when selecting analogies rather than meaningful, structural relations.

Recent simulation-based strategy research suggests that analogical inference using past experience can improve performance outcomes when there is a structural alignment between the source and target problems (Gavetti *et al.*, 2005). Scholars have also argued that disciplined analogical reasoning based on structural similarity of causal relationships may moderate some common strategic decision biases and improve performance (Gary, Dosi, and Lovallo, 2008). However, thus far, there is no evidence about the effectiveness of analogical transfer in situations where the match between a complex managerial source situation and a new target problem is less obvious. Given the substantial evidence from psychology that decision makers are not generally successful in identifying and applying problem analogs, an important agenda for research into the cognitive aspects of strategy is to identify mechanisms that improve analogical transfer in the types of complex, dynamic decision environments faced by senior managers. Also, there has been very little empirical research examining the contextual determinants of knowledge development and analogical transfer in the domain of strategic decision making. This paper reports two experimental studies examining the mechanisms that impact analogical transfer of knowledge from

one managerial problem to an analogous problem and the performance effects attributable to these mechanisms.

In the experiments, two management simulations that share the same causal structure are used to investigate analogical transfer in a controlled setting. Managerial search strategies, knowledge of strategic problems, and analogical inferences develop in highly complex and dynamic organizational decision environments, and this paper focuses on understanding the variation in and connection among these components of decision making under such complexity. The experimental design provides several advantages for measuring and testing the hypothesized causal relationships between contextual factors and analogical transfer. The findings yield important implications for research on analogical reasoning in strategic decision making.

## KNOWLEDGE TRANSFER BETWEEN PROBLEM ANALOGS

To reduce uncertainty about a novel situation, decision makers frequently draw inferences on the basis of knowledge about situations perceived as similar (Gentner *et al.*, 2001; Lee and Holyoak, 2008; Neustadt and May, 1986). Knowledge transfer is defined in psychology as the ability to extend what has been learned in one context to new contexts and as ‘how knowledge acquired in one situation applies (or fails to apply) in other situations’ (Singley and Anderson, 1989: 1). Analogical transfer in problem solving entails reaching the solution to one problem based on experience with a previous, analogous problem.

Reasoning by analogy requires the ability to identify relational patterns and is a central component of human cognition (Gentner *et al.*, 2001; Gick and Holyoak, 1980; Holyoak and Thagard, 1997; Lee and Holyoak, 2008). Prior research shows that children develop a capacity for analogical thinking before they are old enough to start school (Holyoak and Thagard, 1997). Analogical inference is considered such an important aspect of reasoning and problem solving that the four-term analogy problem has become a key component of aptitude and intelligence tests. It is important to note that analogical transfer frequently occurs through subconscious processing and decision makers are often not aware

they are using prior experiences (i.e., analogies) when solving novel problems. Many studies have demonstrated that an analogy can have a strong effect on problem solving without decision makers recognizing the extent of the influence of the analogy (Gentner *et al.*, 2001; Gentner *et al.*, 2003; Schunn and Dunbar, 1996).

Psychologists and cognitive scientists have made extensive use of analogous problem-solving tasks to investigate analogical reasoning. Analogous problems or situations share common structural relations but are typically very different in terms of surface features. Structural relations are the underlying principles or higher order relationships governing the way something works, such as causal, mathematical, or functional relations (Gentner, 1983). Surface characteristics refer to the way something appears. Similarity of structural relations does not require there to be any similarities between elements at the perceptual level (Lee and Holyoak, 2008). Drawing on a physics example, water and air are very different in terms of surface characteristics. For example, water is wet and air is not. There are many other differences in the appearance of water and air such as color, turbidity, and the contextual surroundings (e.g., water is found in lakes and rivers). Despite these differences in surface features, there are important structural similarities that underpin the analogy between the transmission of water waves and sound propagation (Holyoak and Thagard, 1995).

The canonical examples of analogical transfer in psychology involve cross-domain transfer between situations that share the same structural relations but have very different surface features. These examples include the Rutherford-Bohr model of the atom as an analog of the solar system (Gentner, 1983), the solution to a problem involving radiation therapy based on a military strategy (Gick and Holyoak, 1980), and the wave theory of sound derived from the behavior of water waves (Holyoak and Thagard, 1995). Making use of the structural alignment between problems or situations, or structure mapping, is the key feature of analogical transfer.

There is increasing evidence that senior managers and policy makers frequently use analogies from past experience to deal with the complex, multidimensional decision problems involved in making strategic choices (Gavetti and Rivkin, 2005; Gentner *et al.*, 2001; Holyoak and Thagard, 1995; Neustadt and May, 1986).

Facing a novel opportunity or predicament, strategists think back to some similar situation they have faced or heard about, and they apply the lessons from that previous experience. Analogies—to the past, to other firms or industries, and to other competitive settings like sports or war—come up frequently in strategy discussions. (Gavetti *et al.*, 2005: 693).

Transferring existing knowledge about past experiences to deal with a novel strategic challenge simplifies the search process in generating, evaluating, and selecting strategic options (Duhaime and Schwenk, 1985; Gavetti *et al.*, 2005; Schwenk, 1984). Using analogies from prior situations to solve novel strategic problems involves several steps. First, the manager must identify and encode the most important characteristics or features of the target situation. Next, the manager searches his or her library of experiences in long-term memory to retrieve prior situations that have characteristics and features similar to the new problem. This retrieval process might be straightforward if the new problem immediately reminds the manager of prior situations, or may require iterative reinterpretation and re-representation of the target problem until a suitable analog is found in memory. The next step involves using the familiar, prior situation—often termed the source analog or problem—for informing and making inferences about the new situation—the target problem. Transferring insights from prior experience might take the form of a suggested solution for the new target problem, a warning of a problematic issue that could arise, or may enable the potential effects of a proposed solution to be predicted. Such inferences derived from the source analog need to be evaluated and possibly adapted to fit the unique requirements of the target problem. There is wide agreement about these basic constituent processes involved in analogical transfer (Gentner *et al.*, 2001; Kolodner, 1997).

A manager's ability to identify and apply insights from relevant prior experiences and situations as source analogs for novel target problems depends on several factors. The extent to which the manager has interpreted and encoded the structural relations of the prior situation plays an important role. Similarly, the quality of the manager's perceptions about the important structural relations of the new target problem is an important factor.

Lastly, the effectiveness of the manager's mapping procedures to find an appropriate structural alignment between potential source analogs and the new target problem plays a crucial role (Kolodner, 1997). Ultimately, the usefulness of an analogy depends on the validity of a decision maker's similarity mapping between source and target situations (Blanchette and Dunbar, 2000; Gavetti *et al.*, 2005).

The process of finding a structural alignment between situations, while ignoring superficial surface features, often proves difficult in the complex, unstructured settings of strategic decision making. Prior research shows that most decision makers do not effectively transfer knowledge between analogous situations—either consciously or unconsciously—and typically treat each problem or situation as a separate, different challenge when the surface features are different. Prior research found source analogs that share only structural similarity with the target were retrieved only 12 percent of the time (Blanchette and Dunbar, 2000). The evidence that analogical transfer is often poorly done is a concern given the increasing evidence that senior managers and policy makers make frequent use of analogies, as noted above.

## STUDY 1: UNAIDED ANALOGICAL TRANSFER

Many studies have demonstrated that decision makers have great difficulty transferring knowledge between cross-domain problems that share the same structural relations but have different surface features (Holyoak and Thagard, 1995; Markman and Gentner, 1993). Different surface features interfere with decision makers' ability to identify similarities among structural relations. However, most prior studies have used simple or static tasks. Study 1 examines analogical transfer between two complex, dynamic management situations where the potential for analogical reasoning is high. We are interested in the extent to which transfer occurs between these two management situations—that share the same structural relations but have different surface features—without any decision aids or interventions. Given the substantial evidence from prior research about the difficulty of analogical transfer, we predicted there would be no transfer.

## METHOD

Participants were 32 business students at a large university. All participants were paid \$30 for their involvement in the study.

### *Procedures*

We use two versions of an interactive, computer-based simulation of managing and leading a team as the experimental tasks in our study. Leading and motivating a team is one of the primary functions of senior executives (Mintzberg, 1971). In one version of the simulation, decision makers lead and motivate a production team in a manufacturing company. In the second version, decision makers lead and motivate a cricket sports team. Analogies from sports and sports teams often come up when defining managerial problems and business situations (Duhaime and Schwenk, 1985; Gavetti and Rivkin, 2005), and we deliberately chose to examine transfer between these two domains. The two simulations share the same set of causal relations that determine team performance, which were based on extensive research evidence for the effects of goal setting, instructional feedback, and rewards (Locke *et al.*, 1981). The production team version of the task has been used extensively in experimental research (e.g., Goodman, Wood, and Hendrickx, 2004; Wood and Bandura, 1989; Wood, Bandura, and Bailey, 1990). The only differences between the two tasks were the different labels used in the introductory cover stories and in the user interfaces (i.e., surface features of either a production team or a cricket team).

Formulating and implementing strategic decisions in firms involves time delays separating decisions from their resulting impacts, nonlinear relationships, and multiple feedback effects (Gary and Wood, 2011; Paich and Sterman, 1993). The causal structure of the two simulations includes these features of complexity. The set of decisions required are regularly made by every senior executive—including chief executive officers who must manage and lead a team of direct reports—and have considerable potential to influence organizational performance. As in real organizations, competitive success does not come simply from making one-off choices, but rather from a continuous stream of decisions in managing an organization's most valued assets, the people, to guide the buildup of distinctive capabilities over time.

Participants take on the role of a senior manager within the organization and make decisions with the goal of maximizing performance. Specifically, participants make weekly decisions for each member of the team including: job role assignments, performance goals, degree of instructional feedback, and level of social reward. There are five team members corresponding to five job roles, five different goal levels, four instructional feedback levels, and three social reward levels. Decisions in the simulation are interdependent, creating an inherently nondecomposable context; the type of context that prior research suggests should be well suited for analogical reasoning to generate powerful insights (Gavetti *et al.*, 2005).

The 32 participants were randomly assigned to one of two conditions. Half of the participants completed the production team task followed by the cricket team task. The other half of the participants were presented with the reverse sequence. This design enabled us to examine analogical transfer between the two structurally equivalent management situations and also identify any asymmetries of transfer from one task to another caused by the order of presentation. Participants completed 20 decision trials on the source task followed by 20 decision trials on the target transfer task.

### Performance

Participants received a score after each decision trial for the performance of their team. Higher scores were achieved by meeting production targets for the production team or meeting run targets for the cricket team. Scores on the two tasks were in equivalent units for comparison. The performance scores were averaged across all 20 decision trials to compute the mean performance outcomes for both the source and transfer tasks.

## RESULTS

Significant between-group differences on each version of the simulation would be evidence of analogical transfer from the source task to the target. However, there were no significant performance differences between groups on either the production team task [ $t(30) = 0.64$ , *ns*] or the cricket team task [ $t(30) = 1.19$ , *ns*]. The group in Condition 1 completed the production team task as the source

and then the cricket team task as the target. This Condition 1 group achieved a mean performance of 92.4 (s.d. = 22.75) on the production team task and 72.3 (s.d. = 23.59) on the cricket team task. The group in Condition 2 completed the cricket team task as the source and then the production team task as the target. This Condition 2 group achieved a mean performance of 86.58 (s.d. = 28.78) on the production team task and 62.55 (s.d. = 22.85) on the cricket team task. These results show there were no analogical transfer effects in either direction, from production team source task to cricket team target task or vice versa. The results also show that decision makers performed better on the production team task than the cricket team task regardless of whether it was the source or transfer task.

## DISCUSSION

The results demonstrate that transferring past experience from one managerial situation to another with the same structural relations but different surface features is difficult. This is consistent with evidence from both laboratory and field studies that cross-domain analogical transfer is rare, especially for complex tasks (Holyoak and Thagard, 1995; Markman and Gentner, 1993). The findings of Study 1 extend the evidence from prior research on analogical transfer to dynamic decision environments representative of the organizational domain within which senior managers operate. As in other domains that have been extensively studied, our results show that decision makers need assistance to more effectively encode the source problem, retrieve aspects of the source problem from memory, or apply insights from the source problem to a new target situation. In Study 2, we investigate the impact of an intervention on analogical transfer in an attempt to enhance decision makers' ability to use prior experience in a novel situation.

## STUDY 2: SOURCE TASK VARIATION AND ANALOGICAL TRANSFER

The results from Study 1 show that analogical transfer is difficult between management situations. However, prior psychology research has identified several interventions that impact analogical reasoning and transfer. Analogical transfer can

be improved with hints to use a previous source problem, asking questions that lead to reflection about a previous source problem, instructions to make comparisons among problems, and teaching decision makers the key structural principles using multiple example analogs (Gentner *et al.*, 2003; Holyoak and Koh, 1987; Loewenstein, Thompson, and Gentner, 1999; Novick and Holyoak, 1991). While encouraging, many of these results are based on simple or static tasks and may not generalize to strategic decision making in novel management situations. Also, it is unlikely that anyone will be standing by to point out structural similarities between new and prior situations as managerial challenges arise in firms. Research on the cognitive mechanisms that improve learning suggests another type of intervention that may enhance analogical transfer in complex, dynamic settings.

Effective analogical transfer is more likely to occur when decision makers develop richer mental models of the initial source problem that go beyond a surface-level understanding. Research on learning shows that knowledge transfer is only possible after decision makers have acquired sufficient knowledge in the initial setting and that many apparent failures of transfer are, in fact, failures of initial learning (Singley and Anderson, 1989). Decision makers may not transfer knowledge of a source problem simply because they do not learn it adequately in the first place. For example, decision makers who encode the source situation by focusing on superficial, surface features will be unable to identify the structural relations for aligning or mapping the source with a new target problem (Gentner *et al.*, 2003). The more completely an initial source problem is learned, the greater the likelihood that some experience on the source will match a novel problem that arises in the future.

There is evidence that exposure to variations and difficulty levels of a complex problem is one mechanism for improving learning and developing a good structural understanding of the problem (Hesketh, 1997; Paas and Merrienboer, 1994). In particular, implicit learning—acquiring skills and capabilities without the learner's awareness—is enhanced by working on different variations of the same problem compared with working on the same exact task repeatedly (Wulf and Schmidt, 1997). At the group level, working on related variations of a task also leads to higher learning rates compared with working on the same exact task (Schilling *et al.*, 2003). Research shows that knowledge is

more accessible, flexible, deeply learned, and accurate if decision makers have the opportunity to encounter multiple situations in which the knowledge is used and multiple ways in which similar situations are addressed (Kolodner, 1997). Variability facilitates learning through the opportunity to compare and contrast elements across examples, through which a learner is able to identify the underlying structural principles and the range of applicability (Anderson, 1982). This process of learning about the structural principles of a problem improves decision makers' understanding about how to transfer insights from the source to similar situations. Identifying structural parallels between the source and the target is a prerequisite for analogical transfer (Lee and Holyoak, 2008).

In Study 2, a source task variation intervention is used to examine the impact on transfer performance. We expect exposure to variation on an initial managerial source problem will result in sufficient learning of the source to facilitate analogical transfer to a target problem that shares the same causal relations.

*Hypothesis 1: Variation in an initial management situation (the source problem) will increase transfer performance on a novel situation (the target problem) with the same causal relations.*

Furthermore, three ancillary hypotheses connecting learning and transfer performance are also derived directly from psychology findings on learning. Prior evidence shows that knowledge transfer is only possible after decision makers have sufficiently learned an initial problem (Anderson, 1982, 1993; Singley and Anderson, 1989). High performance levels on a task are typically associated with greater task learning. Therefore, we expect higher performance outcomes on an initial managerial source problem will lead to higher transfer performance on a target problem that shares the same causal relations. In addition, more comprehensive learning of an initial managerial source problem should also result in more accurate knowledge of the underlying structural relations of the source. Greater understanding of the structural principles of a problem facilitates transfer to similar problems. Therefore, we also expect that decision makers with higher levels of knowledge on an initial management situation will achieve higher transfer performance on a target problem that shares the same causal relations.

Psychology research on learning has also examined the impact of a range of different search strategies decision makers adopt for exploring a complex problem space. The search strategies range from haphazard random exploration where all factors are changed in an *ad hoc* way to the highly systematic approach of changing one variable at a time while holding others constant. The latter is known by the acronym VOTAT (vary one thing at a time) and research findings show this systematic hypothesis testing approach improves learning and is more likely to lead to identification of the correct structural relations underlying a task (e.g., Bandura and Wood, 1989; Vollmeyer, Burns, and Holyoak, 1996). Decision makers who spontaneously adopt a more systematic hypothesis testing strategy for rule induction during free exploration acquire better knowledge of the rule space and are more successful at subsequent transfer tasks tapping the same knowledge (Vollmeyer *et al.*, 1996). Therefore, we expect decision makers who spontaneously adopt a systematic search strategy to explore an initial management situation to achieve higher transfer performance on a target problem with the same causal relations.

*Hypothesis 2a: Higher performance on an initial management source problem will lead to higher transfer performance on a novel target problem with the same causal relations.*

*Hypothesis 2b: Higher knowledge levels of an initial management source problem lead to higher transfer performance on a novel target problem with the same causal relations.*

*Hypothesis 3: Increasing use of a systematic search strategy to explore a management source*

*problem leads to higher transfer performance on a target problem with the same causal relations.*

**METHODS**

Participants were 96 business students at a large university. Fifty-two percent of the participants were male, 85 percent were between 20 and 34 years of age, and 61 percent had some practical experience as a manager. All participants were paid \$30 for their involvement in the study.

**Procedures**

Figure 1 provides an overview diagram of the experimental design. Participants were randomly allocated to either an experimental or control condition. The same two simulations used in Study 1 were again used in Study 2. All participants completed the production team simulation as the initial source problem, followed by the cricket team simulation as the target transfer problem. Participants in the experimental condition were presented with a variation manipulation while working on the source task that consisted of a slightly altered version of the production team simulation. Each participant followed instructions on individual computers and worked through the decision trials at his or her own pace.

Participants started the experiment by answering questions assessing learning goal orientation. All participants then completed two practice decision trials on the production team source task in order to become familiar with the user interface and the nature of the dynamic decision task. Next, participants completed the first block of learning

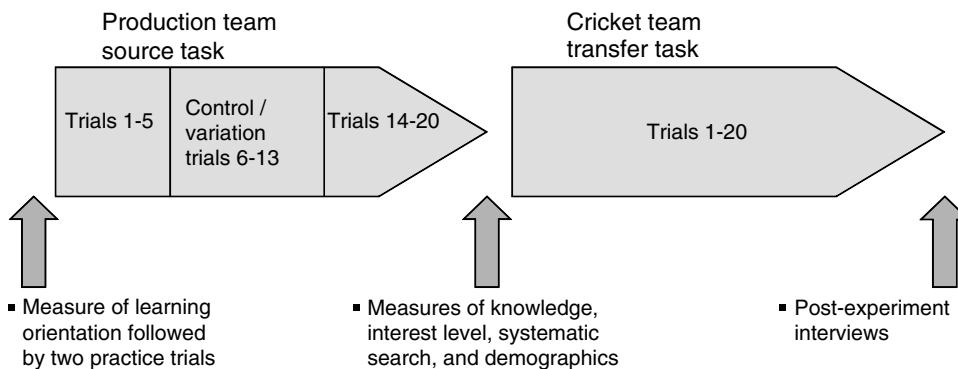


Figure 1. Overview of Study 2 experimental design

decision trials 1–5. For the experimental group, the variation manipulation was introduced in decision trials 6–13. The task reverted back to the control level from decision trial 14. For the control group, the production team task remained exactly the same for decision trials 1–15. Immediately after finishing decision trial 15, all participants were instructed that they should complete another five decision trials (16–20) during which their production team should perform as well as possible. The twentieth trial was the final decision trial on the production team source task. Participants were then asked questions assessing their level of interest and completed a set of knowledge questions and demographic items. Upon completion of these questions, participants were shown an introduction to the cricket team simulation, given two practice trials, and then instructed to get their cricket team to perform as well as possible over 20 decision trials. Before leaving the laboratory, participants were asked whether or not they believed the simulations were based on the same underlying rules of management.

### Source task variation

Task variation was manipulated in this study through changes to the employees managed by experimental group participants in decision trials 6–13 of the production team source task. In the control condition, participants managed the same five employees throughout the 20 decision trials on the production team task. In the experimental condition, two of the employees in the production team were changed at decision trial 6 and then changed back to the original employees at decision trial 14.

Introduction of two different employees in decision trials 6–13 of the learning phase on the source task meant that decision makers were exposed to a slightly altered variation of the production team task. Introducing variability can also alter the complexity of the task, which, in itself, has implications for learning. Although there was still a ‘best fit’ between the five employees and each of the jobs, the fit was not as clear-cut in the variation version of the production team task as it was for the original five employees. Participants in the experimental condition were expected to explore the problem space more during these trials in order to understand how the simulation had altered.

## Measures

### Performance

Performance on the simulation tasks was calculated exactly as described for Study 1 with one change. In order to assess whether decision makers learned the source task, the individual decision trial data were averaged to compute mean performance across three trial blocks for the production team task. Block 1 included decision trials 1–5, block 2 included decision trials 6–13, and block 3 included decision trials 16–20. The data for trials 14 and 15 were excluded from the final analysis as they were influenced by lagged effects from the variation manipulation trials. As in Study 1, performance on the cricket team transfer task was the average across all 20 decision trials.

### Transfer

We adopted the well-established formula for estimating the percentage and direction of transfer from the source task to the transfer task (Murdoch, 1957). To determine whether experience on the production team source task improved performance on the cricket team task, we compared performance on the cricket team task achieved during the transfer phase (i.e.,  $Perf_{Transfer}$ ) with performance from the 16 participants in Study 1, Condition 2 who completed the cricket team task as the source task ( $Perf_{Source}$ ).

Percentage of transfer

$$= \frac{Perf_{Transfer} - Perf_{Source}}{Perf_{Transfer} + Perf_{Source}} \times 100 \quad (1)$$

### Knowledge

Knowledge of the underlying structural relations of the source task was assessed using 12 questionnaire items presented after participants finished working on the production team source task. These 12 items were derived directly from the underlying equations of the simulation. Participants were asked to respond with *true* or *false* after each statement. Two items referred to knowledge about the allocation of employees to jobs, three about the use of feedback, four were concerned with goals, and a further three with the provision of rewards. An example item is ‘if more than 3 or



4 members of the group perform badly, all group members should receive no reward.’ An overall knowledge score was computed by taking the sum of correct answers to the 12 items. The instructions to participants expressly stated that responses should be based exclusively on their experience with the simulation. While we realize this is to some extent impossible, and therefore a limitation for our study, we believe this instruction helps minimize the cases where participants rely exclusively on prior experiences (i.e., outside the simulation) when answering the knowledge questions.

#### *Systematic search strategy*

A measure of how much decision makers engaged in systematic search of the problem space was derived from each participant’s decision data. Systematic search involves unconfounded changes made to decision variables within each block of trials. An unconfounded change is one in which only one variable at a time is changed within a decision trial. This approach allows the participant to test the effect of a change in a single variable by holding the other variables constant. The systematic search strategy measure was computed as the number of unconfounded changes made across each of the four decision categories (i.e., employees, goals, feedback, and rewards) divided by the number of changes it was possible to make within each decision category for each trial block. These trial block proportions were added together for the final measure, enabling comparisons across decision variables, trial blocks, and conditions.

### **Control variables**

#### *Learning goal orientation*

A learning orientation is thought to positively influence performance on a difficult task through a number of processes including the adoption of more flexible and attainable performance standards, a belief that ability can be increased through effort, a willingness to approach tasks at which an individual is not confident of success, a positive view of errors, a focus on intrinsic rewards, and the use of more feedback-seeking behavior (VandeWalle and Cummings, 1997). Dispositional learning goal orientation was assessed using eight items adopted from Button, Mathieu, and Zajac (1996). Responses were based on a seven-point

scale ranging from *strongly agree* (1) to *strongly disagree* (7). An example item is ‘the opportunity to learn new things is important to me.’ The reliability Cronbach’s alpha for learning orientation was 0.80.

#### *Metacognitive activity*

Metacognition includes activities associated with planning, monitoring, evaluation, and reflection. There is substantial evidence linking metacognitive activities to learning (for a review see Chi, Glaser, and Farr, 1988). Metacognitive activity was measured using five items after participants completed the production team source task. The five-item metacognitive activity measure was developed specifically for this task. The five items were designed to assess the extent to which participants reported that they engaged in planning, monitoring, evaluation, and revision when learning the production team task. An example item is ‘as I worked through the weeks, I evaluated how well I was learning the skills needed to improve production output.’ Participants were asked to rate the extent of their agreement with each of the five statements on a seven-point scale ranging from *to a very little extent* (1) to *to a very great extent* (7). The reliability Cronbach’s alpha for these five items was 0.82.

#### *Interest*

The duration and intensity of the experiment might lead to a reduction of interest which could influence performance. To control for any such effects, participants’ interest in working on the production team task was assessed following the metacognitive activity questions. The authors designed the five-item measure to assess the extent to which participants found the simulation interesting and relevant for managers. An example item is ‘I can see the relevance of the production team simulation for management.’ Participants were asked to rate their agreement with each of the five statements on a seven-point scale ranging from *strongly disagree* (1) to *strongly agree* (7). The five items formed a single factor with a standardized Cronbach’s alpha of 0.88.

In addition, a number of demographic variables were used as controls in the analyses. These demographic variables include age, gender, whether English was the participant’s first language, and

amount of management experience. The inclusion of managerial experience controls for prior knowledge in leading and motivating teams.

**RESULTS**

The study means, standard deviations, and correlations are presented in Table 1. As expected, there is a significant, positive relationship between exposure to the variation of the source task and performance on the target transfer task. Also as expected, there are significant, positive relationships between performance on the source task and transfer performance, and between knowledge of the source situation and transfer performance. In addition, adoption of a systematic search strategy was significantly and positively associated with performance on the initial management source problem and transfer performance.

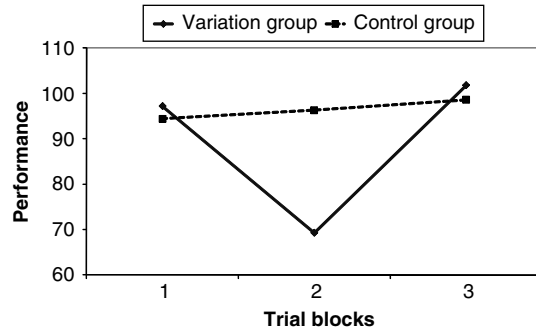


Figure 2. Performance on production team source task across trial blocks by group in Study 2

Figure 2 provides the mean performance outcomes for the two groups across the three trial blocks of the production team source task. The experimental group was exposed to the variation of the source task during trial block 2. Since learning is a prerequisite for transferring insights from one

Table 1. Means, standard deviation, correlations, and reliabilities for Study 2 variables

	Mean	(SD)	1	2	3	4	5	6	7	8	9	10	11
1. Source task variation			—										
2. Source task performance on TB1	95.77	(15.79)	0.09	—									
3. Source task performance on TB2	82.78	(23.91)	-0.57	0.63	—								
4. Source task performance on TB3	100.18	(25.12)	0.06	0.92	0.70	—							
5. Transfer task performance	74.75	(27.50)	0.22	0.32	0.12	0.36	—						
6. Knowledge	7.64	(1.73)	-0.09	0.36	0.30	0.38	0.24	—					
7. Systematic search strategy	0.86	(.37)	-0.07	0.21	0.20	0.24	0.33	0.19	—				
8. Learning orientation	5.83	(.71)	-0.14	0.15	0.25	0.17	-0.05	0.08	0.10	<b>0.80</b>			
9. Interest	22.85	(6.53)	0.06	0.19	0.19	0.20	0.09	-0.03	0.22	0.27	<b>0.88</b>		
10. Metacognitive activity	5.01	(1.06)	-0.07	0.33	0.35	0.37	-0.05	0.05	0.16	0.40	0.43	<b>0.82</b>	
11. Gender (male=1, female=2)			0.04	-0.01	-0.04	-0.06	0.06	-0.11	0.17	0.03	-0.08	0.06	—
12. English 1st language (no=1, yes=2)			-0.09	0.07	0.18	0.15	0.21	0.12	0.07	-0.07	0.01	-0.20	-0.26

N = 96.  
 Correlation values above 0.20 are significant at the 0.05 level.  
 Correlation values above 0.26 are significant at the 0.01 level.  
 Reliabilities reported along the diagonal in bold.

problem to another, we first assessed whether there was evidence that decision makers learned about the production team source task. Using a repeated measures model with performance on the production team source task as the dependent variable, we find a significant difference between performance outcomes across the three trial blocks [ $F(2,93) = 123.81, p < 0.01, \eta^2 = 0.73$ ]. Examination of within-subject contrasts shows a significant performance improvement across both groups between trial block 1 and trial block 3 [ $F(1,94) = 12.16, p < 0.01, \eta^2 = 0.12$ ]. As expected, there is a significant difference between the two groups on the change in performance from trial block 2 to trial block 3 [ $F(1,94) = 162.41, p < 0.01, \eta^2 = 0.63$ ]. Performance of the experimental group decreased sharply for trial block 2 in response to the variation manipulation, but then recovered on trial block 3. The control group continued on the original version of the source task and continued to improve during the second trial block. Overall, these findings show that learning did occur on the source task in both conditions.

A t-test compared transfer performance on the cricket team task between the control and experimental groups. The group exposed to the variation of the initial management source problem achieved significantly higher transfer performance than the control group on the cricket team target task [ $t(94) = -2.17, p < 0.05$ ]. This suggests decision makers in the variation group made better use of insights about the production team source task to outperform the control group on the cricket team task with the same causal relations.

Table 2 provides the performance means, standard deviations, t-test results, and transfer percentages derived from Murdoch's (1957) formula for the cricket team task. Data are included for the variation group, the control group, and for the benchmark group in Condition 2 from Study 1

that completed the cricket team task first (i.e., as the source problem). The performance difference between the control group and the benchmark group from Study 1 is not significant [ $t(62) = 0.90, ns$ ]. There is no evidence of transfer from the source task to the target task in the control group. In contrast, the performance difference between the variation group and the benchmark group from Study 1 is significant [ $t(62) = 2.26, p < 0.05$ ]. These results are evidence of positive transfer for the variation group but not for the control group. Overall, the results discussed thus far support Hypothesis 1 and show that variation on the initial management source problem leads to higher transfer performance on the analogous target problem.

To test Hypotheses 2 and 3, we estimated a regression model with mean performance across all 20 decision trials on the cricket team transfer task as the dependent variable (see Table 3). Model 1 includes only the control variables and shows that decision makers with no managerial experience have significantly lower transfer performance than those with 'quite a lot' of managerial experience ( $B = -24.75, p < 0.05$ ). None of the other control variables are significant. Model 2 includes the control variables and the hypothesized independent variables. Consistent with the results discussed above, decision makers exposed to the source task variation achieved significantly higher transfer performance than the control group ( $B = 10.60, p < 0.05$ ). Also, supporting Hypothesis 2a, decision makers who had higher performance on the production team source task achieved significantly higher transfer performance ( $B = 0.33, p < 0.01$ ). Surprisingly, knowledge level was not a significant predictor of transfer performance ( $B = 1.18, ns$ ) and therefore Hypothesis 2b is not supported. In support of Hypothesis 3, higher levels of systematic search on the source

Table 2. Performance means for each group on the cricket team task

	Mean (SD) performance on cricket team task	t value	Significance	Percentage transfer
Control group <sup>a</sup>	68.79 (24.46)	0.898 <sup>c</sup>	0.373	+4.8
Variation group <sup>a</sup>	80.71 (29.29)	2.258 <sup>d</sup>	0.027	+12.7
Benchmark from Study 1 (Source) <sup>b</sup>	62.55 (22.85)			

<sup>a</sup>  $N = 48$  in each of the control and variation groups in Study 2.

<sup>b</sup>  $N = 16$  Cricket team as source task from Study 1 Condition 2.

<sup>c</sup> t-test of difference in mean performance on cricket task between control group and Study 1 benchmark.

<sup>d</sup> t-test of difference in mean performance on cricket task between variation group and Study 1 benchmark.

Table 3. Regression results for transfer performance in Study 2

	Model 1	Model 2
(Constant)	56.95 (31.00)	26.46 (30.22)
Age 20–24 <sup>a</sup>	10.34 (10.11)	9.65 (9.19)
Age 25–29 <sup>a</sup>	9.37 (9.74)	7.26 (8.94)
Age 30–34 <sup>a</sup>	–1.59 (10.62)	–2.72 (9.56)
Learning orientation	–1.95 (4.47)	–1.91 (4.04)
Mngr experience, none <sup>b</sup>	–24.75* (10.07)	–15.28 (9.39)
Mngr experience, little <sup>b</sup>	–13.97 (10.53)	–4.03 (9.64)
Mngr experience, some <sup>b</sup>	–9.56 (10.54)	–2.17 (9.87)
English first language	11.28 (6.22)	6.19 (5.81)
Gender	9.69 (6.27)	4.95 (5.90)
Interest	0.60 (0.51)	0.19 (0.47)
Metacognitive activity	–1.13 (3.20)	–4.46 (3.10)
Source task variation		10.60* (5.30)
Source task performance on TB3		0.33** (0.12)
Knowledge		1.18 (1.66)
Systematic search strategy		18.69* (7.69)
R <sup>2</sup>	0.15	0.36
Adjusted R <sup>2</sup>	0.04	0.24
F	1.35	2.97**
ΔR <sup>2</sup>		0.21
F of the ΔR <sup>2</sup>		6.46***

N = 96.

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

Unstandardized coefficients with standard errors shown in parentheses.

Dependent variable: transfer performance on cricket team task.

<sup>a</sup>Reference category is 'age 35 plus'.

<sup>b</sup>Reference category is 'managerial experience, quite a lot'.

task resulted in significantly higher transfer performance ( $B = 18.69$ ,  $p < 0.05$ ). None of the control variables were significant in Model 2.

Overall, these results show that—in addition to variation on the source task—adopting a systematic search strategy to explore the source task and achieving high performance on the source task are two mechanisms that significantly enhance analogical transfer. These findings provide further evidence about the importance of adequate learning about the initial management situation before transfer to an analogous target problem is feasible.

To better understand how and why the source task variation intervention improved analogical transfer to the target task, supplementary analyses examined the amount of exploration decision makers undertook during trial block 2. This block of trials coincided with the variation manipulation on the source task. The variation group explored the source task problem space more extensively than did the control group in terms of the indexed number of changes made to decision inputs during trial block 2. The raw number of changes made on each of the four decisions was divided

by the total possible number of changes for each decision during the trial block. These proportions were summed across all four decisions to compute the index. The variation group made significantly more changes [ $M = 1.43$ ,  $SD = 0.58$ ] than the control group [ $M = 1.09$ ,  $SD = 0.65$ ;  $t(94) = -2.61$ ,  $p < 0.05$ ]. In contrast, there was no significant difference between the groups for the number of changes made to decision inputs during trial block 1 or trial block 3 on the source task. These results show that the variation intervention increased exploration of the source task problem space during trial block 2. In the short term, greater exploration resulted in lower performance on the source task for trial block 2. However, the variation intervention ultimately leads to significantly higher transfer performance.

Upon conclusion of the experimental sessions, each participant was asked whether or not he or she thought the two simulations were governed by the same underlying principles. Forty-two percent of the participants realized that the two management simulations were based on the same structural relations. There was a significant correlation between

recognition of the common structural relations and exposure to variation on the source task ( $r = 0.21$ ,  $p < 0.05$ ). Participants exposed to the variation intervention were more likely to realize that the cricket team task was based on the same structural relations as the production team task. Fifty-two percent of participants in the variation group recognized that the two simulations were based on the same underlying structural relations, compared with only 31 percent in the control group. A chi-square test shows the proportion of participants across the two groups that were aware of the structural alignment between the source and target situations is significantly different ( $\chi^2 = 4.29$ ,  $p < 0.05$ ). Overall, these results show that exposure to the source task variation enhances decision makers' ability to map the structural alignment from the source task to the target task. In other words, the variation intervention improved decision makers' analogical reasoning and transfer performance.

## DISCUSSION

Study 2 provides evidence connecting higher levels of learning on the initial management situation with higher analogical transfer. Decision makers must learn an initial source task well enough so that they can subsequently identify structural relations for aligning or mapping the source with a new target task to facilitate successful transfer. As predicted, exposure to a variation of the source task stimulates exploration that leads to higher recognition of the structural alignment between the source and target situations and significantly better transfer performance on a target task that shares the same causal relations. Variation has an immediate detrimental impact on performance in the short term because decision makers quite suddenly find themselves on unfamiliar ground operating in new parts of the problem space. However, the benefits for learning about and encoding the structural relations of the management situation improves decision makers' ability to map the structural alignment from the source to the new target situation and results in higher transfer performance.

Higher performance and higher systematic search on the initial management source problem also led to higher transfer performance. Decision makers who more comprehensively learn an initial problem are more likely to successfully

transfer insights to other similar problems (Anderson, 1982, 1993; Singley and Anderson, 1989). As expected, there was a significant positive correlation between performance over trial block 3 on the source task and knowledge levels about the structural relations of the source ( $r = 0.38$ ,  $p < 0.01$ ). Surprisingly, this superior knowledge did not have a significant impact on transfer performance after controlling for other factors. This suggests that the performance effects of knowledge are fully realized in decision makers' source task performance and have no additive effects on transfer performance.

The experimental group participants were significantly more aware of the structural alignment between the source and transfer situations, providing further support for the conclusion that exposure to variation on the source task helped decision makers develop a richer understanding of the structural relations. However, only 42 percent of the decision makers in our study were consciously aware of the common causal relations between the two simulations. This low level of conscious awareness about structural equivalence and about the use of analogical inference is very consistent with prior research on analogical transfer demonstrating that analogies can have a strong impact on problem solving without decision makers recognizing the extent of the influence (Gentner *et al.*, 2003; Gilovich, 1981; Schunn and Dunbar, 1996). As with other cognitive processing (Wilson and Bar-Anan, 2008), analogical transfer often happens at the subconscious level without decision makers being aware of their own reasoning process. Thus, self reports of analogical reasoning are unlikely to be reliable.

## GENERAL DISCUSSION

There is growing evidence that senior executives make decisions—consciously and unconsciously—using analogical inference. However, prior research overwhelmingly shows that decision makers have great difficulty identifying structurally similar situations for knowledge transfer. The results from Study 1 are consistent with these findings. This is why the findings from Study 2, which identify specific mechanisms that enhance analogical transfer between complex management situations, represent an encouraging and important contribution.

The findings show variation in an initial management situation (the source problem) leads to greater exploration of the problem space, higher recognition of structural similarities between source and target situations, and higher transfer performance. These results suggest decision makers exposed to the variation learn more about the structural relations on the source problem and transfer more knowledge about the structural relations to the target problem. Encoding higher quality mental models of the source situation improves the structural mapping process when decision makers move to the new target situation. Analogical transfer improves as a result. These findings are consistent with prior psychology research highlighting the benefits of task variation for learning in a single domain (Hesketh, 1997; Paas and Merrienboer, 1994; Wulf and Schmidt, 1997) and with management research showing related task variation improves team learning (Schilling *et al.*, 2003). The findings in the current paper extend the application of task variation into cross-domain analogical transfer.

The findings also extend prior research that shows analogical transfer can be improved by providing hints to use a previous problem, pointing out the relevance of the source problem, asking questions that induce reflection about the source problem, and comparing multiple example cases along with guided training about the structural alignment between the cases (Gentner *et al.*, 2003; Holyoak and Koh, 1987; Loewenstein *et al.*, 1999; Novick and Holyoak, 1991). The source task variation in Study 2 enhanced analogical transfer without explicitly informing decision makers about structural relations and similarities. In many complex management situations involving strategic choices, it may not be possible for anyone to provide hints about appropriate source problems or guided training about the structural alignment for relevant example cases. Building rich mental models of the domain through exposure to a variety of experiences may be the only option available for enhancing analogical reasoning and transfer.

The results also have implications about what kind of career experiences prepare candidates for senior executive positions with strategic responsibilities. Rather than staying in the same roles after learning has plateaued or accepting new roles with nearly identical challenges, managers might introduce variation by taking on new challenges that build on and extend their previous experience.

This is consistent with prior research showing that developing expertise in a domain involves mastering a sequence of challenges with increasing levels of difficulty (Ericsson, Krampe, and Tesch-Romer, 1993). However, identifying managerial career paths that build on and extend past experiences, but that are not too different from previous roles to render prior learning unhelpful, can be difficult.

New roles that are unrelated to a manager's prior experience may result in the misapplication of prior knowledge and poor performance outcomes. For example, senior managers adopting a corporate diversification strategy could undermine firm performance by applying the core business dominant logic to new businesses that are not strategically related (Bettis and Prahalad, 1995). Our results suggest that senior managers with a variety of experiences in the core business will develop higher quality representations of their business and should be more effective at the structural alignment processes for identifying new businesses that are truly strategically related (i.e., that share important structural relations). More generally, the findings suggest that managers can enhance knowledge transfer from prior experiences by learning the structural relations underpinning strategic challenges through managing increasingly more difficult variations of those challenges.

The findings also have implications for strategy research advocating that managers should consciously generate analogies to support strategic decisions in novel contexts (Duhaime and Schwenk, 1985; Gavetti *et al.*, 2005; Gavetti and Rivkin, 2005; Schwenk, 1984). The results show that insufficient knowledge about the source analog and poor performance managing the source situation are key constraints in the ability to make useful analogical inferences. Advice to generate analogies to improve strategic choices should be qualified to note that a prerequisite for successful analogical transfer is a rich understanding of the structural principles of the source situation. Simply generating analogies is unlikely to improve strategic decisions in complex situations unless managers have encoded rich mental models of the source situation and obtained a level of mastery managing the strategic challenges in that domain.

The impact of variation on knowledge transfer across analogous situations also has implications for management education. The traditional approach to teaching with case studies helps create

a repertoire of vicarious experiences from which students can potentially draw when solving strategic problems (Gavetti and Rivkin, 2005). However, many courses are designed to pair one topic per week, such as barriers to imitation, with a single corresponding case despite the evidence that students generally do not abstract structural relations from single examples (Gentner *et al.*, 2003; Hesketh, 1997). To support effective learning of the structural relations of key strategy principles, multiple cases of increasingly difficult variations of a strategic problem should be paired with each topic. This is consistent with and extends prior research that shows comparing multiple example cases, with guided training about the structural alignment between the cases, improves analogical transfer (Gentner *et al.*, 2003). Richer cognitive representations of strategic problems illustrated by variations across multiple cases will enhance managers' ability to transfer insights to challenges faced later in their careers.

The results also show that decision makers spontaneously employ a range of different types of search strategies to explore complex problem spaces. Some adopt systematic search strategies while others rely on *ad hoc* exploration. Differences in search routines are an additional source of heterogeneity that can be incorporated into strategy models exploring the role of boundedly rational search in selecting strategic choices (Gavetti *et al.*, 2005; Lenox, Rockart, and Lewin, 2006; Rivkin and Siggelkow, 2007). The findings show that higher use of systematic search improves analogical transfer. Rigorous, unconfounded exploration of the problem space facilitates accurate inferences about the structural relations in the source situation. Exploration using *ad hoc* search processes cannot lead to accurate inferences because there are inherent confounds introduced by changing multiple variables at the same time. Systematic search helps develop richer cognitive representations of the source situation and enhances analogical transfer. This is consistent with psychology research highlighting the benefits of a systematic hypothesis testing approach for learning in a single domain (Bandura and Wood, 1989; Vollmeyer *et al.*, 1996), and extends the application into cross-domain analogical transfer. These results also suggest that training managers to systematically search complex decision environments may be an important way forward to

improve strategic decision making. Firms increasingly use rigorous experimental designs in marketing and advertising tests to inform marketing decisions, and this could be expanded to include a wide range of strategic decisions.

### Limitations and future research

Experimental findings identifying mechanisms that enhance analogical transfer in the laboratory are not conclusive evidence about the impact of these mechanisms in actual strategic decisions by firms. However, recent meta-analyses comparing effect sizes from lab studies and field research reveal a correlation of 0.73 to 0.97 suggesting a high degree of generalizability from lab to field (Anderson, Lindsay, and Bushman, 1999; Cohen-Charash and Spector, 2001). Also, several aspects of the research design contribute to the external validity of the findings and our results suggest a number of implications that can be tested with field data.

The simulations used in this study correspond with a common managerial challenge that is relevant for senior executives and for which the causal relationships are well established. Also, the complexity of the simulations more closely approximates the decision making environments of senior managers than the tasks typically employed in psychology to examine analogical transfer. This is important given the widespread evidence that characteristics of the decision environment—particularly complexity—impact psychological processes and empirical results (Gary and Wood, 2011; Paich and Sterman, 1993; Wood *et al.*, 1990). The experimental design also enabled use of two structurally equivalent tasks, which would be difficult to isolate in the field due to uncertainty about the objective cause-effect relationships. The nature of the tasks may, however, impose some generalizability constraints on our results. For example, many strategic decision problems involve situations that fall short of the structurally equivalent ideal tested in the current study. Also, causal relationships operating for a given strategic challenge can change over time. Insights derived from past experiences must be adapted when there are important differences in the structural relations between the source and target situations (Novick and Holyoak, 1991). Failure to understand important differences between source and target situations and the need to adapt insights drawn from the analogy may yield undesirable

results. Future research should attempt to replicate the results by examining analogical transfer in situations where managers must adapt knowledge drawn from analogies to fit new target problems.

The experimental design also made it possible to manipulate variation of the source situation in a controlled setting and rigorously test the impact on analogical transfer. The results are encouraging but represent only a first step in examining the effects of source task variety on analogical transfer. The current study is limited in that it relies on only one level of variation of the source situation. However, task variation is a continuous and multidimensional construct (Schilling *et al.*, 2003). Future research can extend this work by investigating the impact of different levels and dimensions of task variation on analogical transfer. Research is needed to examine how much variation will maximize learning about complex strategic decision problems and which dimensions of task variation enhance analogical reasoning and transfer.

Although the current study examined analogical transfer of individuals to approximate the decisions of top management teams in organizations, we must exercise caution in generalizing the findings to other levels. Complex group dynamics around communication, coordination, or conflict can shape strategic decision making and may impact analogical transfer. Previous research shows that task variation enhances learning at both the individual (Hesketh, 1997) and group (Schilling *et al.*, 2003) levels. Therefore, it seems likely that the beneficial effects of task variety on analogical transfer identified in the current study will be similarly effective at the group level for top management teams. Future research should attempt to replicate the findings of the current study by examining the effects of task variety on analogical transfer in teams and the interaction between individual and team use of analogies. Such research would provide a better understanding about how the social and political processes in organizations impact analogical reasoning in strategic decision making.

A limitation of the current study is that we did not measure the actual reasoning process. This has been true for most studies of analogical reasoning because isolating the different cognitive processes involved is very challenging; even for much simpler tasks. Reasoning by analogy engages multiple cognitive processes—conscious and subconscious—working in concert, making direct tests of

the reasoning processes very difficult. Recent and new technologies, such as eye tracking devices and brain imaging, may enable future research to isolate and measure the reasoning processes for strategic decisions. Strategy scholars increasingly recognize managerial cognition as an important source of performance differences (Gary, 2005; Gary and Wood, 2011; Gavetti *et al.*, 2005; Kaplan, 2008; Kunc and Morecroft, 2010), and heterogeneity in managers' ability to reason by analogy may play a key role in explaining variation across firms.

Reasoning by analogy can be a very powerful source of strategic insights and the results of the current study identifying mechanisms that enhance analogical transfer are encouraging. However, the risks of drawing on analogies to inform strategic decisions in novel contexts may outweigh the potential benefits in some situations. Exposing managers to a variety of experiences can improve analogical transfer, but introducing variation in the current study also drastically reduced performance in the short term. In some cases, the short run costs of introducing variation will exceed the benefits of improved strategic decision making in the longer term. Also, when the differences in structural relations between source and target situations are too great, analogical reasoning may undermine strategic decisions and alternative reasoning processes may be more effective. Further research is needed to identify the types of situations where managers should and should not reason by analogy to guide strategic decisions.

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