The Costs and Benefits of Bounded Rationality

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Over the past half century, the Carnegie School’s view of organizations as boundedly rational actors has become a cornerstone of organization theory. An important consequence of bounded rationality is that organizations must engage in a process of search and learning in order to identify and evaluate suitable choices. Indeed, bounded rationality implies that this process is itself subject to cognitive challenges. At the same time, in the Carnegie tradition, a growing body of work has employed computational methods to examine search. The intersection of these two ideas has been the nexus of significant advances in organization theory (much of which has been published by Organization Science). The objective of this panel is to take a new – and perhaps even unconventional – look at the consequences of bounded rationality. This panel focuses on bounded rationality not only as a performance-degrading impediment that must be overcome, but also as a mechanism that potentially leads to superior outcomes. The panel encompasses four papers related by these ideas. The first two papers examine benefits of bounded rationality. The last two papers explore the impact of organizational structure on learning outcomes in the presence of bounded rationality.

In particular, the paper by Martignoni and Siggelkow investigates the effect of imperfect understanding of contingency relationships on performance. The conventional wisdom says that a correct mental model of contingencies in the mind of managers would lead to the highest performance. Their computational model shows that this is only partially valid. An interesting result is that over and underspecified mental models can create benefits that are associated with preventing managers from getting stuck too early with a choice that has shown some initial good returns.

The paper by Lee, Posen, and Yi examines imitation - a strategy for organizational search and learning that has been largely overlooked in the literature (relative to that of innovation). They examine the extent to which bounded rationality limits the efficacy of imitation. Naive intuition might suggest that the outcome of imperfect (bounded) imitation will be somewhat less than that which may be garnered by perfect imitation. In contrast, employing a computational model, they identify conditions under which imperfect imitation can generate unexpectedly good outcomes – indeed better than the outcomes achieved if firms were perfect imitators.
The paper by Csaszar shows how the decision-making structure in the organization affects the omission and commission errors (Type I and II errors, respectively), and the consequences of bounded rationality. The key findings of this paper speak to one of the fundamental issues in management: how to create reliable organizations out of unreliable individuals. The implication is that firms in unstable or fermenting environments must try to avoid omissions because these curtail the extent of exploration of new high-fitness positions. On the other hand, firms facing stable or incrementally changing environments try to avoid commission errors, as these may disrupt their currently efficient exploitative operations.

The paper by Lee, Lee, Lee, and Braha studies hierarchical organizational structure in its role as an organization’s mechanism of information processing in the face of bounded rationality. They argue that the much-maligned bureaucratic structure has significant benefits associated with the ability of the organization to engage in learning. In particular, they numerically demonstrate that removing a substantial number of vertical links in the middle management will have detrimental effects on learning performance. It is because different ideas and knowledge dispersed in different subunits are primarily exchanged and recombined through managers at the middle level who play a role of what Granovetter (1973) called “bridges” between seemingly isolated subgroups.
When it Pays to be Neurotic or to Have Blind Spots:  
The Value of Understanding External and Internal Contingencies  
Dirk Martignoni and Nicolaj Siggelkow¹

Contingency relationships form a central feature in the fields of strategy and organization theory. The value of many organizational choices, such as organizational designs or particular activities along the value chain, are deemed to be dependent on other factors: factors that are either outside the control of the organization, e.g., environmental turbulence, or within the control of the organization, e.g., the firm’s current product portfolio. Although the theory of such external contingencies (e.g., Lawrence and Lorsch 1967) and internal contingencies (e.g., Chandler 1962, Miller and Friesen 1984) has a long history, empirical support for these relationships has been much harder to obtain (Donaldson 2001). Even to show relatively simple relationships, e.g., the mutual complementarity among various human resource practices, large data sets and considerable econometric sophistication has been required (Ichniowski et al. 1997). Given these empirical challenges, managers are likely to operate quite often with mental models that do not accurately reflect all contingency relationships that affect the choices they control.

If an imperfect understanding of contingency relationships is the rule rather than the exception, the question of the resulting performance implications is of considerable interest. How valuable is a precise understanding of these relationships? What are the costs of having a mental model that is overspecified or “neurotic,” i.e., assumes interdependencies that actually do not exist? What are the costs of having a mental model that is underspecified or “blind” to interactions that actually do exist? Under which conditions are these errors particularly costly? Is it always optimal to have a correct mental model?

To address these questions, we build a simulation model, an extension of an n-armed bandit model, that allows us to systematically analyze the performance implications of having different types of mental models concerning the presence or absence of external and internal contingencies. In particular, we focus on the effect of different mental models on the ability of managers to learn about the effectiveness of choice alternatives (see Figure 1 for a high-level overview).

While it is fairly difficult to directly measure mental models, the simulation approach we pursue has the distinct advantage that we have complete control over the mental models of our simulated managers. Likewise, we have complete control over the true interaction pattern between choices and contingency factors. This allows us to systematically study the effects of correctly, and over- and underspecified mental models.

While intuition would suggest that a correct mental model of contingencies should lead to the highest performance, we find only partial support for this hypothesis. Over- and underspecified mental models lead to costs but they also can create benefits. On the cost side, underspecified mental models lead managers to choose actions that are good on average (across of a number of

¹ Dirk Martignoni, University of St Gallen, Switzerland; Nicolaj Siggelkow, The Wharton School
states that the manager does not distinguish), even though for each state there may exist an even better solution. Overspecified mental models tend to slow down the improvement of decision making and can lead to less exploration. First, since many combinations of actions/contingency states are assumed to exist, it takes a long time to create experiences, and thus form informed opinions about each combination. Second, given the many assumed possible combinations, the number of experiences for each given cell tend to be few, making the estimates of the effectiveness of each combination unnecessarily noisy. And third, since every activity/contingency state is assumed to be unique, truly existing correlation among returns across states is not exploited.

On the benefit side, however, misspecified mental models can lead to increased exploration. For external contingencies we find it to be helpful, in the case of low complexity, to have somewhat “neurotic” mental models that include more interdependencies than actually exist. These extraneous, assumed interdependencies prevent a manager from getting stuck too early with a choice alternative that has shown some initial good returns.

For internal contingencies there exists, however, a benefit from underspecified mental models. When search is completely endogenous, i.e., the manager chooses which combinations to explore, overspecified, or even correctly specified models can lead to rapid lock-in, particularly in the presence of many interdependencies. By assuming away potential tradeoffs, underspecification leads to increased exploration: a high performance of one activity is assumed to also exist even if a poorly performing other activity is changed. As a result, the manager does not shy away from changing the poorly performing activity, even if this activity might be required for the first activity to achieve its high performance.

We find this result particularly intriguing. The current work on interdependencies using NK-models tends to paint a picture of highly rugged landscapes with managers (and firms) getting stuck very quickly on low, local peaks. While a number of mechanisms, such as different organizational designs, have been described to help firms dislodge themselves from low peaks (e.g., Siggelkow and Rivkin 2005), our results indicate that the (most likely simplified) mental models that managers are employing may create endogenously helpful exploration, allowing firms to avoid getting stuck too quickly.

**Figure 1 Elements of the simulation model**
The Power of Imperfect Imitation
Jeho Lee, Hart E. Posen, and Sangyoon Yi

Is imitation a useful search strategy for enhancing firm performance? We focus on the extent to which bounded rationality limits the efficacy of imitation. A naive intuition would perhaps hold that errors induced in imitation due to bounded rationality would decrease the efficacy of imitation at enhancing the quality of solutions identified by organizations. That is, an organization engaged in imperfect imitation will at best achieve an outcome that will be somewhat less than that which may be garnered by perfect imitation. In contrast, we argue that there is a broad range of conditions under which imperfect imitation may lead to unexpectedly good outcomes.

If imitation is indeed such a powerful strategy for search and learning, why has imitation been largely ignored in strategy? The strategy literature has focused primarily on the imitatee (target of imitation) - and the mechanisms they use to defend their strategic assets such as patents, secrecy, tacitness, and more recently, complexity (Rivkin 2000; Ethiraj et al 2008). At least in part, this imitatee focus is driven by the assumption in the strategy literature that unprotected knowledge diffuses rapidly, and imitation is relatively easy. Yet starting in the 1990’s, research in organization theory began to highlight the possibility that imitation requires significant effort and investment (Cohen & Levinthal, 1990) and the diffusion of knowledge is often remarkably slow (Greve, 2009). This suggests that, from the perspective of the imitator, imitation may be more complex and difficult than has previously been assumed. That said, very little research has focused attention on the use of imitation as a purposeful strategy for search and learning.

We employ a computational approach in which we model an industry of heterogeneous firms employing imitation as a means of search and learning. We find that when firms are not constrained by bounded rationality (perfect imitators), imitation is of limited potential - at best generating performance equal to the best firm. In contrast, when firms were moderately boundedly rational, and as such imitated only imperfectly, firm performance increases significantly. The result stems from the fact that perfect imitation drives out potentially superior solutions from the population as all firms very quickly come to resemble the currently best firm. It is the ability of imperfect imitation to preserve the diversity of knowledge - and indeed, generate new combinations of existing knowledge - that makes imperfect imitation a particularly powerful mechanism of search and learning.

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Organizational Structure as a Determinant of Performance:  
Evidence From Mutual Funds  
Felipe A. Csaszar

This paper empirically studies what is the effect of organizational structure on strategic-level outcomes. There is a long standing concern that the strategy literature needs a better understanding of how organizational structure and decision-making affect organizational performance. This concern has been present in the literature at least since Cyert and March (1963:21), who used the following questions in motivating their theoretical enterprise: “What happens to information as it is processed through the organization? What predictable screening biases are there in an organization? [...] How do hierarchical groups make decisions?” But with a few notable exceptions, questions of this sort remain mostly unexplored (Rumelt et al., 1994:42).

To shed light on these long standing concerns, this paper shows how the decision-making structure among a group of individuals, affects the number of initiatives pursued by organizations, and the omission and commission errors (Type I and II errors, respectively) made by organizations. The paper starts by deriving testable hypotheses from a formal model of how information-processing and structure affects the number of projects pursued by firms, and the number of omission and commission errors they make.

The hypotheses are tested using over 150,000 stock-picking decisions made by 609 mutual funds during two and a half years. Mutual funds offer an ideal and rare setting to test the theory because, as funds are heavily scrutinized, very detailed records exist on the projects they face (possible investments), the decisions they make or do not make (buying or not buying each of these possible investments), and the outcomes of these decisions (the ex-post return of having bought or missed a given investment). The independent variable of the study, the organizational structure of each mutual fund, is coded from textual descriptions of the fund management made by Morningstar. The main dependent variables of the study, omission and commission errors made by each fund, are computed as probabilities by a novel technique that uses bootstrapping to determine, in a way which is comparable across funds, if a fund buys fewer good assets (omission error) or more bad assets (commission error) than average. The empirical tests show strong and robust support for the model, suggesting that organizational structure has relevant and predictable effects on a wide range of organizations.

By describing a pervasive mechanism by which individual decision-making aggregates into organizational level outcomes, this research contributes to understanding how micro decisions turn into macro behaviors. By doing so, it improves the connection between strategy and the behavioral aspects of decision-making (Zajac and Bazerman, 1991), and speaks to one of the fundamental issues in management: how to create reliable organizations out of unreliable individuals. Applications include designing organizations that compensate for individual's biases, and that achieve a given mix of exploration and exploitation.

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Learning in Complex Systems: 
The Role of Hierarchy and Middle Management in Learning
Eocman Lee, Jeho Lee, Ji-Whan Lee and Dan Braha

Research on learning and adaptation has attracted substantial attention in the management area (March 1991; Levinthal and March 1993). Recently, with advances in computational modeling tools, the focus of research interest has been on organizational structure and its effects (e.g., Siggelkow and Levinthal 2003; 2005; Siggelkow and Rivkin 2005, 2006; Fang, Lee, and Schilling 2009; Miller et al. 2006). In particular, this new stream of theoretical research has exploited the power of computational tools to tackle the complexity in and around organizations, such as organizational decomposition, flat team-based organizations, and centralization/decentralization under environmental turbulence and complexity.

However, little systematic research on hierarchy has been done. The paucity of research on hierarchy has been attributed to two factors. First, negative images associated with bureaucracy and its key component, hierarchy, has led to the prediction of the end of bureaucracy (Bennis 1993; Pinchot and Pinchot 1993) and to the exploration of informal or new organizational forms. Second, the lack of detailed knowledge on the topological properties of hierarchy has deterred formal analysis on hierarchy and its effects.

Building on the burgeoning, computational tradition, we examine the role of hierarchy in learning. Given the limitations of our understanding and lack of reasonable idealized network models for specifying complexity inherent in hierarchy, we use a real-world hierarchical network. In particular we are interested in understanding the role of middle management. Over the last few decades, middle management has often been a major target for downsizing attempts in the name of bureaucracy busting. Many of these attempts, however, have turned out to be counter-productive (Adler 1999). In this paper, we raise the following questions. What is a role of hierarchy in recombining and transferring ideas and best practices? Does middle management play a crucial role in maintaining and enhancing learning performance?

Our numerical analysis shows that removing a substantial number of vertical links in the middle management will have detrimental effects on learning performance. This result stems from the remarkable order in learning dynamics that arises from the topological regularity inherent in a typical hierarchical structure. In particular, our numerical analysis shows that an individual’s transient learning performance is systematically higher if he or she is at a higher rank in a hierarchy than if he or she is at a lower rank. Furthermore, subordinates are more likely to learn from their superiors than either their peers at the same rank or their subordinates despite the initial setup that everyone starts with random knowledge—i.e., it is assumed that no one has any prior experience or knowledge. Different ideas and knowledge dispersed in different subunits are primarily exchanged and recombined through managers at the middle level who interact with their peers at the same rank or with their superiors. Our findings suggest that hierarchy plays a role of what Granovetter (1973) called “bridges” between seemingly isolated subgroups in an organizational chart, and that downsizing attempts will eliminate these bridges for the creation and transfer of best practices and knowledge.

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