RESEARCH NOTES AND COMMENTARIES

STRATEGY MAKING, NOVELTY AND ANALOGICAL REASONING — COMMENTARY ON GAVETTI, LEVINTHAL, AND RIVKIN (2005)

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This commentary responds to and builds upon a recent article about the role of analogical reasoning in strategy making (Gavetti, Levinthal, and Rivkin, 2005). Based on conceptual and formal analysis, the authors state that in complex and novel contexts, analogical reasoning may be superior to two established models: rational choice and local incremental search. I show that given an alternative conceptualization of the strategy-making context and main models, analogical reasoning is not necessarily superior. Furthermore, in novel and complex contexts, this model and other approaches such as mental experimentation can play a larger role, particularly in inventing effective strategies. I further extend the analysis by considering some boundary conditions in which analogical reasoning and its alternatives best apply, exploring the idea that blending and adapting several search strategies may be more effective than using only one method, such as analogical reasoning, and advancing new directions for empirical research. Copyright © 2008 John Wiley & Sons, Ltd.

INTRODUCTION

In 'Strategy Making in Novel and Complex Worlds: The Power of Analogy' (Gavetti, Levinthal, and Rivkin, 2005), the authors (hereafter GLR) examine 'how firms discover effective competitive positions in worlds that are both novel and complex' (GLR, 2005: 691). In their engaging and thought-provoking article, GLR propose analogical reasoning, a prevalent strategy-making process relatively untapped in research, as a solution to this central problem and as a potentially important source of novel strategies (GLR, 2005: 708). To delve into the power and limits of analogical reasoning, GLR use conceptual analysis and formal simulation. They conclude that in complex and novel contexts, analogical reasoning (hereafter AR) may be superior to other strategy-making models, particularly rational choice and local incremental search. This idea is significant because it leads to other fundamental questions concerning strategy, strategy making, and cognition in unfamiliar and challenging settings.

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This commentary aims to build on GLR's work to open constructive dialogue on these issues. I submit that to explore fully the role of AR and other models, it is important to make the choices underlying GLR's study more explicit, and to present alternatives. Therefore, my specific objectives are to re-examine GLR's claim about the superiority of AR and to extend GLR's work by exploring alternative notions of novel and complex contexts and strategy, and by considering the applicability of AR and other strategy-making models to discover and invent effective strategies.

In contrast to GLR, I highlight a more endogenous view of environments and novelty, a constructive view of strategy, and less stylized strategy-making alternatives. Consequently, I argue that the power of AR versus that of alternatives may be overstated, and its scope understated. After a brief review of GLR's article, I flesh out the basic logic of my argument and provide an outline for the rest of the commentary.[1]

A brief review

GLR's paper '... aims to shed light on the experiential wisdom that enables strategy makers to cope with novel environments. We argue that the basis of this sort of experiential wisdom lies in analogical reasoning' (GLR, 2005: 691). They describe the AR process as follows: '... when faced with a new and complex setting, managers identify the features of the setting that seem most pertinent, think back through their experiences in other settings with similar features, and recall the broad policies that worked well in those settings. These broad policies then form the starting point for a local search process. Analogies to other settings, drawn from direct or vicarious experience, guide the strategy-making process' (GLR, 2005: 693). AR is particularly effective when managers identify the characteristics that distinguish their industry. Other managerial conditions (such as breadth

and depth of experience) and structural conditions (such as the degree to which complexity can be decomposed) may also enhance or limit AR's effectiveness.

GLR contrast AR with two better-established alternatives: rational choice and local search. *Rational choice*—the application of economic principles through deductive reasoning and systematic analysis of alternatives as represented by the positioning school of strategy (Porter, 1980)—usually requires a quantity of data that may be challenging to manage. This model is therefore more applicable to familiar, stable settings and to modular, less -complex decisions where general knowledge captured in rules and concepts can be employed. *Local incremental search* or experimental strategy as represented by the emergent view of strategy (Mintzberg, 1978), relegates strategy making to a random, myopic process that does not fully leverage individuals' cognitive powers. Incremental strategies can produce highly effective actions, particularly in genuine novelty. However, they usually lead to locally optimal solutions and away from globally effective strategic positions. These alternatives delineate a conceptual space for *analogical reasoning*, a way of transferring and generalizing wisdom from the familiar to the unfamiliar. AR provides a compact, rich representation of similar cases and potential solutions that can bring managers rapidly and efficiently to interdependent decisions. In addition, since it relies on only some experience, it does not require the high familiarity and general knowledge needed for deductive reasoning. Therefore, in situations that are both complex and novel, AR may be superior to its two main alternatives.

GLR augment their conceptual analysis with a creative and rich agent-based computer simulation in which firms must find superior peaks (or better strategies) on a performance landscape. GLR do not empirically contrast AR with a rational deductive approach to strategy making, but rather examine how different variants of AR perform versus local random search. They find that AR is particularly powerful when managers accurately distinguish similar industries from different ones. It is only when they use such high-quality cognitive representations that managers' depth and breadth of experience are helpful. Furthermore, GLR find that even when representation is poor, analogies

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[1] The recent Gavetti, Levinthal, and Rivkin (2005) article is part of a broader stream of research, and is particularly related to two previous articles. Gavetti and Levinthal (2000) uses a conceptual analysis and a simulation to examine the role of cognitive representations. A practitioner-oriented article explores the role, strengths, and weaknesses of managers' analogical reasoning (Gavetti and Rivkin, 2005). I restrict my commentary to the analytic choices and arguments in Gavetti, Levinthal, and Rivkin (2005).

still provide better guidance than random local search does.[2]

Key argument and outline

GLR's argument rests on two analytic choices. First, GLR implicitly view environments and their main features as largely given, so that firms can represent them and apply existing strategies to the new context through AR (GLR, 2005: 693). Second, GLR show the effectiveness of AR against a hyperrational model and a blind local search.

These analytic choices are useful as a first cut. Moreover, simulation studies such as the one used in GLR bear the cost of simplifying complex reality to capture key variables and generate valuable insight. Yet to examine the role of AR and consider other potentially effective approaches, it is necessary to relax some of GLR's simplifying assumptions and step back from the constraints of their formal simulation.

I conduct this thought experiment in three stages. In the first section of the commentary, and departing from GLR, I highlight different gradations of complexity and novelty and show how environments are partly constructed through firms' actions. Thus, the role of strategists is not only to identify effective positions in given settings, but also to construct new strategies and shape the environments of their firms. In the second section, I turn to GLR's second analytic choice. I show how other forms of rational choice, incremental strategy, and AR can be highly useful in complex and novel settings. Next, I show how several search models not considered by GLR, particularly mental experimentation, can provide other means to build on experience, cognition, and representation to form new and effective strategies. I sum up these three points in my key claim: analogical reasoning is not necessarily superior to established alternatives; moreover, in novel and complex contexts, AR and other approaches can play a larger role than that envisioned by GLR, particularly in inventing effective strategies.

In the final section, I broaden the dialogue beyond GLR's assertions in three additional ways: (a) considering some boundary conditions in which

AR and a range of alternatives best apply; (b) exploring how blending and adapting a mix of search strategies may be more effective than using individual search strategies, such as AR, alone; and (c) advancing new directions for empirical research.

ALTERNATIVE CONCEPTS OF CONTEXT AND STRATEGY

Context: complex and novel worlds

Complexity

A key contextual dimension that GLR considered is complexity—a property of highly interactive systems (Simon, 1996). GLR capture complexity as a system of interrelated causal variables, such as a theory. In their study, the complexity of a firm's positioning strategy stems from the interdependence of functional decisions and a firm's decisions across functions. Thus, they capture cause-effect interdependence and offer a more sophisticated way of modeling complexity than many similar simulations.

As GLR suggest, complexity can also be viewed as an attribute of a firm's industry (GLR, 2005: 702). Generally, a cause-effect view of complexity would highlight the forces and developments that shape industry evolution and performance. Environmental complexity can also be represented more endogenously—as the dynamic interaction of actors and their choices over time (Sterman, 2000: 21). In this conceptualization, actors' cognitions and AR are situated in a social context, their searches are mutually dependent, and their representations highlight action-reaction sequences more than stable industry features as described by GLR. Consequently, under this view, other search models such as simulation may be more effective.

GLR's analysis appears to give much more weight to complexity and representation than to novelty, possibly because novelty often heightens complexity. The combination of complexity and novelty creates stronger competition for individuals' limited computational resources and therefore gives cognitive representation an important role. However, as I discuss next, novelty adds considerations beyond those highlighted by complexity, and thus its nature and varieties should be better appreciated.

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[2] I discuss the technical details of the simulation only indirectly. Sorenson (2002) evaluates the fitness landscape metaphor and the NK model underlying the simulation and their application to strategy.

Novelty

Novelty can vary depending on the experience of the firm and its managers, the industry and its evolutionary stage, and other factors. These differences directly affect strategy-making models and reasoning processes.

GLR focus on two types of novelty: an established firm entering a market new to it and its managers (e.g., Circuit City joining the used-car business), and a start-up (e.g., Lycos) in an emerging industry (e.g., the Internet portal industry). While these focal settings may illustrate common ways of using analogies, they are significantly different.

The change for Circuit City and its managers coexisted with several 'givens': the firm was established, it used a strategy from its electronic retailing business, and it entered an established context. When a firm faces novelty that is more limited and can realistically change only a subset of its resource commitments, it faces complexity that is considerably lower than that of a start-up in a new industry. In designing its strategy, it may rely on experience, and import solutions from other settings through AR. However, firms have at least two other options: using available data to guide their strategy through deductive logic, or observing incumbents.

Less structured and more fluid contexts, such as the Internet portal industry in the 1990s, the text-messaging industry and the transforming pharmaceutical industry, present different considerations for managers in their cognitive tasks and reasoning processes. Industry characteristics—the main dimension of representation in GLR's analysis—are particularly affected. The nature of demand, technological designs, and business models is uncertain. Other industry features, such as the intensity of economies of scale, and customers' relative bargaining power, which may be consensual in more stable and mature settings, are not fixed, and their significance and interrelationship may be open to interpretation. Consequently, in more novel and ambiguous settings, the analogical transfer process may suffer because the computation and representation of industry features is difficult and because relevant and familiar solutions are unavailable. Firms may instead need to construct new industry parameters and make new connections between existing elements.

Fundamentally, as I discuss next, less established settings often require a different concept of strategy that is founded less on coping with novelty through positioning and more on shaping environments and inventing new strategies.

The role of strategy

GLR use the topographical imagery of a landscape to represent the context in which strategists work. The main challenge they highlight is 'to identify a viable new strategic position. . .' (GLR, 2005: 691) and 'to position a firm in an industry that is novel. . .' (GLR, 2005: 696). Contrast this view with the following example:

In an interview published in 2001, Mark Levin, former CEO of Millennium, a leading biopharmaceutical company, discussed his firm's strategy in the face of the completion of the Human Genome Project (Champion, 2001). According to Levin, '. . . to understand [industry] forces, you can't just look at a snapshot of the present. You have to see what's come before and imagine how that will shape what comes next. . .' (Champion, 2001: 110). Based on his assumption that the new trends in the industry will lead to personalized medicine, he envisioned a future in which Millennium would move from an upstream research boutique serving pharmaceutical manufacturers to a major vertically integrated bio-pharmaceutical company. The firm implemented initiatives—partnerships, acquisitions, organizational changes, public speeches, and interviews—that would lead it and the industry toward realizing this vision.

Strategy in novel contexts

Clearly, there is more to strategy making in unfamiliar settings than the discovery of effective positions 'out there.' In this example, strategists view their firm's environment not as given but as malleable. Rather than figuring out new strategic options, they envision and construct them. Unlike science, where the main concern is discovery, design in general and the design of strategy in particular focus on invention (Liedtka, 2000). Managers consider not only how things—firms, strategies, industries—are, but also how they *might* look and be improved in the future (Simon, 1996). Managers at Millennium examined what their industry was not and imagined how it might be if some of its unattractive features changed and other developments materialized. They then

derived new-to-the-world strategies to exploit their vision.

When GLR use the image of managers matching strategies with industry constraints, they implicitly draw upon the common view of strategy as a position. Specifically, GLR appear to adopt a passive view of strategy in which the firm takes the structure of the industry as a given to which it matches its strengths and weaknesses. In a more active view, firms may exercise their latitude to shape industry evolution endogenously, particularly in major industry transitions. In this 'strategy as constructing' view, firms try to influence industry structure, exploit changes that affect industry evolution, or both (Porter, 1980: 29–30).[3]

The distinction between 'strategy as matching' or positioning, and 'strategy as constructing' is a matter of degree. At one end of a continuum, firms' environment is stable and their resources are fairly fixed. Firms' well-adapted positioning strategies result in a relatively static match with their established industry. At the other end, firms' resources and the industry are more fluid. In such novel situations, firms' constructive logic is future oriented and aimed at attaining a long-run fit with their evolving environment. Generally, the 'matching' logic may best apply when firms such as Circuit City enter an established or relatively stable industry. By contrast, the 'constructing' logic of Millennium implies a more dynamic fit and best applies when familiar solutions are absent or less relevant. This may occur when industries are new or undergoing transformation, or when a firm adopts a new-to-the-world strategy.

Most important for my arguments, even though in the contexts where they were applied the strategies of both Circuit City and Millennium may have been innovative, the *origin* of their strategies and the reasoning processes used may be very different. In established and relatively stable contexts, and consistent with a matching logic, strategic innovation can originate through the application of familiar solutions drawn from the experiences of the firm or other companies in related contexts.

Conversely, in situations requiring constructive logic and greater departure from convention, firms should envision different industry futures, experiment, and 'write their own textbooks.' The innovative strategies of firms like IKEA, CNN, Cartier, and Honda require imagination and a search for new possibilities (Baden-Fuller and Pitt, 1996). Perhaps the central strategic task in complex and novel settings is to design strategic responses to uncertainty (e.g., Courtney, 2002). In emerging and novel industries, actors recombine existing businesses and resources through entrepreneurial bricolage (Baker and Nelson, 2005; Garud and Karnoe, 2003), reject dominant notions of resource environments, and construct new opportunities (Sarasvathy, 2001). They shape material aspects of the environment through standard setting, integration, alliances, and innovation. They engage in collective actions, seek out relevant information from others, and *socially construct* new reality through advertising, public relations, and other communications that facilitate adoption, provide meaning, and enhance legitimacy.[4]

Consistent with their conceptualization, GLR's imagery of individuals climbing hills and the landscape metaphor both highlight important aspects of a firm's context and strategic task, but they obscure other aspects. An alternative imagery is that of multiple and shifting groups of jumpers on a trampoline. Strategies and performance outcomes (i.e., the shape and peaks of the surface) depend on external changes such as weather, and on interaction and communication with other jumpers. This imagery may better capture the challenges of novel, complex, and partly endogenously changing environments.

The preceding discussion drives home my first point. In contrast to GLR's view of given environments and strategy as 'matching,' I highlight how environments, novelty and complexity are partly constructed through firms' actions. Therefore, the role of strategists and strategy-making models is not only to identify effective positions and apply existing solutions in given settings, but also to construct new strategies and shape their environments.

In Table 1, panel A, I contrast GLR's conceptualization of context and strategy with mine,

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[3] Several other approaches have challenged the relevance of strategic positioning, particularly in turbulent environments. Some suggest that, due to increased competition and change, strategy must be more adaptive and 'morph' (Rindova and Kotha, 2001). Others suggest that firms facing complexity use semi-structured plans and follow simple rules (e.g., Brown and Eisenhardt, 1997).

[4] The very definition of what constitutes novelty may be the outcome of a social negotiation process involving the firm's managers, and other players such as customers, rivals, and financial analysts.

Table 1.   Contrasting views of context, strategic task, and corresponding search models in novel and complex settings

	GLR's view	Alternative views and extensions
A. Context	Complexity as a system of interrelated causal variables. Environments and their features are largely given.	Actors' dynamic interaction as a key source of complexity. Environments are partly constructed, and their features are ambiguous and contested.
	Novelty is largely uniform. Topographical landscape as a metaphor.	Novelty varies and is actively generated by the firm. Trampoline as a potential metaphor.
Strategic task	'Strategy as matching' logic: discovering effective positions, matching strategies to given settings.	'Strategy as constructing' logic: inventing, constructing, and envisioning a strategy. Strategy as shaping the environment, exploiting changes, and responding to uncertainty.
		Summary 1: In a more endogenous view of environments, the role of strategists and strategy-making models extends to constructing new strategies and shaping their environments through alternative means.
B. Search models considered by GLR	The positioning and design approaches to strategy are mainly represented by a strong form of *rational deduction*. This search model presumed effective in familiar, stable, mature, and less complex settings.	A weaker and more realistic form of rationality can encompass many strategy-making models. Deductive reasoning can be highly effective in contexts of moderate novelty and can play an important role in imagining new strategies and structuring the analogical reasoning process.
	Incremental and emergent views of strategy making are represented by a *local search* model operationalized as a random and myopic search. Local search may apply to genuinely novel settings.	Incremental strategy making is much more intelligent than depicted.

Table 1.   (*Continued*)

	GLR's view	Alternative views and extensions
	Strategists use *analogical reasoning* as a source for new strategies by retrieving existing solutions and matching them to new contexts.	It may apply to genuinely novel settings, when firms introduce novel strategies, and has virtues in complex settings. Analogical reasoning has different varieties and assumes additional roles in the construction of new strategies, the facilitation and implementation of strategy, and the social construction of markets. **Summary 2:** Other variants of rational choice, incremental strategy and AR can contribute to effective strategy making in novel and complex settings and help generate novel strategies.
Other search models	Not examined.	**Summary 3:** Several other strategy-making approaches not considered by GLR, particularly mental experimentation and its derivatives as well as case-based models, can provide alternative means to build on experience, cognition, and representation to form new and effective strategies.
C. Conclusion	In novel and complex worlds, analogical reasoning may be superior to established rational choice and local search models.	Considering the above, analogical reasoning is not necessarily superior to established alternatives. Furthermore, in novel and complex contexts, this model and other approaches not considered can play a larger role, particularly in invention of effective strategies.

and summarize my first argument. Next, I discuss actors' search processes.

STRATEGY MAKING IN NOVEL AND COMPLEX WORLDS REVISTED

GLR's second analytic choice—the characterization of the main strategy-making models—directly affects their main premise and holds a key to the alternative roles these and other models can play in novel and complex settings. I reexamine first GLR's main models and then consider alternatives.

Search models highlighted by GLR

Rational choice

Rational choice is usually considered a strategy-making model based on comprehensive search and systematic and broad evaluation of alternatives. Like cognitive representation, it is forward-looking. Unlike cognitive representation, it assumes complete and accurate representation without recognizing individual cognitive limitations (Gavetti and Levinthal, 2000). The authors associate positioning strategy with both a strong and a weak form of rationality. In the strong form, omnipotent hyperrational individuals solve complex decision problems with analytic powers and foresight, using rules rather than case-based reasoning. In this case, the complexity associated with positioning strategy overwhelms rational decision makers (GLR, 2005: 692). However, GLR also view positioning as a systematic (GLR, 2005: 692) and forward-looking strategy-making process (GLR, 2005: 693) distinct from the feedback-based method associated with experiential search (March, 2006). Viewed this way, positioning becomes a subset of other conventional design approaches to strategy, such as strategic planning and scenarios that rely on a weaker form of rationality.

The view of rationality one adopts is immensely important to understanding its effectiveness compared with other models and to identifying the most appropriate contexts in which to apply it. Using the strong form of rationality is theoretically attractive because it dramatizes the contrast with search models based on bounded rationality such as cognitive representation and experiential search. However, it limits the role of rationality in strategy making to familiar, stable, and less complex contexts.

By contrast, the purposeful, anticipatory and systematic analysis of alternatives can play an important role in unfamiliar and complex settings (e.g., Bourgeois and Eisenhardt, 1988) and in strategic innovation. As one can infer from the recollection of Amazon founder Jeff Bezos, vision, personal and professional experience, and public knowledge all played a role in conceiving the new venture (Quittner, 1999). Yet, his comprehensive investigation of 20 retail categories before selecting online book selling, his analysis of factors that would differentiate online from the conventional market, and his risk assessment, indicate that Bezos relied heavily on deductive logic. Cognitive research suggests that some of the same cognitive processes underlying deduction, such as the use of counterfactuals, may explain imaginative thinking (Byrne, 2005). The capacity of individuals to imagine alternatives may allow them to be rational. Thus, in principle, human rationality also depends on imagination (Johnson-Laird, 1982).

Rational deductive logic can help firms deal with the more stable and structural aspects of novel situations, such as when the company, strategy, or industry is already established, when fewer policy decisions are needed, and when complexity is attenuated by constraints. The case of Millennium illustrates that, even in the fluid context of industry transformation, rational consideration of the main future sources of value in an industry can help firms conceive new strategies. This is because some stable elements, such as basic customer needs, exist in most novel situations, and many 'discontinuities' and 'inflection' points often leave structural elements intact (Farjoun, 2007: 205).

In its weaker form, rational analysis can also help managers approach AR more mindfully, as GLR may agree. The advantage of AR in providing compact representation in the face of novelty comes hand-in-hand with the risk of starting with inappropriate analogies or using yesterday's strategies to fight tomorrow's wars. Therefore, managers must balance AR with an equal attention to how things differ, compare multiple analogies systematically, and examine successful and failed strategies.

Rational analysis may indeed be more effective in stable and simpler settings, as GLR suggest. However, that should not diminish its roles

in certain novel and complex settings, particularly in supporting strategic innovation, examining the more stable features of these settings, and structuring the AR process.

Incremental strategy

In its stronger form, local search is depicted as semiautomatic, random, and unguided, and as such, a trial-and-error process. Consistent with this, GLR's simulation compares random search with AR. However, in their conceptual discussion, GLR also use a weaker form that lumps together incremental, experimental and emergent strategy-making approaches (GLR, 2005: 692).

Some of these incremental and experiential approaches are much more intelligent and effective than a random search model suggests. Because they occur in real rather than analog or simulated target settings, experimental strategies may have high fidelity to context (Gavetti and Levinthal, 2000). As recent improvements in the drug development process have shown, good experiments are not blind and are much more cost-effective when guided by theory and deduction (Champion, 2001). Therefore, guided experimental approaches can be effective ways to introduce novelty.

Incremental approaches also have merits in complex settings. When based on mutual adjustment and online feedback rather than on comprehensive planning, they can help simplify interfirm complexity. Particularly in the process of logical incrementalism (Quinn, 1980), complexity is decomposed into subsystems within which the strategies are incrementally integrated to form a final strategy. This approach acknowledges cognitive and organizational limits: different subsystems proceed at different speeds; complexity may overwhelm centralized decision making.

Analogical reasoning

GLR and I agree that a simple adaptation of a familiar experience may be a powerful source of strategic innovation and industry restructuring. Even without direct evidence, the possibility cannot be ruled out that Millennium and Amazon imported their novel strategies implicitly or explicitly from similar situations.

However, firms can also use AR less mechanically, particularly when inventing new strategies.

Firms can harness the generative power of analogies to identify gaps, recognize patterns in complex and changing contexts, and invent new forms of competing. Creative analogies sometimes involve a leap, and combining or contrasting multiple analogies can generate insight. Concrete analogies drawn from the same domain, such as those GLR discuss, are certainly useful. However, symbolic analogies or 'generative metaphors' (Schon, 1983: 184), more abstract and holistic, may trigger different cognitive processes and when drawn from unexpected domains, can generate insight. For example, a firm can use the analogy 'just as the mower blade cuts the grass, the grass gradually blunts the blade' to illustrate that its strategy (the grass) must coevolve with its major customers (the mower), but more slowly. Furthermore, analogies from the firm's experience may differ from external analogies. They may be more salient, and if associated with failure, invite resistance, even if they are valid. Yet, by building on the firm's idiosyncratic history and context, such analogies are more likely to generate unique and potentially novel solutions.

To be effective, the transfer of knowledge from a familiar to an unfamiliar domain needs to go beyond the cognitive undertaking emphasized in GLR to address organizational and interorganizational realities. In addition to generating novelty, managers can use analogies to promote a business model or technological design, to signal intent to competitors, or to gain cognitive legitimacy (Aldrich and Fiol, 1994). The strong symbolic and emotional appeal of analogies and their role in the communication of ideas within a sociopolitical context make them a useful means to mobilize action and implement effective strategies.

The preceding discussion drives home my second point. Other variants of rational choice, incremental strategy, and AR can contribute to effective strategy making in novel and complex settings and generate novel strategies.

Search models not considered by GLR

Mental experimentation

An important alternative and complement to the three processes that GLR discuss—rational deduction, actual or physical experimentation, and AR—is mental experimentation. This fourth search process is particularly relevant given its

centrality to strategy making and its role in introducing novel and effective strategies.

Mental experimentation (or simulation) can rely on the familiar basic cognitive processes of induction and deduction, but is most closely associated with *abduction,* defined by nineteenth-century American philosopher Charles Pierce as the formation of a hypothesis to generate an explanation, particularly of puzzling facts. Abduction can involve different kinds of representation such as concepts, analogies, and images (Thagard, 2005). Although complementary to induction and deduction, one can usefully contrast abduction with these alternatives. In deduction, one reasons that if the premises used to reach a conclusion are true, then the conclusion must also be true. In induction, one infers a generalized rule from particulars, a reasoning process that is inherently *uncertain.* By contrast, abduction is the act of reasoning from the experience to the case. The result is both *meaningful and plausible.* For example, the observation that 'these beans are white' coupled with the claim 'all the beans from this bag are white'—a meaningful rule in this setting—allows us to form the meaningful and plausible hypothesis that 'these beans are from this bag' (Schank, 1998: 847). The basic intuition is that when individuals imagine reality, they start with some tangible clue and then discover or construct a world in which it is meaningful. When Fred Smith introduced the hub-and-spoke system in the air express industry, he started with the premise that shipping parcels differs significantly from moving passengers.

In using abduction to generate and test hypotheses, the designer substitutes mental experiments for physical ones. Unlike trial and error, which may be costly and result in local optimization and patching, such thinking leads to coherent choices (Liedtka, 2000). Therefore, this process is particularly a virtue for positioning strategy because, as GLR discuss, it is composed of interdependent decisions.

Three variants of mental experimentation are relevant to strategy making in unfamiliar settings. First, by imagining potential futures, the process of *visioning* helps firms discover entrepreneurial strategies and combine elements into effective and cohesive solutions (Mintzberg and Westley, 2001). Visual imagery such as GLR use to animate their landscape metaphor is a demonstrated part of human thinking (Thagard, 2005). Pictures and visual mental images provide powerful ways of representing how things may look and so play an important role in the origin of new strategies. Thus, one would expect the use of imagery in the design of new products, businesses, and industries involving computer networks (Napster, Amazon), physical networks (FedEx), and satellites (XM). Although it still benefits from representation and experience, visioning is very different from the passive pattern-matching in which GLR portray AR. Furthermore, since mental representations can also include rules, concepts, frameworks, images, and connections (Thagard, 2005), visioning illustrates that other cognitive approaches that do not directly rely on analogs can usefully deal with novelty.

A second notably potent approach to strategy making and a viable alternative to AR is *scenario* analysis. One can view scenarios as '*focused descriptions of fundamentally different futures presented in coherent script-like or narrative fashion*' (Schoemaker, 1993: 195 [emphasis in original]). An important tool to examine and bound fundamental uncertainties and broaden thinking, scenario analysis decomposes complex phenomena into more analyzable states and is useful in uncertainty and complexity. Although time-consuming, this technique embraces conflict and imagination, counters cognitive biases such as availability and anchoring, facilitates communication, and blends induction, abduction, and deduction. For example, scenarios can be constructed inductively by starting from an existing industry structure and inferring how it might evolve in different ways, then deductively identifying one or more strategies appropriate for each scenario, and, finally, imagining how competitors might respond. Scenarios have been used to design and test new strategies during major transitions and in emergent industries.

Third, *system dynamics models* (e.g., Sterman, 2000) and *simulations* (e.g., Sorenson, 2002) can provide a powerful and systematic means to investigate dynamic, nonlinear, complex contexts to process copious amounts of data and communicate ideas.

Mental experimentation and its cousins—visioning, scenarios, and simulations—often rely on consideration of 'what if' questions and counterfactual thinking (Byrne, 2005). Such conjectures have limitations but seem indispensable in strategizing. For example, at some level, the notions

of positioning and sustained competitive advantage require conjecture about the responses of other players. Moreover, as Millennium illustrates, mental experimentation is likely to be crucial when firms use a constructive logic to generate alternative representations and strategic solutions.

Other case-based approaches

GLR portray AR as encompassing almost any use of case-based reasoning in strategy making. As I showed earlier, finer distinctions between forms of analogies can point out more precisely their potential to generate novelty. Pure AR may also have important differences from other empirical search processes that may be effective in unfamiliar settings. For example, *modeling* (e.g., Bandura, 1986) requires evaluation of not only the applicability of the source strategy to the target problem but also the relevance of the target *model* to the firm's aims. If, in AR, managers match source and target industries and then locate applicable source solutions, in modeling they can observe established strategies in the target market. Similarly, *learning by variation* (e.g., Schilling *et al.*, 2003), an empirical search strategy often used for sequential entries to new markets, may rely on representation by concepts and rules rather than by cases. Sequential entrants build and revise a library of source solutions consisting of variations on a theme or strategy. They may invoke a rule (e.g., 'we succeed as long as we stick to our direct model') or examine how a new industry resembles others in a conceptual hierarchy (such as 'fast-cycle commodity industries').

The preceding discussion highlights my third point: several strategy-making approaches that GLR do not consider, notably variants of mental experimentation and case-based models, provide alternative means to build on experience, cognition, and representation to form new and effective strategies. In panel B of Table 1, I summarize my second and third points and contrast the different views of actors' search processes.

Summary: revisiting GLR's claim

How superior is AR to alternatives? In contrast to GLR's argument, I show that when alternative and no less plausible views of novel and complex contexts, strategy, and strategy-making models are explored, AR is not necessarily superior. Furthermore, in novel and complex contexts, this model

and other approaches can play a larger role, particularly in inventing effective strategies.

I have made three points in support of this argument. First, a more endogenous view of environments underscores a 'strategy as constructing' logic in which firms invent strategies and shape their contexts. Second, a weaker form of rationality and more intelligent experimental approaches, such as those guided by theory and deduction, have important roles in novel and complex settings. Like these variants of established models, AR can be a source of new-to-the-world strategies, particularly when firms combine analogies and use symbolic and internal ones. Third, beyond rational and incremental approaches, other methods not considered by GLR such as mental experimentation and case-based models, can be effective in dealing with and generating novelty. Managers in novel contexts use search strategies, representations and experiences, and reasoning processes that cannot be reduced to analogical transfer. Combined with less extreme rational and incremental models, the range of alternatives to AR that I examined suggests that the area between rational choice and local search is a 'swollen middle.'

As shown on the left side of Table 1, GLR's main premise about the relative effectiveness of cognitive representation and AR may hold within the confines of their key analytic choices. Given their view of context, positioning strategy, and the poles of strong rationality and local search, AR may indeed be superior to its alternatives. Furthermore, the transfer of existing solutions and experience through AR can be an important source of new strategies. Nevertheless, as the right side of the table shows, alternative views that highlight endogenous environments, strategy as constructing logic, less extreme forms of rational choice and local search, and alternative search models attenuate and bound GLR's central claim. They reconsider the relative value of AR against alternatives and underscore other equally important sources of novel strategies.

BROADENING THE DIALOGUE

This final section broadens the dialogue beyond reevaluating GLR's assertions in several ways: (a) providing a 'first cut' on the boundary conditions in which AR and other search models may

best apply, (b) exploring the usefulness of blending and adapting search processes, and (c) exploring new directions for empirical research.

(a) Matching search processes with contextual contingencies

Given the multiple search models and contingencies considered by GLR and extended in this commentary, it may be useful to provide a 'first cut' on how selected conditions match with a particular search model. In Table 2 below, I particularly examine three contingencies: (a) *context*—interactively complex and dynamic settings, (b) *strategy*—strategy as matching versus constructing, and (c) *strategy process* considerations such as facilitation of the decision process and implementation.

Among GLR's stylized models, the rational deductive logic in its strong form may be largely applicable to familiar, stable, and less complex settings, and local search can be effective under genuine novelty. As in Table 2, both approaches have limitations when the strategy process is considered. Particularly, rational logic allows structured deliberation and learning, but without affective or symbolic content may be more limited in gaining organizational commitment. Similarly, a potential limitation of local search is that it usually fails to provide and communicate a clear direction.

Among less extreme versions, a weaker form of rational-deductive logic is common and can be effective in situations of moderate novelty, when the strategic task is based on a matching logic, and as a source of novel strategies. Similarly, 'logical incrementalism' (Quinn, 1980) shows that more attenuated versions of experimental and incremental search can be effective in complex and moderately novel situations.

Among models not directly examined by GLR, case-based models, such as modeling (Bandura, 1986), can be effective in positioning and in complex and moderately novel situations, particularly when learning and differentiating from existing firms is possible. Additionally, all three variants of mental experimentation—visioning, scenarios, and formal simulations—can be highly useful in conceiving new strategies. Visioning may be limited in providing the detailed guidance needed for positioning, but can communicate a strategy clearly and elicit affect needed for securing commitment. Scenarios, although effective in moderately novel

and complex settings and as a learning tool, may be limited in highly complex and genuinely novel situations. Simulation—effective in dynamic settings, in dealing with complex interactions, and in facilitating learning and communication—is more limited in generating affect and commitment.

What about AR? As GLR suggested, AR may be inferior to rational deduction in simple and more stable contexts and to local search strategy in conditions of genuine novelty and discontinuity. Thus, AR can be more effective in complex and moderately novel contexts and when supporting a 'strategy as matching' logic. In moderately novel settings, AR may be comparable to other models such as deductive logic, scenarios, and visioning, which require some experience but not the general knowledge and rules usually needed for rational choice in its strong form. Finally, since new ideas, solutions, and insights can originate in different representations and computational models, AR is likely comparable to other ways of constructing new strategies, including deductive reasoning and mental experimentation.

Table 2 illustrates some conditions in which other approaches not specifically considered by GLR may be *more* effective than AR. Under discontinuity, applying known solutions through AR may be ineffective; approaches such as experimentation and scenarios may be preferred. Simulations can trump AR in situations involving highly interactive complexity between firms, in dynamic settings, and in dynamic aspects of strategy formulation such as planning sequences of moves. Finally, visioning may lead to creative strategies when existing solutions are limited and in contexts such as networks that favor visual representation.

(b) Combining search models

GLR imply that the use of individual search models such as AR is unlikely to lead systematically to effective strategies unless augmented with other search mechanisms. For example, cognitive representation and AR can get a firm to a promising strategy, and local search can help refine it. I further suggest that in novel and complex settings, search models may be more effective blended and adapted than alone.

Strategy making in unfamiliar settings involves tasks such as decision making, problem solving, explanation, learning, design, and experimentation, and thus requires the combination and adaptation

Table 2. Matching search models with various contextual contingencies: a preliminary assessment

Contextual conditions:	Search models:
	- Mental experimentation a. Visioning b. Scenarios c. Computer simulations - Rational deductive logic (strong form) - Local random search - Rational deductive logic (weaker form) - Experimental incremental search (more intelligent than random search) - Case-based reasoning: a. Vicarious learning/modeling b. Analogical reasoning (AR)
1. Considered by GLR:	
Familiar and stable settings	*Favors rational choice (strong form)**
Modular, less complex settings	*Favors rational choice (strong form)*
Genuine or extreme novelty, discontinuity	*Favors local search. Limited applicability to rational choice (strong form).* Scenarios can be highly effective. Other approaches are moderately effective.
Complex and moderately novel settings	*Favors AR. Rational choice (strong form) and local search are limited.* Other approaches, particularly vicarious learning, visioning, incremental search, and deductive logic (weak form) are also viable.
2. Other conditions:	
a. Context	
High interactive complexity (i.e., ecology of competitors)	May favor formal simulations and to a lesser degree scenarios. Rational choice (strong form) has limited applicability. AR and other models are moderately effective.
Dynamic considerations (e.g., lag and time ordering)	Favors formal simulations.
b. Strategy	
Strategy as matching/positioning	Favors rational choice (strong form). Other approaches, particularly vicarious learning, incremental search, and deductive logic (weak form) are also viable.
Strategy as constructing logic/inventing new strategies	May favor mental experimentation in general, yet each of the other approaches can also be an input. Combinations of analogies and internal and symbolic analogies can be good sources for creative strategies.
c. Strategy process	
Facilitation of decision processes and implementation of novel strategies	Rational deductive logic (strong form) and simulation provide structure and learning but may be inadequate to garner participants' support. AR and visioning can facilitate communication, learning, and implementation. Local search and vicarious learning may be less effective in generating commitment and providing direction.

* Contingencies discussed by GLR are italicized.

of different kinds of intelligence. And, as examples like Amazon show, new and effective strategies originate and evolve through combinations of multiple search processes. Consequently, strategists may be better off to:

(a) draw upon a wider set of search mechanisms and techniques;
(b) understand the nature, strengths, and weaknesses of each search model and the particular conditions in which it is most applicable;
(c) recognize the nature of different contextual conditions and their configurations;
(d) apply the most suitable tool or combination of tools to the circumstances; and
(e) modify the mix of models when their availability or conditions change.

Nevertheless, the ideal of combining and adapting search models can be compromised when some search mechanisms are used in tandem or sequentially, and can depress rather than enhance their effectiveness. For example, the strict use of a highly rational choice process may inhibit the use of intuition and visualization. Similarly, the premature convergence on a salient analogy may constrain mental experimentation. Furthermore, conditions may be contradictory in terms of their cognitive demands. The high stakes involved in a strategic decision in a complex environment may justify the activation of a rational process; however, the complexity militates against it.

Using an adaptive mix of search processes can also become exceedingly complex. Relying on the tools most available or appropriate and attending to limited aspects of the context might address this problem. As well, researchers and practitioners may be able to apply Occam's razor principle to discover the minimal effective set in each context.

The idea of combining and adapting search models may provide the best approximation of managerial cognition, design and strategy making in practice and thus suffice as motivation for researchers to overcome some of these challenges.

(c) New directions for empirical research

How can GLR's formal simulation be extended to alternative conceptualizations of context and models? First, the existing simulation gives the most importance to the initial choice of strategy. Once strategists choose the first performance peak, they cannot do much to change it other than move incrementally to neighboring and less promising performance peaks. This is why the initial cognitive representation is so crucial to GLR's study. To allow for a more intelligent and potentially more realistic search, it may be necessary to relax this assumption. Although good initial representation may be important, equally important is the ability of strategists to revise or scale up their initial strategies and representations. Drastic revisions may require costly organizational adjustments, but that may not be significant when the entry is incremental and the organization is new. A firm can enter a novel context by experimenting on a small scale and using the feedback to experiment mentally and eventually to form a better representation of the industry. U.S. entertainment giant Disney and auto supplier Magna in Canada illustrate that firms can start small and reach high performance peaks.

Additionally, it appears that GLR's simulation does not allow for the interaction of multiple searchers, and thus does not consider how that affects searches. It is conceivable that in some real-world novel contexts, such as Circuit City's entry to the used car business, the success of strategies introduced through AR may stem in part from the reaction of a firm's rivals. To the extent that a firm introduces an analogy that is radically different from current strategies, its rivals may overlook or discard the approach or be entrenched in their own strategies, thus giving the new one time and space to flourish. Simulating this possibility may require modeling complexity as an interaction of multiple agents with different search modes as well as different elasticity.

A second research opportunity is to contrast AR, particularly as conceptualized by GLR, with mental experimentation. Naturally, one needs to recognize that the two search strategies can be complementary. At a basic level, abduction, induction, and deduction are interrelated cognitive processes. Furthermore, analogies can serve as potential inputs to mental experimentation. For example, managers can use symbolic or visual analogies to construct alternative industry scenarios.

Yet, one way to compare these two processes is to consider boundary conditions that may favor one model over another. For example, in interactively complex and dynamic settings, computer simulation, a variant of mental experimentation, has a

dramatic advantage over AR of speed, accuracy, and efficiency because it can rely on much broader libraries of experiences than can individuals, and can test for more contingencies and variables. An alternative is to construct a formal architecture, as GLR did to represent AR, which will capture the similarities and consider the differences. For example, effective AR and mental experimentation benefit from quality representations and broad repertoire. However, in the case of AR, managers may draw on their broad experience to find the best match with their representation of the key parameters of the current context. By contrast, effective mental experimentation requires searchers' imagination to generate divergent representations of future contexts.

These extensions do not directly contest GLR's results, and may require more complex modeling than GLR could achieve within their space limits and analytic choices. Yet they illustrate interesting opportunities for future research.

CONCLUSION

Finding and inventing effective strategies in uncertain, novel, complex, and changing contexts is a demanding managerial task. In introducing analogical reasoning as a new and potentially powerful solution, Gavetti, Levinthal, and Rivkin (2005) tackle an important practical problem as well as two great scientific mysteries: cognition and the origins of novelty. Building on GLR's analysis, I have mentally experimented with different views of context, strategy, and search models to show how their conclusions are sensitive to their conceptualization. GLR likely left some of these alternatives out of their study for simplicity's sake, rather than because they overlooked them. Yet, explicating alternatives is essential for a broader dialogue. My analysis demonstrates how other search strategies—both established and less familiar—can be equally effective to AR.

My commentary also touches upon other questions: What is the role of strategy in these challenging environments? Are these environments given or malleable? Where do novel strategies come from? What are the prospects of search mixtures? What are the respective roles of rationality and imagination? These questions are fundamental to strategy research and reside on the fault lines of different debates in the field.

GLR's article illustrates what good analogies are supposed to do: provide an important starting point for further search. I have followed their lead and shown how a different representation can extend their work. Our arguments acknowledge at least one key point: the power of analogies depends on the particular representation used.

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