

Attentional Triangulation: Learning from Unexpected Rare Crises

Claus Rerup

Richard Ivey School of Business, University of Western Ontario, London, Ontario N6A 3K7, Canada,
crerup@ivey.uwo.ca

Attention to weak cues lies in the eyes of the beholder, but there are ways to entice such cues into collective view. To examine the link between attention to weak cues and learning from rare events, I use longitudinal, qualitative data to develop an attention-based perspective on how organizations learn from a crisis, a specific type of rare event. Learning from a crisis involves understanding why the crisis occurred and developing organizational designs for preventing the crisis from reoccurring. My data illustrate how disparity in attention to issues across the chain of command and the inability to coherently attend to weak signs of danger resulted in an unexpected crisis at Novo Nordisk, a world leader in diabetes care. The main contribution of my study is the development of the concept of attentional triangulation, which refers to the intersection of three interdependent dimensions of organizational attention (stability, vividness, and coherence) to identify issues that have the potential of having critical consequences for the organization. I also elaborate on the structures and processes that organizations can enact to facilitate attention triangulation for learning from rare events.

Key words: organizational learning; attention; rare events; weak cues; design; multilevel research

History: Published online in *Articles in Advance* August 31, 2009.

Introduction

Organizational crises are rare events that can threaten the viability of organizations (Pearson and Clair 1998) but also provide opportunities for learning (Carley and Harrald 1997, Baum and Dahlin 2007, Argote and Greve 2007). Learning from organizational crisis involves understanding the causes of the crises as well as identifying ways of preventing similar rare events from recurring. Research on organizational crises (Turner 1976, Sheaffer et al. 1998), errors (Ramanujam 2003), and competitive threats (McMullen et al. 2009) has found that organizations experience adverse events when they fail to notice and act on weak cues that signal potential threats (Ansoff 1975, Vaughan 1996, Weick and Sutcliffe 2007). Organizations focusing on preventing crises invest in knowing what is happening in their environment by attending to weak cues (Marcus and Nichols 1999, Haeckel 2004, Dillon and Tinsley 2008). Weak cues are internal or external signals that can alert an organization of potential threats and opportunities (Dutton and Ashford 1993).

In this paper, I focus on (1) the link between weak cues and threats and (2) why organizations ignore weak cues and experience unexpected, rare events. Organizations do not attend to weak cues either because they do not recognize the cues as indicators of potential problems (Weick 1995) or because they lack the attentional resources to do so (Ocasio 1997). As Simon (1947, pp. 100–101) notes, “organizations and institutions provide the general stimuli and attention-directors that channelize the behaviors of the members of the group, and that

provide those members with the intermediate objectives that stimulate action.” Another possibility is that weak cues are noticed, but only by those who are close to where the cues manifest (Lampel and Shapira 2001). These individuals may recognize the meaning of weak cues, but they do not have the power, resources, or motivation to either speak up or act on them (Edmondson et al. 2001, Bouquet and Birkinshaw 2008).

The purpose of this paper is to advance an attention-based framework of how organizations learn from an unexpected, rare crisis. Specifically, I develop the concept of attention triangulation to explain how organizations can identify potential threats from weak cues in their environment and prevent a crisis from reoccurring. This attention-based perspective delineates processes of attention (1) over time and (2) across multiple hierarchical levels, two aspects that have not been adequately addressed in prior research on attention and learning from rare events (Gavetti 2005, Roux-Dufort 2007).

The framework I develop is based on theories of learning and attention. These theories emphasize that attention is a limited resource (Simon 1947, March and Simon 1958, Cyert and March 1963, Argote and Greve 2007) and the need for balancing attention load and capacity (Cohen et al. 1972, Greve 2008). They also note that several forms of attention are important in organizations (Weick and Sutcliffe 2006). Research on attention has been used to explain how organizations identify threats and opportunities (Dutton and Ashford 1993, Bouquet and Birkinshaw 2008, Julian and Ofori-Dankwa

2008). My attentional triangulation framework adds to this line of work by outlining not only how organizations can overcome managerial inattention to emerging threats (McMullen et al. 2009), but also how they can develop intelligence to detect weak cues about a possible crisis or adverse event. This contribution addresses undertheorized elements of organizational learning (Levinthal and Rerup 2006, Weick and Sutcliffe 2006) and emphasizes the value of developing organizational designs (Madsen et al. 2006, Dunbar and Starbuck 2006) for coordinating the attention of “the broader organization... across the broad range of possible issues that may be germane to the organization at any given time” (Gavetti et al. 2007, p. 527).

My theorizing is grounded in qualitative data from Novo Nordisk, a world leader in diabetes care, which recovered and learned from an unexpected crisis in 1993. In particular, I explore how a merger between Novo and Nordisk in 1989 distracted its members, distributed across the chain of command, from attending to weak cues, leading to a crisis in 1993. In the next section, I introduce three dimensions of organizational attention and the concept of attentional triangulation. I use these concepts to analyze how lack of sufficient attention to issues by managers and employees located at various hierarchical levels contributed to the crisis and subsequently drove the efforts of Novo Nordisk to learn from it.

The study of Novo Nordisk contributes to our understanding of learning from rare events in at least two ways. First, it proposes that attentional processes are critical for learning, an aspect that has not been fully developed in research on learning following the Carnegie school tradition (Gavetti et al. 2007). Learning requires understanding of causal relationships, and attending to weak cues is one way to collect data on potential or actual causes. Second, it illustrates specific organizational practices, structures, and designs (Dunbar and Starbuck 2006) that are the outcomes of learning from a crisis. Research often assumes that organizational learning is a cognitive activity (Huber 1991), but my findings emphasize that learning also involves developing new behaviors and embedding them in practice.

Three Dimensions of Organizational Attention

A broad, cross-disciplinary stream of research focuses on organizational attention (Hansen and Haas 2001, Jones and Baumgartner 2005, Barnett 2008, Salvato 2009). Organizational attention has been defined as “the noticing, encoding, interpreting, and focusing of time and effort by organizational decision-makers on both (a) issues: the available repertoire of categories for making sense of the environment; problems, opportunities and threats; and (b) answers: the available repertoire

of action alternatives; proposals, routines, projects, programs, and procedures” (Ocasio 1997, p. 189).

Because organizations and their decision makers cannot attend to all issues (Simon 1947, Cyert and March 1963), they tend to allocate their attention based on each issue’s salience and relevance. Once managers have attended to issues that they consider crucial, they allocate attention to other issues (Greve 2008). Alternatively, they structure the organization so some units and levels attend to some issues while other levels attend to other issues (Argote and Greve 2007). Both forms of allocation reduce attention load by narrowing the number of issues on which a decision maker focuses. Attention allocation also makes it possible to automate, routinize, simplify, and thus speed up the decision-making processes. As such, attention allocation can serve to focus attention on specific issues and prevent attention from being distracted to less important and perhaps peripheral issues (Ocasio 1997, Gavetti et al. 2007).

A downside of the attention allocation approaches described above is that they can prevent organizations from recognizing weak cues about topics, such as emerging issues, for which they have no available repertoire of categories (Levinthal and Rerup 2006), thereby keeping the organization ignorant of changes in the environment. Narrow attention to a few select issues potentially reduces an organization’s ability to detect subtle changes in both existing and emerging issues (Miller 1993). For an organization to learn from such changes, discrimination of nonsalient, peripheral, and potentially irrelevant cues of small adjustments in an issue need to be noticed and their distinctiveness retained rather than lost in an existing category (Weick and Sutcliffe 2006, 2007).

Attention Stability, Vividness, and Coherence

Organizations need to retain weak issue-specific cues in new categories to notice potential problems. To do so, organizations need to both divide and integrate the attention focus of their decision makers to more clearly discriminate between issues and detect emerging problems. The dual need for differentiation and integration of attention unfold around three dimensions: stability, vividness, and coherence. I derived these dimensions of attention by alternating between the data in the study presented below and the literature on attention (Ocasio 1997, Weick and Sutcliffe 2006, Bouquet and Birkinshaw 2008) and organizational design (Lawrence and Lorsch 1967, Siggelkow 2002, Gavetti 2005, Dunbar and Starbuck 2006). Although the three dimensions are not meant to be comprehensive of all possible forms of attention, I propose that they are critical subcomponents of an organization’s attention system whose interaction can help us to better understand how its members detect weak cues and proactively learn from a crisis. A related argument has been proposed by scholars who study attention at the individual level of analysis (Posner and Petersen 1990, Posner and Rothbart 2007).

Attentional Stability. Attention stability refers to sustained attention to issues. Stability is realized when the mind takes clear possession of one out of what seem several simultaneously possible issues or objects. “Focalization [and] concentration of consciousness are of its essence. . . . [Attention stability] implies withdrawal from some things in order to deal effectively with others” (James 1982, p. 382). In line with James (1982), the attention-based view of the firm (Ocasio 1997, Hoffman and Ocasio 2001, Ocasio and Joseph 2005) conceptualizes attention as a metaconstruct that captures the time and effort an organization takes to scan, notice, encode, and interpret issues. It focuses mainly on the role of the stability of attention in organizations, which is generated through multiple, repeated, and focused scanning of a few key issues over time. It promotes a deep but relatively narrow awareness of what goes on in a specific context. Attention stability is important because an issue’s potential complexity and cues of danger are seen only when it is looked at with accuracy and discipline over time.

Attentional Vividness. Attention vividness refers to the complexity of representation of issues. It involves the development of fluid and evolving categories for noticing and classifying issues and stimuli. Vividness is realized when the mind focuses on several objects or issues. Diffusion and diversion of consciousness to peripheral issues are of its essence (Weick and Sutcliffe 2006). Attention vividness implies inclusion and incorporation of the relationship between figure, ground, periphery, and center, because vivid awareness of what goes on in a context is derived from relationships, not parts. “If the periphery gets less attention than the center . . . then it is not at all clear that . . . the center holds. To lose the periphery is to lose the context for the center, which means the center vanishes” (Weick 1995, p. 104). In line with this relational argument, the literature on mindfulness (Weick and Sutcliffe 2006, 2007; Vogus and Sutcliffe 2007) argues that the ability to proactively discern daily warning signs and turn them into issues that can drive preventive action unfolds when organizational members focus on a set of issues with vividness. Vividness of attention is generated by focusing on many issues at the same time and appreciating more complex and sometimes contradictory interpretations of what the data mean. It mobilizes a rich but relatively broad awareness of what goes on in a specific context. Attentional vividness refers to the richness and detail of organizational scanning and interpretation (Weick 2007).

Attentional Coherence. Attentional coherence refers to how similar or compatible attention to issues is across levels, units, and people. Attentional coherence coordinates individual attention stability and vividness into collective properties. The work on organizational coordination (Bechky 2003) and distributed cognition (Michel 2007) suggests that many forms of work involve both

specialized departmental activities across hierarchical levels and occupational communities, where deliberate activities are used to build attentional stability and/or vividness to certain issues, and collaborative activities, where deliberate activities focused on synchronization are carried out to build attentional cohesion across departmental boundaries and hierarchical levels. Attentional cohesion denotes the deliberate involvement of multiple organizational individuals, teams, departments, and hierarchical levels in scanning, sharing, and interpreting information, including weak cues. It deliberately coordinates collective attention to specific issues across people, units, functions, levels, and communities, and thereby reduces attentional fragmentation and confusion.

Attentional Triangulation

Attentional triangulation refers to the combination of the three different dimensions of attention to comprehend the same issue with greater clarity and depth. In navigation, triangulation is an approach “that uses multiple reference points to locate an object’s exact position” (Jick 1979, p. 602). Weick (1979, pp. 35–42) makes similar arguments about the necessity of balancing generality, simplicity, and accuracy in theory development. Furthermore, Martin’s (1992) framework states that organizational culture can be more fully analyzed by using three perspectives (integration, differentiation, and fragmentation). Similarly, I propose that organizations can improve their recognition of weak cues by attending with stability, vividness, and coherence. Each dimension of attention produces incomplete identification of weak cues. Triangulation allows organizations to increase the speed and accuracy in identifying issues that are potentially relevant. Attentional triangulation is important because organizations are faced with a myriad of issues at any given time. The challenge is to anticipate which issues are likely to be consequential, given that “[o]rganizations learn to pay attention to some parts or their comparative environment, and to ignore other parts” (Cyert and March 1963, p. 123).

The idea of attentional triangulation captures the notion that the intersection of the three dimensions of attention proactively identifies, pinpoints, or isolates issues that can evolve into events that are potentially consequential. It assumes that one or two dimensions of attention to an issue alone are insufficient in the long run to detect and prevent a crisis. For example, over time an organization is likely to build a myopic or unnuanced understanding of an issue if attention stability and coherence to that issue are high but attention vividness is low or absent. Likewise, if attention vividness and coherence to an issue are high but attention stability is low, the organization is likely to jump from one issue to another without staying long enough with anyone issue to figure out if it represents a threat (Levinthal and March 1993).

To prevent crisis, an organization needs to figure out how to integrate the three competing goals of attention.

Attentional triangulation to coordinate the competing goal of stability, vividness, and coherence requires significant deliberation. “Coordination is not something that develops by accident. It must be won by intelligent, vigorous, persistent, and organized effort” (Gulick 1996, p. 87). Attentional triangulation is difficult because an organization does not deliberately build this capability just by combining attention stability, vividness, and coherence. Instead, it uses multiple deliberate approaches to search for and coordinate relevant hidden clues about potential threats. The practices associated with attentional stability, vividness, and coherence can potentially increase the quality of attentional triangulation—multiple relatively independent attempts to discover and understand the same issues—but attentional triangulation is not simply the sum of these practices. Instead, an organization may have to intentionally create organizational designs, structures, and processes that lead to attentional triangulation.

Attentional Triangulation and Organizational Design

Senior and middle managers’ role in deliberately enacting organizational designs that facilitate attentional triangulation is crucial. How these individuals take charge (Morrison and Phelps 1999, Dutton et al. 2001) and voice their concerns (Hirshman 1970, Morrison and Milliken 2000, Edmondson et al. 2001) generates cultural and structural properties. These properties influence how frontline personnel pay attention to issues, and thus how the organization categorizes weak cues and learns from potential rare events (Weick et al. 1999).

Yet little is known about how organizational designs structure the attention to weak cues at different hierarchical levels, and how attention vividness, stability, and coherence are coordinated across the chain of command. The “weight/status” and “voice/silence” of the involved participants may affect how clearly an organization attends to an issue or event (Morrison and Milliken 2000, Edmondson et al. 2001, Bouquet and Birkinshaw, 2008). Because the creation and enactment of organizational designs that facilitate attentional coordination to weak issue-specific cues involves employees from many levels and functions, it is important to understand how aspects of attentional triangulation are developed and aligned across the organization.

The microdynamics of interaction between disparate hierarchical levels and the difficulty of coordinating attention across boundaries are not well understood, especially in regard to the mundane activities that organizations use to increase the quality of attention necessary to build a capability for detecting and learning from rare events (Gavetti 2005, Salvato 2009). Furthermore, to understand the interdependent attentional patterns

of multiple individuals located in various departments and/or different hierarchical levels, an organizational perspective is required. That is, studies of how these dimensions affect the detection of and learning from rare events should move from the individual level to the collective level.

In what follows, I illustrate how Novo Nordisk created learning barriers that interfered with triangulating attention to issues across the chain of command. These barriers include distractions (e.g., organizational merger), lack of discipline in sharing knowledge, and a culture of superiority that caused employees to not voice their concerns about potential problems. I also specify how members of Novo Nordisk tried to overcome these learning barriers by deliberately creating a number of structural designs and practices around attentional triangulation.

Methods

Research Context

Using a grounded design to develop new theory (Glaser and Strauss 1967), I conducted fieldwork at Novo Nordisk between 1999 and 2005. Novo Nordisk has the broadest diabetes product portfolio in the pharmaceutical industry, including the most advanced products within the area of insulin delivery systems. It is a subsidiary of the holding company Novo A/S, which was created in 1989 from the merger of two leading Danish pharmaceutical companies that specialized in diabetes care: Novo Industri A/S and Nordisk Gentofte A/S. Between 1998 and 2000, Novo Nordisk was split into two separate entities, Novo Nordisk and Novozymes, with the former concentrating on healthcare and the latter on manufacturing enzymes. Both company headquarters are located in Copenhagen, Denmark. As of August 2007, Novo Nordisk employed 23,600 people; its net revenue in 2006 was \$6.5 billion.¹

Novo Nordisk was an ideal site to study learning from crisis and processes of attention. As a large, knowledge-intensive firm, it was characterized by specialization and a strong formal organization that attended to specific issues. Additionally, the pharmaceutical industry underwent significant structural, technological, and regulator change in the 1980s and 1990s (Galambos and Sturchio 1998, Achilladelis and Antonakis 2001). These changes induced Novo Nordisk to restructure significantly (e.g., the merger in 1989 and the split in 2000). In line with the literature on attentional allocation during mergers and acquisitions (Yu et al. 2005), the structural design changes modified the work context for all employees by introducing new issues such as cross-firm collaboration and building a new marketing organization (in addition to existing issues such as regulation and product quality), which members had to attend to with stability, vividness, and coherence.

1993 *GMP Crisis*. Millions of products used in the United States (e.g., medications, medical devices, and veterinary products) are produced abroad and regulated by the Food and Drug Administration (FDA). To protect the health of American consumers, FDA specialists inspect foreign facilities that export food, medication, and other regulated products to make certain that they follow good manufacturing practices (GMPs) (Mathieu 2000). In 1993, a mock FDA manufacturing audit revealed so many product quality problems that Novo Nordisk risked losing its license to sell insulin in the United States. Although there was nothing wrong with the quality of its insulin, Novo Nordisk was unable to document all the details of its manufacturing processes (Jacobsen 2000). As such, Novo Nordisk did not comply with the FDA's stricter enforcement of GMPs. "While there were a number of individuals within the Novo Organization...who were aware of...the increasingly stringent application of FDA standards, this information never received significant attention from corporate until it was too late" (Kamper et al. 1999, p. 1).

The company's immediate response was to discard six months of insulin production targeted for the United States. Although the insulin was in compliance with the standards of regulatory agencies outside the United States, Novo Nordisk did not want to sell a product in one part of the world that was not perceived to be satisfactorily manufactured in another part (Kamper et al. 1999). This radical response prevented Novo Nordisk from being shut down by the FDA, but it created another problem. Novo Nordisk had a responsibility to ensure that its customers had a reliable supply of insulin, and had to ask Eli Lilly, its main competitor, to take over most of its customer base in the United States. To prevent similar future events, the firm implemented a new management system—the Novo Way of Management (NWM). This system represented an important lesson learned: To detect and learn from unexpected rare events, Novo Nordisk had to be better at coordinating attention to weak cues across the chain of command.

Data Collection

I used the literature on attention (Ocasio 1997) and mindfulness (Weick et al. 1999) to loosely structure the data collection. Nonetheless, the relevance of coordinating among attention stability, vividness, and coherence across hierarchical levels emerged from the data. Given that Weick and Sutcliffe's (2006) ideas about attention vividness and stability did not emerge until after the data collection was complete, I did not enter the field with these concepts in mind. The following questions guided my data collection and analysis: (1) How do different hierarchical levels pay attention to weak cues? (2) How do organizations respond to and learn from rare events? (3) How do organizations produce their own crisis?

The data was collected from three overlapping sources: (1) semistructured interviews, (2) documents, and (3) participant observation. I combined and triangulated these sources to develop theory and maintain the integrity of my analysis (Miles and Huberman 1994). To control for memory bias, I compared my interview data with historical documents held in Novo Nordisk's corporate library, and found no significant differences between what happened in 1993 and what my informants reported.

Semistructured Interviews. I recorded and transcribed 28 interviews with 23 informants. I started all interviews by asking open-ended questions and was careful not to emphasize that I was interested in any specific events. I deliberately interviewed people at various levels in the hierarchy (e.g., chief executive officers (CEOs), vice presidents, department managers, and employees) and from different functional areas (e.g., human resources, quality control, manufacturing, and stakeholder relations (SR)) to study converging and opposing interpretations of the GMP crisis. The interviews focused on how various departments and hierarchical levels attended to particular cues and issues. This approach allowed me to identify patterns across hierarchical levels and draw tentative relations among key concepts and themes.

Documents. I collected retrospective data, totaling 4,200 pages, including implementation manuals for the NWM, case studies about Novo Nordisk, annual reports, newspaper articles, and commentaries by financial analysts. Some of this material included interviews with senior managers (current and retired) who commented on the GMP crisis in 1993. These documents helped me engage informants in reflections and discussions about specific issues and events.

Participant Observation. During the fieldwork, I participated in a two-day seminar with 30 employees from Stakeholder Relations. This department is responsible for Novo Nordisk's external community relationships and organizes the company's environmental and social reporting. During group discussions, the participants talked freely about the GMP crisis, and they willingly answered my questions over lunch and during breaks. Several seminar sessions also addressed the GMP crisis. By participating in these seminars, I was able to interact informally with a wide range of people, and thereby check the validity and consistency of my interview data.

Data Analysis

I developed the concept of attentional triangulation by developing comparative tables (Strauss and Corbin 1990). Specifically, I used multiple data sources to trace key issues that my informants and their respective hierarchical level/function considered important before the GMP crisis in 1993 (see Table 1). This analysis helped

Table 1 Attention to Issues Across Four Hierarchical Levels: Pre-GMP Crisis in 1993

Issue	Senior management	Middle management	Plant management	Shop floor
Issue 1: Insulin quality and safety	Yes, important. Stability but not vividness.	Yes, important. Stability but not vividness.	Yes, priority. High stability and vividness.	Yes, priority. High stability and vividness.
Issue 2: Merger of Novo and Nordisk	Yes, priority. High stability and vividness.	Yes, priority. High stability and vividness.	Not top priority. Some stability and vividness.	Not top priority. Some stability and vividness.
Issue 3: FDA compliance	Nonissue—we are world champs. Low stability and vividness.	Nonissue—we are world champs. Low stability and vividness.	Yes, priority. High stability and vividness.	Yes, priority. High stability and vividness.
Issue 4: Build marketing organization	Yes, priority. High stability and vividness.	Yes, priority. High stability and vividness.	No attention.	No attention.

me to develop longitudinal cross-level theory by discerning how the work context (Bechky 2003) caused distinct hierarchical levels to pay attention to particular issues with changing degrees of stability, vividness, and coherence.² It generated the insight that Novo Nordisk's work context initiated attentional fluctuations across time and levels to particular issues, and that this disparity in the quality in the stability, vividness, and coherence of attention to particular issues explained the onset of the crisis in 1993.

I followed established practice for developing an inductive data structure consisting of first-, second-, and third-order categories (Nag et al. 2007). As a result of the review process, I present only the third-order categories (Figure 1) that were used to craft the case narrative. Figure 1 represents a dynamic conceptualization of attentional triangulation that discerns how Novo Nordisk learned to prevent future rare events from the unexpected rare crisis in 1993. By emphasizing variations in attentional triangulation before, during, and after Novo Nordisk restructured in 1989, Figure 1 shows how a chronology of attention preceded the GMP crisis. Consequently, Figure 1 captures the learning process involved in sustaining attentional triangulation at Novo Nordisk to learn from rare events.

As the first column of Figure 1 shows, the character of Novo Nordisk's current configuration of attentional

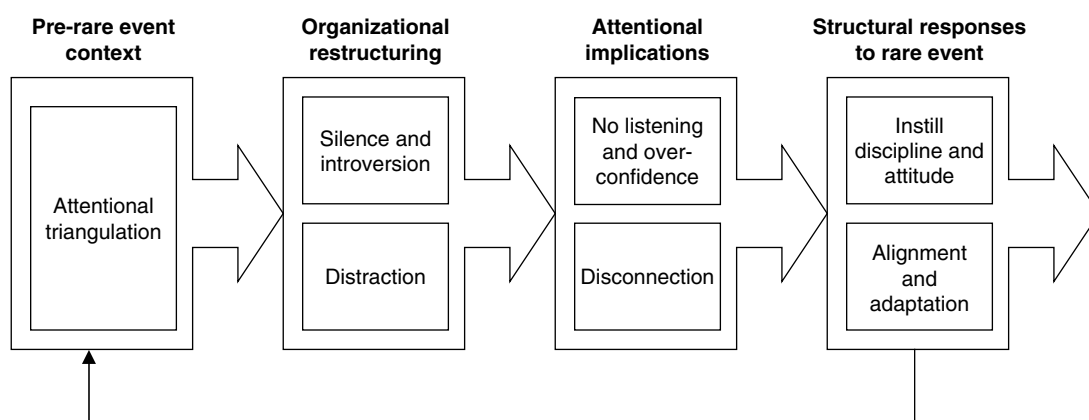
triangulation constitutes the organizational context prior to the rare event in which the restructuring initiative occurred (second column). This initiative (e.g., merger) was a distraction that caused silence and introversion and diluted the quality of attention of employees and managers to several issues. Silence, introversion, and distractions entailed serious implications (third column) for how members of the organization not only interacted but also attended to issue-specific cues. The GMP crisis ultimately led to a number of adaptive responses (fourth column), notably, the creation of the NWM, a collection of practices that help Novo Nordisk to share issue-specific information with discipline and an attitude of humility across the chain of command.

In an effort to increase the trustworthiness of the framework (Corley and Gioia 2004), several informants from Novo A/S and Novo Nordisk A/S read, reread, and commented on this paper. After several iterations, the informants conveyed that my framework accurately represented what had occurred.

Case Narrative: The GMP Crisis at Novo Nordisk

Because specialization is inherent to performing defined tasks, each hierarchical level exhibits local differences in stability and vividness to particular issues. As a result

Figure 1 Learning Dynamics Underlying Attentional Triangulation and the Inception of Rare Events



of these differences, attention coherence was not a given at Novo Nordisk. Some hierarchical levels gave higher attentional stability and vividness to particular issues than others did. As a result, certain issues were infused with specific beliefs, judgments, feelings, and meanings at particular levels. When people at one level attend to an issue about which they have strong beliefs and feelings, their attention can be distracted, unfocused, and potentially deprived of details and richness unless they deliberately interrelate with people at another level who are willing to voice their alternative beliefs and feelings about the same issue. The key issues and the configuration of attention to these issues across four hierarchical levels prior to the GMP crisis are summarized in Table 1.

Pre-Rare Event Context

The most prevalent theme across interviews and secondary data sources regarding the context prior to the GMP event was the success experienced by both Novo and Nordisk in the 1970s and 1980s. “We were world champions” was the most common expression that informants used to describe how the firms’ success created a culture of overconfidence and invulnerability. That culture did not motivate people to follow up on concerns and scan issues multiple times. Nor did it motivate managers to engage with discipline in detailed and rich scanning of warning signs voiced by employees. Therefore, overconfidence decreased the quality of Novo Nordisk’s collective attention stability, vividness, and coherence. As Department Manager C, who started to work for Novo in 1989, noted:

Before the GMP crisis, a lot of able people voiced their concerns about our quality system. My manager said many times over many years that...they needed more people in quality assurance to comply with new demands from the FDA. But middle management ignored these comments because we were world champions. Everybody had the opinion that nothing could go wrong for us because Novo was floating on water and had been doing so for a long time... We were closed towards the environment and no one was afraid of anything. Nothing could happen to us... Back then, people were getting fired for pointing out that something was wrong... Criticism was seen as a sign of disloyalty toward the organization... We had an IT system that was not very good. I broke away from the culture by saying that it was not very good... but I could see it was not well received. My supervisor explained that we did not talk that way at Novo... He said that everything that Novo did was great because Novo was the best in the world... We did not make mistakes.

The belief that Novo was the best in the world created a context in which middle management assumed it did not need to magnify weak, infrequent, and unusual cues in a disciplined manner. By discouraging people from speaking up, new messages that signaled impending trouble were not crafted. Keeping quiet gradually

decreased attentional coherence. For example, the manager’s attention to GMP compliance in the above example was high on stability and vividness because she voiced her doubts many times over several years. Attention coherence was low, however, because middle management’s attention vividness and stability to this issue was low. To align attention stability and vividness to FDA compliance across levels, “you had to convince your own boss, his boss, and his boss that this was an issue and then he had to convince his boss that it was a good idea to do things in a different way. Such a system does not work in practice” (senior vice president). As a result, the hierarchical decision-making structure prevented the chain of command from developing a high level of attention coherence to FDA compliance.

My informants provided many examples when attention stability and vividness to a particular issue was developed at the bottom of the chain of command, but attention coherence to the issue did not exist across the hierarchy. This disparity existed because (1) there were no mechanisms for coordinating and exchanging information about potential threats and (2) a culture of superiority did not motivate middle managers to look into concerns raised by employees with discipline (Interviews 1, 2, and 3 with a facilitator; interview with a business manager). To be sure, the entire chain of command could not attend to all issues with stability and vividness. If they did, a balance between attention load and attention capacity would not exist. Yet Novo’s structure, culture, and the “world champion syndrome” restricted the organization from coherently increasing the quality of its collective attention stability and vividness to weak cues signaling potential danger across issues by discouraging people from voicing their doubts.

Organizational Restructuring

Within this context of silence and not listening to one another, Novo successfully developed genetically modified insulin. In 1988, Nordisk Gentofte (Nordisk) approached Novo with a merger proposal. This proposal was a surprise because the relationship between the two companies had been antagonistic for 65 years. The firms were located only six miles apart, but very rarely exchanged any information. Nordisk was concerned that it was unable to produce genetically engineered human insulin. Novo’s CEO said, “The main advantage of the merger lies in strengthening joint research and development capabilities” (Mads Øvlisen in Pederson 1989, p. 10). The merger was challenging, however, because the firms’ cultures were so different (Interviews 1 and 2 with the CEO of Novo A/S). At Nordisk, the management style was formal and analytical because decisions were made quickly by the people higher in the hierarchy, who did not build a lot of consensus. Its culture was one of conflict, centralization, command, and control. Novo’s

culture was characterized by decentralization, harmony, agreement, and democratic principles. Decision making was consensus driven and discussion oriented. Although Novo was much bigger than Nordisk, Novo's CEO said, "The merger isn't a case of one company acquiring the other, but two sound, well-run companies on the move getting together so they can move faster" (Mads Øvlsen in Pederson 1989, p. 13). The CEO of Novo A/S continued:

An issue was that most people were going to get new managers and that some of the current managers would not be managers in the future. For example, it was no longer necessary to have two subsidiaries, general managers, etc., in every country. Who should be the manager and where should the regional headquarters be located? . . . We expected that it would take three years or maybe more to integrate Novo and Nordisk. In 1992, the situation is that the organization is growing and people are focused on the market but an extraordinary amount of resources are still being used on looking at our own belly button. It was as if the entire organization introverted to solve all the internal problems, new managers here and there, and to some degree we lost our external focus on the market.

When an entire organization focuses mostly on internal issues and meets to solve specific problems, the stability, vividness, and coherence of attention to these issues increases. The downside of this focus is that unless there are meetings and practices that help the organization to focus externally, it can simultaneously decrease the stability, vividness, and cohesion of attention to external issues. The merger influenced all employees (interview with the vice president of quality control). As a result, some level of attention stability to Issue 2 in Table 1 existed across the organization because employees were talking about how the merger would change their work. Yet attentional vividness and coherence did not develop in the same way because the merger had to be successful. Department Manager B said:

Top management used its energy to turn the merger into a success. Success meant that there could not be any open conflicts . . . This was dangerous because in manufacturing we noticed that the regulatory demands, especially GMP demands from the FDA, were increasing. We could not discuss this problem . . . The signal from top management was that either you agree or you're out.

As described above, many employees already did not voice their doubts because of the "world champion syndrome," so this was a strong signal that further generated silence across Novo Nordisk's rank and file. Furthermore, people did not speak up. As one senior vice president stated, "the merger forced us to work with our old enemy. It was difficult. Who could you trust? It was not obvious so people were looking out for themselves." When people do not speak up, they do not share critical

information. Attention stability and vividness to issues can still develop at local levels of the chain of command, but if individuals at these levels have limited decision power and motivation to craft new initiatives, a hierarchical organization may not pay adequate attention to emerging problems. Department Manager A explained:

The FDA was very focused on validation in the early 1990s. We had to document and verify that our manufacturing processes lead to the declared outcomes . . . In manufacturing, we were aware that it was something we had to do. But validation takes a lot of time and resources. So we wrote a number of memos and asked for more staff. Our requests were turned down because management was focused on marketing. Their priority was to channel resources into building the marketing organization. As a result of this focus, they denied us the resources we asked for . . . Since then I have asked myself many times why I did not bypass the entire management hierarchy. Why did I not go directly to top management? Today, I have learned that if one thinks that something is really not as it should be, then one should not accept being oppressed by middle management. But back then I accepted it and so did many others.

Low attention coherence to FDA compliance was an important theme because after the merger, plant managers and shop floor employees were neither encouraged to look for "validation problems" nor rewarded for reporting them. There was no mechanism in place for motivating people to voice their concerns in a disciplined manner. Given past performance, middle managers did not consider validation problems to be a priority because they were focused on building the marketing organization. This focus endured among middle and upper managers because analysts at that time said that "lack of marketing strength remains Novo Nordisk's most often cited problem, a weakness many industry experts feel will be remedied with the combined sales force and a little time" (Kamper et al. 1999, p. 8). A senior analyst at a major bank explained why senior management was focused on building the marketing organization:

Sales and distribution costs in the pharmaceutical industry increased much more during the 1990s than research and development costs. It happened because the competition increased when patents on blockbuster drugs ran out and cheap copy products started to flood the market. These products could take up to 80% of the market overnight. It was extremely important for the manufacturers to get as much out of their products as long as they were protected by patents. That explains why we have seen a significant increase in the sales and distribution costs in the American market where prices are higher . . . The American market is extremely driven by sales and marketing. It is allowed to give free samples to a degree that is not allowed in many European countries . . . An effective marketing organization is extremely important.

Attentional Implications of the GMP Crisis

Novo Nordisk's organizational structure made it difficult to develop attentional coherence to FDA compliance across the chain of command. Despite efforts to decentralize decision making, the postmerger structure of Novo Nordisk was hierarchical and bureaucratic. "In the early 1990s, all information traveled from one level to the next in the hierarchy. There was no bypass or other route in the system" (vice president). This procedure made it hard for weak cues of danger from the shop floor to reach senior management without going through the chain of command. Novo's decentralized culture evaporated during the early 1990s; shop floor employees were disempowered and their reports were watered down as they filtered up through the chain of command.

Everybody was thinking that it was a "good idea to simplify the argument so my manager could also understand it" and "I wonder if he really needs to know this and that." Consequently, what was written in the original version of the report on page 3 under bullet point 4 and which was an alarm bell for the specialist was likely to be deleted in the version that senior management read. (CEO of Novo A/S)

Filtering information this way reduced the vividness of attention by reducing the richness of information shared across the chain of command, and caused important issue-specific information about FDA's stricter enforcement of GMP to be overlooked.

Novo Nordisk tried to circulate richer knowledge across the chain of command, but employees at different hierarchical levels still developed fragmented and disconnected understandings of FDA compliance and other issues. In other words, attention cohesion was low. Senior and middle management were focused (e.g., attention stability) on building the firm's marketing organization, responding to competitive pressure from Eli Lilly and ensuring the merger's success. Employees and managers in manufacturing and quality assurance cared about product quality and new regulatory requirements. They recognized that the regulatory environment was changing, but this fact barely registered on top management's radar screen. "The people in manufacturing were aware of the situation, but they were unable to make senior management listen and attend to these signals. . . . We continued to manufacture drugs by following our own standards" (CEO of Novo A/S).

During the late 1980s, Novo continuously improved its manufacturing process, but did not report or register all these changes with the FDA. From a product quality perspective, a failure to register changes with the FDA was not a problem because the changes did not influence the insulin's quality. "But from a regulatory perspective, the changes did not convince the authorities that we produced our insulin in a way that matched how the product was registered" (new CEO Novo Nordisk).

Regulatory compliance gained senior management's full attention in 1993 when Novo Nordisk's Department of Quality Assurance invited a group of retired FDA officials to conduct a mock audit. Given the introverted focus discussed earlier, the auditors "removed the veil from Senior Management's eyes" (vice president). Department Manager B said:

The inspectors started in insulin filling, but we realized very quickly that our quality problems were not confined to this department, or to manufacturing for that matter. It was the entire firm. The entire firm was imbued with arrogance towards the FDA. We had our own way of interpreting the rules, which was not in agreement with how the authorities looked at it.

The external auditors identified more than 100 areas of noncompliance, just a few months before the company was to be officially evaluated against FDA regulations on GMPs. The findings were a surprise to senior management and a blow to Novo Nordisk's reliability and survival: "The [mock] auditors discovered so many problems that they thought there was cause to close the company" (Jacobsen 2000, pp. 212–213).

Structural Responses to Rare Events

Novo Nordisk responded to the crisis by discarding six months of insulin production and implementing a new validation and quality system (interview with Department Manager B). Between 1993 and 1997, it increased the size of its quality assurance department by almost 250%, from 180 to 620 employees. By adding more people and requiring them to interrelate with the entire organization, the quality of Novo Nordisk's attention capacity was greatly improved. Furthermore, an "integrated ISO approach to quality assurance was developed, including semi-annual Quality Management Review (QMR) sessions where quality related issues are identified and consolidated across all units and hierarchical levels" (interview with vice president of quality assurance). These practices are still in place today and make sure that Novo Nordisk in the future will not be in noncompliance with FDA regulations.

During this same period, older plants were closed down and substantial investments were made in building new manufacturing facilities to comply with the FDA. By 1994, Novo Nordisk was cleared by the FDA to sell insulin in the United States. A conservative estimate of the crisis' direct costs is \$100 million, excluding lost sales, investments in new manufacturing facilities, damage to reputation, and other intangibles.

The GMP crisis further triggered efforts to develop practices and organizational designs to increase the quality of attentional triangulation. Henrik Gørtler was the corporate human resource manager of Novo Nordisk in 1993 when he was charged with developing a new management system that would prevent similar unexpected events. Gørtler and his team found that the

Table 2 The Novo Way of Management

Values	Commitments	Fundamentals
Accountable Each of us shall be accountable—to the company, ourselves, and society—for the quality of our efforts, for contributing to our goals, and for developing our culture and shared values.	Financial responsibility We will work to continuously improve our financial performance by setting high objectives for growth and value creation and deliver competitive performance in these areas. We will maintain an open dialogue with our stakeholders and comply with international reporting standards.	1. Each unit must share and use better practices 2. Each unit must have a clear definition of where accountabilities and decision power reside 3. Each unit must have an action plan to ensure improvement of its business performance and working climate
Ambitious We shall set the highest standard in everything we do and reach challenging goals.	Environmental responsibility We will work to continuously improve our environmental performance by setting high objectives and integrating environmental and bioethical considerations into our daily business. We will maintain an open dialogue with our stakeholders and report annually on our environmental performance. We subscribe to the International Chamber of Commerce's Charter for Sustainable Development. We support the United Nations Convention on Biological Diversity.	4. Every team and employee must have updated business and competency targets and receive timely feedback on performance against these targets 5. Each unit must have an action plan to ensure development of teams and individuals based on business requirements and employee input
Responsible We shall conduct our business in a socially and environmentally responsible way and contribute to the enrichment of the communities in which we operate.		6. Every manager must establish and maintain procedures in the unit for living up to the relevant laws, regulations, and group commitments
Engaged with stakeholders We shall seek an active dialogue with our stakeholders to help us develop and strengthen our business.		7. Each unit and every employee must know how they create value for their customers
Open and honest Our business practices shall be open and honest to protect the integrity of the Novo Group companies and each employee.	Social responsibility We will work to continuously improve our social performance by setting high objectives and integrating social, human rights, and health and safety considerations into our daily business. We will maintain an open dialogue with our stakeholders and report annually on our social performance. We support the United Nations Universal Declaration of Human Rights.	8. Every manager requiring reporting from others must explain the actual use of the reports and the added value 9. Every manager must continuously make it easier for the employees to liberate energy for customer-related issues
Ready for change We must foresee change and use it to our advantage. Innovation is key to our business and therefore we will encourage a learning culture for the continuous development and improved employability of our people.		10. Every manager and unit must actively support cross-unit projects and working relationships of relevance to the business

Source. Demerger Document, Novo Nordisk A/S, October 16, 2000, p. 11.

existing management system was arrogant and insensitive to frontline manufacturing employees because it “simplified, reduced, and twisted the exchange of information.” These features work against improving attentional vividness and cohesion because they reduce information richness and thus weak issue-specific cues signaling potential danger. To Gürtler, the GMP crisis suggested that “it was necessary to develop a system that gave senior management and the entire management system an unbiased second or third opinion.” Such a system would intentionally improve the quality of attentional triangulation by changing the discipline and attitude with which information was exchanged across the chain of command. The system, which increased Novo Nordisk’s attention capacity, was launched in 1997. It was called the Novo Way of Management (NWM). The values, commitments, and principles of the system are summarized in Table 2. The key theme of the NWM is to stimulate Novo Nordisk to actively attend to established and emerging issues through openness, continuous learning, and dialogue. The NWM was developed to

help Novo Nordisk increase its quality of attention stability, vividness, and coherence to issues by encouraging unit managers to work with their peers to solve problems, share knowledge, and move the company toward a decentralized structure in which everyone felt obligated to not only voice their concerns about core issues but also to listen to concerns about emerging issues voiced by colleagues, peers, and managers.

Before the GMP crisis, Novo Nordisk was not intentionally focused on structurally integrating and coordinating the stability, vividness, and coherence of its attention to subtle changes in issues to detect and learn from rare events. To develop a capability to detect and learn from rare events by attending in a coordinated way to weak cues across the chain of command, the company introduced several methods: (1) stakeholder relations, (2) organizational audits, and (3) facilitation.³ People were hired or transferred from other functions to execute these methods. As a result, Novo Nordisk’s attention capacity was expanded because these people were dedicating their time and effort to attend to weak cues.

Stakeholder Relations: A Structural Solution to Coordinate Weak Cues. The GMP crisis indicated that Novo Nordisk needed to scan the external environment consistently and carefully for changes and trends, and to structure itself to better discern these cues coherently across the chain of command. More consistent scanning improves attention stability. Richer scanning increases attention vividness. A new structure focusing on dialogue across hierarchical levels facilitates attention coherence. The Stakeholder Relations Department employed about 20 people and was created to improve attentional stability and vividness to emerging issues by scanning the opinion of a wide section of Novo Nordisk's stakeholders. Part of its mandate was to talk to the company's critics to "identify dilemmas, initiate reflection, install respect for differences, produce alertness, and facilitate a corporate culture that values openness and humility" (employee from Stakeholder Relations). By talking to critics and considering their perspectives, Novo Nordisk's attention vividness to emerging issues such as corporate social responsibility and genetic modification would increase. SR helps Novo Nordisk to consistently generate stability, vividness, and coherence around issues that it would otherwise find difficult to focus on. SR brings controversial issues into the organization by organizing sessions that cause people from various departments and hierarchical levels to discuss these issues together. It also organizes sessions between nongovernmental organizations and employees at Novo Nordisk to make sure various managers get a sample of "raw data" from the field. The effect on Novo Nordisk's attention focus appeared to be significant, because several informants good-naturedly described their SR colleagues as "corporate brainwashers." In an industry where financial performance is king, SR has put new issues on a crowded corporate agenda.

Organizational Audits: A Structural Solution to Increase Attention to Shared Goals. The five people that run Organization Audit ensure and measure that every unit does its best to realize Novo Nordisk's annual goals. These goals, set by the executive management team, change on an annual basis and are used to evaluate each unit's ability to develop its own employees and to assess whether the organization is adapting sufficiently to meet current and future business objectives. The audits uncover issues that might prevent the firm from realizing these objectives and initiate projects to overcome these obstacles. Organizational audits increase attentional stability and coherence to specific emerging issues by forcing the organization to coherently focus on a new set of goals on an annual basis.

Facilitation: A Structural Solution to Coordinate Internal Weak Cues Across the Chain of Command. The GMP crisis revealed that to detect and learn from rare events, Novo Nordisk needed to improve its exchange

of information and channeling of attention to issues across the hierarchy. In response, the company recruited a group of 14 "facilitators" from its most experienced, well-respected, and best performing managers. The role is a cross between those of an auditor, coach, broker, and integrator. It focuses on generating attention cohesion to emerging problems across the chain of command. One facilitator explained:

The facilitators are brokers. Not so much among different departments, but more within the hierarchy. We serve two main functions. First, the "police function," which aims to detect if people are doing their job in ways that do not comply with the NWM. This function helps people to perform their job better. Second, the "feedback function," which helps people to improve their job performance by making them reflective and pointing out activities in their unit that are done smarter in other units.

Facilitators visit different organizational units across the Novo Group to evaluate how well each unit complies with the NWM. A typical facilitation team consists of two facilitators with different career and personal backgrounds (Interviews 1 and 2 with a facilitator). The visits may be organized by department, division, or geographical area, but all units are visited every three years. A facilitation visit begins with a background briefing for everyone in the unit, followed by informal interviews with about 40% of the unit's employees. Some interviews are conducted with individuals and others occur in groups. Facilitators use open-ended questions to uncover employee concerns and "talk about the issues that are normally not being discussed. Nothing is taboo" (facilitator). These informal discussions allow employees to "bypass all filters in the hierarchy. A situation where critique or warning signs from below don't get to the top because they are explained away in the process [is] less likely to happen today" (Facilitator).

When all interviews are completed, the facilitators analyze and discuss the results of their visit and prepare a report that evaluates whether the unit is managed in a way that reflects the NWM. This report identifies areas for improvement and sets out an action plan for making necessary changes. The facilitators discuss the report with the unit's management team, and then with all employees. The facilitation typically lasts five days and is concluded when the manager and the facilitators sign off on the report. After the facilitation, each item in the action plan is assigned to an individual, who is then responsible for ensuring that it is completed within set timelines. One of the facilitators keeps in close contact with the unit to monitor progress. Facilitation improves the quality of attention by not only identifying anomalies such as small failures and knowledge gaps across hierarchical levels, but also by signaling that senior management is serious about listening to the front line with discipline. Facilitation is not about breathtaking innovations but about discipline and the right attitude. Discipline is important because the ability to detect weak cues

Table 3 Facilitation Data: Action Points per NWM Fundamental

	Number of action points per fundamental											Total	No. of facilitations	No. of action points per report
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11 ^a			
1999	45	72	113	58	66	58	33	11	45	12		513	64	8
2000	11	32	79	45	36	11	13	5	33	5		270	34	8
2001	12	57	101	73	71	38	20	3	50	1		426	56	7.6
2002	7	56	105	50	60	31	11	1	31	3		355	52	6.75
2003	10	44	65	54	46	43	9	5	28	3		307	47	6.5
2004	4	26	48	35	31	24	4	4	20	3	21	220	44	5.0
Total	89	287	511	315	310	205	90	29	207	27	21	2,091	297	
%	4	14	24	15	15	10	4	1	10	1	1	100		

Notes. Data for 1999 refer to Novo Nordisk. Data for 2000 to 2004 refer to Novo Nordisk after the demerger (excluding Novozymes). Data for 2004 include nine months of results.

^aIn April 2004, Novo Nordisk added an 11th fundamental: "Everyone must continuously improve the quality of their work." This fundamental is specific to Novo Nordisk.

before they compound into a crisis is created by systematically paying attention to the mundane details of ordinary daily activities. Facilitation is, as one facilitator said:

a sanity check that provides an opportunity to find a number of small cracks where local practices are starting to drift away from the NWM. . . . It is not our job to solve big problems because there are not supposed to be any big problems. . . . If we constantly ran into big issues, our system would not be working. We go around and find a number of small issues. We don't know if they would develop into something bigger if we ignored them. But we don't run the risk. We follow up on the small stuff.

Facilitation requires the right attitude because 95% of the concerns raised are irrelevant (Interview 1 with a facilitator). By looking for and attending to small problems with discipline, the facilitators hope to foreshadow trouble that can expand and cause larger system breakdowns. As emphasized by a facilitator:

We point to issues that could pose a danger in the future if they are left unnoticed. . . . We do not invent these problems because we hear about them from the employees. They have a concern, but local management has been a bit deaf with respect to looking into the concern. Then we ask why they are deaf about it and indicate that it sounds pretty relevant to us. Then local management usually takes a look at the issue.

Systematic data on the Novo Nordisk facilitation process is available from 1999 and is summarized in Table 3. The record is both revealing and reassuring. From 1999 to 2004, facilitators annually identified an average of 348 action points. Because these issues were detected early, none of them caused a crisis. But the frequency of these incidents suggests that units do not always comply with the NWM. The average 348 action points per year tell us that attentional triangulation is a dynamic process that requires constant rebuilding, vigor, and persistence. It cannot be left unattended. The last column of Table 3 shows that the average number of

action points per facilitation report is declining. As one facilitator suggested, this was because "the units are at a much better level today [even though] our expectations have increased."

The bottom row of Table 3 shows that over half (54%) of the action points (i.e., nonevents) arising from all facilitations conducted from 1999 to 2004 concerned the development and implementation of action plans (Fundamentals 3, 4, and 5 in Table 3). Year in and year out, it is these fundamentals that draw action points. This is not because the action plans were ignored, but because these fundamentals became increasingly difficult to live up to. As one facilitator described it, "our expectations to how a unit complies with Fundamentals 3, 4, and 5 are gradually being adjusted upwards." As Novo Nordisk learned how to develop and implement action plans, the facilitators raised their expectations and required the units to provide more evidence of how they complied with the NWM.

The GMP crisis had a profound impact on Novo Nordisk. The company realized that this rare event could not be blamed on a single error. Instead, it was the result of how the company as a collective was paying attention to weak cues, and a change in attitude and structure was needed. The NWM was part of this change and it altered the content and quality of how the organization was attending to issues in its internal and external environment. The NWM in general, and the facilitation process in particular, helped Novo Nordisk to develop attentional triangulation and a capability for detecting and learning from rare events.

Discussion

The study of Novo Nordisk emphasizes the limitations of standard reinforcement learning processes of trial and error by pointing out the significance of learning proactively from issue-specific weak cues (see also Levinthal and Rerup 2006). My key message is that attentional

triangulation forms a basis for effective learning by helping organizations to proactively attend to subtle cues. Attentional triangulation is important because it can help organizations to focus on weak cues that come from lower levels in the chain of command. Focusing on these cues is necessary to detect and learn from rare events in a competitive landscape that for many organizations is becoming increasingly global, diverse, technological complex, and fast paced. Novo Nordisk operates in such a landscape.

Novo Nordisk learned from the GMP crisis that (a) it had failed to pay attention to the issue-specific cues that were generated inside the firm and (b) that it needed to develop internal processes and structures to prevent this from happening again. The logic behind the NWM suggests that by increasing the quality with which people attend to weak cues managers can potentially enable decision makers to build baseline data about nonevents, and thereby prevent rare events in the future. This observation is related to Ashby's (1958) law of requisite variety and suggests that an organization can only detect variety in the environment, such as weak cues, non-events, or emerging problems, to the extent that it has sufficient internal attentional variety to represent it. By extension, I am arguing that to notice weak cues it is necessary to develop and triangulate between dimensions of the collective attention system to magnify and coordinate the nonconceptual properties of weak cues.

Attentional triangulation is particularly relevant in complex organizations that require deep specialization of its members to function successfully. Specialization is necessary in many organizations because attention is a scarce resource (March and Simon 1958, Cyert and March 1963, Greve 2008, Huckman and Zinner 2008). To prevent overload and increase performance, Novo Nordisk used various structural designs to distribute, regulate, and focus the attention of its members on a limited number of tasks and issues. Although specialization decreases the attention load of individual decision makers, the evidence from Novo Nordisk also suggests that "the more the work is subdivided, the greater is the danger of *confusion*, and the greater is the need for overall...coordination" (Gulick 1996, p. 87; *italics added*). Confusion or ignorance of FDA compliance was a reality at Novo Nordisk because attention to this issue remained specialized and disintegrated. In support of these arguments, a large research literature has suggested that specialized, automatic, and mindless mental and behavioral processes play a more prominent role than deliberate and mindful ones in issue diagnosis (Dutton 1993, Julian and Ofori-Dankwa 2008).

In line with Weick and Sutcliffe (Weick and Sutcliffe 2006, Sutcliffe and Weick 2008), the findings from Novo Nordisk suggest that when the allocation of attention is done with discipline and mindfulness, a wealth of issues do not create poverty of attention, but can instead

be plentiful and enable decision makers to intelligently coordinate and attend to more issues. Through discipline and mindfulness, organizations can improve not only the available repertoire of categories for making sense of issues in the environment, but also the available repertoire of action alternatives (Ocasio 1997) for detecting and learning from emerging issues and rare events. In line with Dutton (1993) and Marcus and Nichols (1999), the results from Novo Nordisk suggest that we need to rethink the role that more deliberate and mindful (rather than automatic and mindless) processes play in detecting vague and emerging complex issues (Weick and Sutcliffe 2006, Julian and Ofori-Dankwa 2008). Although the findings from Novo Nordisk need to be replicated in other contexts, they constitute an important complement to the attention-based view of the firm (Ocasio 1997) by proposing an attentional perspective for exploring how the enactment of specific organizational designs can influence the elasticity of an organization's attention capacity, and thus the quality of its ability to detect and prevent rare events.

These varying perspectives on attention and their undertheorized relationship suggest that further theorizing and grounding can help us to build new knowledge about learning from rare events. The purpose of this paper has been to make a contribution to this integrative agenda.

Preventing Rare Events by Attending to Weak Cues from the Lower Levels

The study of Novo Nordisk suggests that to effectively coordinate the weak cues identified by a specialized work force it is necessary for an organization to deliberately develop organizational mechanisms that balance the trade-off between attention stability, vividness, and coherence. Balancing these trade-offs is not a simple, mindless, and automatic process. It takes effort, persistence, and hard work, but is valuable because it can help a specialized knowledge-intensive organization to detect potential threats. Attentional triangulation accomplishes this balance by building shared knowledge about core and emerging issues across the organization.

Detecting and learning from rare events requires attending to the minute details of what goes on in a context. Attending to more cues and issues in a coordinated manner requires more attention capacity. To increase Novo Nordisk's attention capacity to deal with that increase in load, they expanded the quality organization with a factor of 12 and implemented semianual quality management reviews where specific quality issues are shared across the chain of command. They also developed the NWM to coordinate attention to core and emerging issues more generally, and hired about 50 people to execute facilitations, stakeholder relations, and organizational audits.

The annual total direct cost of the NWM and stakeholder relations is about \$20 million compared to a total cost base for Novo Nordisk of \$3 billion per year. Financially, the senior managers conveyed that the NWM made sense given the detection of 348 action points per year from 1999 to 2004 (see Table 3). They also mentioned that from a learning perspective the NWM was useful because it is difficult to initiate changes in beliefs, values, and behavioral patterns without the data in Table 3. As such, the results from Novo Nordisk suggest that learning from rare events is improved when organizations collect data about situations that can have potential negative consequences, even when these are not realized. Such data are needed to convince employees about the need for change to prevent crises.

The senior managers would not speak about specific threats that had been detected after implementing the NWM. Instead, they spoke about the value the NWM generated in terms of positively changing the care, attitude, and quality with which the entire organization was exchanging weak and sensitive information. They also mentioned that it is impossible to put a price tag on the indirect value of increasing the willingness of the lower levels of the organizations to speak up and voice their concerns. When employees voice their concerns, they sometimes produce noisy data. The “cost” of such complaints is a downside of the NWM. However, when employees interrelate and voice their concerns with mindfulness, data for detecting threats and learning from them is produced because at Novo Nordisk the facilitation process helps such raw data to travel unfiltered to the top of the hierarchy. As such, the study of Novo Nordisk makes an important contribution to the emerging literatures on error reporting (Ramanujam 2003, Zhao and Olivera 2006) and silence and voice in organizations (Morrison and Milliken 2000, Edmondson et al. 2001, Bouquet and Birkinshaw 2008, Tangirala and Ramanujam 2008) by emphasizing the role of voice and silence in detecting and learning from rare events.

An effective early warning system such as the NWM is made up of “small wins” (Weick 1984)—hundreds of mundane conversations with people across the organization. Although improved attentional triangulation is related to quantitative changes in behavior (e.g., more scanning, more information sharing, etc.), simply doing more of the same will not, in the long run, improve the quality of attentional triangulation. Instead, increasing the quality of attentional triangulation requires qualitative differentiation, which denotes the character or nature of the work required to generate attentional triangulation. A qualitative change entails organizational designs (e.g., routines, integration mechanisms) that intentionally modify what various hierarchical levels do when they attend to issues with stability, vividness, and coherence. At Novo Nordisk, a qualitative change occurred when the facilitation process was implemented because

it created a disciplined way for weak cues and information to be collected, interpreted, and shared across the chain of command. Qualitative changes involve doing completely new things or doing existing things in new ways, such as creating the Stakeholder Relations Department. Creating Stakeholder Relations represents a minor change to Novo Nordisk overall practice, but it expanded the way Novo Nordisk scanned, interpreted, and shared information about emerging issues and nonevents in a turbulent industry. Small changes can have large effects.

The NWM, with its focus on, for example, facilitation, suggests that the three dimensions of attention (stability, vividness, and coherence) become recursively interlinked through organizational designs. The ability of these designs to mindfully and consistently coordinate the three dimensions determines the quality of attentional triangulation. Historically, research on these three dimensions has not been connected. Yet the account of Novo Nordisk presented here suggests that they should be seen as subcomponents of a multidimensional construct (Law et al. 1998, Bouquet and Birkinshaw 2008) that might or might not covary. In other words, an increase or decrease in one of these dimensions does not necessarily lead to an increase or decrease in the other two dimensions. Corrosion of the quality of attention in any of these dimensions will decrease, but not eliminate, an organization’s short-term ability to detect and learn from weak cues. Future research needs to study how reliable specific configurations of attentional triangulation are in different contexts. For example, we need to know if one or two dimensions of attention are “enough” to detect weak cues to keep an organization from experiencing rare events. The data from Novo Nordisk suggest that high levels of attention stability and vividness to core and emerging issues existed at the lower levels, but that attentional cohesion was weak across the chain of command. This configuration was effective for years until the FDA started to more strictly enforce its regulations about GMP. We need to know if lack of attentional cohesion during periods of change causes rare events in other industries.

Learning from a Rare Crisis to Prevent Future Rare Events

This study of Novo Nordisk addresses how attending to weak cues from the lower levels can help organizations to prevent and learn from rare events. It covers two separate learning phenomena. The first is how Novo Nordisk learned from the GMP crisis experience and developed the NWM. The second concerns the ongoing search and defusing of potential threats as the company implements the NWM. My interviewees at Novo Nordisk did not pretend that the NWM was perfect and that it would detect and prevent all future unexpected rare events. They believed, however, that it had improved the skills, discipline, and attitude with which noisy data

were being collected, interpreted, and shared across the chain of command. They also emphasized that the NWM was preventing groupthink (Nemeth et al. 2001), which may occur when organizational members try to minimize conflict and reach consensus without critically testing, analyzing, and evaluating ideas (Janis 1972).

The interviewees described the employees in Stakeholder Relations and the facilitators as devil's advocates. In this role, an individual argues a position that another is less familiar with, thereby increasing conflict and dissent, which in turn expands attentional vividness by highlighting problems and alternatives. The data suggest that by having some employees (e.g., facilitators, stakeholder relations employees) serve as devil's advocates, both the quality of attentional triangulation and learning from rare events can increase. Nonetheless, having employees become devil's advocates may not completely prevent unexpected rare events from occurring. As the data related to the NWM suggest, institutionalizing this role generates a mechanism for producing attentional and interpretive tension across the chain of command. Yet this mechanism will be productive only if senior management does not bypass the opinion of those assigned this role (Nystrom and Starbuck 1984).

The link between the failure to detect weak cues signaling danger and the onset of rare events has a long history (Cunha et al. 2006). Prior research has focused mainly on systems of early warning and anticipation that top management sponsors (Ansoff and McDonnell 1990). Fewer studies have considered the onset and prevention of rare events from a multilevel attentional process perspective that emphasizes the importance of weak cues in detecting potential threats and preventing rare events (Roux-Dufort 2007). In contrast, the present study develops the microfoundations (Gavetti 2005, Salvato 2009) for understanding how various levels in the chain of command can be analyzed as meaningful entities that may capture and share weak cues to stall unexpected rare events. The focus on weak cues rethinks the concept of crisis as a rare, abnormal, and out-of-the-ordinary situation by suggesting that rare events exist long before and long after the actual event. The existence of weak cues about the GMP crisis suggests that this event was incubating long before it was discovered and defined as a crisis by senior management in 1993. As such, the study of Novo Nordisk suggests that rare events can be seen as "a fault line and a hinge between a degenerative organizational past evolution and a future of change" (Roux-Dufort 2007, p. 106). Rethinking rare events this way allows us to approach the GMP crisis as a process of accumulation of deficiencies and weaknesses rather than a sudden and extraordinary event.

Conclusion

Although each of the three dimensions of attention (stability, vividness, and coherence) has been separately

considered by other scholars, my study of Novo Nordisk ties them together to form an integrated multilevel theoretical model that combines insights from the Carnegie school (March and Simon 1958, Cyert and March 1963, Ocasio 1997, Gavetti et al. 2007, Argote and Greve 2007) and Weick and Sutcliffe (2006, 2007), with cross-level arguments from the literature on integration, differentiation, and coordination (Lawrence and Lorsch 1967, Snook 2000, Bechky 2003). These links, and the pharmaceutical context in which this study has examined them, suggest that organizational attention is not just a structural, monolithic phenomenon that can be stabilized and controlled by top executives. Instead, it is a dispersed and evolving process that, if analyzed closely, can help us understand the microdynamics of how organizations detect weak cues and learn from rare events by balancing the intersection of attentional stability, vividness, and coherence. Building on prior conceptual work (Rerup 2005, Levinthal and Rerup 2006, Weick and Sutcliffe 2006), this study is the first empirical attempt to accomplish such integration. More theory development and empirical testing is necessary to further reveal and integrate the understudied aspects of organizational attention and learning explored in this paper. Indeed, more work is welcome and necessary to further develop and empirically test the construct of attentional triangulation and its role in processes of organizational learning.

Acknowledgments

The author thanks the members of the Novo Group for contributing their time to this study. He is especially grateful for the time and support of Anders Bressendorff, Henrik Gürtler, and Lise Kingo. Without their help, this study would not have been possible. He is also extremely grateful to the special issue editors (Zur Shapira, Jamal Shamsie, and Joseph Lampel), three anonymous *Organization Science* reviewers, Fernando Olivera, and John Lafkas for their critical, developmental, and insightful comments, which greatly improved the message of this paper. This paper also benefited from insightful comments from Linda Argote; Mary Benner; Beth Bechky; Oana Branzei; Michael Cohen; Gina Dokko; Merrillyn Earl; Martha Feldman; Peer Fiss; Denny Gioia; Andy Hargadon; Guy Holburn; Mark Kennedy; Dan Levinthal; Ian MacMillan; Jim March; Joanne Martin; Laurie Milton; David Obstfeld; Willie Ocasio; Hans Pennings; Carlo Salvato; Paul Schulman; Dick Scott; Nicolaj Siggelkow; Kathleen Sutcliffe; Bob Sutton; Tillman von Schroter; Mark Zbaracki; and seminar participants at Copenhagen Business School; INSEAD; London Business School; the University of Michigan Interdisciplinary Committee on Organizational Studies (ICOS); the University of Southern California, Marshall School of Business; Stanford University (Scandinavian Consortium for Organizational Research); The Wharton School; the York University, Schulich School of Business; and the 2006 Organization Science Winter Conference. He is also grateful for the feedback from Colin Eden, George Huber, Majken Schultz, and the participants in the "Cognition in the Rough V" professional development workshop at the

2002 Academy of Management meetings. Thanks to Alykhan Haji, Lars Lund-Thompson, and Shalina Ismail for terrific research assistance. Earlier iterations of this paper won Best Paper Awards at the 2002 European Conference on Organizational Knowledge, Learning, and Capabilities, and at the 2004 Academy of Management meetings. Financial support from Novo Nordisk, the Danish Social Science Research Council, and the Richard Ivey School of Business at the University of Western Ontario is greatly appreciated. All errors are the author's.

Endnotes

¹As described by Kamper et al. (1999), diabetes is a chronic disease wherein the body does not produce or properly use insulin, the hormone that allows glucose to enter and fuel the cells of the body. Diabetes is caused by genetic and environmental factors such as obesity and lack of exercise. Many people do not realize that they have diabetes until they develop one of its life-threatening complications, such as blindness, or kidney, nerve, or heart disease. There are two major types of diabetes. (1) Insulin-dependent, or Type 1, diabetes accounts for 5%–10% of all cases and results from the body's failure to produce insulin. People with Type 1 diabetes must take daily insulin injections to stay alive. (2) Noninsulin-dependent, or Type 2, diabetes results from the body's inability to make enough insulin or use it properly. Type 2 diabetes can often be controlled by weight loss, improved eating habits, and exercise. Until the early 1920s, the only way to control diabetes was a diet low in carbohydrates and sugar, and high in fat and protein. In 1922, scientists at the University of Toronto extracted insulin from an animal pancreas. This process, licensed royalty free, was the basis for diabetes care until 1982, when Eli Lilly introduced genetically engineered human insulin.

²The conceptual integration of the three dimensions of organizational attention through the construct attentional triangulation emerged from the data. I used existing labels such as stability, vividness, and coherence as my data analysis deepened and in an effort to build on work that was published as I crafted this paper (Gavetti 2005, Weick and Sutcliffe 2006, Bouquet and Birkinshaw 2008, Salvato 2009). Before I realized that the constructs of stability, vividness, and coherence were used in the literature, I used my own labels (permanence, richness, and integration) to capture the patterns in my data.

³How Novo Nordisk intends to think and act is described in the charter, which describes Novo Nordisk's values, commitments, and fundamentals—the basic management principles also known as the Novo Way of Management. Novo Nordisk has adopted the charter for companies in the Novo Group and commits itself to act inside this framework. Companies in the Novo Group use five specific follow-up methods to provide ongoing systematic and validated documentation of their performance regarding the group criteria and the NWM: (1) financial follow-up and reporting, (2) environmental and social reporting, (3) organizational audit, (4) facilitations, and (5) succession management. Due to space limitations, I am addressing in detail only facilitations in this paper. Stakeholder Relations is a separate department and is not directly part of the NWM, although both initiatives help Novo Nordisk spot weak cues of trouble. For more detail on the NWM and Stakeholder Relations, please visit www.novonordisk.com, and read the cases by Kamper et al. (1999) and Schultz et al. (2004).

References

- Achilladelis, B., N. Antonakis. 2001. The dynamics of technological innovation: The case of the pharmaceutical industry. *Res. Policy* **20** 535–588.
- Ansoff, I. 1975. Managing strategic surprise by response to weak signals. *California Management J.* **18** 21–33.
- Ansoff, I., E. McDonnell. 1990. *Implanting Strategic Management*. Prentice Hall, New York.
- Argote, L., H. R. Greve. 2007. A behavioural theory of the firm—40 years and counting: Introduction and impact. *Organ. Sci.* **18** 337–349.
- Ashby, W. R. 1958. Requisite variety and its implications for the control of complex systems. *Cybernetica* **1** 83–99.
- Barnett, M. L. 2008. An attention-based view of real options reasoning. *Acad. Management Rev.* **33** 605–628.
- Baum, J. A. C., K. B. Dahlin. 2007. Aspiration performance and railroads' patterns of learning from train wrecks and crashes. *Organ. Sci.* **18** 368–385.
- Bechky, B. A. 2003. Sharing meaning across occupational communities: The transformation of understanding on a production floor. *Organ. Sci.* **14** 312–330.
- Bouquet, C., J. Birkinshaw. 2008. Weight versus voice: How foreign subsidiaries gain attention from corporate headquarters. *Acad. Management J.* **51** 577–601.
- Carley, K. M., J. L. Harrald. 1997. Organizational learning under fire. *Amer. Behav. Scientist* **40** 310–332.
- Cohen, M. D., J. G. March, J. P. Olsen. 1972. A garbage can model of organizational choice. *Admin. Sci. Quart.* **17** 1–25.
- Corley, K. G., D. A. Gioia. 2004. Identity ambiguity and change in the wake of a corporate spin-off. *Admin. Sci. Quart.* **49** 173–208.
- Cyert, R. M., J. G. March. 1963. *A Behavioral Theory of the Firm*. Basil Blackwell, Cambridge, MA.
- Cunha, M. P., S. R. Clegg, K. Kamoche. 2006. Surprises in management and organizations: Concept, sources and a typology. *British J. Management* **17** 317–329.
- Dillon, R. L., C. H. Tinsley. 2008. How near-misses influence decision making under risk: A missed opportunity for learning. *Management Sci.* **54** 1425–1440.
- Dunbar, R. L. M., W. H. Starbuck. 2006. Learning to design organizations and learning from designing them. *Organ. Sci.* **17** 171–178.
- Dutton, J. E. 1993. Interpretation on automatic: A different view of issue diagnosis. *J. Management Stud.* **30** 340–357.
- Dutton, J. E., S. J. Ashford. 1993. Selling issues to top management. *Acad. Management Rev.* **18** 397–428.
- Dutton, J. E., S. Ashford, R. M. O'Neill, K. A. Lawrence. 2001. Moves that matter: Issue selling and organizational change. *Acad. Management J.* **44** 716–736.
- Edmondson, A. C., R. M. Bohmer, G. P. Pisano. 2001. Disrupted routines: Team learning and new technology implementation in hospitals. *Admin. Sci. Quart.* **46** 685–716.
- Galambos, L., J. L. Sturchio. 1998. Pharmaceutical firms and the transition to biotechnology: A study in strategic innovation. *Bus. Hist. Rev.* **72** 250–278.
- Gavetti, G. 2005. Cognition and hierarchy: Rethinking the microfoundations of capability development. *Organ. Sci.* **16** 599–617.
- Gavetti, G., D. Levinthal, W. Ocasio. 2007. Neo-Carnegie: The Carnegie school's past, present, and reconstructing for the future. *Organ. Sci.* **18** 523–536.

- Glaser, B. G., A. L. Strauss. 1967. *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Aldine, Chicago.
- Greve, H. R. 2008. A behavioral theory of firm growth: Sequential attention to size and performance goals. *Acad. Management J.* **51** 476–494.
- Gulick, L. 1996. Notes on the theory of organization. J. M. Shafritz, J. S. Ott, eds. *Classic of Organization Theory*, 4th ed. Wadsworth, Belmont, CA.
- Haeckel, S. H. 2004. Peripheral vision: Sensing and acting on weak signals. *Long Range Planning* **37** 181–189.
- Hansen, M. T., M. R. Haas. 2001. Competing for attention in knowledge markets: Electronic document dissemination in a management consulting company. *Admin. Sci. Quart.* **46** 1–28.
- Hirshman, A. O. 1970. *Exit, Voice and Loyalty: Responses to Decline in Firms, Organizations and States*. Harvard University Press, Cambridge, MA.
- Hoffman, A. J., W. Ocasio. 2001. Not all events are attended equally: Toward a middle-range theory of industry attention to external events. *Organ. Sci.* **12** 414–434.
- Huber, G. P. 1991. Organizational learning: The contributing processes and the literatures. *Organ. Sci.* **2** 88–115.
- Huckman, R. S., D. E. Zinner. 2008. Does focus improve operational performance? Lessons from the management of clinical trials. *Strategic Management J.* **29** 173–193.
- Jacobsen, K. 2000. *Mads@novo.dk*. Gyldendal, Copenhagen.
- James, W. 1982. *The Principles of Psychology*. Harvard University Press, Cambridge, MA.
- Janis, I. 1972. *Groupthink*, 2nd ed. Houghton Mifflin, Boston.
- Jick, T. D. 1979. Mixing qualitative and quantitative methods: Triangulation in action. *Admin. Sci. Quart.* **24** 602–611.
- Jones, B. D., F. R. Baumgartner. 2005. *The Politics of Attention: How Government Prioritizes Problems*. University of Chicago Press, Chicago.
- Julian, S. D., J. C. Oforn-Dankwa. 2008. Towards an integrative cartography of two strategic issue diagnosis frameworks. *Strategic Management J.* **29** 93–114.
- Kamper, A., J. Podolny, J. Roberts. 1999. Novo Nordisk (A)—Global coordination. Case IB-20A, Stanford Graduate School of Business, Stanford University, Stanford, CA.
- Lampel, J., Z. Shapira. 2001. Judgmental errors, interactive norms, and the difficulty of detecting strategic surprises. *Organ. Sci.* **12** 599–611.
- Law, K. S., C. S. Wong, W. H. Mobley. 1998. Toward a taxonomy of multidimensional constructs. *Acad. Management Rev.* **23** 741–755.
- Lawrence, P. R., J. W. Lorsch. 1967. *Organization and Environment, Managing Differentiation and Integration*. Harvard University Press, Cambridge, MA.
- Levinthal, D. A., J. G. March. 1993. The myopia of learning. *Strategic Management J.* **14** 95–112.
- Levinthal, D. A., C. Rerup. 2006. Crossing an apparent chasm: Bridging mindful and less mindful perspectives on organizational learning. *Organ. Sci.* **17** 502–513.
- Madsen, P., V. Desai, K. Roberta, D. Wong. 2006. Mitigating hazards through continuing design: The birth and evolution of a pediatric intensive care unit. *Organ. Sci.* **17** 171–178.
- March, J. G., H. Simon. 1958. *Organizations*. Wiley, New York.
- Marcus, A. A., M. L. Nichols. 1999. On the edge: Heeding the warning of unusual events. *Organ. Sci.* **10** 482–499.
- Martin, J. 1992. *Organizational Culture: Mapping the Terrain*. Sage, Thousand Oaks, CA.
- Mathieu, M. 2000. *New Drug Development: A Regulatory Overview*. Parexel International Publishers, Waltham, MA.
- McMullen, J. S., D. A. Shepherd, H. Patzelt. 2009. Managerial (In)attention to competitive threats. *J. Management Stud.* **46** 157–181.
- Michel, A. A. 2007. A distributed cognition perspective on newcomers' change process: The management of cognitive uncertainty in two investment banks. *Admin. Sci. Quart.* **52** 507–557.
- Miles, M. B., M. Huberman. 1994. *Qualitative Data Analysis*, 2nd ed. Sage Publications, Thousand Oaks, CA.
- Miller, D. 1993. The architecture of simplicity. *Acad. Management Rev.* **18** 116–138.
- Morrison, E. W., F. J. Milliken. 2000. Organizational silence: A barrier to change and development in a pluralistic world. *Acad. Management J.* **25** 706–725.
- Morrison, E. W., C. C. Phelps. 1999. Taking charge at work: Extrarole efforts to initiate workplace change. *Acad. Management J.* **42** 403–419.
- Nag, R., K. G. Corley, D. A. Gioia. 2007. The intersection of organizational identity, knowledge, and practice: Attempting strategic change via knowledge grafting. *Acad. Management J.* **50** 821–847.
- Nemeth, C., K. Brown, J. Rogers. 2001. Devil's advocate versus authentic dissent: Stimulating quality and quantity. *Eur. J. Soc. Psych.* **31** 707–720.
- Nystrom, P. C., W. H. Starbuck. 1984. To avoid organizational crisis, unlearn. *Organ. Dynam.* **15** 53–65.
- Ocasio, W. 1997. Towards an attention-based view of the firm. *Strategic Management J.* **18** 187–206.
- Ocasio, W., J. Joseph. 2005. An attention-based theory of strategy formulation: Linking micro- and macroperspectives in strategy process. *Adv. Strategic Management* **22** 39–61.
- Pederson, A. 1989. Spawning a new biotech giant. *Chemical Week* (January 25) 10, 13.
- Perason, C. M., J. A. Clair. 1998. Reframing crisis management. *Acad. Management Rev.* **23** 59–76.
- Posner, M. I., S. E. Petersen. 1990. The attention system of the human brain. *Annu. Rev. Neurosci.* **13** 25–42.
- Posner, M. I., M. K. Rothbart. 2007. Research on attention networks as a model for the integration of psychological science. *Annu. Rev. Psych.* **58** 1–23.
- Ramanujam, R. 2003. The effects of discontinuous change on latent errors in organizations: The moderating role of risk. *Acad. Management J.* **46** 608–617.
- Rerup, C. 2005. Learning from past experience: Footnotes on habitual entrepreneurship and mindfulness. *Scandinavian J. Management* **21** 451–472.
- Roux-Dufort, C. 2007. Is crisis management (only) a management of exceptions? *J. Contingencies Crisis Management* **15** 105–114.
- Salvato, C. 2009. Capabilities unveiled. The role of ordinary activities in the evolution of product development processes. *Organ. Sci.* **20**(2) 384–409.
- Schultz, M., J. R. Rubin, M. J. Hatch. 2004. Novo Nordisk: Focusing the corporate brand. Case UVA-BC-0192, Darden School of Business, University of Virginia, Charlottesville.

- Sheaffer, Z., B. Richardson, Z. Rosenblatt. 1998. Early-warning-signals management: A lesson from the Barings crisis. *J. Contingencies Crisis Management* **6** 1–22.
- Siggelkow, N. 2002. Evolution towards fit. *Admin. Sci. Quart.* **47** 125–159.
- Simon, H. A. 1947. *Administrative Behavior: A Study of Decision Making Processes in Administrative Organizations*. MacMillan, Chicago.
- Snook, S. A. 2000. *Friendly Fire: The Accidental Shootdown of U.S. Black Hawks over Northern Iraq*. Princeton University Press, Princeton, NJ.
- Strauss, A., J. Corbin. 1990. *Basics of Qualitative Research. Grounded Theory Procedures and Techniques*. Sage Publications, Newbury Park, CA.
- Sutcliffe, K. M., K. E. Weick. 2008. Information overload revisited. G. P. Hodgkinson, W. H. Starbuck, eds. *Handbook of Organizational Decision Making*. Oxford University Press, Oxford, UK, 56–75.
- Tangirala, S., R. Ramanujam. 2008. Exploring non-linearity in employee voice: The effects of personal control and organizational identification. *Acad. Management J.* **51** 1189–1203.
- Turner, B. A. 1976. The organizational and interorganizational development of disaster. *Admin. Sci. Quart.* **21** 378–397.
- Vaughan, D. 1996. *The Challenger Launch Decision*. The University of Chicago Press, Chicago.
- Vogus, T. J., K. M. Sutcliffe. 2007. The safety organizing scale: Development and validation of a behavioral measure of safety culture in hospital nursing units. *Medical Care* **45** 46–54.
- Weick, K. E. 1979. *The Social Psychology of Organizing*, 2nd ed. McGraw-Hill, New York.
- Weick, K. E. 1984. Small wins. Redefining the scale of social problems. *Amer. Psychologist* **39** 40–49.
- Weick, K. E. 1995. *Sensemaking in Organizations*. Sage, Thousand Oaks, CA.
- Weick, K. E. 2007. The generative properties of richness. *Acad. Management J.* **50** 14–19.
- Weick, K. E., K. M. Sutcliffe. 2006. Mindfulness and the quality of organizational attention. *Organ. Sci.* **17** 514–524.
- Weick, K. E., K. M. Sutcliffe. 2007. *Managing the Unexpected*, 2nd ed. Jossey-Bass, San Francisco.
- Weick, K. E., K. M. Sutcliffe, D. Obstfeld. 1999. Organizing for high reliability: Processes of collective mindfulness. *Res. Organ. Behav.* **21** 81–123.
- Yu, J., R. M. Engleman, A. H. Van de Ven. 2005. The integration journey: An attention-based view of the merger and acquisition integration process. *Organ. Stud.* **26** 1501–1528.
- Zhao, B., F. Olivera. 2006. Error reporting in organizations. *Acad. Management Rev.* **31** 1012–1030.

Copyright 2009, by INFORMS, all rights reserved. Copyright of *Organization Science: A Journal of the Institute of Management Sciences* is the property of INFORMS: Institute for Operations Research and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.