Managerial Response to Changing Environments: Perspectives on Problem Sensing from Social Cognition

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This paper characterizes managerial problem sensing, a necessary precondition for managerial activity directed toward organizational adaptation, as composed of noticing, interpreting, and incorporating stimuli. It then reviews the constituent social cognition processes that make certain kinds of problem-sensing behavior, including errors, relatively likely to occur. Implications for the organizational issues of crisis, chance events, break points, and extreme change are explored.

May you live in interesting times
Ancient Chinese curse

Upheavals in the social environment, such as dramatic changes in labor markets, severe dislocations in factors of production, or sudden shifts in the ethnic makeup of an area population, require extraordinary adaptive responses on the part of organizations. Because decision makers and managers are charged with formulating, directing, coordinating, and managing the organization's response to rapid environmental change, they have been important subjects in many analyses of adaptation (Stinchcombe, 1965; Nelson and Winter, 1974; Aldrich, 1979). A crucial component of managerial behavior in rapidly changing environments is problem sensing, the cognitive processes of noticing and constructing meaning about environmental change so that organizations can take action. Recent analyses of organizational decision making under crisis have called for an improved understanding of the cognitive processes of managers (Hall, 1976: 210; Smart and Vertinsky, 1977: 640). Recent research on social cognition has begun to provide that understanding by revealing processes and outcomes relevant to how managers analyze a changing environment.

This paper outlines research on social cognition and suggests how it can be used to understand and predict managerial problem sensing. The focus is on individual behavior over relatively short periods (i.e., weeks and months). Throughout the paper, we draw examples from the energy domain, since organizational adaptation to changes in energy production and consumption is an extremely important current policy topic and, thus, studies of adaptation to changes in energy supply and demand are readily available (Stobaugh and Yergin, 1979; Koreisha and Stobaugh, 1979). Most analyses to date, however, have failed to consider explicitly how patterns of individual thinking and memory influence organizational variables and processes in adaptive behavior. By example, we hope to illustrate their importance in this domain.

THE PROCESS OF PROBLEM SENSING

Although behavior that solves problems need not always be preceded by problem-sensing behavior (March and Olsen, 1976), intentional problem solving depends on some awareness of the problem to be solved. In previous work on organizational problem sensing, researchers have attempted to understand when problems are noticed and why problems go unnoticed. Most work on the circumstances under which problems are noticed focuses on aspiration-level triggers, that is those points at which circumstances fall below some level defined as satisfactory or acceptable. Work on aspiration-level triggers,

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growing primarily out of analyses of resource-allocation behavior (Cyert and March, 1963; Crecine, 1969; Larkey, 1979), has postulated that managers evaluate stimuli against internal performance or aspiration criteria, such as market share, return on investment, last year's sales, last year's budget, or last year's energy supplies (Pound, 1969; Hall, 1976; Billings, Milburn, and Shaalman, 1980). If the comparison implies results equal to or better than the aspiration level, then no problem exists. If the comparison indicates results worse than the aspiration level, a problem exists and problem-solving behavior will begin (see Figure 1).

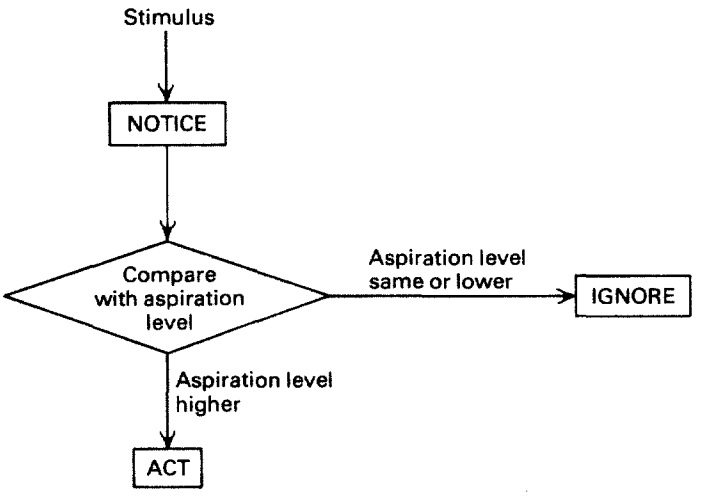

Figure 1. Aspiration-level-trigger problem sensing.

In aspiration-level formulations, relevant stimuli are well defined and easily noticed; their interpretation is relatively straightforward (historical criteria dominate) and they are incorporated, as received, into organizational expectations. Because these characteristics of aspiration-level processing are predictable, they comprise what we call routine problem sensing. Their operation is not necessarily perfect, however. Stimuli can be misinterpreted; historical criteria can become obsolete; expectations can be misleading. Analyses of detection failures have focused on national security (Wohlstetter, 1963; Allison, 1971; Shlaim, 1976), physical disasters (Fritz, 1967; Dynes, 1970; Turner, 1976; Dynes et al. 1979; Perrow, 1981), and organizational crisis (Hall, 1976; Sproull, Weiner, and Wolf, 1978; Starbuck, Greve, and Hedberg, 1978). In these situations, managers either fail to notice or misinterpret available information about the existence of a problem (see Figure 2).

Most work on the circumstances under which problems go unnoticed focuses on detection errors, usually explained by "signal-to-noise ratio" arguments. That is, although relevant information indicating that there is a problem is available to managers, other information has a stronger signal and therefore obscures either the existence or meaning of the relevant information. Here both noticing and interpreting are the main barriers to effective problem sensing.

In both aspiration-level and detection error formulations, managerial cognitive processes are central. Problem sensing is

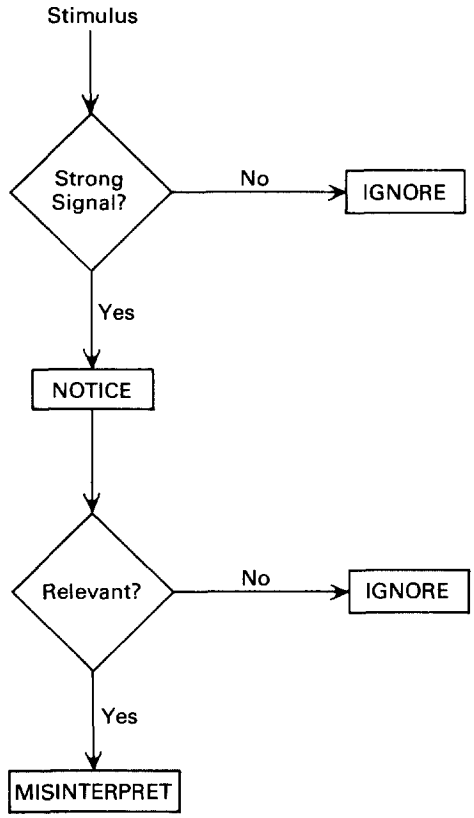

Figure 2. Detection errors in problem sensing.

composed of three cognitive processes: noticing, interpreting, and incorporating stimuli. In noticing stimuli, managers must distinguish potentially problematic stimuli from the myriad stimuli available to them. Organizational variables relevant here are those that relate to the channeling of available stimuli to the manager from which he selects a subset; examples of such variables are environment-scanning procedures (Keegan, 1974) and structural differentiation (Lawrence and Lorsch, 1969). In interpreting stimuli, managers must construct meaning for, or assign meaning to, the stimuli. Organizational variables relevant here are those that influence interpretation — for example, goals, policies, and strategies (Kaufman, 1963), and response repertoires (March and Simon, 1958). In incorporating stimuli, managers must remember or retain the interpreted stimuli and associate them with other relevant cognitions. In organizations, variables relevant to the incorporation of stimuli influence the difficulty or ease of information storage and organizational memory; examples of such variables are organizational age and size, institutionalization of control structure, and beliefs and information systems (Zucker, 1977; Markus, 1980). Noticing, interpreting, and incorporating stimuli are necessary and prior conditions for problem solving to occur.

Although previous work in problem sensing has contributed to our understanding of these three processes, it is limited in its conception both of stimulus and interpretation. Work on detection errors assumes that the quality of "problemness" is inherent in the stimulus; errors result from not attending to these innate qualities in a timely fashion. The work done on aspiration-level triggers, on the other hand, assumes that

problemness depends more on the state of the perceiver than on anything inherent in the stimulus. While work on aspiration-level triggers accords importance to perceiver aspirations, it underemphasizes the perceiver's capacity to notice stimuli in the first place. The appearance and salience of stimuli are taken for granted only across a narrow domain of topics. A more general theory of problem sensing should encompass a broader view of both stimulus and its representation by managers.

Four simple ideas emerge as the conventional wisdom on problem sensing. They continually appear in explanations of failures and in advice on how to improve. In order to improve problem sensing, it is argued, individuals or organizations should (1) learn from experience, (2) plan, (3) increase the speed with which managers receive information, and (4) increase the range of information managers receive.

Learning from experience. Managers who have learned from their past mistakes are able to avoid similar ones in the future by recognizing conditions similar to those that led to the past mistakes and by taking corrective action. Similarly, managers who have learned from their past successes are able to capitalize on similar conditions in the future. Belief in the virtue of learning from experience is embodied in executive searches for experienced management and in boards-of-inquiry or fact-finding commissions and hearings.

Planning. Planning improves problem sensing because it provides clear criteria against which potential deviation can be measured. By providing milestones or targets, planning makes it possible to notice and correct minor problems before they turn into major ones.

Increasing information speed. If managers receive information sooner, they can sense problems sooner; thus they have more time in which to correct them. Managers themselves often embody this belief in their preference for "live action" (Mintzberg, 1973) and informal channels of communication (Keegan, 1974).

Increasing information range. If managers receive a wider range of information, they are potentially able to spot problems they would miss if their vision were narrower. Proposals to increase the range of information managers consider, such as multiple advocacy (George, 1972) or dialectic planning (Mitroff and Emshoff, 1979), are based on this assumption.

Like all conventional wisdom, these ideas have some merit. But as a result of predictable processes of social cognition, there are times when each of them leads to sensing problems later rather than sooner, slower rather than faster, superficially rather than seriously, and erroneously rather than correctly.

Failing to notice a problem stimulus or misinterpreting a problem stimulus as nonproblematic are the failure modes identified in previous work. But other failures can also occur. Managers can needlessly define a situation as a problem, ministerpreting a nonproblematic stimulus as problematic. They can also misinterpret the causes of a correctly identified problem stimulus, which could potentially lead to fruitless or damaging action. Also, with multiple problem stimuli, managers may remember and learn from spurious relationships among stimuli. The work on social cognition reviewed in the next section both amplifies

each of the three major subprocesses in problem sensing and suggests ways in which errors can occur.

THEORIES OF SOCIAL COGNITION

All theories of social cognition share two main assumptions about the nature of human information processing. The first is that individuals have a limited capacity to deal with all the information in their environments and to process what they do perceive (Miller, 1956; Simon, 1957). The ability to notice and interpret information varies with learning and innate capabilities, with social pressures, and with the technical limits of the information search. The second assumption is that cognitive processes — perceiving, encoding, storing, retrieving, and inferring — lie along a continuum of requirements for attention, effort, and higher order mental activity (Kahneman, 1973; Norman, 1976). At one end of the continuum there are such relatively automatic processes as perceiving spatial relations. At the other end are such highly sophisticated processes as using a mnemonic device to remember names of committee members. Automatic processes are relatively unaffected by environmental or organismic conditions, while effortful processes are greatly influenced by such conditions as personal intention, learning, and social influence.

Three distinct theoretical approaches to social cognition are currently under active investigation. Social perception emphasizes how people encode information and use it in explanations. Information processing emphasizes the organization of information in memory, and the third approach is actually a set of theories about motivation that makes predictions that bear on how people think about their environments.

Social Perception

According to social perception theories, perception is a process in which the perceiver constructs reality by performing cognitive operations on cues derived from the environment (Brunswick, 1952; Heider, 1958; Kelley, 1973). Among the ideas stimulated by this theoretical framework are those dealing with the active construction of cause-effect relations. In these processes, individuals may over-, under-, or mis-estimate the importance of particular environmental features as causal agents.

Five concepts dominate social perception theories: the augmentation principle, the discounting principle, illusory correlation, illusory causation, and automatic scanning.

The augmentation principle. This principle says that "If, for a given effect, both a plausible *inhibitory* cause and a plausible *facilitative* cause are present, the role of the facilitative cause in producing the effect will be judged greater than if it alone were present" (Kelley, 1971: 12). This principle suggests, for example, that if *X* event occurs in spite of strong efforts to counter it, then the strength of the facilitative cause of *X* will seem greater. Because both inhibitory and facilitative causes are usually present in situations to which decision makers attend, decision makers will tend to overestimate the influence of a plausible causal agent. For example, if a disruption of one's oil deliveries occurs despite strong preventive measures, then the possible cause of the disruption — political mistakes in Washington, competitors' violation of implicit agreements, or

deliberate price fixing by suppliers — will seem all the more credible and powerful.

The discounting principle. This principle suggests that if one powerful facilitative cause is present, other plausible causes will seem less influential (Kelley, 1971). This principle assumes that decision makers will try to account for events in their environment by taking possible causes into account, but they will focus on the most powerful. For instance, if gasoline lines form, seemingly in response to strong external forces such as a disruption of foreign oil deliveries, alternative causes of the gas lines, such as anticipatory hoarding by domestic oil companies, will tend to be discounted. Also, behavior that reflects multi-caused long-term trends, such as driving smaller cars, will tend to be attributed to the single, immediate, powerful causal agent (foreign oil shortages) rather than to the many, longer term, less obvious causes of the behavior.

Illusory correlation. Illusory correlation refers to perceiving or inferring events as correlated due to their fortuitous associative pairing, their mutual infrequent occurrence, or some other attentional mechanism (Hamilton and Gifford, 1976). Pairs of events that are nominally similar, catastrophic, negative, intense, or unexpected are candidates for illusory correlation. Psychologically spurious correlations may derive from the fact that pieces of information are processed and stored in convenient (efficient) chunks. When events are fortuitously linked, the association is stored and is retrieved either as a "fact" or as plausible evidence of correlation (Crocker, 1981). For example, prosecutions for profiteering in the gas industry may seem correlated with prosecutions for political corruption because both involve the justice system. Warring in the Middle East may appear correlated with inflation because both are unpleasant. Subsidies for solar energy may seem correlated with its price because both trends are discussed at the same meeting.

Illusory causation. Illusory causation refers to the premature or inappropriate inference of causality through false association of events. Individuals, groups, organizations, and societal events that are salient and draw attention are viewed as causal. What draws attention? Examples are an organization that we are instructed to monitor, a prominent official, an issue that hits the front pages, minority representatives in a committee, victims of misfortune, firms whose geographic location is unusual (e.g., McArthur and Post, 1977; Taylor and Fiske, 1978). In each instance, people or events that are salient capture attention and appear to be causal even if they are not. Since we observe others' behavior more readily than we do our own, others seem more causal than we ourselves do (Jones and Davis, 1965; Jones and Nisbett, 1971). According to this actor-observer attributional bias, managers observing other managers may perceive them as more effective than these others think themselves to be. By the same process, managerial behaviors that managers themselves consider innocuous might be viewed by others as highly controlling. Another aspect of illusory social causation is the "fundamental attribution error" (Ross, 1977). This bias is the tendency to attribute dispositional causes to others' behavior — we think they behave in a particular way because of their character, or attitudes, or wishes, and not because of the situation in which they find themselves (e.g., Jones et al., 1971; Miller, 1976).

People use illusory social causation in attributing causality to events as well as to people. Events that are "available" in memory may exemplify illusory causes that do not really exist. A colorful anecdote about a neighbor's attempt to insulate his house, for instance, will seem to provide evidence about homeowners and energy conservation. Further, the anecdote about the neighbor may seem to be a more effective heuristic for thinking about trends in energy conservation than is statistical data based on hundreds of people. In spite of evidence that homeowners are generally not insulating their houses and are not responsible for the decline in energy demand in buildings, the anecdote leaves a strong impression to the contrary.

In addition to the salience of information, its recency also affects interpretation. The information on which we base our explanations of the world is often limited to that most recently acquired or used (Wyer, 1980). The impact of the recency effect on perceptions of causality has implications for managers' judgments of change. Decision makers' use of certain concepts to interpret ambiguous information (scarcities of a factor of production, for example) may be the result of fortuitous events that led these concepts to be used just previously, even if their use was unrelated to the new purposes to which the information is being applied (Higgins and King, 1981). Further, once judgment is made concerning the causes of events, this judgment is used as a basis for later judgments, independent of the information on which the judgments were originally based (e.g., Lingle and Ostrom, 1979).

While researchers using attribution theories assume that perceived events are "analyzed" for causality according to particular variations (e.g., degree of distinctiveness, consensus, and consistency, Major, 1980), a different model of social perception, prompted by Gibson's (1966, 1979) theory of object perception, assumes that people actively detect environmental invariants rather than rely solely on inferences about environmental variation to understand their environment (McArthur, 1980). The decision of a builder to begin constructing solar housing, for example, would involve active search for contextual information, such as the financial position of other solar builders. The builder, however, is likely to notice more than is actually meaningful, for example, that other solar builders went to the same college. Such coincidences of history lead him to reason by analogy (e.g., others' investment strategies are assumed to be similar because they went to the same college) and increase his own confidence in his judgment based on the analogy (Gilovich, 1981). Basing judgment on spurious associations may seem foolish, but Gibsonians argue that perceiving irrelevant and incidental analogies and similarities in one's environment is equivalent to detecting important environmental rewards and dangers.

Whether normatively appropriate or not, reasoning by analogy and similarity is very common, especially when potential associations are easily brought to mind (Tversky and Kahneman, 1973; Higgins, Rholes, and Jones, 1977). A colleague's experiences with installing a solar collector, for example, may have more influence on one's attitude toward solar energy than less vividly remembered statistics on current marginal costs and benefits of solar investments. The extent to which some feature of the current situation appears to resemble events

from the past also determines associative thinking (Kahneman and Tversky, 1972). Hearing the disruption of oil deliveries from the Middle East described as a violation of a nonaggression pact calls to mind World War II and the need for intervention. Hearing the same disruption described in terms of a CIA-revealed guerrilla strike reminds one of Vietnam and the desirability of uninvolvement (for laboratory evidence, see Gilovich, 1981).

Automatic scanning. Individuals gather information about environmental cues automatically and by directed search. In directed search, they have intentions or objectives, exert effort, follow learned patterns, improve with practice, and deteriorate under high stress. Automatic scanning, on the other hand, is a direct perceptual process of which people are not aware. In automatic scanning, individuals continuously receive and encode certain aspects of situations to which their attention is directed; the process is relatively unaffected by intention, effort, learning, practice, or arousal (Hasher and Zacks, 1979). Among the features of situations that are automatically noticed are the frequency of events, the spatial characteristics of physical and social settings, time, word associations, segmentation into units of behavior, and associative pairing of traits and events (e.g., Newtson, 1980).

Much has been said about directed search in organizations, but the implications of automatic scanning have not been studied. Automatic scanning nevertheless involves the processing of factors important to managerial problem sensing, such as frequency and timing of events. These automatically processed data will influence inferential thinking, even though inferential thinking is itself a directed, effortful process. To illustrate, suppose a manager hears it said that there are 500,000 solar swimming pools in California. The frequency with which the opinion is heard is processed automatically, and the manager's certainty that the assertion is true increases along with increases in the frequency of occasions the assertion is made (e.g., Hasher, Goldstein, and Toppino, 1977). This certainty would influence the manager's estimate of the importance of solar development and, therefore, is not a trivial outcome.

Another example of the effect of automatic scanning on noticing may be derived from studies of the way people assign individual and group behavior to stereotypes. A consistent finding is that the matching process involved in categorizing people is highly constricted and dominated by "primacy," that is, as soon as salient characteristics of the observed persons or groups match key features of a currently active category of persons or groups, search and encoding essentially stops (Jones et al., 1968). Automatically (and without intention), the new persons or groups are "assigned" to the first meaningful framework. Experience with the new persons or groups will then be interpreted within the framework of the stereotypic categories to which they have been assigned, and the behavior of the perceiver will follow from implications of the discovered framework. Much may hang on fortuitous associations of information, people, and stereotypes. DeLorean (Wright, 1979) says of his experience in General Motors that many good suggestions regarding small cars, pollution controls, safety belts, standardization, and quality control were rejected by executives because they were initially associated with the

"wrong" groups — dealers, suppliers, engineers, and other outsiders to the higher administration.

Research based on social perception models suggests four major propositions on how managers process information about rapidly changing social environments.

Proposition 1. When managers actively infer causality, exaggeration and mono-causal reasoning will dominate their analyses.

Proposition 2. When managers infer causality, then environmental changes, rather than the actions of the managers' organizations, will appear causal.

Proposition 3. When managers infer causality, then vivid events and fortuitous associations will overcontribute to causal explanations of environmental change.

Proposition 4. Automatic search will influence causal inference based on the salience and frequency of events.

Information Processing

Information-processing theories of social cognition (e.g., Nisbett and Ross, 1980) are built on a base of experimental research on verbal learning, memory, and problem solving. They all assume that a person operates on representations of the world that exist in the mind. Their emphasis is on the steps that follow perception: encoding, representation and organization of encoded material, memory, and retrieval. The steps are sequential and dependent on one another.

Given the limited capacity of human beings to deal with all of the information in their environment, encoding must be a selection task. But selection is not a process of arbitrarily picking and choosing among all available information. Rather, people attend to and encode salient material — events that are unpleasant, deviant, extreme, intense, unusual, sudden, brightly lit, colorful, alone, or sharply drawn. In the world of organizations, salient information includes unanticipated drains on cash flow, new taxes and regulations (unpleasant information), predictions of best and worst outcomes (extreme information), disruptions of routine and emergencies (intense, unusual, sudden information), and publicity and iconoclastic executives (colorful information). The behavior and outcomes of competitors, of course, are sharply drawn — a figure against ground. In addition to their positive impact on selective attention and encoding, salient events are stored prominently in memory and so are relatively easy to retrieve; that is, they are "available" (Tversky and Kahneman, 1973). Salient events also have impacts on memory because they can be imagined (Carroll, 1978), are susceptible to explanation (Ross, Lepper, and Hubbard, 1975), elaboration (Loftus, 1979), hypothesis confirmation (Snyder and Swann, 1978), and innuendo (Wyer and Srull, 1981). In sum, salient information has greater weight in the determination of what is remembered and how well organized it is.

In addition, because of the limited capacity of individuals to deal with information, information that can be embedded into existing, heavily organized, and interconnected knowledge structures has greater weight (Taylor and Crocker, 1980). Information demanding attention, that is, salient information, will be incorporated into organized knowledge structures and long-term memory if it seems relevant to those structures (e.g., Rothbart, Evans, and Fulero, 1979; Cohen, 1981). If the infor-

mation is too discrepant, it will be discounted or forgotten. This joint effect of salience and relevance leads to the prediction that decision makers will best incorporate information that is discrepant enough to capture attention but not so discrepant as to seem irrelevant.

In information-processing models, knowledge of prior behavior and expectations about behavior are organized in abstract structures called schemas, scripts, or stereotypes (Langer and Abelson, 1972; Hayes-Roth, 1977; Langer, Blank, and Chanowitz, 1978; Bower, Black, and Turner, 1979; Graesser et al., 1980). These knowledge structures are the constructs against which new information is tested for relevance (Fiske and Linville, 1980; Fiske, 1982). The knowledge structures, as we noted elsewhere (Sproull, Kiesler, and Zubrow, 1981) cause certain material to be more salient than other material so that it is highlighted in memory and inference. These structures can cause erroneous recalling of schema-relevant details that did not in fact occur and erroneous reordering of events so that they are recalled in a schema-consistent ordering even though they were presented out of order.

Moreover, associative thinking leads to expectations that are both well organized and resistant to new evidence. Incidental observations of similarity activate organized knowledge structures (Abelson, 1976; Cantor and Mischel, 1977; Taylor and Crocker, 1980) through which people "understand" the associated events to be predictable and meaningful. Observed or threatened price increases fit into the "inflation" schema; people who support fuel-cost subsidies to welfare recipients fit the "liberal" prototype; arguments against increased coal production are from an "environmentalist" script. These schematic processes tend to be all or nothing affairs: when a decision maker applies the inflation schema to a given situation, unknown aspects of the situation (such as the true rate of productivity) are automatically filled in by the schema, although not necessarily accurately so (Bruner, 1957; Bower, Black, and Turner, 1979; Graesser et al., 1980).

Schema-based expectations affect the judgment, memory, and use of new information (e.g., Feldman-Summers and Kiesler, 1974; Taylor and Jaggi, 1974; Kassin, 1979). For example, if a decision maker expects to find thieves among the oil companies, the companies he judges dishonest will be remembered as having more thief-consistent attributes (e.g., secrecy) and fewer thief-inconsistent characteristics (e.g., philanthropy) than would be the case without the prior expectation. Also, he will use the stereotype to infer characteristics of the observed organizations that were not given in the information on which the judgment was based (e.g., the dishonest firms are thought to be politically connected).

Research based on information-processing models suggests three major propositions for managerial information processing with respect to rapidly changing social environments.

Proposition 5. Managers operate on mental representations of the world, and those representations are likely to be of historical environments rather than of current ones.

Proposition 6. Since managers best incorporate information that is mildly discrepant, major environmental changes are unlikely to be incorporated.

Proposition 7. Only if managers develop schemas for extreme environmental change will they be likely to incorporate extreme environmental events.

Social Motivation

Whereas social perception and information-processing theories both focus on relatively neutral information, social motivation theories focus on personally enhancing information. These theories begin with the idea that decision makers have strong goals, motives, preferences, drives, and needs. For these decision makers, information serves two main purposes: it bolsters attitudes and beliefs about social reality, and it provides social or normative approval of behavior and beliefs (Deutsch and Gerard, 1955).

Decision makers' goals differ according to the various theories of social motivation. For example, in dissonance and other consistency theories, decision makers' goals relate to maintaining consistency among their images of themselves, their attitudes, and their decisions (Festinger, 1957; Aronson, 1969; Higgins, Rhodewalt, and Zanna, 1979). In equity theories, the goals are to perceive and to experience a "just" world (Lerner, 1970; Walster, Walster, and Berscheid, 1978). The function of cognitive processes is to link information with whatever the particular goals are. For example, legislators may claim that a bill favorable to strip mining is "pro-energy" and not "anti-environment," thereby enabling the legislators to maintain images friendly to environmentalist groups. Further, the legislators may seek ambiguous rather than clear information about the real implications of supporting the bill to avoid learning something about themselves that they may not wish to know (e.g., Snyder et al., 1979; Gibbons and Wright, 1981). The biases of decision makers depicted in theories of social motivation complement rather than contradict the biases of decision makers who are portrayed in theories of social cognition. Take, for example, the portfolio manager who remembers how a hunch about demographic trends led to a single good organizational decision to invest in condominiums but who forgets all the poor predictions and bad decisions. A double determination of bias is produced by the coincidence of self-interest and happiness. According to theories of social motivation, one remembers the things that make him look good in his own eyes and those of others (Weary, 1979; Swann and Read, 1981). According to theories of social cognition, one recalls the good things about events that make him happy, because they are salient (Bower, 1981).

The logic of motivationally driven social cognition applies whether motives are held only by individuals or are shared in groups. Organizations, subunits within organizations, as well as individual members of subunits, are egocentric. Members of a subunit perceive the world in ways that enhance the importance of their subunit's role in the organization (e.g., Dearborn and Simon, 1958; Lawrence and Lorsch, 1969; Bradley, 1978). They will perceive their unit as more responsible for its successes and less responsible for its failures than is truly the case. They will assign individual responsibility for success (but not failure) to themselves and to those of the group who hold high status.

Considerable evidence supports the idea that decision makers' commitments are to programs, policies, and procedures first,

and to data second (Davis and Salasin, 1975; Staw and Ross, 1978; Leviton and Hughes, 1981). U.S. auto manufacturers have been criticized for not collecting more market data during the late 1960s and early 1970s. Such data would have demonstrated the increasing popularity of small foreign cars. Motivationally driven social cognition theories would suggest that even had the information been available, executives would have either attacked its validity or ignored it because of their commitments to their own large-car programs.

Research based on social motivation suggests three general propositions for managerial information processing with respect to rapidly changing social environments.

Proposition 8. When managers encounter information about the environment that confirms their beliefs, they will believe that information is diagnostic.

Proposition 9. When managers are heavily invested in any situation, they are relatively likely to discount information about environmental changes detrimental to that situation.

Proposition 10. Only if managers are committed to operating within a rapidly changing social environment will they mentally incorporate information about extreme environmental events.

Despite differences among them, all three approaches to social cognition have something to say about people's expectations about the nature of information — its order, form, structure, and usefulness. Drawn to salient material in their environment, people consider it informative. The information, if it fits with existing beliefs, is incorporated (see Figure 3). Hence, much of what people would label as information only reaffirms old news. True information — that which alters conceptions, tests attitudes, or changes how data are used — seems in all approaches to require both some measure of inconsistency or incongruence and a good concordance with existing expectations and cognitive organization. Table 1 summarizes some of the ways in which errors can occur in mangerial problem sensing, based on the processes discussed above.

ORGANIZATIONAL IMPLICATIONS

The social cognition approaches reviewed above offer some cautions on the conventional wisdom of improving problem sensing through learning, planning, and increasing the timeliness and range of information provided to managers. Each of the approaches suggests ways in which lessons learned from prior experience can be inaccurate or biased. When managers "learn" or construct explanantions about what caused their prior experiences, any errors of attribution or motivational interpretation will make those same attributes salient in current situations. When managers remember distinctive experiences aschematically, they will be likely to overgeneralize the extent to which a few similar attributes of current situations represent close analogues of the previous distinctive experience. When managers have had a great deal of experience with certain classes of problems, their schematized view of them can cause them to "fill-in" data that are actually missing in current situations.

Each of the approaches also suggests ways in which planning can lead to problem-sensing errors. Stimuli suggesting the necessity of extreme deviation from planning targets may be

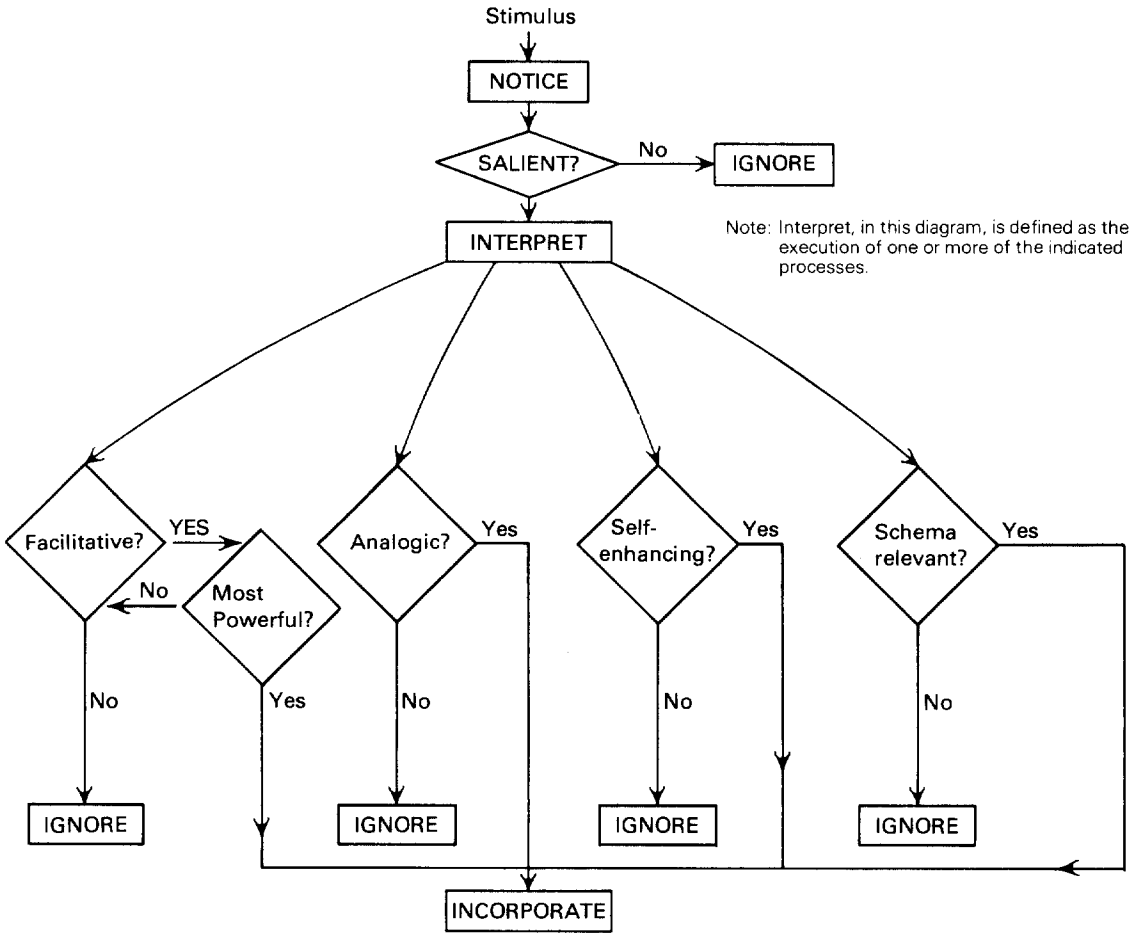

Figure 3. The process of problem sensing.

Table 1

Likely Errors in Problem Sensing

Social Perception
Illusory correlation
Assume events are correlated, that in fact are not, because they are similar.
Illusory causation
Assume events are causal, that in fact are not, because they are focus of attention.
Information processing
Gap-creating
Assume events did not occur, that in fact did, because they are schema-irrelevant.
Gap-filling
Assume events occurred, that in fact did not, because they are schema-relevant.
Ignoring overly discrepant information
Fail to code or store information that is extreme or highly surprising.
Social motivation
Preference for ambiguous information
Prefer ambiguous information to avoid self-deprecatory learning.
Preference for self-enhancing information
Fail to code or store self-deprecatory information.

ignored because they are contrary to expectations. When managers have a personal stake in the plans, they will be likely to underinterpret stimuli indicating planning failures or overin-

terpret stimuli indicating planning successes. Even without a personal stake in the plans, managers can exhibit errors of attribution in evaluating planning success or failure.

The difficulty with increasing the speed with which information reaches the manager is that primacy effects will still occur; they will just occur sooner. Information overload and errors of attribution will also occur sooner. Although there may be good noncognitive reasons for advocating more timely information, increasing the rate of information acquisition does not alter the kinds of cognitive processes discussed above.

Increasing the range of information managers receive, given total limits on capacity, can simply increase the opportunity for constructing illusory correlations, erroneous causal explanations, or false analogies.

These cautions suggest ways in which understanding of social cognition processes should temper our conventional wisdom about problem sensing. The potential effects of problem-sensing processes on behavior may be illustrated by considering how managers respond to organizational breakpoints, crisis, chance events, and extreme changes.

Organizational Breakpoints

When people gather information from the environment, they receive it as irregular chunks or segments of situations and behavior rather than as a flow of continuous events or evenly punctuated episodes. For example, X x x x x X x x x will be perceived as two chunks divided by the upper case X. Notice how salience — the upper case letter — determines the breakpoint. In life, sudden or unpredictable changes, events much reported in the press, and catastrophes are breakpoints for the perception of change. Calendar-based demarcations such as seasons and years are also breakpoints. Such breakpoints are better organized and remembered than are other, more routine, environmental occurrences. And because they are both perceived and remembered with particular clarity, they seem to cause change as well. Common breakpoints in organizations include quarterly reports, annual budgets, reorganizations, and leadership successions.

Managers' perspectives affect their punctuation of segments of behavior; segmentation then has implications for the manner in which decision makers frame problems and solutions. Salient events will be used to segment a sequence of behavioral actions and therefore to influence attributions of causality. In X x x X x x X x x, the upper case letter segments the sequence and is perceived as more likely to have "caused" the lower case than the reverse. This pattern suggests that if decision makers assume that problems precede solutions, then salient events are automatically defined as problems, whereas the lesser events following them will be perceived as derivative problems or solutions.

In situations in which attention is fortuitously directed by events, uncertainty increases information segmentation and automatic scanning. The condition occurs when ordinary information processing is interrupted by failure of an active schema, by disruption of expected environmental patterns, and by changes in the perceiver, such as those caused by stress in personal life or the taking of new roles (Greenwald and Saka-

mura, 1967; Wortman and Brehm, 1975; Bower et al., 1979; Louis, 1980; Hastie, 1981). Uncertainty causes a finer segmentation of observed behavior or events as an adaptation to the need for more information (Newtson, 1973). In other words, under uncertainty, increased information is automatically made available to the perceiver by his adjusting the level of his analysis of the environment, so that segmented units or categories are divided at more (and less obtrusive) breakpoints. Up to a point, finer units provide more detailed information for encoding and organizing in memory; however, employing more and finer units of analysis challenges the capacity of the information processer, so we would expect searching and encoding to cease earlier, or information overload will result.

The effect of uncertainty on automatic segmentation — the adjustment to smaller units — may account for the putative tendency of decision makers to overreact to detail and to early information (first impressions) when faced with an emergency. Physiological stress, environmental disruption, and unpredictability create large psychological uncertainty; segmentation is fine, and details of the situation are processed until too much information has been made available. Then, search ceases, and the decision maker ends up unable to "see the forest for the trees." The process is unconscious and decision makers would not be expected to recognize it in themselves. In fact, their attention to detail might produce the subjective impression of their having gained much useful information as well as confidence that what was learned early is sufficient for directing future action (Wilder, 1978; Newtson and Rinder, 1979; Sproull, Kiesler, and Zubrow, 1981).

Organizational Crisis

Once an emergency in the organization has been identified, it generates both information and the demand for information. This is because the emergency itself gives distinctive signals whereas the organization's on-going "problem" (disrupted standard procedures, blocked goals, emotional stress) has multiple, unclear dimensions. Salient cues from "out there" are sought and used to interpret these dimensions of the problems within. While the emergency exists because the society or organization is disrupted, decision makers may focus unduly on the immediate disrupting element — the supply cut-off, power surges, or inoperative computers.

Emergencies are distinguishing for the actors involved as well as distinctive in themselves. Crises are occasions for managers to demonstrate competence (Miller, 1980; March, 1981). "Successful" managers are expected to concentrate time and effort during emergencies, to react to conflicting information calmly, and to control or coordinate its distribution (as in containing rumors). These expectations of competence focus managers' attention on what they are doing in the "central scene" of the emergency. This focus on their performance exaggerates managers' perceived contribution to the general activity — a result that may account for the high morale often attached to emergency situations (Miller and Ross, 1975; Schlenker and Miller, 1977; Ross and Sicoly, 1979).

If managers underinterpret crises or overinterpret non-crises, as may occur if the wrong cues are salient or stimuli are antithetical to existing schemas, the response will be inappro-

priate (Fritz, 1967; Breznitz, 1976). Mistaken theories of cause and effect will also influence behavior in crises. For example, to the extent that managers attend to adverse environmental events, their interpretations of those events will be good for their consciences — they will perceive other organizations and other managers to be at fault (e.g., Orvis, Kelley, and Butler, 1976). Their interpretations, at the same time, will be bad for their flexibility of response, because they will underestimate the extent to which their own behavior contributed negatively to those events (Arkin and Duval, 1975).

Memories of past crises will tend to be aschematic and poorly remembered in terms of any organized plan, theory, or norm of the organization but well remembered in detail (such as time of day or what people said) or in terms of a "crisis" or "screw-up" schema (e.g., Loftus and Marburger, 1982). Because of the memory discordances and the absence of an appropriate, shared framework for the events that occurred, there will also tend to be arguments in the organization over what actually occurred, what was accomplished, and what applies to the situation at hand (Hastorf and Cantril, 1954; Perrow, 1981). Therefore, in the next crisis, just when there is an absence of standard procedure on which to base either predictions or behavior, there is also a deficiency of memory. This deficiency may prove helpful, however, in the common situation where no past action is relevant.

The processes described above imply that organizational decision making will be differentially effective in a crisis, depending on the extent to which decision makers are practiced in coping with similar crises. Experts do not segment events as finely as do neophytes; they focus more on general constructs and less on details (Dyer and Fiske, 1981). Therefore, although the chances of crises repeating themselves are small, expert crisis managers may deal with them more effectively.

It is sometimes claimed that managers overestimate the probability of rare catastrophic events and spend too much time planning for them, even when the costs are high. Yet according to the ideas about uncertainty described above, the unease over anticipated catastrophic events is not unfounded. While the probability of their occurrence may be overestimated, the likelihood of an individual's being able to deal with them objectively is slim. Therefore, planning for crisis may be a good idea. The plan itself may not work, but planning activities provide an opportunity for cognitive rehearsal of coping with high uncertainty. (See Thompson, 1981, for a review of the effects of cognitive control on reactions to stressful events.)

Overinterpreting Chance Events

At least one implication of overestimating the extent to which other organizations are causal (responsible for outcomes) is that decision makers may take measured actions in response to chance events that they believe were intended and caused by other organizations. Attributing each change of oil prices to political decisions by Arab states rather than to normal variability, for example, may lead to a political response (such as an agreement to sell aircraft). Attributing the same variability to intentional decisions of domestic oil firms, on the other hand, may lead to an economic response (such as selling off coal stocks).

In complex environments, attributing cause to essentially chance events reinforces ineffective probability-matching behavior — trying to anticipate rare problems rather than acting on the basis of frequent ones. The automobile firm, for example, may causally link consumer demand to fluctuating consumer interest in small or big cars and continually change model plans on that basis. However, this strategy will prove ineffective if the underlying demand is mainly based on price and quality rather than on size. Although probability matching can provide managers with a basis for demonstrating their alertness, dedication, and skill, it can also lead to overenthusiastic problem sensing and an ensuing commitment to the resulting inefficiencies.

Schemas for Extreme Change

When explanations of events are attached to behavior (through the processes of noticing and interpreting stimuli), they link the interpretations in memory with other interpretations, increase expectations of future events, and persist in influencing conclusions. The presence of factors perceived to be causally related to a given event increases the perceived likelihood of that event's occurrence (Ajzen, 1977; Silka, 1978). This perception persists even in the face of new disconfirming information. For example, when research subjects are told about false feedback they received on their performance in an experiment, they persist in believing the implications of the disconfirmed information (Ross, Lepper, and Hubbard, 1975; Anderson, Lepper, and Ross, 1980). Subtle differences in the original feedback can lead subjects to retrieve selectively subsets of their past behavior that have different implications for their attributes or attitudes (e.g., Salancik, 1974). This implies that a manager who learns that a "successful" program is actually a dreadful mistake may continue to believe the assumptions that led to the original decision. In memory, the data, assumptions, and inferences lose their essential linkage, so that disconfirming one part of a judgment (e.g., a conclusion) may have no effect on the other parts (e.g., the data on which the conclusion was based).

One of the ways to increase attention to disconfirming evidence is to develop schemas for change. If people expect and predict change, they are likely to notice its occurrence and incorporate its implications. Note that this suggestion, grounded solely in cognitive processes, is in the same spirit as that of those who encourage flexible organization design (Hedberg, Nystrom, and Starbuck, 1976; Hedberg and Jonsson, 1978). In order to take into account motivationally driven interpretation, people should be rewarded for developing schemas for extreme change that will encourage them to seek out extreme information. The U.S. corporate penchant for elaborate forecasting and planning activities discourages the development of schemas for extreme change. It concomitantly increases the likelihood that, for motivational reasons, stimuli substantially inconsistent with the forecast or plan will be ignored.

These implications, of course, are not exhaustive. They are meant simply to illustrate the views that can be developed if one does not restrict stimuli to a narrow and routine range or assume problemness to be innate in a stimulus. Table 2 suggests some organizational features that affect the cognitive processes involved in problem sensing.

Table 2

Organizational Features Affecting Aspects of Problem Sensing

Cognitive processes	Organizational features
Noticing and encoding salient material	Financial and regulatory information Forecasts of best and worst outcomes Emergencies Publicity Actions of competitors
Ignoring overly discrepant information	Planning targets Routines
Segmenting information	Organizational breakpoints: calendar-driven breakpoints (quarterly reports, annual budgets); leadership succession; reorganization
Automatic scanning	Organizational stereotypes Uncertainty
Inferring causality	Vivid organization stories and anecdotes
Incorporating schema-relevant information	Routines Corporate strategy and identity beliefs
Incorporating self-enhancing information	Past decisions Incentives structure

CONCLUSION

We have suggested that managerial problem sensing, a necessary precondition for managerial activity directed toward organizational adaptation, is composed of the macro-processes of noticing, interpreting, and incorporating stimuli. Each of these processes is composed of more micro-social-cognition processes. The social cognition processes operate in such a way as to make certain kinds of problem-sensing behavior and errors more likely to occur. They also have implications for the continued use of the conventional wisdom about the importance of learning, planning, and increasing the timeliness or range of information, as well as for a host of organizational issues, including crises, chance events, breakpoints, and extreme changes.

Two lines of research could profitably follow from what has been presented here. One is a systematic analysis of the interactions among cognitive and organizational variables. Some such interactions were mentioned at the beginning of this paper; they could provide a starting point for analysis of how organizational variables affect cognitive processes. Recent work on managers as symbol manipulators (Pondy, 1978; Pfeffer, 1981) could provide a starting point for how managerial cognitive processes affect organizational variables. Another line of research is to conduct empirical investigations of cognitive processes within organizations. The nature of the phenomena requires research methods that can capture the fine structure of noticing, interpreting, and incorporating stimuli. Hence, experiments (e.g., Martin and Powers, 1982), field experiments (e.g., Sproull, Kiesler, and Zubrow, 1981), and ethnography (e.g., Van Maanen, 1981) recommend themselves over coarser methods such as retrospective case studies or surveys.

Using examples from the energy system, we have tried to indicate how research in problem sensing would be applied. Some problems in the energy system, such as the timing of a power plant explosion, a minor shortfall in oil supplies that leads to widespread hoarding, or an assassination that destabilizes

the government of an oil-exporting nation, are unforeseeable by any analytic techniques we know (Stern, 1982). The response to such surprises may be more or less successful depending on decision makers' ability to notice, interpret, and incorporate the unexpected. Our work is intended as a caution to any who would assume that managers *of course* notice emerging problems in their environment in a timely fashion, *of course* interpret them accurately, and *of course* incorporate them into appropriate strategies for decision making. Our work is also intended as an antidote to disgusted observers of lack-of-managerial-response. Managers are not usually dim-witted. The process of problem sensing requires prodigious and predictable cognitive effort, but if we fail to understand that process, we will also fail to understand the actions based on it.

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