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A Study on the Relationships between Organizational Members' Cognitive Styles and Their Perception of Problems

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Abstract

Organizations are problem-solving systems. The solving of a problem begins when the decision maker perceives it. This study aims at proposing a general framework of problem perception and examining how organizational members' cognitive styles affect their problem perception. To verify the proposed hypotheses, the researcher conducted an on-site field study. During a period of four months, the researcher played a role of a participant observer and interviewed the company members concerning their problem perception. This study was done in a large construction company in Taiwan. The total number of interviewees were 56, including most of the company's top executives, engineers, and management staffs. The researcher then content analyzed a sample of 192 "problems" and coded them in terms of relevant variables.

The results of this study showed that intuitives are more likely to use "opportunistic" processes of problem perception than their sensing types counterpart. In other words, intuitives tend to transform an initial state to a goal state for future processes of selection. On the other hand, sensing types are more likely to use "problematic" processes of problem perception than their intuitives counterpart. In other words, sensing types tend to compare an initial state to an existing standard to look for congruence between the two.

Keywords: Cognitive Style, Problem Perception, Problem Solving Processes

Organizations, March and Simon (1958) have advised us, are problem-solving systems. That a problem first must be recognized or perceived in order for it to be solved may seem almost too obvious a proposition, as may the idea that problem-solving processes and outcomes will be importantly affected by how a problem is perceived (on these points, see, e.g., Mintzberg, Raisinghani, and Theoret, 1976; Nutt, 1984; Hunt and Magenau, 1984). Perhaps for this reason, the matters have been little studied. Most organizational (and other) studies treat "problems" and the situations in which they are embedded as if they already are well-defined (March, 1980); and, indeed, they frequently

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contrive them to be so. Analysis of problem-solving has been thereby shunted away from early problem-definition toward later choice-making processes and so has failed to facilitate an understanding of the overall nature of the phenomenon (Dery, 1984).

This study, therefore, focuses on attention, perception, and definition: on the "front-end" question of how organizational actors, specifically managers, construe "problems" as a basis for acting in real world settings. We concentrate on these premonitory features of problem-solving by asking, first, a conceptual question: what is it about a situation that makes it seem "problematic" to an actor and prompts action to search for a solution? And, second, we ask an empirical question about how characteristics of a problem-solver affect problem definition.

1. A General Model of Problem Perception

Decision-making and problem-solving are temporal processes that intervene between informational inputs and eventual behavioral outputs (Hunt and Magenau, 1984, p. 119). (Problem-solving we understand to be simply a case of decision-making under uncertainty.) Newell and Simon (1972) conceptualized these processes as "a goal-directed sequence of mental operations." Trope and Ginossar (1988) have suggested that the "mental operations" envisaged by Newell and Simon are "condition-action production rules," and that "problem-solving involves a search for a sequence of productions that will transform [some] initial state of knowledge... into [a goal state] (p. 213)," subject to constraints concerning the application of production rules. Trope and Ginossar use the game of chess to exemplify a production process: the initial state is the starting position of pieces on the board; the goal is mating, achievement of which is subject to rules of the game.

As sketched in Fig. 1, we use a scheme (see, Hunt and Magenau, 1984, Hunt, et al, 1989) that divides the sequence of decision-making or problem-solving productions into "periods" (Pre-decision, Decision, Post-decision) and within-period "stages" (Recognition, Evocation, Presentation of Choice, Process of Choice, Output/Outcome). Since we are interested here mainly in "front-end" questions of problem perception and definition, we concentrate on what in the Hunt/Magenau model are called Predecisional stages of the Evocation of Choice together with the Presentation of Choice that eventuates from it and marks temporal and functional transition from the definitional Pre-decision to a choice-taking Decision period in an overall decision-making or problem-solving process.

In the Hunt/Magenau model, Evocation is an integrative perceptual/cognitive phenomenon that encompasses two part-processes or facets: problem "Recognition" and "Diagnosis." (The model describes various categories for coding the event structures of these and other decision stages and their facets.)

Recognition is understood simply as a stimulus (or cue) function: an environmental feature that attracts attention. What precisely this means is, and probably will remain, somewhat vague. We shall come back to the matter shortly in a discussion of the phenomenology of "problems," but, for the moment, it is enough to say that, experientially, "problems" denote "demand"

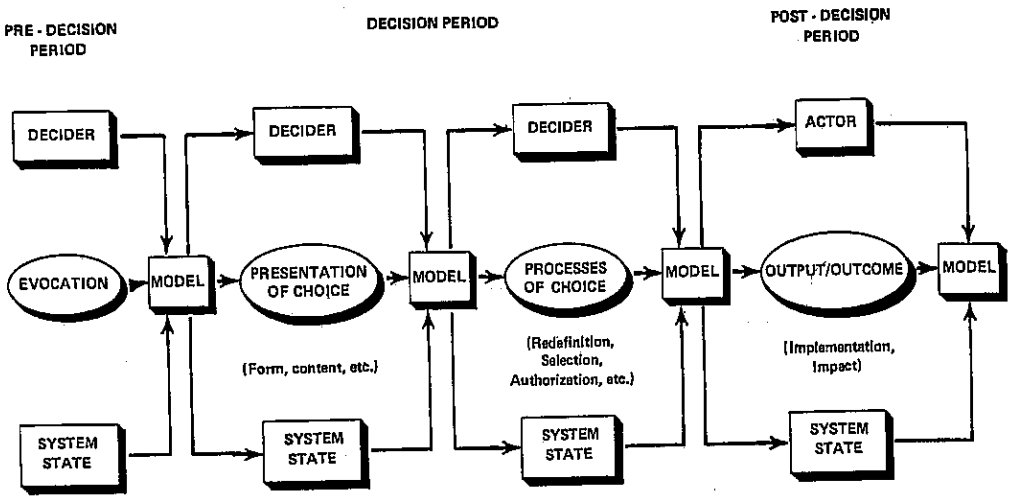

Figure 1: Decision-Making Model

properties of environments. They refer to conditions that capture attention, arouse, and "motivate" action.

The second facet of problem Evocation, Diagnosis, refers to an interpretive coding process which gives meaning to informational input about a situation and eventuates in a problem definition or Presentation of Choice to an actor (a presentation which is subject to subsequent redefinition during decision-making/problem-solving).

The perception or Evocation of a problem can be modelled, after Prinz (1984), as arising from an interactive process whereby an actor matches sensory input to some implicit standard(s). Referring to Figure 2, imagine (1) an actor presented with what Prinz calls "Stimulus Information" about some situation (the left-side of the model, which corresponds roughly to Hunt/Magenau's Recognition). Now (2), imagine this actor rummaging (or the right-side) through files (memory) for "knowledge structures" that (3) "fit" the inputs and make them actionably sensible (Diagnosis). Oversimplifying a bit: if a match is found, there is no problem, action may ensue. If no match is found, however, a problem exists. Thus, a situation is "problematical" to the extent that it is uncertain or unknown to an actor, in the pragmatistic sense of the actor not knowing or being sure what to do with it. (See Wofford and Goodwin, 1990, for a considerably more elaborated, but parallel, "script-based" model of cognitive processing and decision-making.)

The processes of Recognition/Diagnosis, which together define problem Evocation, may in some instances be very brief and essentially seamless. Other times they may be protracted and clearly differentiated. In any event, Hunt and Magenau suggest that, as part of the process of defining what Newell and Simon (1972) called a "problem space," i.e., constructing a representation of a task environment, Evocation may be coded in various ways including the extent to which it emphasizes sense-making via "fact-finding" or via "possibility-

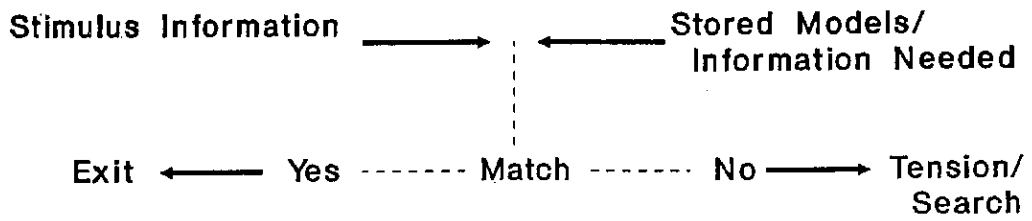

Figure 2: Matching Cognition and Action (After Prinz, 1984)

seeking." We'll return to this shortly.

Meanwhile, the Presentation of Choice to a decision-maker (or, the "problem" to a problem-solver) that eventuates from Evocation represents an "initial state" (or definition) of a problem and marks a transition from a Pre-decision to a Decision period (during which, as noted earlier, the problem may be variously redefined). Hunt and Magenau propose coding the Presentation of Choice on a number of facets, one of which is its "form," which they suggest may be (again, among other possibilities) "problemistic" or "opportunistic."

A "problemistic" form emphasizes the problematical qualities of a matter, its deviant character, and orients to restoration of a status quo ante. An "opportunistic" form, on the other hand, orients more to opportunities for expressive change from the status quo that may be opened by a "problem." Obviously problem "forms" may blend such features in varying degrees; but for present purposes, we treat them categorically. In any case, it is clear that the conceptualized form of a problem –the Presentation of Choice — essentially prefigures the "goal state" of problem-solving, even if substantial redefinition occurs during the subsequent Decision period.

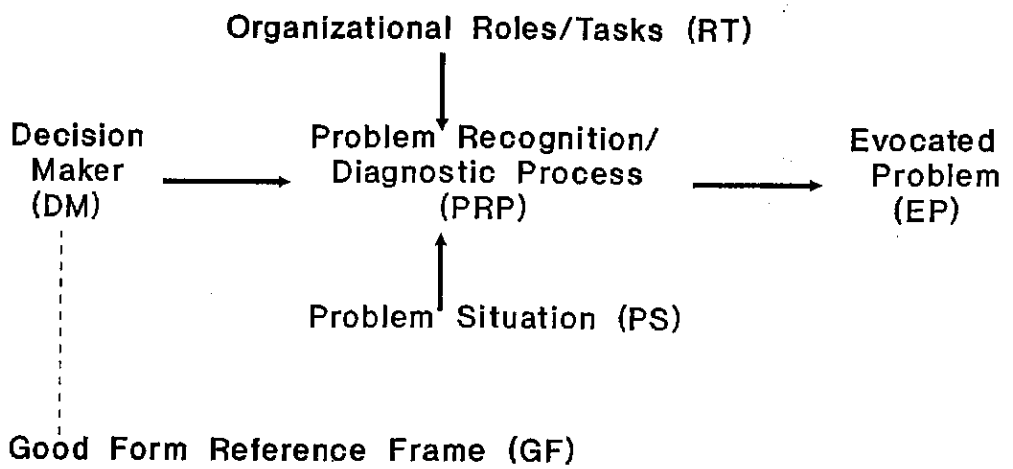

Figure 3: Problem Evocation Process

Figure 3 describes a contingency model of the problem Evocation process which is adapted from Hunt and Magenau's (1984) general decision model (see also Hunt, et al, 1989). The general model envisages a decision-maker, in a choice situation, engaging in the processes of evaluation and interpretation outlined above that are preparatory to acting (which may or may not actually occur). More specifically to problem Evocation, Figure 3 depicts an evoked problem (EP) as a perceptual/cognitive resultant of a problem recognition/diagnostic process (PRP), which is defined as an integration of three interrelated variables: cognitive orientations of the problem recognizer or decision maker (DM); information on the nature of the situation or context (PS); and organizational roles/tasks (RT). In the present study we concentrate on the contribution of decision-maker characteristics, specifically cognitive styles, to processes of problem Evocation although attention will be paid to possible confounding effects from problem-solvers' work roles/tasks.

On The Nature of Problems

To this point we have passed lightly over the question of exactly what a problem is, suggesting simply that problems arise from a condition of uncertainty about what to do in some situation. We need to say more on this subject, especially about the standards by which situations are judged.

Phenomenologically, a person who has "no problem" with a situation is someone who feels "comfortable" with that situation, understands the "meanings" of it, experiences a sense of "completion and closure" regarding it, and believes he/she knows how to "deal" with it. A person who does have a problem with a situation, on the other hand, experiences some "deficiency" of the above factors, as Prinz's matching model implies (and Wofford and Goodwin's requires).

Thus problems, first of all, are "percepts:" i. e., "way(s) ..... object(s) or situation(s) appear to a subject....." (Allport, 1955, p.23). They result from discrepancies between information about situations and an actor's repertory of knowledge structures or cognitive models for comprehending and responding to them. In the language of classical Gestalt psychology, a "problem" can be construed as a case of situational "poor form." And, given a postulated general tendency toward "good form" in perception, it follows that "poor forms" will be unstable and will induce tensions (action tendencies) to "improve" their form. Much as envisaged in control theory (e.g., Ilgen and Klein, 1988) and Miller, et al's (1960) TOTE model, actions, or at least tension and action tendencies, will be triggered to reduce the perceived discrepancy, i.e., to improve the "form" of the situation, which is tantamount to solving the problem.

Perceptions of social situations obviously are more complex than perceptions of the simple objects on which Gestalt research concentrated; but, as with objects, meanings are embedded in situations and the transactions of people with them (see Allport, 1955; Prinz, 1984). People may be assumed to have standards (or images) of "Good Form" for social situations as well as for objects, and associated action modes (e. g., scripts). These "Situational Good Form" standards refer, usually implicitly, to ideal states, goals, or reference frames and criteria for judging incoming information about social situations.

Material deviations from "Situational Good Form" will be perceived by an actor as "Poor Form," which, we suggest, may be tantamount to Recognition of a problem.

The Situational Good Forms that define the goal states of problem-solving may be "common" or "idiosyncratic" standards. The former are "external" norms such as organizational policies, plans, codes of ethics, etiquette, and the like that are more or less adhered to by most members of an organization or other social unit. Idiosyncratic norms, of course, are "internal" and person-specific.

Good form standards may also vary as to the precision with which they are defined. Specification of their form quality requirements may be exact or it may be vague, the kind of good form that is only known when it is seen. Trope and Ginosar's chess game exemplifies both the common and exact cases: a class of heavily constrained problem-solving in which the parameters of the production process are explicit, formal, and shared, albeit that procedural discretion is allowed. Social problem-solving, on the other hand, commonly allows much wider discretionary latitude, especially on the "front-end," and therefore more often resembles the weakly constrained vague and idiosyncratic cases. Still, it, too, is subject to the same kinds of constraint, in particular constraint of its production process by its initial states and goal definitions, even if neither of these is well specified at the outset (or maybe even at the end).

At least two main varieties of deviation from situational "good form" can be recognized: one is a case (on the "left-hand side" of Prinz's scheme) where, after search, no one knowledge structure (model) can be found to match the stimulus information. This case can be seen in two versions: a. "indeterminacy:" a situation for which an actor has no knowledge structure (i.e., the tags on no existing scripted model match the stimulus information about the situation); or b. "equivocality," where there is more than one model that seems to fit. Presumably responses to these cases or sub-varieties will be different in some ways (e.g., in the nature of the cognitive processing they provoke [see Wofford and Goodwin, 1990]); but, for now, having noted the distinction, we shall say no more about it.

The second main variety of "good form" deviation is a case, on the "right-hand side" of Prinz's scheme, which is based on an assumption that actors' knowledge structures are organized hierarchically so that some are generally preferred over others as actionable models. Presumably actors will be disposed to actout their preferences but they may experience difficulty matching them with actual situations.

These two general varieties of deviation from situational good form are not necessarily mutually exclusive, but they do have different behavioral implications. Briefly, either case of the first variety suggests an essentially reactive orientation on the part of the actor. The performance model they suggest is of the form: give me a problem, I'll find a way to deal with it. The second variety, on the other hand, is more proactive, in the form: I've got a solution, find a problem to fit it (or a situation to use it). This distinction between reactive and proactive orientations recalls March and Olsen's (1976) metaphor about the functional autonomy of "solutions" that may, as it were, go looking

for problems. It is, in any case, an idea that is important to this research, as will be seen later in our discussion of cognitive styles.

Summarizing: perceptually, a "problem" is a situation in one or another variety of "poor form." Like tasks, problems are experienced as demand properties of actors' environments. Melding cognitive, motivational, and motor elements, quite like Lewin's (1935) interrupted tasks, they have the combined effects of orienting people toward features of their environments while simultaneously inducing tension that motivates cognitive-motor action calculated to improve the form of the problematic situation, i.e., to "solve" the problem.

Cognitive Styles and Their Effects on Problem Evocation

Hunt, Krzystofiak, Meindl, and Yousry (1989) have stated that "... consistent differences in individuals' perception and assimilation of information amount to 'styles' of thinking which define how a person comes to grips with complex problems, both in terms of conscious strategies and unconscious habits" (p.438). From this premise, they suggested that cognitive styles (among other characteristics of a decision-maker)have direct effects on problem-solving/decision-making processes (see also Robey and Taggart, 1981). Cognitive styles are likely to affect not only constructions of the "initial state" of a problem (i.e., recognition/diagnosis), they will constrain both the production process and definitions of goal states, the more so the less the formal constraint.

Sensing vs. Intuitive Types and Problem Perception

In his writing on psychological types, Jung (1923) postulated a theory of individual differences couched in terms of modes of mental functioning. According to Jung, people are equipped with two distinct ways of perceiving. One, sensing, involves becoming aware of things empirically: directly through sensory modalities. The other way of perceiving is intuitive: an unconscious process of ideation that assimilates incoming stimuli to prior mental models and their implications. Jung assumed that "sensing" types are people who tend to be preoccupied with the actuality around them and pay little attention to cognition or inner voices. Intuitive people, on the other hand, may be so involved in searching among their ideas for expressive possibilities that they hardly look at actualities.

Table 1 summarizes some contrasts between "sensing" and "intuitive" types in work contexts. Studies (see Myers and McCaulley, 1985) have also shown that individuals whose interests lie in direct experience tend to be in applied occupations (e.g., civil engineering) rather than occupations where theory is of great importance (e.g., nuclear physics).

Generalizing, we posit that, compared with Intuitives, Sensers tend to prefer more highly structured and routinized situations, are more present- and continuity-oriented, concentrate more on the details of situations, are data-sensitive and analytical. In terms of the "good form" ideas discussed earlier, we assume that sensers tend to be "reactive" in their relations with their environments. Compared with Sensers, Intuitives are more proactive, improvisational, holistic and likely to rely on insight (rather than data), future-and change-oriented, and disposed to trial-and-error possibility-seeking. Hence,

TABLE 1
Possible Effects of Sensing/Intuitive Preferences
in Work Situations (Hirsh and Kummerow, 1990, p.6)

SENSING
like using experience and standard ways to solve problems
enjoy applying what they have already learned
may distrust and ignore their inspirations
seldom make errors of fact
like to do things with a practical bent
like to present the details of their work first
prefer continuation of what is, with fine tuning
usually proceed step-by-step
INTUITION
like solving new complex problems
enjoy learning a new skill more than using it
may follow their inspirations, good or bad
may make errors of fact
like to do things with an innovative bent
like to present an overview of their work first
prefer change, sometimes radical, to continuation of what is
usually proceed in bursts of energy

with reference to Hunt/Magenau codings of Presentations of Choice, we conclude that sensers will tend to construe problems "problemistically," while intuitives will do it "opportunistically." And, from these thoughts, two broad research hypotheses follow:

Hypothesis 1: Individuals with sensing preferences will more often a. identify problems in terms of deviations from existing standards than will those with intuitive preferences, and b. will seek solutions that return situations to a status quo ante. Individuals with intuitive preferences will more often identify problems in terms of new possibilities and change than will those with sensing preferences.

Hypothesis 2: Individuals with sensing preferences will be more likely to engage in detailed factual searches than will those with intuitive preferences. Individuals with intuitive preferences will be more likely to engage in possibility-finding searches than will those with sensing preferences.

2. Method

In order to evaluate these hypotheses, a field study in a single organization was designed to yield snapshots of organizational actors' problem evocation processes. Along with some disadvantages, there are three main advantages to this approach. One is the method's naturalistic character. The situations studied were actual occurrences, not artificially contrived ones. The "problems" identified were actual constructions of decision-makers during their daily activities.

A second advantage of a field setting for a study of problem perception is that it allows one to obtain large samples of problems in wide variety across a number of organizational contexts. And, finally, our intention in this research was to evaluate the effects of individuals' cognitive styles on problem perception separately from their roles and tasks. The latter are apt to be stronger and clearer in a naturalistic environment than in one that is artificially contrived.

2.1. The Researcher as a Participant Observer

Data were gathered via individual interviews (see below) during February-June, 1991 by the author acting as a participant observer in the company where the study was done. This had the virtue of allowing observation of activities as they unfolded and, hence, an appreciation of the context within which problems developed, especially given the investigator's familiarity with the organization from a previous two-year employment there. Also, the investigator's continuous presence in the company put him in a position to verify events bearing on incidents reported in interviews, and to make unobtrusive supplementary or confirmatory use of relevant written reports, meeting records, and other physical evidence referred to in or relevant to informants' reports. The full support of the com- pany's president made the whole project possible. In this way, the investigator was able to gain a clearer understanding of the "problems" reported, as they were perceived by the informants and to assure basic data quality. In addition, many members in the company wrote weekly plans, and in several units were required to keep daily work diaries, both of which were used to confirm and clarify events reported in interviews.

Study Site. The research site was a large and successful construction company in Taiwan that had grown from fewer than 50 employees in 1986 to about 250 at the time of the study. Three groups (divisions) were included in the study: its Construction Group; its Construction and Development Group; and a Real Estate Group.

Entry. Data collection was preceded by a three-week pre-study "warm-up" period during which the investigator became familiar, "in-role;" and assimilated to the company setting, a process much facilitated by his having previously worked there and by his background in engineering and management. He was, therefore, familiar with relevant professional terminologies in the work setting and knew the company's general management system and culture.

The pre-study period began at a regular monthly meeting of company personnel with a formal introduction and request for full cooperation with the

research. The investigator introduced himself and gave the following description of the project on which cooperation was sought:

> "... the project is about problem recognition in the company, that is, the process through which each one of us recognizes problems. Understanding this process will facilitate effective decision-making in the company. In the coming months, I will arrange individual appointments with you. During 20 to 30 minute interviews, you will be asked to describe a problem that you recently encountered and the process through which you recognized it. Further information will be provided to you in our future meetings. Your support to this project is crucial. Thank you very much."

During the pre-study period, the investigator got to know almost all informants personally.

2.2. Informants and Interviewing

Informants. Excluding the company's president and vice-president, the sample included most of the company's high level managers, engineer specialists, managerial staffs (e.g, system analysts, finance or accounting specialists), and several site supervisors. Criteria for selection were, first, availability. (Three managers and sales persons were excluded from the sample because of limited availability.) Second, accounting and data entry clerks, secretaries, and receptionists were excluded from the study. Owing to the simplicity of their tasks. Finally, of the company's three major construction sites, one was too large in size for the researcher to manage and another was too far from the company offices. The study was, therefore, limited to the third one.

The final sample of 56 informants consisted of one associate vice president of construction; 4 assistant vice presidents; 8 managers; 34 management staffs, designers, and engineers; and 9 site supervisors. Ten of the 56 informants were females, one of whom was a manager. The informants represented a good cross-section of the company's functional areas: accountants, financial analysts, general managers, personnel staffs, management information system analysts, engineer specialists, construction site supervisors, subcontracting specialists, construction estimation specialists, architectural designers, and land-transaction specialists. By professional background, 25 informants were construction engineers, 7 were architects or art-related designers, and the remaining 24 were management-related personnel or persons with no specific professional concentration.

Interviewing. During pre-study meetings, eligible informants were briefed on what the interviews would be like, and instructed as follows:

> "Identify one problem in relation to your work during the past week that stands out most clearly in your memory. Describe the problem and how you recognized it in your own words."

Informants were advised to take notes, and, in any case, to be prepared to provide a detailed description of the problem and its conditions during the interview. Interview schedules were set, and the researcher primed each informant to report on problem recognition by asking them to think of a problem they had recognized before the scheduled time of each interview.

Interviews were unstructured, but informants were encouraged to report

in detail on the following subjects: the substance of the problem; when and how the informant became aware of it; who was involved in it and in the process of its recognition, and in what ways; the temporal patterns of interaction among different actors involved in identifying the problem; the context of the problem (machine failures, physical defects, etc.); what specifically the problem was; and how the problem was first noticed.

After brief greetings, interviews began with the informant being asked to describe a problem he/she recently recognized in his or her work in the company. At the start of an interview, the researcher tried not to interrupt the informant's report. He interrupted only when it became necessary to clarify content or to encourage reporting in greater detail.

Typically reports went on for several minutes without interruption. When the informant paused for a fairly long interval, this was taken to indicate completion of description. The investigator then joined in a conversation, perhaps asking the informant to say more about some details of the problem or its perception. Following is an example of such questioning by the interviewer:

Informant: ... the workers do not want to wear safety hats at their work ... it is almost impossible to ask them to wear them.
Interviewer: Does the company impose any penalties if they don't wear them?
Informant: We do have rules for that. But, they just bring their hats with them, not wearing them.
Interviewer: So, you mean, the rules only require them to bring their hats with them?
Informant: No. The rules say they have to wear them ... But, for convenience's sake, they don't want to wear them ...

Some informants brought notes to the interview to guide their thoughts. For some informants, pre-arranged schedules for interviewing were infeasible. The investigator therefore had to watch for times when such informants were available. At the end of each interview, the researcher thanked the informant for his/her time and efforts.

Interviewing was done in a room private enough to prevent unnecessary disturbances from possible guests of the informant. (Most interviews were held in the company's conference room.) Interviews ranged in length from 10 to 60 minutes with an average of 20 minutes. Thirty-eight of the 56 informants were interviewed four times; seven were interviewed three times; eight were interviewed twice; and three were interviewed once. All interviews were tape-recorded, with the company's and the informants' permissions. After a closer look at the interview recordings, the researcher found that informants often talked about sensitive as well as controversial issues in the company, indicating their full confidence on the study.

These interviews were the primary source of information concerning the problems that were encountered by the informants during the four-month study period.

2.3. Data Quality: The Problem of Retrospective Reports

The use of retrospective reports from informants is a common research

procedure in social/behavioral science and management research, including studies of decision processes (Huber, 1985; Huber and Power, 1985). It has both advantages and disadvantages.

A major advantage of the method is that one may obtain data economically which would be very costly otherwise. Ordinarily it is simply infeasible to observe something like problem evocation as it unfolds for different individuals in various locations. Besides, the processes at issue are, by and large, inherently unobservable and knowable only by report after-the-fact.

There is an obvious question, however, about the dependability or stability of retrospective reports over time. In an experimental study, however, Huber (1985) found evidence of substantial temporal stability of verbal reports across a moderate time interval (an average of 19 months).

Inaccurate and biased reports from informants in field studies may arise for other reasons than simple passage of time. In their discussion of verbalizing rules in concept attainment and learning, Ericsson and Simon (1980), for example, cited evidence of experimental subjects' difficulties in verbalizing the complex hypotheses they learned (e.g., Wilson, 1974). Hence, there is a risk that informants' verbal reports may omit information that they in fact used to perform a task. Furthermore, for any number of reasons, informants may not be motivated to provide complete information to a researcher.

To offset the possible incompleteness and biases of retrospective reports in the present study, three meliorative tactics were used: (1) reduction of the time between an event and its recall – a two-to-four-week interval was the average elapsed time for informants' reports on their problem evocation processes (a much shorter period than Huber's 19 months); (2) special efforts to motivate recall (and general cooperation) – the researcher explained to each informant the usefulness of the study both to the company and to themselves, and company management's full support for it; (3) elimination of risks of candor – informants were asked to provide "candid information on their actual problem recognition processes," and were assured that their responses would not be used in any way for evaluation of their work performance.

2.4. Assessing Cognitive Styles

Each informant completed a translated version of the Myers-Briggs Type Indicator, which includes 26 items on its "sensing-intuitive" scale (see, Myers, 1962). Respondents chose between two words or expressions, each indicating a corresponding psychological type. The resulting scores on the scales were used to dichotomize respondents' cognitive preferences into sensing types and intuitives. The MBTI has been widely used in research and shown to be both reliable and valid (see Myers and McCaulley's (1985) review).

Translation of the MBTI into Mandarin Chinese was done by the author and subsequently revised by two bi-lingual Chinese graduate students. The final Chinese version was then back-translated into English. The resulting English version showed good equivalent meaning when compared with the original questionnaire. Finally, the translation was pre-tested to ensure its internal consistency. For a sample of 36 Chinese from Taiwan, the ALPHA coefficient on sensing-intuitive items was found to be .8275.

Of the 56 informants in the research sample, a total of 17 was found to

be "intuitive." Of these 17, four were females (of 10 in the sample), five were art-related designers, eight engineering specialists, and four general managers. All eight engineering specialists were in construction management, technology, or the new venture department.

The 39 "sensing" types had a broad range of specialties: two art-related designers; nine site-supervisors; seven engineer specialists; 18 management staffs; and three high-level managers. A reliability test of the sensing/intuitive scale with the 56 informants showed an ALPHA coefficient of .8392.

3. Results

Taking informants' cognitive styles as an independent variable and their content-coded verbal reports on problem perception as dependent variables, data analyses to test the hypotheses on relations between cognitive styles and problem perception are reported in this section. First, however, we need to describe the analysis and coding of the informant interviews. "Unitizing" Interview Protocols. The tape-recorded verbal reports from each interview were transcribed for content analysis. These transcripts were then divided into basic "units" for coding. Units were identified by pauses in the flows of informants' verbal reports. That is, a recognizable pause in a flow of consecutive utterances defined a boundary between two units. Hence, a unit was bracketed by pauses.

Example 1:

Informant #7 (Problem 1): ... [pause] I'll first look for a column, spend some time on it [pause] find a column try to use the method [pause] after you try the method [pause] if the problem still exists, ok, try another column [pause] think of some other ways to deal with it [pause] ...

In this example, the informant was trying to think of ways of reducing defects when pumping concrete into columns. The set of utterances was segmented into five units by the seven pauses noted in the passage:

Unit 1: I'll first look for a column, spend some time on it

Unit 2: find a column try to use the method

Unit 3: after you try the method

Unit 4: if the problem still exists, ok, try another column

Unit 5: think of some other ways to deal with it

In order to trim the interviews into a constant length, only the first 80 units of each interview were analyzed; and to test the reliability of unit counts, a second person independently "unitized" 31 transcripts from nine randomly selected informants (one sixth of the total number of informants). The count of units identified by the independent person ranged from 73 to 98 units, with an average of 82.5. The percentage of mutually agreed-upon pauses in each transcript (out of the original count of 80 units) ranged from .69 to .91, with an average of .83. Thus, over 80 percent of the pauses were identified by both coders, which seems quite good for such a task.

TABLE 2
A Summary of Codes in terms of Sensing/Intuitive Dichotomy

variable	key words
deviations from existing standards	formal rules, regulations, and procedures, e.g., application forms
possibility	possible, likely, risk, opportunity
fact-finding	action words with a meaning of searching for information on the status quo, e.g., urging, pushing, asking for
possibility-finding	interrogative phrases, action words, and thinking processes with a meaning of probing into future, e.g., how to, look for, try, think of

3.1. Content coding

Earlier we suggested that "existing standards" and "possibilities" were among the good form standards that may be implicated in the perception of problems. We also suggested that two alternative ways of diagnosing or elaborating the definition of recognized problems were by "fact-finding" or by "possibility finding." Therefore, each of the 80 verbal units for 57 informants was content coded on the following four dimensions: (1) deviations from existing standards: (2) possibilities; (3) fact-finding; and (4) possibility-finding. A summary of the codes is shown in Table 2; and illustrations of the coding process follow.

3.1.1. Coding Deviations from Existing Standards

Some examples of an "existing standard" are formal rules, regulations, and procedures. The criterion for coding "deviations from existing standards" was that the informant express discomfort with a situation that deviated in some way from such an existing standard. Key words for coding deviations from existing standards were apt to be directly related to some such standards, as the following example shows.

Example 2:

Informant #43 (Problem 1): ... [pause] they did not give us the application form for withdrawal before the time we processed monthly salary [pause] it was New Years Days they were leaving [pause] right after the New Year many were planning to withdraw [pause] but we did not know who wanted to leave [pause] when we got their forms they're already gone [pause] ...

According to the unitizing principle, this segment of utterances was divided into the five units listed below with key words for "existing standards" underlined:

Unit 1: they did not give us the application form for withdrawal before the time we processed monthly salary

Unit 2: it was New Years Days they were leaving

Unit 3: right after the New Year many were planning to withdraw

Unit 4: but we did not know who wanted to leave

Unit 5: when we got their forms they're already gone

Thus, in this example, two units met the criterion of containing key words (application forms) signifying "existing standards." Therefore, with their context, two units were counted as "deviations from existing standards".

3.1.2. Coding Possibilities

A "possibility" for a given problem was defined by key words having a meaning of "likelihood in the future," as opposed to "facts on the status quo." Examples of such key words are possible, likely opportunity, and risk. Any unit containing such a word was counted as one instance of "possibility".

Example 3:

Informant #7 (Problem 4): ... [pause] to cut it that way is very difficult [pause] it's possible that [pause] the labor cost will be a lot higher [pause] ...

According to the unitizing principle, this segment of utterances was divided into three units (key word underlined):

Unit 1: to cut it that way is very difficult

Unit 2: it's possible that

Unit 3: the labor cost will be a lot higher

Thus one unit of this utterance was counted as indicating "possibility".

3.1.3. Coding Fact-Finding

The coding of "fact-finding" relied on key action words or phrases with a meaning of "searching for information on the status quo", rather than "probing into the future."

Example 4:

Informant #13 (Problem 4): ... [pause] we were kept pushing the construction estimation unit [pause] urging them to give us data [pause] since if Mr. X does not have the information [pause] he has no way to do the checking [pause] the result was [pause] almost every person every week were pushing them two three times [pause] ...

According to the unitizing principle, this utterance consisted of the following six units (key words underlined):

Unit 1: we were kept pushing the construction estimation unit

Unit 2: urging them to give us data

Unit 3: since if Mr. X does not have the information

Unit 4: he has no way to do the checking

Unit 5: the result was

Unit 6: almost every person every week was pushing them two three times

Three of the units contain key words, i.e., pushing and urging, with a meaning of "searching for information concerning the status quo"

3.1.4. Coding Possibility-Finding

A unit containing a key word with a meaning of "probing into the future," rather than "searching for information on the status quo," was counted as an instance of "possibility-finding." Key words for possibility-finding were in some ways similar to those for fact-finding. "Possibility-finding" key words were mainly of three kinds: (1) action words; (2) words related to thinking processes; and (3) interrogative phrases.

Using an earlier example, Example 1, four units of the utterances were counted as "possibility-finding" (key words underlined):

Unit 1: I'll first look for a column spend some time on it

Unit 2: find a column try use the method

Unit 4: if the problem still exist ok try another column

Unit 5: think of some other ways to deal with it

Thus four of these units meet the criterion of containing key words (action words) with a meaning of "probing into the future," and so are coded as "possibility-finding." The third unit ("after you try the method") contained an action word ("try") but without a future-orientation.

Coding reliability was evaluated by having an independent coder do the unitized verbal transcripts of nine randomly selected informants. The second coder was briefed by the investigator about the background of the company and the nine informants. Illustrations of the coding process, such as the examples above, were shown to the person. Correlations between the two independent coders' counts for each of the four coding dimensions were .59, .89, .76, and .73 (all $p < .01$ or better), suggesting fairly good inter-rater reliability.

3.2. Hypothesis Testing

Using the content-coded data, hypotheses on the effects of cognitive style on problem evocation were tested via one-way analyses of variance. First, problem evocation by individuals with sensing preferences was compared with that by those with intuitive preferences. In a total of 191 problems, an average of .53 units per problem were found by sensing types based on "deviations from existing standards," as against an average of .00 unit per problem by intuitives (see Table 3). By ANOVA (see Table 4), sensing types, as expected, gave significantly more emphasis to "deviations from existing standards" as a

TABLE 3
Frequency on Count of Key Words in terms of Sensing/Intuitive Dichotomy

variable	overall average	average per inforrmant (sensing)	average per informant (intuitive)
deviations from existing standards	0.37	0.53	0.00
possibility	2.02	1.88	2.32
fact-finding	1.52	1.78	0.93
possibility-finding	1.63	1.23	2.54

TABLE 4
ANOVA Matrix on Problem Recognition in terms of Sensing/Intuitive Dichotomy

variable	d.f.	F	sig. of F
deviations from existing standards	190	11.467	.01
possibility	190	1.507	n.s.
fact-finding	190	5.338	.05
possibility-finding	190	19.377	.01

basis for problem evocation than did their intuitive counterparts (F=11.467, d.f.=190, $p < .01$).

Sensing types mentioned an average of 1.88 units of "possibility" per problem, and intuitives an average of 2.32 units (see Table 3). However, although in the predicted direction, this difference was not statistically significant (see Table 4).

On the other hand, when compared on "fact-finding" (which was based on a count of action words/phrases with a meaning of searching for information on the status quo), sensing types mentioned an average of 1.78 units per problem and intuitives an average of .93 units (see Table 3). Thus, sensing types were significantly higher on "fact-finding" in problem evocation than were their intuitive counterparts (see Table 4).

Finally, an average of 1.23 units of "possibility-finding" per problem was mentioned by sensing types, and 2.54 units by intuitives (see Table 3). Hence, intuitives were significantly more disposed toward "possibility-finding" in prob-

lem evocation than were sensing types (see Table 4).

Thus, three of the four predictions on effects of cognitive style on problem evocation processes were supported by the data: individuals with a sensing preference were more likely ($p < .01$) than intuitives to identify problems in terms of deviations from existing standards; and they were also more likely ($p < .05$) to engage in detailed searches for facts in problematical situations than were intuitives. On the other hand, intuitives were more likely ($p < .01$) to engage in possibility-finding than were sensing types. Propensities toward problem evocation in terms of possibilities, however, were not significantly different for the two types.

3.3. Possible Confounding Effects of Informants' Roles/Tasks

It is possible that informants' work may confound the effects of cognitive styles. Intuitives, for instance, might be concentrated in jobs (e. g., design work) that are somehow theoretical - or future-oriented. In order to check this possibility, first, a test was done between intuitives in design work and the remaining intuitives. If confounding effects existed, instances of "possibility-finding" should have been higher for "intuitive designers" than for the remaining intuitives. Table 5, however, shows that this was not the case: "possibility-finding" was no more frequent for "intuitive designers" than for other intuitives.

TABLE 5
ANOVA Matrix Contrasting Intuitive Designers and Other Intuitives

variable	d.f.	F	sig. of F
possibility-finding	62	0.003	n.s.

Tests were also done between those intuitives in the construction management, technology, or new venture departments, and the remaining intuitives. The difference on "possibility-finding" this time was significant (see Table 6), which suggested a possible confounding effect causing the significant difference between sensing types and intuitives.

TABLE 6
ANOVA Matrix Contrasting Intuitives in Construction Management, Technology, New Venture Department and Other Intuitives

variable	d.f.	F	sig. of F
possibility-finding	62	4.109	.05

Therefore, to test further for possible confounding effects, the variable identifying informants in the construction management, technology, or new venture department was inserted into a regression equation along with the variable for sensing/intuitive preferences. The two beta weights of the equation were both significant beyond the .01 level, indicating that individuals' sensing-intuitive tendencies exerted effects on problem evocation separately from any effects of their tasks (Table 7).

TABLE 7
Regression Coefficients separating Effects
by Tasks and by S-N Dichotomy

variable	beta weight	sig. of T
tasks (construction management, technology, or new venture department)	.2553	.01
S-N Dichotomy	.1951	.01

4. Discussion and Conclusions

To recap the empirical findings: of the four predictions made here regarding relations between individuals' cognitive styles and the perception of problems, three were supported. Sensing types were found to indentify problems in terms of deviations from existing standards more often than intuitives, and to be more likely to engang in detailed searches for facts in problematic situations. For their parts, intuitives were more apt to look for possibilities in such situations than were sensing types. Identifying problems in terms of possibilities, which was expected to correlate with an intuitive style, was, however, not significantly related to style (although it was in the expected direction).

Thus, evidence, albeit incomplete, was found of differential association of cognitive styles with two general "forms" of problem evocation: "opportunistic" processes transformationally oriented to the fitting of situations to solutions, and more conservational "problemistic" processes oriented to fitting solutions to situations. In the former case, arguably favored by "intuitives," the self-conceptualized "presentation of choice" to a decision-maker or problem-solver focuses on changing an initial state to a transformed goal state. The problemistic form, which sensers seem to prefer, is contrastingly oriented more to maintaining a status quo by bringing "problematic" situations into conformance with pre-existing external standards.

These findings of decision-maker effects on problem perception both complement and supplement those of Hunt, Krzystofiak, Meindl, and Yousry (1989). Their experiment demonstrated consistent effects of cognitive style on strategies over various stages of decision-making. The present study contributes further evidence of generalized decision-maker effects on decision processes, specifically including the perception (or evocation) of the problems that are the subjects of the process. Furthermore, it adds further definition to particulars of relationships between specific individual difference variables and selected aspect of the overall processes of decision-making and problem-solving.

Although bearing clear kinship to Wofford and Goodwin's (1990) laboratory research on cognitive processes in decision- making, to our knowledge, no other study has approached the issue of problem perception in the way this one has, either conceptually or procedurally. A conceptualization of problems was offered here in terms of Gestalt principles of "good form." Like Wofford and Goodwin's and Prinz's (1984), the model used here suggested

that the mechanism of problem evocation involved perceptions of discrepancies ("Poor Forms") arising from a cognitive-motor matching process which induces a discrepancy- reduction process to move the individual's perceptual field toward a "Good Form."

The pumping methods problem in Example 1 above, for example, prompted various trial-and-error activities by the informant. One attempt was to use wooden plates to guide the concrete so that it went down into the columns without being "screened" by the steel bars. Another method was to use high-pressure pumping equipment to force concrete into the lower half of the columns. These trial methods were attempts to reduce defects in the concrete columns which are readily interpretable as a discrepancy-reduction process guided by an actor's implicit "good form" standards. Similarly, in the case of the quarrel between a worker and a site supervisor about the unavailability of resources necessary to performance of the former's job, the problem of conflict (i.e., a lack of harmony) was "solved" (at least for the moment) by the chief supervisor persuading the worker that the resources would be forthcoming.

Thus the idea of deviations from situational "good form" standards proved a helpful way of conceptualizing the micro- analytic basis of problem evocation. Informants generally were able to describe one or another kind of desirable state for particular situations and appeared to use those standards in their perceptions of pro- blems. The informant in Example 1 above, for instance, describing the "problem" of defects in columns found in a construction site, said that the "problem" occurred mainly because the columns were loaded with steel bars, which left hardly any space for the concrete to flow down to the bottom. An "ideal" state of the situation, a "good from," in this case, was defined by generally accepted civil engineering standards. Columns with observable holes might very likely fail to meet strength requirements. Thus, the particular conditions at that construction site constituted a "poor" form, i.e., were "problematic," on a quite explicit "public" criterion.

The informant who mentioned a quarrel between a worker and a site supervisor, on other hand, used a more ambiguous standard, saying that a "state of harmony" was more desirable than one of conflict. "Breaking" harmony was, for him, a poor form of social relationships and, hence, was a "problem." Thus, in each of these instances (and in others reported in the research), the presence of a "problem" was definable in terms of "deviations from Good Form standards for social situations." A problem's solution, its "goal state," then, was definable, ceteris paribus, by its "initial state," in terms of reducing deviations of a condition from a standard (or, perhaps, by changing the standard).

Thus, individual decision-makers in this research could plausibly be seen as acting to sustain Good Form images of social situations. Their experience of discrepancies from these images could also be seen as motivating their subsequent behavior, i.e., as prompting problem-solving activities oriented toward elimination of those discrepancies. More research, either in the field or the laboratory, on the details of how all this works, particularly the "thinking practices" involved, is plainly feasible, as this and Wofford and Goodwin's research testifies, and would contribute significantly to a fuller understanding of the complex process foundations of decision-making and problem- solving.

Footnotes

1. The "knowledge structures" alluded to in this passage can be conceived as cognitive models which include performance programs. They may be supposed to come with "tags" indicative of the stimulus conditions or situations when and where they apply.
2. Conceivably, counting repetitions of the same words might tend to exaggerate absolute frequencies, but there is no reason to believe it would affect relative ones. Moreover, the examples obviously are English translations of what, in Chinese, were different words.

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