Developments In Business Simulation & Experiential Exercises, Volume 21, 1994

INFORMATION AND UNCERTAINTY AS STRANGE BEDFELLOWS: A MODEL AND EXPERIENTIAL EXERCISES

Michael J. Fekula, United States Air Force Academy

ABSTRACT

Because organizational reality yields uncertainty, an effective classroom experience must extend beyond the traditional coverage of a discipline by exposing students to methods of handling uncertainty. One potential practice is to teach students to differentiate data from information, and to engage in a search process, which reduces uncertainty by Identifying meaningful patterns in data. This paper presents a model and identifies related experiential exercises useful in making the uncertainty reduction process explicit for students.

INTRODUCTION

Rapid change and diminishing resources make uncertainty a costly reality for organizations in the nineties. The traditional solution to the problem of uncertainty is, of course, information. Just as governments throw dollars at social ills, organizations feed uncertainty information.

Although a solution, information is also part of the difficulty. Despite its abundance, some firms still experience problems (see for example, Zuboff, 1988) because the mere presence of uncertainty begs the question, *What information?* More than an exercise in information-gathering, tackling uncertainty means learning the unknown. Any serious attempt to address this problem must acknowledge that the players involved can be ill-informed to the point where they are unsure of the information they need to solve a problem. This paper considers the process of uncertainty reduction from that perspective.

Because uncertainty yields unpredictable ambiguity, the classroom experience should extend beyond traditional fact-based learning. We must teach our students to develop insights which will transcend current knowledge If we are sincere in our efforts to address uncertainty. Today's teaching responsibility includes not only the covering of the discipline, but in effect, teaching the *uncovering* of the discipline. Students must be made aware of the limits of our understanding and engage in a classroom process which teaches them to discern the information that they will need when faced with uncertainty. The ensuing discussion addresses information and uncertainty, and presents a model followed by experiential exercises used to make the uncertainty reduction process explicit for students.

UNCERTAINTY AND INFORMATION

Uncertainty can be characterized as randomness in a situation faced by individuals. For our purposes, this means that the greater the uncertainty, the greater the freedom of choice because one option looks as good as the next when the best alternatives are not readily apparent to decision-makers. From that perspective, researchers (Shannon & Weaver, 1949) also equate uncertainty with the concept of entropy as a means to better understand the idea of information.

Information can been described and shown mathematically as a decrease in entropy or randomness (Shannon & Weaver, 1949). This conceptualization forges a link between information and uncertainty. As a decrease in entropy, Information represents less randomness or freedom of choice. Parameters develop around the most appropriate decisions or actions as information appears. Information reduces uncertainty because it diminishes the apparent randomness in a situation.

Uncertainty reduction is a role, but not a definition of information. Herein, the best definition of information Is Bateson's (1979) notion of *a difference that makes a difference.* This characterization conveys the importance of information essential to a receiver in a particular situation, as opposed to routine communication. Information will serve to reduce uncertainty only when it is relevant to the situation, and relevance means that it makes a difference. This explains why vast amounts of what is commonly called Information can be inadequate for problem resolution.

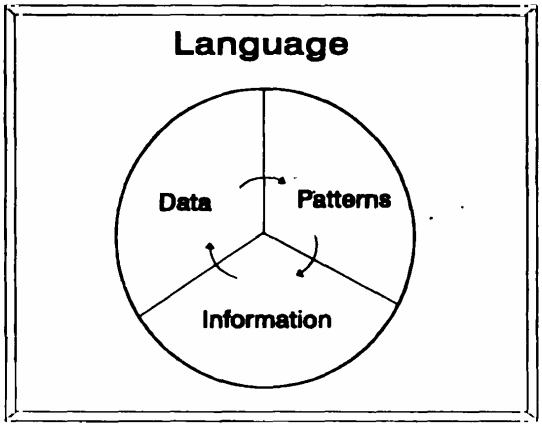
Part of the confusion sterns from the failure to differentiate routine communication from the receipt of information. An event which captures a receivers attention equates only to a *message,* or form of communication which Perelman (1976) describes as a mere *difference;* however, when such an event *makes a difference* to the receiver, then it is information. This differentiation is important because messages which embody information serve to change the state of randomness or entropy in a system, and thus alter the amount of uncertainty being experienced by the receiver. Conversely, messages do not influence uncertainty when they fail to *make a difference* in the system state.

This conceptualization scheme proposes that uncertainty reduction is the result of a change in a system state. The conclusion to be drawn is that, although bedfellows, information and uncertainty are strange bedfellows. It is expedient for us to compare information and uncertainty, but they are more accurately represented as discrete entities. In effect, uncertainty and information are Incommensurable concepts; they are not subject to comparison because information is context dependent, while uncertainty is context free. Uncertainty reduction generates a change in the *nature* of the system, not merely a change within the system.

This may seem a trivial distinction, but it has important implications since It establishes the claim that the uncertainty in a situation will not yield clues about the particular information needed to deal with it because information does not exist while the system is in that state. Thus, we are unsure of what we need until there occurs a change in the system. The essential change is a reduction in the randomness of the system, caused by the emergence of information. We reach that state by actively engaging the system and developing the information that we need.

Thus, an uncertainty reduction process targets the existence of randomness in a system. Figure 1 and the following sections address the variables and processes, which comprise that system.

FIGURE 1
THE UNCERTAINTY REDUCTION PROCESS



DATA

We must differentiate data from information. Data can be seen as raw facts, figures or observations that are devoid of meaning. Ambiguity, randomness, and freedom of choice are some of the attributes of data or stimuli which individuals face under conditions of uncertainty.

To make sense of data, it is essential to engage in conscious inquiry. As Perelman (1976) indicates, a database consists only of a set of *differences, which* have no potential to communicate information until they are transmitted or begin to flow. In this sense, a data source can be seen as a set of undelivered messages.

Two things must occur for information to emerge from data. First, the messages must get transmitted; this is where the individual actively attends to data or stimuli. Second, the messages must make a difference to the receiver; in this case, the receiver discerns a relevant pattern in the data.

In actuality, we find that existing data are not completely random. Data is subject to at least two forces in the uncertainty reduction process. First, it is subject to choice because an individual will focus on selected data. Previous training, education, or experience will govern data choices or the stimuli that people pay attention to. Although we are entering the discussion of our model (Figure 1) at the data step, the process is cyclical and indicates that existing information will make a difference in the data chosen.

In individuals, this process is represented through the idea of cognitive schemata, which contribute, to interpretations. A schema is a cognitive framework that provides a knowledge base which human beings use to interpret stimuli (Gioia & Pool, 1984). Interpretation is the beginning of a process in which individuals translate data or stimuli into expressions which have meaning or relevance (Daft & Weick, 1984). It is a critical component because it determines the factors or events, which get ignored or emphasized by individuals like managers (Miles & Snow, 1978). Experience and knowledge build the existing schemata that govern what individuals pay attention to (Dearborn & Simon, 1958; Lyles, 1981). Thus, the uncertainty reduction process starts with some foundation, which biases an individual toward the selection of particular data.

A second force impacting data is its capacity to yield particular patterns when analyzed. Some data are subject to stochastic processes, which yield, distinct, patterns based on certain probabilities. In language, we can assign probabilities to particular sequences of letters and wards. For example, as Shannon and Weaver (1949) illustrate, in the English language a word beginning with] is never followed by *b, c, d, f, g, j, k, I, q, r, t, v, w, x,* or *z;* therefore, the probability is zero that the second letter is one of those, arid the probability greater than zero that it is another letter. Similarly, if we say, *in the event,* the probability that the next and fourth word is *that,* is greater than the probability that the next word is *elephant.*

Data which are subject to stochastic processes have the potential to yield information because probabilities indicate partial knowledge (Campbell, 1982). However, this information does not exist until someone capable of discerning the patterns and their meaning evaluates it. The characteristics of both the data and the individuals evaluating it are forces that will govern pattern discernment.

PATTERNS

A pattern implies some sort of form, arrangement, or relationship among separate entities. Patterns serve to reduce complexity because they decrease the number of things one must attend to. Further, Smith (1980) suggests that pattern recognition is a mental capacity that can be vigorously exercised.

Since complexity and change are key forces driving uncertainty, pattern recognition is essential to uncertainty reduction. The problem we face in the social sciences is that we cannot know all of the patterns associated with organizational phenomena. Even useful theories will fail to capture the variations found in particular cases. Individuals need a process to develop essential information when existent patterns fail them. People experience complexity contributing to uncertainty when they encounter data or stimuli that fails to fit into the existing organization of information in their brain (deBono, 1973). Although we cannot possibly place every essential schema in the brain, we can teach our students to search for and discern patterns.

Searching and discerning must be recognized as two different activities. Our focus is upon the process of actively engaging data or stimuli in the search for patterns. As previously established, an individuals ability to discern a pattern will be governed by the nature of the data and existing schemata. Although individuals will vary in their effectiveness, at least we can teach them to search for patterns.

Traditionally, our pedagogy has focused upon communicating the content of a discipline, and this approach remains valid. In the face of

Certainty, course content is both necessary and sufficient: however, when faced with uncertainty, course content, though necessary, is insufficient. In the latter case, individuals cannot rely only upon past learning; they must engage in learning anew. They must know how to discover and become informed by recognizing new relationships. To be effective in a world of uncertainty, students must learn to learn. One approach to this mandate is to teach people to look for relevant patterns in data. Pattern discernment reduces the complexity, randomness, or entropy in data or stimuli. As individuals identify relevant patterns, they see differences, which make a difference, and thus information, which reduces uncertainty.

INFORMATION

Information is a difference which makes a difference, and "Just how much difference a message makes is, in fact, our measure of its information content" (Perelman, 1976, p. 68). Messages, which make a great deal of difference, contain ample information and tell us much new about a situation. Information reduces uncertainty because it reduces ones freedom of choice by specifying or limiting the number of sensible ways to view data. The ability to discern relevant patterns is the behavior we hope to teach students to engage in.

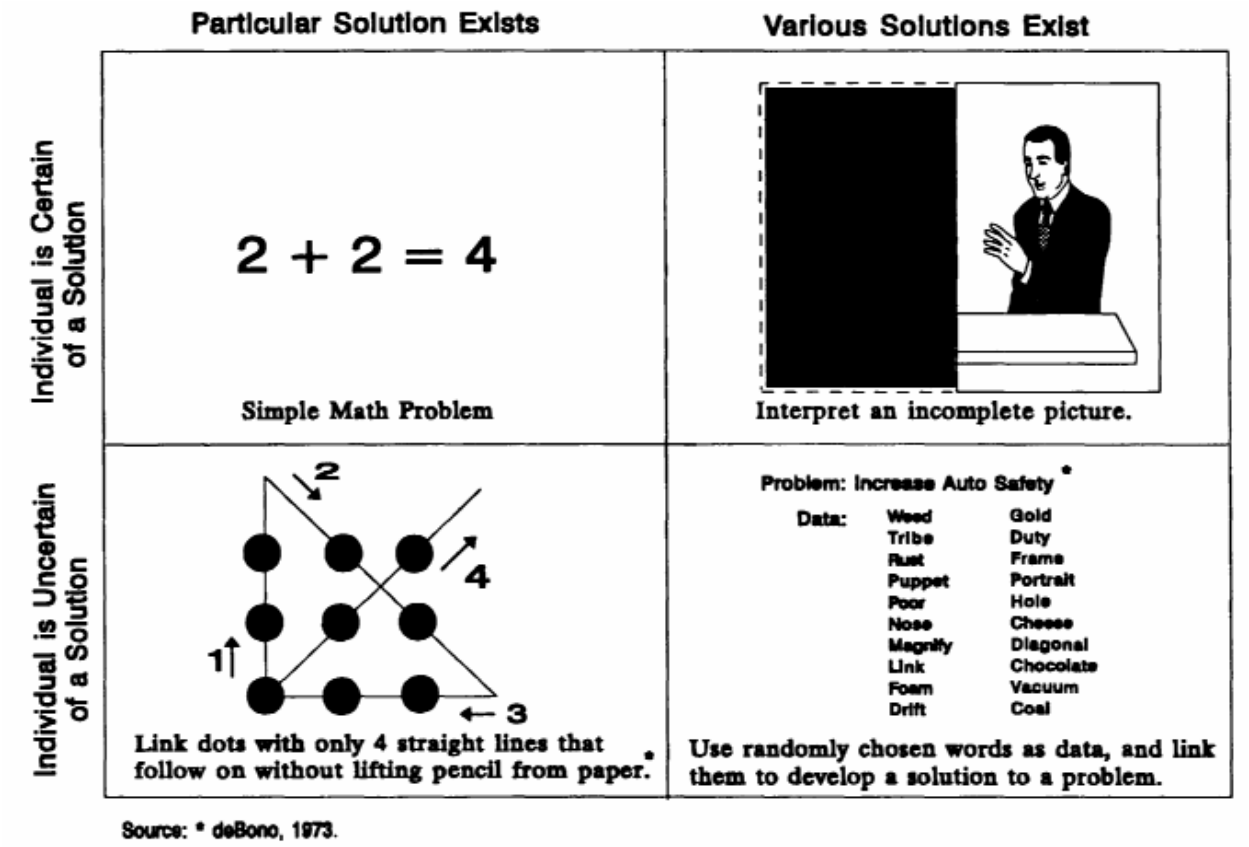
THE META-LEVEL ROLE OF LANGUAGE

Language is a body of words and systems for their use. As a system, the parts of our language can exhibit both entropy and information, but only when these parts are viewed in association. Language provides the separate components which can be arranged and rearranged (deBono, 1973) to allow us to discern new patterns and relationships. Our system of language plays a key role because it allows change, and change in a system is necessary to address uncertainty. Consider the 26 letters of the English alphabet as unchanging, yet through limitless rearrangements and the development of relevant patterns we communicate enormous amounts of information.

EXPERIENTIAL EXERCISES

A variety of experiential exercises could be used to illustrate pattern identification. As pictured in Figure 2, I chose four to account for varying degrees and types of uncertainty in a task.

FIGURE 2
TYPES OF UNCERTAINTY EXPERIENTIAL EXERCISES



The first exercise is a simple math problem to indicate a task, which has not only a particular solution, but one in which the Individual is fairly certain that he or she can produce a solution. In the case of a mathematical formula, one could also be certain of producing the correct solution; however, the goal of these exercises is to focus on the process involved, as opposed to the accuracy of a solution.

In another case, we present an old problem, with which students may be familiar, even if they do not recall the solution. It is that possibility which makes the problem valuable for our purposes. As illustrated in Figure 2, the problem is to link dots under certain constraints. The original intention of this exercise is to get people to challenge their assumptions about constraints. For our purposes, although people realize that there is a solution, they are not immediately aware of it, unless they remember seeing it before. They will attempt to identify various patterns of lines in order to solve the problem, but only one pattern works.

In a third exercise, individuals receive a picture in which part of the scene is covered. Here, the subject is tasked with making an interpretation of what is going on in the situation (deBono, 1973). In this case, because the individual has some Information relating to their task, and that information frames the context of the problem, they will be fairly certain that they can produce a reasonable interpretation to complete the picture. This exercise illustrates that pre-existing information will direct the attention and interpretation of the individual. The picture provides the data which gets interpreted based on the patterns, relationships, or information evident in the data already. Combined with foreknowledge, individuals then key on those patterns which make the most sense about the rest of the picture which is an uncertainty.

The final exercise exhibits a great deal of randomness. Where the other exercises provide some measure of certainty, this one attempts to present greater uncertainty and the chance to restructure the existent patterns of thinking which are natural for individuals to follow (deBono, 1973). The task deliberately presents unrelated pieces of data to provide the opportunity for restructuring ones thought processes. As deBono (1973) claims, an important aspect of this process is randomness. If the subject is given the chance to select data, then that data has relevance, and the random effect is lost. Although, in reality, we can select relevant data, here the effort is to show students that they can identify patterns, which are not readily apparent or predictable.

In the exercise, students are given a problem statement and data to solve it. The data are a set of words randomly taken from the dictionary. By themselves, the words are intended to represent complete randomness or uncertainty because they communicate nothing. Through the rules of language, the words get arranged to provide information, which addresses the problem. Note that only sensible patterns will provide relevant information to solve the problem. This exercise should persuade students that they have the capacity to analyze data and identify patterns that produce valuable information. Further, when they are free to choose relevant data, their effectiveness could be greater.

CONCLUSION

The premise of this paper is that we reduce uncertainty by decreasing randomness in data or stimuli. Data is a key mediating variable between existent schemata and the identification of new patterns. In turn, patterns mediate the relationship between data and information. Pattern identification is an important way to reduce randomness inherent in data and develop relevant information.

The prescription of this paper is to teach the model of uncertainty reduction, and use experiential exercises to show students that they are capable of discerning patterns in a variety of uncertain situations. The limits of this paper include the very abstract notions of data, patterns, and information; therefore, the teacher is left to determine what constitutes appropriate data, patterns, and information for their particular discipline. The proposed model offers merely a starting point for such determinations.

REFERENCES

Bateson, G. (1979) *Mind and Nature* Glasgow: William Collins Sons & Co. Ltd.

Campbell, J. (1982) *Grammatical man: Information, entropy, language, and life.* New York: Simon & Schuster.

Daft, R. L., & Weick, K. E. (1984) Toward a model of organizations as interpretation systems. *Academy of Management Review, 9,* 284-295.

Dearborn, D. C., & Simon, H. A. (1958) Selective perceptions: A note on the departmental identification of executives. *Sociometry, 21,*140- 144

deBono E. (1973). *Lateral thinking: Creativity step by step.* New York: Harper Colophon Books.

Gioia D. A., & Pool, P. P. (1984) Scripts in organizational behavior. *Academy of Management Review, 9,* 449-459

Lyles, M. A. (1981) Formulating strategic problems: Empirical analysis and model development. *Strategic Management Journal, 2,* 61-75

Miles, R. E., & Snow, C. C. (1978) *Organizational Strategy, Structure, and Process* New York: McGraw-Hill.

Perelman, L. J. (1976) *The global mind: Beyond the limits to growth.* New York: Mason/Charter.

Shannon, C. E., & Weaver, W. (1949) *The mathematical theory of communication* Urbana, Illinois: University of Illinois Press.

Smith, P. F. (1980) Urban aesthetics In B. Mikellides (Ed.), *Architecture for People* (pp. 74-85). New York: Holt, Rinehart and Winston.

Zuboff, 5. (1988). *In the Age of the Smart Machine.* New York: Basic Books, Inc.