AN EXPERIMENTAL STUDY OF INFORMATION SEEKING IN THE DECISION PROCESS

by

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B.Sc., University of Victoria, 1972

A THESIS SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

in the Department

of

Psychology

ACCEPTED
FACULTY OF GRADUATE STUDIES
[redacted]
DEAN
DATE 3 May/76

We accept this thesis as conforming

to the required standard

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UNIVERSITY OF VICTORIA

April 1976

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Abstract

A survey of the current literature in the area of decision making reveals several persistent problems, including the lack of a definition of decision. This thesis approaches decision making as a process including information acquisition and processing, rather than as a discrete behaviour occurring subsequent to these events. Two hypotheses derived from the model are tested: that two forces are operating in the decision making process, one toward acquiring information and the other toward choosing one of the alternatives; and that relative valences are preferred in making decisions. Fifty-six undergraduate psychology students, 28 males and 28 females, served as subjects; their task was to assume the role of captain of a space ship and to decide which of two imaginary planets they would colonize, on the basis of information supplied to them by the ship's computer, on request, one item at a time. After each request, they were asked to state which planet they would choose on the basis of their current information about the planets. In one condition, comparable information about the planets was available to the subjects, while in the other it was not, although the subjects expected that it would be; for example, in the comparable information condition, subjects could ascertain the oxygen content of the atmosphere on both planets, while in the non-comparable information condition, information about the oxygen content of the atmosphere was available for only one of the planets. The experimental hypothesis that the order of requests for information (the PATH) would differ from the headings obtained subsequent to each request for information (the LOG) was confirmed; $\underline{t}\ (55) = -6.54$, $\underline{p} < 0.001$, two-tailed. The hypothesis that comparable information would be sought when making a decision was also confirmed; multivariate $\underline{F}\ (12, 43) = 3.158$, $\underline{p} < 0.003$. The results tend to support the conceptual hypotheses and the underlying model. Some implications of the results, and of the usefulness of the approach in the study of decision making are discussed. The difficulty of generalizing from an imaginary laboratory situation to the real world decision situation is also discussed, with the conclusion that, with proper precautions, the use of an imaginary decision is an appropriate and valuable tool for investigating the real-life situation.

Committee Members: Dr. C. W. Tolman [redacted]

Dr. K. C. Quorn [redacted]

TABLE OF CONTENTS

Page

LIST OF FIGURES

ACKNOWLEDGMENTS

Peter M. Cumberbirch, B.Sc., M.Sc., wrote the programs ULYSSES and ODYSSEUS which were used in the experiment; his imaginative use of language helped the subjects enter into the spirit of fantasy required in the experimental setting.

Many persons acted as pilot subjects as the research was in the process of development; their participation and helpful comments were greatly appreciated.

The persons who served as subjects in the actual experiment did so at a very inconvenient time of year; without their willing participation, the experiment would have been a far less pleasant task.

Dr. Janet B. Bavelas supervised the research and stimulated the development of the underlying ideas with insight-provoking questions; her guidance, and that of the other committee members, Dr. C. W. Tolman and Dr. K. C. Quorn, are gratefully acknowledged.

CHAPTER I

THEORIES OF DECISION MAKING: BASIC ISSUES

The thread of decision making is inextricably woven into the fabric of human life. Each day, men and women are confronted by countless decisions, some important and others trivial, some immediate and others with far-reaching consequences. Most people, in looking over their lives, can point to crucial decisions, to decisions wisely made, and to poor decisions. Decision making constitutes an integral part of human functioning, and, as such, has been the focus of a great deal of investigation.

The earliest attempts to formulate principles of decision making were made by the mathematicians who served as advisors to the court of the French king Louis XIV; they were primarily decision making rules of practical applicability, but they led to the development of mathematical probability theory, which has played a critical role in the development of modern decision theories. Such rules or principles for making decisions are typical of what are called normative or prescriptive theories of decision making: they outline (or prescribe) how decisions ought to be made. Most of the current economic, philosophical, and mathematical models of decision making fall into the category of prescriptive theories; ethical systems are a special subset of the normative model. Psychological theories of decision making, on the other hand, tend to be descriptive in nature: they seek to describe the manner in which decisions are actually made rather than how they ought to be made. Prescriptive theories make certain assumptions about the decision maker that are not explicitly required of him in descriptive models: the prescriptive decision maker is presumed to be completely informed, infinitely sensitive, rational, and to maximize something (usually value, or its subjective counterpart, utility) in his choice. Descriptive theories, on the other hand, usually presume (often implicitly) rationality or at least consistency, and maximization or satisfaction, but are not as concerned with complete information and perfect discrimination among alternatives.

Decision theories may also be classified as algebraic or probabilistic; algebraic theories are those which assume that if an individual prefers alternative A to alternative B once, then he will always prefer A to B. Probabilistic theories assume that A is preferred to B with some probability. Algebraic theories are thus a special subset of probabilistic ones, in which the probability that alternative A is preferred to alternative B equals one. Historically, algebraic models preceded probabilistic ones. Edwards (1961) comments on the shift from algebraic or deterministic theories to probabilistic or stochastic ones which had occurred since his earlier review (1954) and notes that the development of stochastic models was an accomodation to the empirical findings of inconsistency and intransitivity. Inconsistency exists when a person who is required to make a choice from the same set of alternatives under the same conditions as a previous choice does not repeat the previous choice. Nonstochastic theories attempt to explain inconsistencies by attributing an error to the individual; stochastic models, by their very nature, are not required to explain inconsistencies.

Intransitivity exists when a person prefers alternative A to alternative B, B to C, and C to A; it has been attributed to conflicting stimulus dimensions (Edwards, 1954) and to random choices between pairs of indifferent alternatives (Edwards, 1961). In any case, violation of the transitivity assumption invalidates the algebraic models. For this reason, modern decision theory places more emphasis upon probabilistic models, which involve instead the assumption of stochastic transitivity. There are different forms of this assumption, usually referred to as strong and weak stochastic transitivity. If the probability that A is preferred to B and the probability that B is preferred to C are both greater than or equal to one-half <u>and</u> the probability that A is preferred to C is greater than or equal to the larger of those probabilities, then the condition of strong stochastic transitivity is said to exist. If the former conditions exist, but the probability that A is preferred to C is greater than or equal to one-half, then weak stochastic transitivity is said to exist. Mathematically, strong stochastic transitivity is said to exist when $p(A,B)$, $p(B,C) \geq 0.5$, and $p(A,C) \geq \max p(A,B)$, $p(B,C)$, and weak stochastic transitivity when $p(A,B)$, $p(B,C) \geq 0.5$, and $p(A,C) \geq 0.5$. Strong stochastic transitivity is often found to be violated in empirical research, while the weaker assumption is more frequently found to exist. Whether or not any form of stochastic transitivity is found seems to depend on the decison situation, especially on the set of alternatives available. The assumption of stochastic transitivity, like its algebraic counterpart, rests on the assumption of human rationality; as we shall see later, this assumption too is often empirically violated, and may be theoretically unclear (that is, rationality may mean one thing in one situation and something quite different in another; see Garfinkel, 1960).

Two further ways of distinguishing among theories of decision making may be mentioned: they may be distinguished on the basis of the method used for specifying preference (simple choice versus ranking) or on the basis of outcomes (certain versus uncertain). The former distinction will not be considered further, except to note that simple choice theories need not meet the previously mentioned criterion of transitivity. The latter distinction, however, is of some interest. Theories dealing with certain outcomes are those in which alternative A always leads to outcome a and alternative B always leads to outcome b. Theories of uncertain outcome are those in which alternative A leads to outcome a_1 with probability x and to outcome a_2 with probability 1 - x, while alternative B leads to outcome b_1 with probability y and to outcome b_2 with probability 1 - y. Note that the probability referred to in the certain-uncertain dichotomy is the probability that a given outcome will result from a person's choice of an alternative, not the probability that a person will select a given alternative. The latter type of probability belongs to the algebraic-probabilistic distinction among theories of decision making which was discussed earlier. A further distinction may be drawn amongst theories of uncertain outcome: those situations in which the probabilities x and y associated with the outcomes are known are referred to as decisions made under conditions of risk; those situations in which the probabilities are unknown are termed decisions made under uncertainty. There is some disagreement about the use of the terms risk and uncertainty in this context. Edwards notes: "There does not seem to be any general agreement about which concept ahould be associated with which word." (1954, p. 391); the usage here follows Edwards. Theories which deal with decisions made under conditions of certain outcome are greatly weakened when applied to situations of uncertain outcome, whether the probabilities associated with the outcomes are known or not; the converse is also true.

Despite the proliferation of theories of decision making, however, there is still no adequate representation of human decision behaviour. Krantz, Atkinson, Luce, and Suppes have noted, in writing about the area of preferential choice (which is considered a subset of the topic of decision making):

> There is no lack whatever of technically excellent papers in this area, but they give no sense of any real cumulation of knowledge. What are the laws of preferential choice behavior? (Since three of the editors have worked in this area, our attitude may reflect some measure of our own frustration.)
>
> (1974, p. xii).

This same critique may be applied to the general area of the study of decision making: there is no lack (perhaps even a surfeit) of technically excellent papers, but there is no sense of a cumulation of knowledge, nor any sense of an insight into the laws governing human decision behaviour. Good (1964) and Tukey (1960) point out that there is not even an explicit and generally accepted definition of what constitutes a decision. Most studies of decision making focus on the final decision, which is assumed to be a discrete behaviour occurring after information acquisition and processing have taken place; other studies have concentrated on the acquisition and/or processing of information carried out before a decision is made. Thus, most models of decision making are at least two-stage models, with research concentrated on one stage or the other; Pruitt (1961) has proposed a four-stage theory. None of the studies, which have sometimes resulted in elaborate mathematical models representing hypothetical weighting schemes, have proven to be an adequate representation, either descriptively or predictively, of the human decision making process. Winkler and Murphy, in commenting upon the interest among psychologists in human decision making behaviour as evidenced by the quantity of research in the area, suggest another reason for the lack of a satisfactory model:

> The research has included a considerable amount of experimental work, much of which has involved purposely simple, artificial situations. Such simple situations are easy to deal with and to explain to typical subjects, and they also possess the advantage of being relatively simple to analyze. However, <u>their very simplicity and artificiality makes the justification for generalizing the results of these experiments to more realistic inferential and decision-making situations questionable</u>. (1973, pp. 252-253, emphasis added).

The uncertainty about the definition of a decision seems to be a major problem. Experiments in decision making have involved situations of judgment, diagnosis, and preference--all of which seem, at least superficially, to be situations in which a decision is required, yet on closer inspection it is apparent that there are qualitative differences in these situations which quite likely affect not only the decisions which are made, but the way in which those decisions are made.

Tukey differentiates between decisions and conclusions; in making this distinction, he notes the lack of a good definition of what constitutes a decision:

> Some of us have read about decision theory, most of us have heard of it, and all of us make decisions. But do we have a clear idea of what a decision-theorist's decision is? Have the books made the essential situation clear? Or have they discussed only the externals of a single formulation? In fact, there has been so little discussion of essentials that I have had to formulate my own idea of what a "decision", in the sense of modern decision theory, really is.
> The decisions of practice are far more nearly of the form "let us decide to act for the present as if" than of the form long conventional in treatments of decision theory--"we accept". The distinction is important and too often neglected. The restrictions "act ... as if" and "for the present" convey two separate and important ideas, ideas which serve to distinguish conclusions from decisions.
> (1960, p. 424).

Tukey further clarifies this distinction between decisions and conclusions. In making decisions:

> Evidence concerning the relative rewards from the alternatives ...(is)... weighed. The consequences in the present situation of various actions (not decisions!) ... are... assessed. We ...(decide)... that in this single specific situation, the particular action that would be appropriate if A were truly greater than B is the most reasonable action to take....Decisions to "act for the present as if" are attempts to do as well as possible in specific situations, to choose wisely among the available gambles.
> (p. 425).

Conclusions, on the other hand, are:

> ... acts whose essential characteristics differ widely from the making of decisions. Conclusions are established with careful regard to evidence, but without regard to consequences of specific actions in specific circumstances.... A conclusion is a statement which is to

> be accepted as applicable to the conditions of an experiment or observation unless and until unusually strong evidence to the contrary arises.
> (p. 425).

Decisions, according to Tukey's definition, appear to be based on underlying and long-lasting conclusions. Careful consideration of some of the experimental investigation of decision making suggests that the tasks which are set for subjects have occasionally been conducive to forming conclusions rather than to making decisions; that is, they involve the subjects' conclusions about the "true" state of nature drawn from the evidence which has been presented to them.

Tukey's remarks serve to pinpoint a second and related problem: the lack of a definition has resulted in research which is focused on the decisions made, rather than on the process of making them. This is true both for the normative theories of economics and for the more descriptive theories of psychology. Although the latter are intended to describe the process by which decisions are made, they are often used in a normative way; that is, the model is used to predict what the person ought to choose, and deviation from the predicted choice is treated as failure of the subject to decide correctly or consistently, rather than failure of the model to predict the person's choice behaviour. The descriptive theories have thus become normative. Wendt (1973) offers several criticisms of normative models of decision making. His most telling argument is the difficulty alluded to before, and discussed in Garfinkel (1960), of understanding rationality. That action which is rational in one situation may be totally irrational in another. Those axioms which lead to rational behaviour under one set of circumstances may not do so under another. Audley (1964) makes a similar point, and raises two other objections to the normative use of theories in psychological research on decision making. In agreement with Wendt, he notes that the normative "rational man" can easily be shown to be a convenient, although misleading, fiction. Audley states that "... rational schemes may sometimes provide a template with which the rational performance ... can be compared." (1964, p. 27). This, as indicated earlier, is what has happened to psychological theories of decision making, which were originally intended to be descriptive, but which have developed normatively. His second objection is that most models of decision making

> ...are concerned with which of several alternatives should or would be chosen, and as a psychological question this is not really part of a study of decision making. The answer to questions of this kind will be found in other areas of psychology, such as learning or motivation, which investigate the basis of an individual's habits and preferences.... In an empirical study of decision making the most important psychological problems concern the actual processes of choice: the gathering and sifting of evidence and the competition of alternative responses.
> (Audley, 1964, p. 27).

In other words, in the psychological study of decision making, it is the process of deciding, not merely the ultimate decision, which should be the focus of attention. Audley's third objection to the normative use of decision models is that "... they are generally very static and make no attempt to deal with the essentially dynamic aspects of human and animal choice." (1964, p. 27).

If our goal is to formulate a truly descriptive theory of decision making (that is, one which describes how people actually behave), then it seems appropriate to abandon, at least temporarily, the concept of rationality. It is not inappropriate to formulate normative theories based on some understanding of rationality; in fact, it seems a commendable aim to design a model which will provide rules or guidelines for selecting the best course of action. But such models have two empirical limitations. The first is that normative models are situation-bound; that is, they apply (or prove to be rational) only in specific and often very limited situations. The second limitation is that they prescribe the best course of action for the "long run" rather than for the individual case; many important decisions in our lives are unique events, and the strategy in the "long run" may not be the appropriate one for the individual case. We must also bear the first limitation in mind in formulating a descriptive model; much of the available experimental evidence suggests, at least indirectly, that the situation plays a major role in determining the way in which decisions are made (Becker & McClintock, 1967; Edwards, 1954, 1961; and Rapoport & Wallsten, 1972).

There are other problems confronting those who study the decision making behaviour of men and animals. Since most theories involve a combination of some type of value concept with some type of probability concept, the most persistent problems are those involving the concepts of value and probability. Very early in the investigation of choice behaviour it became apparent that the value of an object, or even of an amount of money, was not the same for all persons; nor did the value of an object or an amount of money remain the same for a given individual as his circumstances changed. In order to deal with this problem, the concept of subjective value, or utility, was introduced. As an example of the concept, consider the case of a man who, on one day, has no money compared with the same man who, on another day, has a million dollars. In the former state, the utility of $0.20, the price of a chocolate bar, may be considerable, while in the latter state it may be negligible. Edwards and Tversky (1967) define utility as the evaluation of relative attractiveness of alternative states; in the example given, the alternative states for the man in the "poor" condition are those of having no money and of having $0.20, while for the man in the "rich" condition the alternative states are those of having $1,000,000.00 and of having $1,000,000.20. Although the value of the $0.20 remains the same (that is, it will buy a chocolate bar for the "poor" man and for the "rich man), the utility of the money changes as the man's circumstances change; this becomes more apparent if the man is hungry. The measurement of utility has proved to be a thorny problem, first for economists, and later for psychologists who adopted the concept. Even psychophysical methods, which seem to work very well for developing psychological scales for other physical stimuli, do not provide a satisfactory method of measuring utility; utility scales appear to be very individualistic (see Edwards, 1954, for a discussion of the various economic and psychological attempts to find a general measure of utility). Nevertheless, despite the problems involved, the concept of utility seems to be firmly entrenched as a part of modern decision theory. Many of the current theories involve maximization of utility in some form or another.

The second component of many theories of decision making is the concept of probability. Some theories incorporate the objective probability of an event, while others employ the subjective probability. The measurement of objective probability is usually straightforward in the experimental settings in which it is employed, but it is often not possible, or even conceivable, to measure objective probabilities in real situations; it is doubtful, even in experimental settings, that decision makers actually use objective probabilities. Subjective probability presents essentially the same problems that utility does: it is difficult to measure and it appears to be a highly individualistic concept. When the two components of utility and subjective probability appear together, a third problem emerges: the two are confounded; what was a difficult measurement problem becomes one which has not been adequately resolved. (See Becker & McClintock, 1967; Edwards, 1954, 1961; and Rapoport & Wallsten, 1972, for a more detailed discussion of this and other problems of modern decision theory; Edwards, 1954, is a particularly good review of the economic literature on the problems of utility measurement.)

In summary, the problems facing the decision theorist seem formidable. There is a vast literature consisting of economic, mathematical, and philosophical, as well as psychological insight into decision making. There are numerous theories, both normative and descriptive, but there is no cohesiveness, there is divergence rather than convergence, and there is little actual understanding of decision making behaviour. There are the problems of rationality, consistency, and transitivity; the difficulty of measuring utility and subjective probability; and the further problem created by their confounding influence upon one another. There is the difficulty created by the lack of a generally accepted definition of what a decision is, a difficulty which is further reflected in the multi-stage models of decision making and the research which concentrates on one stage (usually on the decision made) rather than on the process of making decisions. There is the problem of creating an experimental setting which is sufficiently complex to justify generalization to real-life decision situations, yet simple enough to permit adequate control of the independent variables and data which are susceptible to analysis. These problems range from theoretical to practical concerns; it appears that what is needed is a complete reconceptualization of the decision making process--one which avoids the problems encountered to date, but which draws on the knowledge acquired by previous research. Such an undertaking is beyond the scope of this paper--it may be, in fact, that the search for a global theory of decision making is an impossible dream, doomed to failure. Instead, this paper will pay particular attention to one type of decision situation, in which a person must decide between two complex alternatives, where he initially has no information about either alternative, but where he can obtain information about both of them; it will also focus on the process of deciding rather than on the final decision.

CHAPTER II

A LEWINIAN APPROACH TO DECISION MAKING

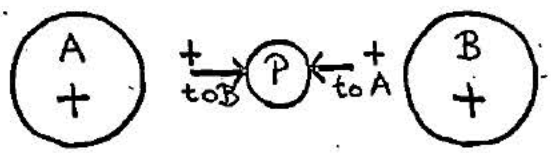
We cannot understand or explain behaviour without some underlying theoretical structure; we cannot observe behaviour without our point of view affecting what we see. We need to be aware of our underlying structure and of our point of view, for they will interact with our observations as we formulate a theory. An approach which seems congenial is that of the Lewinian concepts of life spaces, valences, and conflict resolution (Lewin, 1936). The idea of the life space suggests the possibility of decision regions, and of a path or locomotion through various regions constituting the process of making a decision. The concepts of valence and utility are closely corresponding ideas; Edwards writes:

> The notion of utility is very similar to the Lewinian notion of valence.... Lewin conceives of valence as the attractiveness of an object or activity to a person.... Thus, psychologists might consider the experimental study of utilities to be the experimental study of valences, and therefore an attempt at quantifying parts of the Lewinian theoretical schema.
>
> (1954, p. 389).

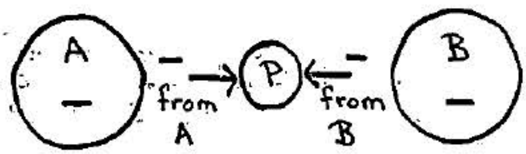
We shall also consider elements of Tversky's elimination-by-aspects model of decision making (1972a, 1972b) for its theoretical contributions concerning complex alternatives.

Within the framework of Lewinian theory, decisions may be construed as the resolution of conflicting forces toward and/or away from the alternatives available. In some (relatively few) cases, this conflict may be of an approach-approach or avoidance-avoidance nature, but in most real-life decision situations, the conflict is of a double (or multiple) approach-avoidance nature (that is, each of the alternatives has both positive and negative characteristics). It is the latter situation, in which the alternatives are complex (that is, composed of more than one relevant characteristic), which is of interest here: it is presumed that decisions are made on the basis of the relative valences of the alternatives, but it is not clear how the positive and negative characteristics interact for each alternative, as well as across alternatives, to produce the final valences.

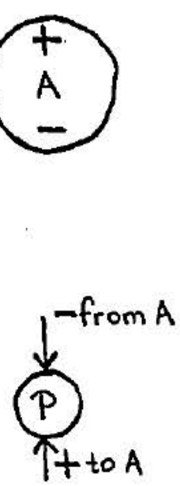
In the simpler approach-approach and avoidance-avoidance situations, the person must choose between two alternatives; these alternatives are positively valenced in the former instance, and negatively valenced in the latter. The valences are considered to correspond to forces acting on the person; when they are positive, the force is exerted in a direction toward the alternatives, and when negative, in a direction away from the alternatives. Conflict is said to exist when two forces act on the person in such a way as to balance each other. Figure 1(a) depicts an approach-approach conflict; Figure 1(b) shows an avoidance-avoidance conflict. An approach-avoidance conflict occurs when an object has positive and negative valences, each of sufficient magnitude to balance the other. In this situation, the individual approaches the object or activity, attracted by the positive valence, only to withdraw, repelled by the negative valence. This situation is shown in Figure 1(c). When there are two objects in the field, each with positive and negative valences, a double approach-avoidance conflict



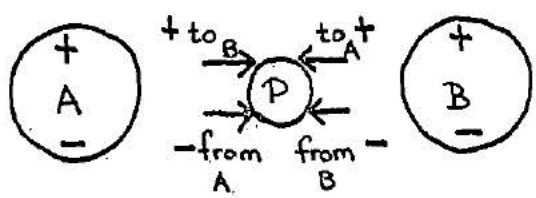
(a) Approach-Approach



(b) Avoidance-Avoidance



(c) Approach-Avoidance



(d) Double Approach-Avoidance

Figure 1. Types of conflict

is said to exist; see Figure 1(d) for an example. What we wish to import into our conception of the decision situation from these ideas about conflict situations is the idea of forces acting on the person, corresponding to the valences of the alternatives. Valence, as we indicated earlier, has a great deal in common with the more familiar decision theory concept of utility.

Tversky (1972b) describes choice as "an elimination process governed by successive selection of aspects" (p. 285); he calls this the elimination-by-aspects (EBA) model. Aspects, in Tversky's model, are the values specific to the alternative of what we have previously called characteristics; for example, if the characteristic were colour, the aspect might be blue. Tversky's model, like so many of the modern decision theories, is formally outlined in the mathematics of set theory, but he also provides a verbal description which is of more value for our purposes. He describes the covert sequential elimination process which constitutes the EBA model thus:

> Suppose that each alternative consists of a set of aspects of characteristics, and that at every stage of the process, an aspect is selected (from those included in the available alternatives) with probability that is proportional to its weight. The selection of an aspect eliminates all the alternatives that do not include the selected aspect, and the process continues until a single alternative remains. If a selected aspect is included in all the available alternatives, no alternative is eliminated and a new aspect is selected. Consequently, aspects that are common to all the alternatives under consideration do not affect choice probabilities.
>
> (1972b, pp. 284-285).

Tversky maintains that his model is closely related to the lexicographic model of Coombs (1964) and Fishburn (1967), in which relevant attributes of the alternatives are ordered prior to making the decision. Tversky's model differs in that "no fixed prior ordering of aspects (or attributes) is assumed" (1972b, p. 285).

Both the EBA model and the Lewinian resolution of conflict approach assume that a person is informed about the alternatives available to him (that is, that a decision occurs after information acquisition and processing). But, as suggested previously, it may be that decision-making is not a discrete behaviour occurring subsequent to information acquisition and processing but a continuous process which influences what information is acquired and how it is processed, which in turn influence the final outcome of the decision process.

We might characterize the decision process as being composed of three adjacent areas of the life space of the person; see Figure 2. The first of these is entered when it is known that a decision is to be made; it might be considered as a region of "getting ready" to make the decision (Bavelas, Note 1). Some information acquisition and processing may occur in this region. The second region might be called the "deciding" region; more information is acquired and processed, the behaviour of vicarious trial and error appears as tentative decisions are made and rejected, and gradually the final decision is made. The third region corresponds to having made the decision; it is termed the "decided" region.

Suppose that a person must choose between two alternatives, A and B; these alternatives are multidimensional, and have both positive and negative characteristics (that is, the possibility exists for a double approach-avoidance conflict to arise). Suppose

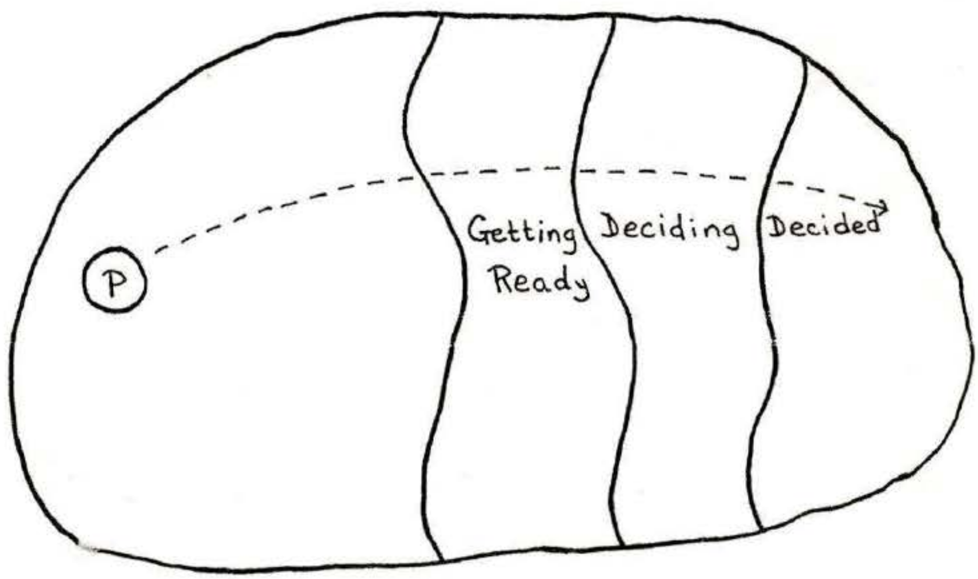
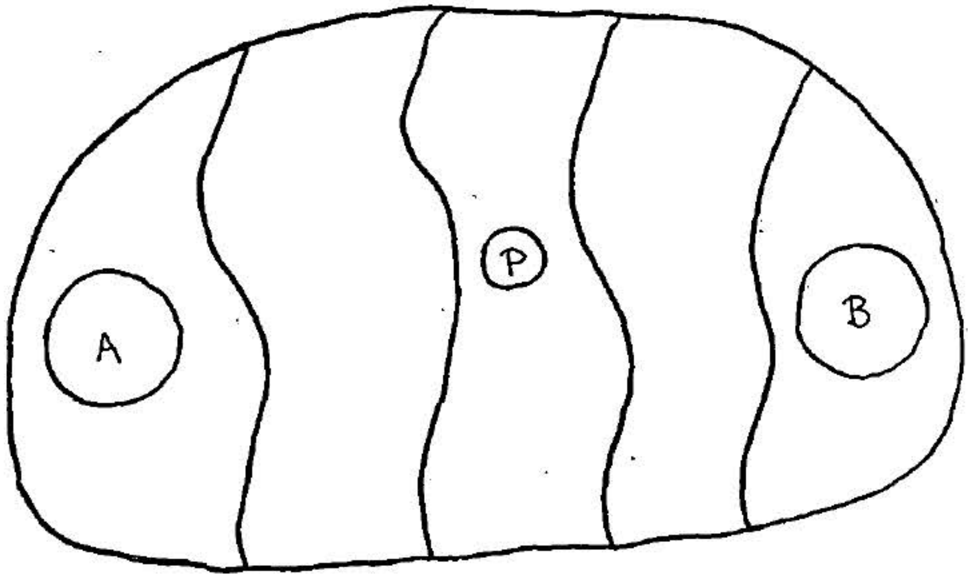


Figure 2. The decision process consists of a path through three adjacent areas of the life space.

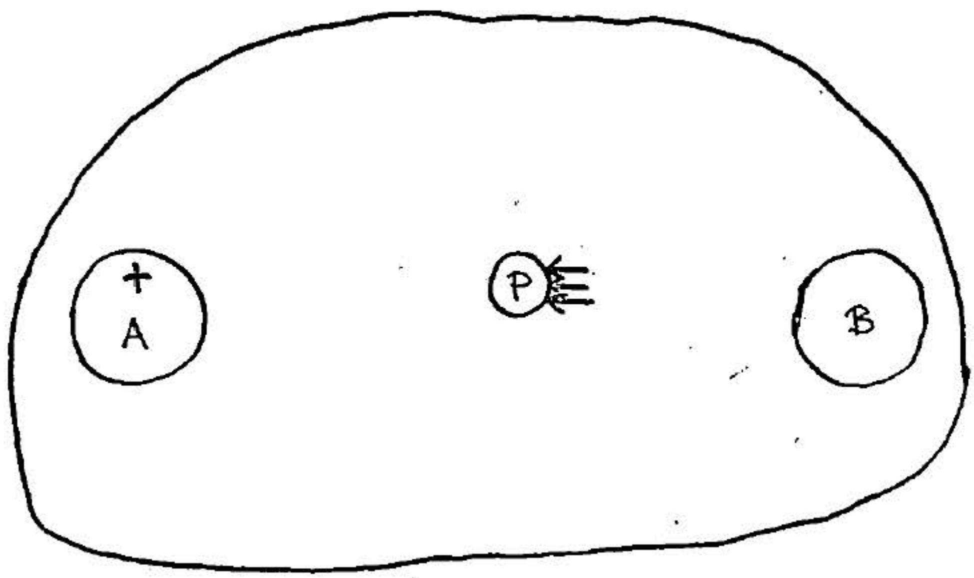
also that, prior to entering the region of "getting ready", the person had no information about A or B, but that information about the alternatives was available. Let us consider what the person might do in making his decision.

One option which is open to him is to choose either A or B blindly, without seeking any information; presumably in this case $p(A,B) = p(B,A) = 0.5$, although for any individual $p(A,B) > p(B,A)$ or vice versa, if the person believes that A is luckier than B, etc.. This situation is not of particular interest, as it depends on idiosyncratic factors, and, in effect, ignores the problem.

Alternatively, the person may seek information about A or B. If the first piece of information he acquires is about alternative A, and is considered positive (that is, favourable to A) then the situation is as shown in Figure 3(b): the valence of A is slightly positive, while the valence of B remains neutral. The positive valence of A corresponds to a force acting on the person in the direction of A. If this were a complete representation of the situation, it would follow that the person would continue to seek information about A as long as it continued to be positive, or as long as the valence of A remained positive (that is, any unfavourable or negative information failed to outweigh the positive). This simple model, however, does not correspond to what happens when people are asked to make choices; in general, they seem to seek information about <u>both</u> alternatives. This suggests that the decision situation is different from a simple conflict situation, that there are other factors than the valences of the alternatives



(a) Before any information is received



(b) After positive information about A is received

Figure 3. Forces acting on the person

operating. One of these seems, on the basis of pilot work, to be an impulse toward what is sometimes termed "rationality", sometimes "fairness"--that is, there seems to be a tendency to require information about both alternatives before a decision is made (or at least, before a decision is finalized). This tendency is fostered by the consumer advocates of modern society, who advise careful evaluation of all available alternatives before purchasing a product, but it seems that this is an explicit expression of an implicit inclination rather than simply a matter of education. What explanation might be offered for this phenomenon?

It might be suggested that the decision situation requires an act of the will, the use of that faculty which separates man from the animals; such rationality is not required in the conflict situation, where the person is not required by the character of the situation to perform an act of reason, but is subject instead to the drives of his animal nature. But such an answer is more poetry than explanation; it answers the question "Why does man behave 'rationally' in a decision situation?" with the reply "Because he is a rational being". The problem lies partly in the use of the word rational, which may have many different meanings; rationality may be reflected in many different behaviours. It has long been apparent that the "rational man" of decision theory is simply a convenient fiction for economists and philosophers--and one which even they are beginning to discard (see Simon, 1959). Garfinkel has listed fourteen behaviours which he calls "the rationalities" (1960, p. 73). One of these behaviours is that of categorizing and comparing, which corresponds to the tendency mentioned earlier to seek information about both alternatives before making a decision. Garfinkel notes:

> It is commonplace for a person to search his experience for a situation with which to compare the one he addresses. Sometimes rationality refers to the fact that he searches the two situations with regard to their comparability, and sometimes to his concern for making matters comparable. To say that a person addresses the tasks of comparison is equivalent to saying that he treats a situation or a person or a problem as an instance of a type. Thereby the notion of a "degree of rationality" is encountered. The extensiveness of a person's concern with classification , the frequency of this activity, the success with which he engages in it are frequently the behaviors meant by saying that one person's activities are more rational than another's.
> (1960, p. 73).

But we cannot explain the apparent rationality of seeking information about both alternatives by appealing to man's rational nature when the irrationality of intransitivity confronts us in so many instances of choice behaviour.

There is, however, an alternative explanation for the observed behaviour of seeking information about both alternatives. Information about alternative A may be positive, negative, or neutral to a given individual; if it is either positive or negative, the valence of A is affected, as are the forces acting on the person. But, in any case, this information tells us nothing about B (we disregard those instances in which A and B are known to be opposites, because in those cases information about A is also information about B), and thereby increases our uncertainty about B; the more we learn about A, the greater our uncertainty about B becomes. This assumes that any aspect of an alternative (for example, that it is blue) is virtually meaningless without comparable information about the aspect of the other alternative on the same characteristic (for example, that it is red). The person may like blue, but he may like another colour even better. Unless the aspect of the alternative under consideration happens to be at one extreme of his preferences--most or least preferred--it cannot be evaluated in isolation from the corresponding aspect of the other alternative. More generally, this assumes that information in a choice situation is always relative, that it is the comparison of A and B on a given dimension or characteristic which is important. Thus, when the person knows that he must decide between A and B, information about A alone, or B alone, is unsatisfactory. If A appears poor, B could be worse; if A looks good, B might be better. As information is acquired about one alternative, uncertainty about the other alternative is increased. This uncertainty creates a force towards learning more about B, which must be differentiated from a force towards B. This (quasi)need to obtain information is essentially what differentiates a decision situation from a conflict situation. In the decision situation two distinct types of forces are operating: forces toward acquiring information about the alternatives, and forces toward (or away from) the alternatives; in the conflict situation only the latter are operating. Cartwright and Festinger (1943) proposed the existence of restraining forces in a judgment situation; these could be differentiated from the driving forces resulting from valences. They write:

> A person usually will not announce his judgment before a given magnitude of difference between driving forces is reached. In any situation which can be set up in an

> experiment, restraining forces are also present which prevent the subject from going off 'half-cocked.' The person wishes to be reasonably certain that he is correct.
>
> (Cartwright & Festinger, 1943, p. 598).

These restraining forces were seen as decreasing as a function of time. The force toward acquiring information which I have proposed is analogous to the restraining force, except that it is considered to be an active force leading the individual to seek information.

It may be noted in passing that a decision situation may become a conflict situation if the cost of acquiring information is too great, or the capacity of the individual to process more information is exceeded; the force toward acquiring more information is neutralized (or counterbalanced) in such situations. Similarly, a conflict situation may become a decision situation if previously inaccessible information becomes available, or a limited processing capacity is increased.

If, as Tversky and others have suggested, decisions are based on a sequential selection of attributes (or aspects, in Tversky's EBA model), it follows that the decision maker expects to know the position of each alternative on a given characteristic or dimension (an alternative could not be eliminated, in Tversky's model, unless its aspects were known). It follows from this that the uncertainty which results when information is given about a characteristic of one alternative produces a force toward acquiring the corresponding piece of information about the other alternative. That is, the uncertainty which results from partial information (information about some characteristic of one of the alternatives) is not reduced by <u>any</u>

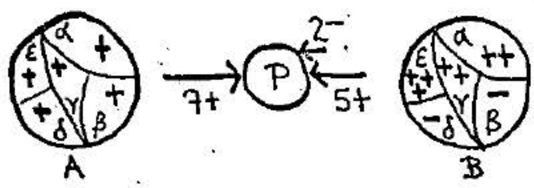
piece of information about the other alternative, but by information about the same dimension. According to this formulation, decision makers ought to prefer decision situations in which comparable information is available about both alternatives, or in which it is possible to obtain such information; similarly, when they are seeking information, they should tend to pursue comparable items of information about each of the alternatives.

Before suggesting an experiment to test this assertion, let us summarize the proposed model of decision making. It is suggested that decision making is not a single, discrete behaviour occurring after information has been obtained and processed, but a process which begins when the decision maker realizes that one of two or more alternatives must be chosen, and ends when one of them has been selected. The actual decision making period is probably preceded by a period of "getting ready", which entails realizing that a decision is to be made and perhaps the beginning of information acquisition and processing, and which may be considered as a period of figure-ground definition (that is, bringing the decision making situation into sharp focus against the background of the other activities of the life space). This figure-ground definition is important, because it brings into play in the decision situation forces which are not active in the simpler conflict situation, namely the forces toward acquiring information about the alternatives, as well as those of the conflict situation, namely the forces of attraction to and repulsion from the alternatives. As information is acquired, it influences the respective valences of the alternatives, but it is the relative valences of the alternatives, rather than their absolute valences, which determine which of the alternatives is chosen. The relative valence is determined by comparing alternatives on as many dimensions as it is possible (or desirable) to obtain a comparison. Where comparable information is not available, the decision becomes more difficult, as the relative valence must be determined by cross-dimensional comparisons. The individual will continue to seek information about the alternatives until his capacity to store and process such information is reached, until the supply of available information is exhausted, or until the relative valence of one of the alternatives is sufficiently strong to move him into the region of that alternative (the "decided" region of Figure 2). I have suggested two parameters governing decision making behaviour: uncertainty, and relative valence (which corresponds to the more familiar notion of utility). Uncertainty creates a force toward acquiring more information; I have suggested that this may be directed at acquiring a very specific item of information. The relative valence creates a force toward one or the other of the alternatives; when the relative valence is zero (that is, the alternatives have equal valences), a conflict situation exists. It is important to remember that we specified complex alternatives, that is, multi-dimensional ones; and that the nature of most real-life conflict situations is one of double approach-avoidance. It is further suggested that the positive and negative attributes of an alternative do not simply sum together to produce a valence for the alternative, which is then compared with the summary valence of the other alternative to create the relative valence. Instead, it is proposed that each piece of information about an aspect of an alternative is compared to the corresponding piece of information about an aspect of the other alternative to provide a relative valence for that characteristic of the alternatives, and that these relative valences combine to create the force towards one or the other of the alternatives.

What I have suggested may be clarified by reference to Figure 4. When the alternatives are considered separately, the forces toward A are equal to the forces toward B (Figure 4(a)); however, when the two alternatives are compared on each aspect, the forces corresponding to the relative valences are not equal--those toward B exceed those toward A (Figure 4(b)). It is important to note, in the situation depicted in Figure 4(b), that the forces acting on the person are not determined by the summation of the valences for each alternative, but by the number of valences of the alternative which exceed the corresponding valences of the other alternative. The force toward an alternative which results when its valence exceeds that of the other alternative is proportional to the importance of the dimension or characteristic under consideration. Note that in Figure 4(b) each dimension of the alternatives is of equal importance.

The situation suggested above is proposed as the ideal one, in which comparable information is available about the alternatives. If such information is not available, it seems likely that the decision will be found to be more difficult, both because of the greater difficulty of weighing non-comparable information and because of the

Alternative A		Alternative B	
Characteristic	Value	Characteristic	Value
α	+	α	++
β	+	β	−
γ	+	γ	++
δ	+	δ	−
ε	+	ε	+++

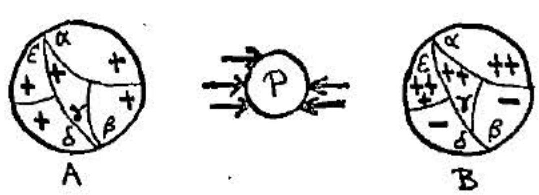


Summary Valence = 5^+ Summary Valence = $7^+ + 2^- = 5^+$

Forces on P: 5 toward A, 5 toward B; resolution: conflict

(a) Alternatives considered separately; summary valence

Alternative A		Relative	Alternative B	
Characteristic	Value	Valence	Characteristic	Value
α	+	+B	α	++
β	+	+A	β	−
γ	+	+B	γ	++
δ	+	+A	δ	−
ε	+	+B	ε	+++



Forces on P: 2 toward A, 3 toward B; resolution: toward B

(b) Comparison by aspects; relative valence

Figure 4. Methods of calculating valence

unresolved uncertainty created by the non-comparable items.

CHAPTER III

METHODS

The experiment described in this chapter was designed to investigate the process of decision making; more specifically, to study how people explore information relevant to a decision under different conditions of information accessibility. Two major criticisms of previous work in decision making were borne in mind as this design was formulated: Tukey's observations (1960) on the lack of definition and the consequent failure to discriminate decisions from conclusions; and Winkler and Murphy's comments (1973) on the problems of generalizing the results of research on decision making to real-world situations because of inadequate or inappropriate designs. The problem of definition remains an issue to be faced by all those whose work may be subsumed under the heading of decision making; this includes those who study judgment, preferential choice, or diagnosis. Since there is no general concensus as to what constitutes a decision, it is important for each researcher to define carefully what constitutes the making of a decision for his particular research. In this experiment, decision making was defined as a process which began when the person learned that he would be asked to choose between two alternatives, continued as he acquired and processed information about the alternatives, and ended when he announced his choice of one or the other of the alternatives. To a certain extent, any decision is based on the formulation of a conclusion, and the decision required by this experiment was not exempt from this interaction. However, insofar as the task was one which required the person to "act for the present as if" (Tukey, 1960, p. 425) it fell within Tukey's definition of making a decision rather than within his definition of drawing a conclusion.

The problem of generality of experimental results is one which confronts all researchers, but it becomes particularly relevant in the situation of decision making, where the parameters of the decision situation are so poorly defined. So much of the experimental work has oversimplified decision making, with the result that the results cannot be generalized to more realistic situations. Although the present research considered only two of the possible parameters, uncertainty and relative valence of the alternatives, the results may be more amenable to generalization because of the less restricted experimental conditions allowed by the adoption of a broader definition of the decision making process, without corresponding loss of experimental control. The warning which applies in generalizing any experimental results to the real world is of paramount importance in research on decision making: the experimental situation must be analogous to a real-life situation to the extent that the results are to be generalized.

The decision making situation which is of interest here is one in which one of two alternatives must be chosen; at the outset the decison maker knows nothing about the two alternatives, but information about them is available to him. In addition, the available alternatives are complex (that is, composed of more than one relevant characteristic), and their characteristics are positive, negative, and neutral. In order to avoid the possibility that differential experience in real-life decision situations (for example, in choosing a car, or in deciding what career to pursue) would influence the results, the experimental decision was an imaginary one, but one which was nontrivial and which might someday arise: the subject was asked to decide which of two planets he would choose to colonize, if he were the captain of a space ship. In order to help him make his decision, information about the two planets was available to him from the ship's computer. This information was available, on request, one item at a time. In one condition, the decision maker had access to comparable information about the two planets (that is, if he knew the size of Planet A, he could learn the size of Planet B), but in the other condition, comparable information about the planets was not available (that is, once the decision maker knew the size of Planet A, he could never discover the size of Planet B). The instructions for the first condition clearly indicated that information about the two planets was ordered in a comparable fashion; that is, if the information about Planet A consisted of items about size, colour of sky, and distance from Earth, in that order, then the items of information about the size, colour of sky, and distance from Earth of Planet B were similarly ordered. The instructions for the second condition, however, suggested that comparable items of information were available but that they were not ordered in a comparable fashion; that is, if the items about Planet A were ordered as described previously, the items about Planet B might be in the order colour of sky, size, and distance from Earth (see Appendix A for the instructions for the two conditions).

Thus, each person in the experiment was presented with a decision making situation in which he had to decide between two complex alternatives about which he initially knew nothing but in which information about both of the alternatives was available to him.

Two conceptual hypotheses were derived from the model presented earlier: (1) that two separate forces are operating in the decision making situation, one driving the decision maker to acquire information about the alternatives, and the other driving him toward choosing one or the other of the alternatives; and (2) that people seek out comparable information about multi-dimensional alternatives in order to use relative valences in formulating their decisions. The first hypothesis was tested experimentally by asking the person to indicate which planet he would choose on the basis of his current information after he had received each piece of information. The order in which he asked for items of information about the planets (his PATH) was then compared with the order of his headings (his LOG). According to the conceptual hypothesis, the PATH and the LOG should be different from each other; more specifically, the ratio of items about the planet which is chosen to the total number of items should be greater in the LOG than in the PATH.

The second hypothesis was tested experimentally by creating two conditions of information accessibility, one in which comparable information was available to the decision maker, and one in which such information was not available when the decision maker was led to believe that it might be. In the former condition, the requests for information should alternate between items, while in the latter there should be clusters or runs of items about one planet, as the decision maker searches for an item comparable to one he has obtained for the other planet. In addition, when asked what further information he would like to have had before finalizing his decision, a person in the comparable information condition ought to ask for general information about both planets, while one in the non-comparable information condition ought to ask questions specific to one planet, directed at obtaining information to match that which he already has about the other planet.

The items of information about each planet were queued so that items of major importance (for example, the oxygen content of the atmosphere, or the purity of the drinking water) were spaced evenly through the queue. The items were also arranged so that the planets were of equal attractiveness when all the items were known. The procedure for organizing the information queues is described below.

Information Queues

Prior to the main experiment, one hundred items describing the two planets were presented in questionnaire form to 24 subjects; these items were randomly arranged with two constraints: no more than three items describing the same planet could appear in sequence, and no comparable items could appear consecutively. Subjects were asked to place each item into one of three categories: desirable characteristics, neutral characteristics, and undesirable characteristics. On the last page of the questionnaire was a list of the 46 dimensions described by the 100 items; the subjects were asked to rate the importance of each dimension on a five-point scale, ranging from "vital" to "trivial". Two of the subjects responded to the latter task in a manner inconsistent with the instructions; their results on this task were discarded. Thus, for the first task, N = 24, while for the second, N = 22. For the format of the questionnaire, see Appendix B.

The importance ratings were considered first. The number of subjects who placed a dimension in either the first or second category of importance (vital information or very important information) was considered the score for that dimension; the scores for all dimensions were then ranked. Five dimensions were found which were rated as important by 20 people or more; one of these dimensions subsumed three descriptive items for each planet, so that the five dimensions of importance corresponded to seven items of description per planet. An item corresponding to one of these dimensions (the oxygen content of the atmosphere) was placed at the beginning of the information queue for each planet, and items corresponding to the remaining dimensions of importance were placed at seven-item intervals in the queues (that is, the first, eighth, fifteenth, twenty-second, twenty-ninth, thirty-sixth, and forty-third items in each queue were considered of importance by at least 90% of the subjects). One of the remaining dimensions, type of star, seemed to be of questionable value, so it was placed at the end of the queue for each planet. The remaining 40 dimensions, which subsumed 42 items for each planet, were divided into six groups consisting of seven items each; the items in each group were of approximately equal rank in importance. Six items were drawn, one from each of the groups, and these items, in a randomly assigned order, were placed after Item 1; a further six items were drawn as before, and placed after Item 8, again in a randomly assigned order. This procedure continued until all the places in the information queues had been filled. The only constraint on the items so placed in the queues was that the sum of the importance scores for all groups of dimensions should be the same.

After the order within the information queues had been established, the ratings of attractiveness were checked to ensure that the planets were equivalent. The sign of an item was determined by the category into which the greatest number of subjects placed it; those which fell in the desirable category were considered positive, those which fell in the undesirable category were considered negative, and the remainder were considered neutral. Initially there was a slight imbalance, but after exchanging two items descriptive of Planet A for two descriptive of Planet B, a balance of relative valences was obtained between the two information queues; see Appendix B. For the information queues obtained by this procedure, see Appendix C.

The Experiment

Subjects

The experimental subjects were 59 undergraduate psychology students at the University of Victoria; 29 were males and 30 were females. Three subjects had to be dropped from the experiment because of technical errors which caused the computer program to terminate prematurely. This left 56 subjects, 28 males and 28 females. None of the people who filled out questionnaires participated in the experiment.

Programs

Two APL programs were written for this experiment by P. M. Cumberbirch; one, ULYSSES, provided comparable information about the two planets, and the other, ODYSSEUS, did not. Except for the difference in information presented, the wording of the two programs was identical; that is, the language which the computer used to interact with the subjects was the same in both cases. Also, no matter which planet the subject asked about first, he always received the same item of information: "The oxygen content of the atmosphere is 16%; the remainder is constituted by inert gases. (Earth's atmosphere contains roughly 21% oxygen.)". Appendix D contains flow charts for the two programs, copies of the programs, and sample printouts for each of them.

Procedure

The subjects were assigned to one of the two conditions of information accessibility in randomized blocks by sex, thereby ensuring an equal number of males and females in each condition. Each subject had the same task: to assume the role of captain of a space ship carrying colonists to a new planet, and to decide which of two planets to colonize. The subjects initially knew nothing about the two planets, except that they were designated A and B; they were informed that the ship's computer contained information about the two planets which it would supply, on request, one item at a time. This information was stacked in queues for the two planets, as described earlier. The instructions for the comparable information condition indicated that comparable items of information were available at corresponding locations in the queues; that is, if the first item in the A-queue was the size of the planet, the first item in the B-queue was the size of Planet B; see Appendix A. The instructions for the non-comparable information condition indicated that, while comparable items of information were available, their locations in the queues were not corresponding; that is, if the first item in the A-queue was the size of Planet A, the first item in the B-queue might be the colour of the sky on Planet B, and the size of Planet B might be somewhere else in the queue; see Appendix A. In fact, however, comparable items of information were not available to the subjects in this condition.

The experiment was run on an APL terminal connected to the University of Victoria computer; this added a note of authenticity to the experimental situation as well as minimizing the influence of the experimenter on the subjects. Each subject was asked to read the instructions while the experimenter established contact with the computer and loaded the appropriate program: ULYSSES for the comparable information condition, and ODYSSEUS for the non-comparable information condition. After the subject had read the instructions, the experimenter reviewed some aspects of operating the terminal and answered any questions raised by the subject. When all questions had been answered and the subject appeared sure of the procedure, the appropriate program was started. Appendix D gives sample printouts for the two programs. In essence, the subject was asked to give his name, and then to request an item of information about either planet.

After he received the information, he was asked to enter in the Ship's Log his heading; that is, which planet he would choose to colonize on the basis of his present state of knowledge. Then he was asked whether or not he wished more information about the planets; if he answered "Yes", he was asked about which planet he wished the information, and so on. This procedure continued until he answered "No"; then he was asked to state which planet he wished to colonize, and the program terminated.

Following this, the experimenter asked the subject to recall as much as possible about the two planets; which items or dimensions were most important in making his decision; and what other information he would have liked to have had prior to making his decision.

These questions concluded the experiment. At this point, the experimenter offered to answer any questions posed by the subject, and debriefed him to the extent of his interest.

Results

Dependent Variables

Twelve dependent variables were obtained from the data; some of these were intended to test specific hypotheses, while others were included for the purposes of post hoc investigation.

Three of the measures were derived from the order in which the subject requested information (that is, his PATH). The first was simply the number of items of information requested (N); the second was the ratio of the number of items requested about the chosen planet to the total number of items requested (PC/N); and the third was the ratio of the number of runs (that is, strings or clusters of one denomination; for example, AAA and BBBBB each constitute one run, while AABBABA constitutes five runs) to the total number of items (PR/N).

Two measures were derived from the headings recorded in the Ship's Log; these are analogous to PC/N and PR/N, and are labelled LC/N and LR/N. LC/N was the ratio of the number of headings toward the chosen planet to the total number of headings in the LOG (this number corresponds to the total number of items requested, since subjects were required to make an entry in the LOG after each piece of information was received). LR/N was the ratio of the number of runs of headings to the total number of headings.

High scores on PC/N or LC/N indicate that a high proportion of the requested items or headings were about the planet which was eventually chosen; low scores indicate a high proportion of items about the non-chosen planet.

High scores on PR/N or LR/N indicate short runs and frequent alternation between planets; a score of 1.00 indicates alternation at each item (that is, ABABA, etc.). Low scores, conversely, indicate that items tend to appear in runs or clusters; a score of 1/N indicates that only one item appears in the PATH or LOG, as the case may be (that is, AAA or BBBBB).

A sixth dependent variable was the number of items recalled about the planets relative to the number requested (#R/N); a seventh variable (#A/#R) accounted for the number of items recalled accurately (that is, for the correct planet) relative to the number recalled. In the former case, a high score indicates a high proportion of information recalled, while a high score for the latter variable indicates accurate recall.

The eighth and ninth dependent variables were derived from responses to the question regarding further information subjects would have liked before finalizing their decisions; the eighth variable was the number of questions directed at acquiring specific information about one planet relative to the total number of questions asked (#C/T), and the ninth was simply the total number of questions (T).

The tenth measure was a bi-valued variable indicating which planet was finally selected for colonization; a score of 1 indicated that the planet chosen was the one about which information had first been requested (the planet on which the oxygen content of the atmosphere was 16%), while a score of 2 indicated that the other planet had been chosen (the planet on which the oxygen content of the atmosphere was 24%).

The eleventh and twelfth measures were variables indicating whether recall (RD) and accuracy (AD) were better for the chosen planet or for the non-chosen planet. RD was calculated by dividing the ratio of the number of items recalled about the chosen planet (#RC) to the number of items requested about the chosen planet (NC) by the ratio of the number of items recalled about the non-chosen planet (#RR) to the number of items requested about the non-chosen planet (NR). That is,

$$RD = \frac{\#RC/NC}{\#RR/NR}.$$

AD was calculated by dividing the ratio of the number of items accurately recalled about the chosen planet (#AC) to the number of items recalled for the chosen planet (#RC) by the ratio of the number of items accurately recalled about the non-chosen planet (#AR) to the number of items recalled for the non-chosen planet (#RR). That is,

$$AD = \frac{\#AC/\#RC}{\#AR/\#RR}.$$

When RD or AD was greater than 1.00, recall or accuracy was greater for the chosen planet; when RD or AD was equal to 1.00, recall or accuracy was equal for the two planets; and when RD or AD was less than 1.00, recall or accuracy was better for the non-chosen planet.

Statistical Hypotheses

The conceptual hypothesis that two different forces are operating in a decision making situation was represented in the experimental setting by the hypothesis that the subject's PATH through the information is different to the headings in his LOG. A preliminary test of this hypothesis may be made by comparing PC/N and LC/N for all subjects; if the hypothesis that the PATH and the LOG are evidence of the activity of different forces is true, then the proportion of items about the chosen planet should be different for the PATH and the LOG. A *t*-test for correlated means (McNemar, 1969, pp. 113-114) is the appropriate statistical technique for this analysis.

The conceptual hypothesis that people prefer to use relative valences in making decisions was represented in the experimental setting by the hypothesis that people will tend to seek out comparable information when they are confronted with a decision making situation.

Three tests of this hypothesis may be made in the present situation. First, the degree to which comparable information is sought is reflected by alternating between planets in requesting information in the comparable information condition, but by searching through runs of items in the non-comparable information condition. A comparison of the two groups on the variable PR/N should reflect this difference; PR/N for the comparable condition should be greater than PR/N for the non-comparable condition. Second, if the subjects in the non-comparable condition are looking for an item about the second planet to match one which is known about the first, they ought to process fewer of the items in the runs; that is, more items should be recalled in the comparable than in the non-comparable condition. This may be tested by comparing #R/N for the two groups; #R/N for the comparable condition ought to be higher than #R/N for the non-comparable condition. Third, seeking after comparable information ought to be reflected in the number of specific, single-planet questions asked at the conclusion of the experiment; this would be found by comparing #C/T for the two groups. If the model which serves as the basis for this experiment is correct, then #C/T should be greater for the non-comparable than for the comparable condition.

These three hypotheses may all be tested by one-tailed *t*-tests for correlated means; however, since the total number of variables in the experiment is large, and since some of the variables may be correlated, a more conservative procedure is to use a multivariate analysis of variance, followed by univariate *F*-tests if the multivariate test is significant (Harris, 1975; Hummel & Sligo, 1971).

Analysis

The *t*-test for correlated means on the variables PC/N and LC/N was significant, $t\ (55) = -6.54$, $p < 0.001$, two-tailed. The significance of this test suggests that the PATH and the LOG are different from each other; inspection of the mean values for the two variables ($\overline{X}_{PC/N} = 0.58$, $\overline{X}_{LC/N} = 0.81$) suggests that the number of items requested about the chosen planet tends to be just slightly higher than the number requested about the non-chosen planet (58% to 42%), while the number of headings toward the chosen planet tends to be considerably higher than the number of headings toward the non-chosen planet (81% to 19%). That is, there seems to be a tendency to seek information about both planets, even though a preference for one planet is indicated. This evidence supports the hypothesis that there are two separate forces operating in a decision making situation, one toward acquiring information about the alternatives, and one toward selecting one of the alternatives.

The procedure of multivariate analysis of variance followed by univariate tests described previously was used to test the remaining hypotheses. This technique was carried out on the IBM 370 computer at the University of Victoria, using Clyde's program (1969) for multivariate analysis of variance adapted to be run on this facility.

The multivariate test of the information condition was significant, $F\ (12, 43) = 3.158$, $p < 0.003$. The information condition accounted for 46.8% of the total variance. Univariate tests of PR/N, #R/N, and #C/T were also significant; $F_{PR/N}\ (1, 54) = 6.503$, $p < 0.014$; $F_{\#R/N}\ (1, 54) = 4.294$, $p < 0.043$; $F_{\#C/T}\ (1, 54) = 24.133$, $p < 0.001$.

For these variables, the information condition accounted for 10.8%, 7.4% and 30.9% of the total variance, respectively.

The significance of the multivariate analysis of variance suggests that there are differences in behaviour between the two conditions of information accessibility. More specifically, the two experimental groups differ in the way they gather information (PR/N), the proportion of information they remember (#R/N), and the type of questions they ask at the conclusion of the experiment (#C/T).

The mean scores on the variable PR/N were 0.61 for the comparable information condition and 0.45 for the non-comparable condition. The higher score in the former group indicates a greater tendency to alternate between items in seeking information; the lower score for the latter group indicates a tendency to seek items of information in clusters for each planet. This result confirms the experimental hypothesis that such alternation and clustering of items would occur in the two groups, but, by itself, does not confirm that the reason for the alternation and clustering is the desire for comparable information.

The mean scores on the variable #R/N were 0.67 for the comparable condition and 0.55 for the non-comparable condition. Recall of items was thus greater in the comparable information condition than in the non-comparable condition. This difference is again in the direction predicted by the experimental hypothesis, but, as with the previous result, does not confirm the proposed underlying mechanism; that is, one must not jump to the conclusion that people recall fewer items in the non-comparable condition because they are searching for comparable items of information and hence failed to process a number of items they received.

The mean scores on the variable #C/T were 0.11 and 0.58, for the comparable and non-comparable conditions respectively. This result confirms another experimental hypothesis: the proportion of specific questions, directed at obtaining information corresponding to items already encountered for the other planet, was far greater for the non-comparable condition than for the comparable condition. This also offers support to the proposal that relative valences are part of the mechanism underlying the search for information in a decision making situation.

Taken together, the results for these three dependent variables strongly suggest that comparing information is an important part of the decision process. The sequence in which people asked for information, their differential recall, and their post-experimental inquiries are behaviours which are consistent with the relative valences hypothesis and with the proposed search for comparable information.

CHAPTER IV

DISCUSSION

The experimental results tend to confirm the research hypotheses, and, by extension, provide support for the conceptual hypotheses and the underlying model. The data suggest that there are two separate forces operating in a decision making situation, and that people seek to make decisions on the basis of comparable information about the alternatives or, in the terminology of the Lewinian conceptual framework outlined earlier, by using a method of relative valences. This experiment provided only a preliminary test of the model, which requires further investigation and development; for example, do people seek comparable information when more than two alternatives are given? The results, however, have several implications for the further investigation of descriptive models of decision making.

First, the experimental findings strongly suggest that decision making should be studied as a process including information acquisition and processing rather than as a discrete behavioural event occurring subsequent to information gathering. This means abandoning the current multi-stage models in favour of a more holistic approach.

Second, the finding that people seek out comparable information has implications for the type of information provided in research settings, and, beyond that, for the use of concepts like valence and utility. If the concept of relative valence is justified, as both the experimental results and the common sense definitions of rationality suggest, then information about one dimension of an alternative has little value unless information about that dimension is available for the other alternative. The process by which decisions are made when comparable information about the alternatives is not available is a matter for speculation and investigation; certainly, in the present case, when people thought that such information might be available, they went looking for it. This suggests that the utility of a given item of information may be relative rather than absolute; that is, for any given item, the utility may depend much more on the item with which it is compared than on the absolute intrinsic value of the item. This relativity of utility is explicit in its definition (Edwards & Tversky, 1967), but it does not seem to have been translated into the empirical use of the concept. The concept of relative valence is reinforced in our culture by consumer advocates who advise comparison of various alternatives on many dimensions; and by advertisers, who compare the aspects of their product with those of their competition, choosing those attributes for which the relative valence is toward the advertised product. Relativity is further reflected in our humour: "How do you like your wife?" "Compared to what?".

While it is often impossible to gather information one piece at a time so that the relevant aspects of the alternatives can be considered as a unit, it seems likely that the information, however acquired, is processed in this way. That is, while we may learn that A is red, sweet, and costs 20¢, and that B is tart, costs 40¢, and is blue, in that order, we probably process this information as red versus blue, sweet versus tart, and 20¢ versus 40¢. This has obvious implications for advertising. If people make decisions by this comparative process, then it seem more sensible to advertise that A is red while B is blue, A is sweet while B is tart, and A costs 20¢ while B costs 40¢ rather than listing all A's characteristics followed by B's characteristics--or than simply listing A's characteristics.

Much more research needs to be done before the model presented here could be said to be an adequate and accurate description of human decision making behaviour in the given setting. One possible extension has already been mentioned: the situation in which there are more than two alternatives to evaluate in making a decision. There are many other questions which might be investigated: under what conditions does the present model apply? what happens to the decision making process when the decision maker knows that comparable information is not available? do relative valences operate differently in non-comparable information settings, or is some other mechanism involved?

It might be argued that the imaginary decision required in this experiment was not representative of real world decisions simply because it was imaginary. It is always possible that this is so, and care must be taken that the results of the experiment are not generalized to a situation in which they do not apply; however, various arguments may be offered in favour of using an imaginary setting in experimental work. First, an imaginary setting minimizes the effect of differential experience in actual decision making; people who have already bought a car may behave differently to those who have not in an experiment where the decision is which of two cars to buy. Second, an imaginary setting allows an experimenter to investigate a nontrivial decision situation, which might not be amenable to more realistic investigation for financial or ethical reasons. Third, Barker (1946) found that subjects who made hypothetical choices (that is, indicated what their choice would be if the opportunity for a choice were provided) exhibited the same behaviour and made similar choices to subjects who made "real" choices. Thus, for both theoretical and practical reasons, the use of an imaginary setting seems justified in studying decision making behaviour, and the generalization of the results to real-life decision making appears to be valid.

Finally, the experimental results provide empirical evidence that the common sense sort of rationality is operating in a decision making situation; however, whether the activity of seeking comparable information accurs because it is considered to be rational, or whether the behaviour is considered rational because it occurs so prevalently is a question which remains to be answered.

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APPENDIX A

INSTRUCTIONS

1. Comparable Information Condition

This experiment is designed to investigate the way in which people make decisions when they start with no information, but have the opportunity to obtain information about the available alternatives. Philosophers, economists, mathematicians, and psychologists have been studying how people make decisions for a long time: some of the earliest work in decision making was done by the mathematicians in the court of the French king Louis XIV. While philosophers, economists, and mathematicians tend to be interested in how people ought to make decisions, psychologists are more interested in how people do make them. Very little is known about the processes by which people actually do make decisions. The purpose of this study is to further explore these processes. Since very little is known about how people make decisions, it follows that we cannot say if there is a right or wrong way to make them; your decision making process may be very different to that of another person, but we do not know and are not concerned with knowing if one way is better than another. It is important for the purposes of this study, then, that you go about making your decision in the way that is best for you, without concern for making it in the "right" way. I have used an imaginary situation (the choice between two planets) rather than a more realistic one (for example, the choice between two cars) so that all those who participate in this experiment will start with the same information about, and experience of, the situation.

Imagine that you are the captain of the spaceship Ulysses, which will be taking the first group of colonists to a new home on a far distant planet. As captain of the ship and leader of the expedition, you are responsible for choosing which of two planets this group will colonize--and your decision, once made, is final; once the Ulysses has landed on a planet, it cannot leave.

To help you make your decision, information about the two planets is available from your computer. This information was obtained by space probes sent to each of the two planets. You may receive this information by requesting the computer to tell you about Planet A or about Planet B; at each request the computer will print out one item describing some characteristic of whichever planet you have requested. This information is "stacked up" in queues for Planets A and B. Since the probe sent to Planet A was identical to the probe sent to Planet B, comparable information is available about the two planets; that is, if you receive a piece of information regarding the size of Planet A, you will find the corresponding piece of information about the size of Planet B at the same location in the queue. For example, if the information were stacked as shown below, and you requested a piece of information about A, another piece of information about A, a piece of information about B, a third piece of information about A, and another piece of information about B you would receive the information in the order A1, A2, B1, A3, B2.

"A" Queue	"B" Queue
1. Size of Planet A	1. Size of Planet B
2. Colour of A's sky	2. Colour of B's sky
3. Distance to A from Earth	3. Distance to B from Earth

After you have received each piece of information, enter in the Log the heading on which you would steer the ship if you had to decide on the basis of your current information. This heading, or direction, does not commit you to choosing that planet; it merely indicates which planet you would choose if no more information were available.

You may then request another item of information about <u>either</u> planet, or, if you wish, state your final choice of a planet.

Please note that you need not alternate your requests for information between planets (that is, ABAB, etc.); neither the previous request nor the present heading needs to influence your request. You cannot request specific information (for example, you cannot ask "What is the colour of the sky on Planet B?", or "Give me information B3."); you may simply request information about one planet or the other, and you will receive whatever information is next in that queue.

Terminal Operating Instructions

I will establish contact with the computer for you; after that you will "talk" to the computer by typing your messages on the terminal keyboard. First the computer will ask you for your name;

you may use your own name, your student registration number, or an alias. Type your name on the terminal keyboard, but do not use the SHIFT key; this keyboard produces only capital letters, and does not require use of the SHIFT key. After entering your name, depress the RETURN key, located at the right-hand side of the terminal. Next, the computer will ask you about which planet you wish to receive a piece of information; enter either an "A" or a "B", and depress the RETURN key. The item of information you have requested will be printed out for you, and the computer will then ask you to enter your present heading in the ship's Log (which is stored in the computer's memory banks). This entry will be either an "A" or a "B", depending on whether you would choose A or B if there were no more information available. Remember to depress the RETURN key after your entry. Then the computer will ask you if you want more information; if you do, type in the word "YES", depress RETURN, and follow the procedure just described for requesting information and entering your heading in the ship's Log; if you do not want more information, type in the word "NO", and depress RETURN. The computer will then ask you which planet you wish to colonize; enter an "A" if you have decided on Planet A or a "B" if you have decided on Planet B. After you have entered your decision in the computer, it will set a suitable course to the chosen planet for you. At this point I will have some brief questions for you to answer, and these will conclude the experiment.

If you have any questions about the procedure at any time during the experiment, please ask them. Are there any questions before we begin?

2. Non-Comparable Information Condition

The instructions for this condition were identical to the instructions for the comparable information condition, with the exception of the paragraph beginning "To help you make your decision", which is found on page 57. The sample information queues were also different. The following paragraph and sample information queues were used in the non-comparable information condition.

To help you make your decision, information about the two planets is available from your computer. This information was obtained by space probes sent to each of the two planets. You may receive this information by requesting the computer to tell you about Planet A or about Planet B; at each request the computer will printout one item describing some characteristic of whichever planet you have requested. This information is "stacked up" in queues for Planets A and B. Although the probes sent to Planet A and Planet B were identical, they did not encounter the required information in the same sequence. Consequently, the first piece of information about A does not correspond to the first piece of information about B; that is, if you receive a piece of information regarding the size of Planet A, you might find a piece of information about the colour of B's sky at the same location in the queue. For example, if the information were stacked as shown below, and you requested a piece of information about A, another piece of information about A, a piece of information about

B, a third piece of information about A, and another piece of information about B, you would receive the information in the order A1, A2, B1, A3, B2.

"A" Queue	"B" Queue
1. Size of Planet A	1. Colour of B's sky
2. Colour of A's sky	2. Size of Planet B
3. Distance to A from Earth	3. Distance to B from Earth

APPENDIX B

QUESTIONNAIRE AND ITEM RATINGS

1. Questionnaire

Listed below are 100 items which describe imaginary planets. Imagine that you are the captain of a space ship searching for a planet on which to found a colony. Indicate for each item how you rate the quality described; if the characteristic is one which you think is desirable if a colony is to be founded on the planet, mark a "+" beside the number of the item; if the characteristic is one which you think is undesirable, mark a "-" beside the number of the item; and if the characteristic is one which you find neither desirable nor undesirable, mark a "0" beside the item number.

1. The atmosphere on this planet is exceptionally dust-free; visibility is much greater that on Earth, to the extent that a new sense of distance may be necessary.
2. Although bacteria and viruses abound in the indigenous life forms, they are not incompatible with human life.
3. This planet has no moon, but is orbited by a ring of rocks and dust not unlike the asteroid belt of Earth's solar system.
4. Irregularities in the planet's orbit about its sun produce certain eccentricities in electromagnetic activity; to date, no way has been found to predict when these will occur.
5. There is almost never any wind of sufficient magnitude to cause extensive damage on this planet.

6. This planet is rich in deposits of iron, copper, zinc, and tin; there are also rich lodes of natural uranium.
7. There is very little life in the ocean, most of it limited to the coastal regions.
8. This planet has a wide bane of tropical climate around its equator.
9. The surface of this planet is somewhat spongy.
10. Plant growth is controlled by cross-fertilization carried out by birds and insects; the growth period extends over 2.5 planet years, but at any moment in that period, some growth is ready for harvesting.
11. The sole land mass appears to shift position during each revolution of the planet around its sun.
12. The period of rotation of the planet (that is, one planet day) is equivalent to 20 Earth hours.
13. The soil of this planet contains many nitrates, and useful amounts of calcium.
14. One of the birds on this planet lays eggs which are edible, rich in protein, and have a flavour like Brussels sprouts; the birds are numerous and their eggs plentiful.
15. There are several areas of gently rolling hills which may once have been mountain ranges; the rivers are broad and shallow.
16. The oxygen content of the atmosphere is 24%; the remainder is constituted by inert gases. (Earth's atmosphere contains roughly 21% oxygen.)
17. This planet has a narrow tropical region, but broad temperate zones.

18. Peculiar atmospheric conditions limit radio communication on the surface of the planet.

19. There are frequent tremors felt at the surface of the planet, indicating intense seismic activity.

20. The water in the rivers is fit for human consumption, but leaves a subtle aftertaste.

21. Some species of animals on this planet appear to have highly organized social structures, similar to the ants and bees of Earth.

22. This planet is slightly larger than the Earth.

23. The surface of this planet is very hard.

24. One of the plants on this planet bears fruit of a very attractive colour and smell; uncooked it is toxic, but cooked it is edible and tasty.

25. Roughly two-thirds of the planetary surface is covered with water.

26. Because this planet is not tilted on its axis as the Earth is, there are no changes of season; one area has constant summer, another constant spring or fall.

27. Nowhere on the planet does the temperature drop below -10° C or climb above 20° C.

28. Very few stars are visible from this planet.

29. This planet has seasons like Earth's, except that autumn and spring are extended in relation to winter and summer.

30. Some species of animals on this planet appear to be organized into extended family groupings.

31. This planet is covered by a thick layer of cloud much of the time.

32. This planet revolves around its sun once in every 320.5 days; that is, one planet-year equals 320.5 Earth days.

33. The force of gravity on this planet is equal to 0.67 times the force of gravity on Earth.

34. This planet is the only satellite of its sun.

35. This planet's star is what is known as a red dwarf, or Type M star.

36. There are no purple or red objects on this planet; the colours which may be seen range from a deep orange to violet.

37. This planet is somewhat smaller than the Earth.

38. Peculiar conditions in the ionosphere prevent communication outside the system.

39. This planet is the fifth satellite of its sun, in a twelve planet system.

40. Several species of feline creatures are indigenous to the planet; these appear to be small and placid.

41. There are several species of kangaroo-like animals on this planet; one such species appears to be of sufficient size and gentleness that it might be used as a mode of transportation.

42. The polar ice-pack on this planet is permanent and changes very little from year to year; there are very few ice-bergs.

43. Only during one season of the year do clouds appear in any number.

44. The largest species of indigenous fauna appears to be docile, slow-moving, and extremely stupid.

45. While none of the plant life appears to be useful for construction purposes, it could be used to provide material for clothing.

46. One of the insects on this planet produces a fine thread not unlike that of a spider, but much stronger and more durable; in large quantities it could be used to make cloth.

47. There are frequent "meteorite showers" in the vicinity of this planet; however, it is very rare for any of the particles to penetrate through the atmosphere to the surface of the planet.

48. There is a comet which orbits this planet once every 45 Earth-years; approximatly every fifth orbit, the planet passes through the tail of the comet, but no damage is done.

49. From space, this planet appears to be slightly flattened at the poles, with a bulge at the equator.

50. Approximately three-quarters of the planetary surface is covered with water.

51. More stars are visible to the naked eye from this planet than are visible from Earth.

52. Sound waves travel slightly faster on this planet than they do on Earth; most sounds have a sibilant quality to them.

53. The surface of the planet is marked by several young mountain ranges, and occasional deep crevices.

54. The natural vegetation on this planet is edible, but has no nutritional value for human beings.

55. The period of rotation of the planet (that is, one planet-day) is equivalent to 37 Earth hours.

56. The natural vegetation on this planet is highly toxic when ingested by human beings.

57. There are numerous deposits of coal on this planet; these could be

mined easily and safely, and would provide an inexpensive source of power.

58. This planet has two moons; it is very rare to have a night on which one or the other is not visible.

59. The oxygen content of the atmosphere is 16%; the remainder is made up of inert gases. (Earth's atmosphere contains roughly 21% oxygen.)

60. From space, this planet appears deep green in colour, with areas of blue and tan.

61. One of the birds on this planet has a call which resembles the bark of a dog.

62. One of the native flowering plants on this planet produces large showy flowere in a variety of brilliant colours.

63. There are no life-forms on the planet at the present time which appear to have an equivalent-to-human intelligence, but ruins and fcssil remains suggest that a complex civilization once existed here.

64. This planet has a gravity which is equivalent to 1.7 times that of Earth.

65. The river water must be chemically treated before it is fit for human consumption.

66. Sunspots on the star of this planet periodically produce violent perturbations of the planet's magnetic field; these occur at predictable intervals.

67. There is an insect species on the planet which apparently communicates by whistling; each individual insect can be identified by

its whistle.

68. There are large numbers of easily accessible precious stones on the planet, but they are generally hidden in formations similar to the so-called "thunder eggs" of Earth.

69. There are several geysers on the planet; these erupt with considerable force, but at predictable intervals.

70. Several of the insect species communicate by means of frequencies within the visible spectrum; sometimes very colourful displays can be seen.

71. Although there is no evidence of the presence of intelligent life forms on the planet at this time, there appear to be artificial structures on its surface.

72. There are several varieties of wingless birds on this planet, some of which are very swift; it is possible that they could be used as a means of transportation..

73. There is intense volcanic activity on this planet.

74. This planet's star is a blue-white star, or Type F star.

75. There is very little naturally occurring radioactive material on this planet; there are, however, large deposits of lead, iron, molybdenum, and bauxite (from which aluminum is extracted).

76. In certain areas of this planet, large caverns are found; in these caves are a variety of interesting "geological" formations similar to the stalagmites and stalactites of Earth.

77. There are a variety of life-forms in the ocean, some of which live at great depths.

78. From space, this planet appears deep blue in colour, with several

areas of orange and scarlet.

79. There is a carnivorous form of plant life on the planet, but it does not appear to be dangerous to human life.

80. There are four large land masses on this planet, as well as scattered island groups.

81. There are a large number of naturally occurring crystal formations on the planet; when crystals of various colours are found together, their appearance is quite breath-taking.

82. During 4 months of the year, brilliant electrical displays, similar to the Northern Lights of Earth, are visible from the Northern Hemisphere.

83. A variety of species of small creatures are indigenous to the planet; some appear to be predatory and ferocious.

84. This planet revolves around its sun once in every 1032 days; that is, one planet-year equals 1032 Earth days.

85. One of the birds on this planet has a call which sounds like a Swiss yodeller.

86. From space, this planet appears to be a perfect sphere.

87. The soil of this planet contains a great deal of clay, and considerable amounts of lime.

88. There are several types of bacteria and viruses found on this planet; at least one type is fatal to man.

89. At any given time, several violent, hurricane-like storms may be in process at various places on the planet.

90. There is a small flowering shrub on this planet whose flowers give off a scent similar to that of the roses of Earth.

91. The polar ice on this planet disappears completely at the height of the summer, but re-forms each winter; ice-bergs occur occasionally.

92. The surface temperature of the planet ranges from -40° C to 40° C.

93. Several of the larger plant forms could be used as building materials; the leaves of one species of ground plant provide excellent roofing material.

94. There are numerous waterfalls on this planet; these are generally accessible, and would provide an excellent and inexpensive source of power.

95. Both temperate zones are subject to violent electrical storms, with awe-inspiring displays of fork-lightning.

96. There are several species of mushroom-like parasitic plant forms on this planet; some of these appear edible, while others are toxic.

97. The atmosphere on this planet is often filled with very fine dust particles which impair visibility and give distant objects a hazy appearance.

98. Sound waves travel slightly slower on this planet than they do on Earth; there is a subjective impression of greater resonance.

99. There is nothing coloured blue or violet on this planet; visible colours range from a blue-green shade to purple.

100. Plant growth is apparently controlled by an innate mechanism; periods of growth are variable across species, and there appears to be no relation between growing period and time of year.

Imagine that you are choosing a planet on which to found a colony. Several factors are listed which might be important in making this decision. Indicate for these factors how important you think information about each of them to be. If the information about a given factor is vital (that is, absolutely necessary) circle the number 1; if the information is very important, circle 2; if it is moderately important, circle 3; if it is relatively unimportant, circle 4; and if it is trivial, circle 5.

1. The visible colours	1	2	3	4	5
2. The seasons	1	2	3	4	5
3. The period of plant growth	1	2	3	4	5
4. The utility of natural growth	1	2	3	4	5
5. The length of the planet-day	1	2	3	4	5
6. The insects	1	2	3	4	5
7. The mineral formations	1	2	3	4	5
8. The atmospheric conditions	1	2	3	4	5
9. The type of star	1	2	3	4	5
10. The natural resources	1	2	3	4	5
11. The solar system's size	1	2	3	4	5
12. Presence of intelligent life	1	2	3	4	5
13. Length of the planet-year	1	2	3	4	5
14. Geological features	1	2	3	4	5
15. Climatic zones	1	2	3	4	5
16. Area covered by water	1	2	3	4	5
17. Gravitational force	1	2	3	4	5

18. Atmospheric oxygen	1	2	3	4	5
19. Edibility of vegetation	1	2	3	4	5
20. Speed of sound	1	2	3	4	5
21. Bacteria and viruses	1	2	3	4	5
22. Oceanic life	1	2	3	4	5
23. Dangers from indigenous life-forms	1	2	3	4	5
24. Satellites	1	2	3	4	5
25. Size of the planet	1	2	3	4	5
26. Winds	1	2	3	4	5
27. Small animal life-forms	1	2	3	4	5
28. Clouds	1	2	3	4	5
29. Land masses	1	2	3	4	5
30. Planetary terrain	1	2	3	4	5
31. Availability of drinking water	1	2	3	4	5
32. Electrical activity	1	2	3	4	5
33. Temperature range	1	2	3	4	5
34. Animals suitable for transportation	1	2	3	4	5
35. Sources of power	1	2	3	4	5
36. Animal organization	1	2	3	4	5
37. Astronomical activity	1	2	3	4	5
38. Flowers	1	2	3	4	5
39. Surface texture	1	2	3	4	5
40. Soil analysis	1	2	3	4	5
41. Plant forms	1	2	3	4	5
42. Electromagnetic activity	1	2	3	4	5
43. Colour of planet	1	2	3	4	5

44. Shape of planet	1	2	3	4	5
45. Polar ice activity	1	2	3	4	5
46. Bird songs	1	2	3	4	5

1 = Vital information

2 = Very important information

3 = Moderately important information

4 = Relatively unimportant information

5 = Trivial information

Thank you for your assistance.

2. Item Ratings

(a) Attractiveness

Each item number is followed by three numbers separated by a slash mark; the first of these numbers indicates the number of positive ratings the item received, the second indicates the number of neutral ratings, and the third the number of negative ratings. For example, Item 1 received 15 positive ratings, 7 neutral ratings, and 2 negative ratings; its score is recorded as shown: 1. 15/7/2. Occasionally, a subject would mark a question mark beside an item; items so marked are indicated by adding another slash mark followed by a ?. The numbers refer to the numbers of the items on the questionnaire.

1. 15/7/2	2. 8/13/3	3. 2/14/8	4. 1/9/14	5. 17/3/4
6. 17/3/4	7. 2/4/18	8. 17/5/2	9. 3/4/17	10. 19/2/3
11. 0/9/15	12. 5/14/5	13. 22/2/0	14. 20/3/1	15. 19/3/2
16. 20/1/3	17. 20/3/1	18. 4/3/17	19. 0/1/23	20. 7/10/7
21. 8/14/2	22. 6/17/1	23. 3/7/14	24. 12/7/5	25. 11/8/5
26. 3/6/15	27. 12/1/11	28. 1/9/14	29. 12/10/2	30. 10/12/2
31. 1/5/18	32. 6/18/0	33. 9/9/6	34. 3/18/3	35. 1/13/9/?
36. 1/15/8	37. 2/18/4	38. 1/7/16	39. 4/18/2	40. 12/10/2
41. 16/7/1	42. 15/8/1	43. 9/7/8	44. 7/8/8/?	45. 8/6/10
46. 20/3/1	47. 2/17/5	48. 4/17/3	49. 3/21/0	50. 9/5/10
51. 16/8/0	52. 9/8/7	53. 12/9/3	54. 1/3/20	55. 7/12/5
56. 0/0/24	57. 21/1/2	58. 15/8/1	59. 0/2/22	60. 9/14/1
61. 2/18/4	62. 23/1/0	63. 13/8/3	64. 0/5/19	65. 0/2/22
66. 3/5/16	67. 6/15/3	68. 7/15/2	69. 10/9/5	70. 14/7/3

71. 9/8/7	72. 18/6/0	73. 0/1/23	74. 6/13/3/2?	75. 20/2/2
76. 16/7/1	77. 19/5/0	78. 6/17/1	79. 8/10/6	80. 13/10/1
81. 22/2/0	82. 20/2/2	83. 2/5/17	84. 2/11/11	85. 6/17/1
86. 4/17/3	87. 5/7/11/?	88. 1/4/19	89. 1/1/22	90. 23/1/0
91. 8/11/5	92. 5/6/13	93. 23/1/0	94. 23/1/0	95. 4/4/16
96. 7/13/4	97. 0/6/18	98. 4/12/8	99. 2/12/10	100. 7/10/7

(b) Importance

Each dimension was given a score which was the number of people who rated it vitally important (1) or very important (2). These scores were then ranked, from lowest (1) to highest (46). The score and rank for each dimension are given below.

Dim.	X	Rank	Dim.	X	Rank	Dim.	X	Rank	Dim.	X	Rank	Dim.	X	Rank
1	3	8.0	11	0	2.5	21	17	38.5	31	21	44.5	41	17	38.5
2	16	35.0	12	14	30.5	22	14	30.5	32	12	27.0	42	7	18.0
3	16	35.0	13	4	11.5	23	15	33.0	33	14	30.5	43	0	2.5
4	18	41.0	14	11	24.5	24	1	5.0	34	6	15.5	44	0	2.5
5	8	20.0	15	11	24.5	25	5	14.0	35	16	35.0	45	6	15.5
6	4	11.5	16	17	38.5	26	11	24.5	36	4	11.5	46	0	2.5
7	10	22.0	17	13	28.0	27	4	11.5	37	3	8.0			
8	20	42.0	18	21	44.5	28	7	18.0	38	3	8.0			
9	7	18.0	19	21	44.5	29	11	24.5	39	9	21.0			
10	21	44.5	20	2	6.0	30	14	30.5	40	17	38.5			

(c) Relative Valence

Each item was assigned a valence (+, 0, or -) on the basis of the category to which it was most frequently assigned. Corresponding items were then compared for the two planets in order to obtain the relative valence. (Note: The items are arranged in their final order; that is, in the order in which the subjects saw them. See Appendix C.)

#	A	B	Res.	#	A	B	Res.	#	A	B	Res.	#	A	B	Res.	#	A	B	Res.
1	-	+	B	11	0	0	*	21	+	+	*	31	+	-	A	41	-	-	*
2	+	+	*	12	-	+	B	22	+	+	*	32	+	0	A	42	-	+	B
3	-	-	*	13	+	-	A	23	0	0	*	33	+	0	A	43	+	-	A
4	-	+	B	14	-	-	*	24	0	0	*	34	0	0	*	44	+	+	*
5	+	+	*	15	-	-	*	25	0	+	B	35	0	+	B	45	0	0	*
6	0	0	*	16	+	0	A	26	+	-	A	36	-	-	*	46	-	+	B
7	+	+	*	17	+	+	*	27	+	-	A	37	+	+	*	47	-	0	B
8	0	-	A	18	0	0	*	28	0	0	*	38	0	0	*	48	+	+	*
9	+	0	A	19	-	+	B	29	-	+	B	39	0	0	*	49	0	+	B
10	+	-	A	20	-	+	B	30	+	-	A	40	0	0	*	50	0	0	*

* indicates no resultant force; A indicates a force toward A; and B a force toward B. There are 26 instances in which there is no resultant force (that is, in which the signs of the valences are equal); there are 12 instances in which the resultant force is toward A; and 12 in which it is toward B.

APPENDIX C

INFORMATION QUEUES

1. Planet A

THE OXYGEN CONTENT OF THE ATMOSPHERE IS 16 PERCENT; THE REMAINDER IS MADE UP OF INERT GASES. (EARTH'S ATMOSPHERE CONTAINS ROUGHLY 21 PERCENT OXYGEN.)
ONE OF THE BIRDS ON THIS PLANET LAYS EGGS WHICH ARE EDIBLE, RICH IN PROTEIN, AND HAVE A FLAVOUR LIKE BRUSSELS SPROUTS; THE BIRDS ARE NUMEROUS AND THEIR EGGS PLENTIFUL.
THE SURFACE OF THIS PLANET IS VERY HARD.

A VARIETY OF SPECIES OF SMALL CREATURES LIVE ON THE PLANET; SOME APPEAR TO BE PREDATORY AND FEROCIOUS.

THIS PLANET HAS A NARROW TROPICAL REGION, BUT BROAD TEMPERATE ZONES.

THIS PLANET IS THE FIFTH SATELLITE OF ITS SUN, IN A TWELVE PLANET SYSTEM.

THERE ARE SEVERAL AREAS OF GENTLY ROLLING HILLS WHICH MAY ONCE HAVE BEEN MOUNTAIN RANGES; THE RIVERS ARE BROAD AND SHALLOW.
THE WATER IN THE RIVERS IS FIT FOR HUMAN CONSUMPTION, BUT LEAVES A SUBTLE AFTERTASTE.

SOUND WAVES TRAVEL SLIGHTLY FASTER ON THIS PLANET THAN THEY DO ON EARTH; MOST SOUNDS HAVE A SIBILANT QUALITY TO THEM.

THIS PLANET HAS SEASONS LIKE EARTH'S, EXCEPT THAT AUTUMN AND SPRING ARE EXTENDED IN RELATION TO WINTER AND SUMMER.

THERE IS A COMET WHICH ORBITS THIS PLANET ONCE EVERY 45 EARTH YEARS; APPROXIMATELY EVERY FIFTH ORBIT, THE COMET'S TAIL SWEEPS ACROSS THE PLANET, BUT DOES NO DAMAGE.
THE SOIL OF THIS PLANET CONTAINS A GREAT DEAL OF CLAY, AND CONSIDERABLE AMOUNTS OF LIME.

THERE ARE FOUR LARGE LAND MASSES ON THIS PLANET, AS WELL AS SCATTERED ISLAND GROUPS.

SUNSPOTS ON THE STAR OF THIS PLANET PERIODICALLY PRODUCE VIOLENT PERTURBATIONS OF THE PLANET'S MAGNETIC FIELD; THESE OCCUR AT PREDICTABLE INTERVALS.
PECULIAR ATMOSPHERIC CONDITIONS LIMIT RADIO COMMUNICATION ON THE SURFACE OF THE PLANET.

SEVERAL OF THE INSECT SPECIES COMMUNICATE BY MEANS OF FREQUENCIES WITHIN THE VISIBLE SPECTRUM; SOMETIMES VERY COLOURFUL DISPLAYS CAN BE SEEN.
THERE ARE SEVERAL VARIETIES OF WINGLESS BIRDS ON THIS PLANET, SOME OF WHICH ARE VERY SWIFT; IT IS POSSIBLE THAT THEY COULD BE USED AS A MEANS OF TRANSPORTATION.
FROM SPACE, THIS PLANET APPEARS TO BE SLIGHTLY FLATTENED AT THE POLES, WITH A BULGE AT THE EQUATOR.

THERE IS VERY LITTLE LIFE IN THE OCEAN, MOST OF IT LIMITED TO THE COASTAL REGIONS.

WHILE NONE OF THE PLANT LIFE APPEARS TO BE USEFUL FOR CONSTRUCTION PURPOSES, IT COULD BE USED TO PROVIDE MATERIAL FOR CLOTHING.
THERE ARE NO LIFE-FORMS ON THE PLANET AT THE PRESENT TIME WHICH APPEAR TO HAVE AN EQUIVALENT-TO-HUMAN INTELLIGENCE, BUT RUINS AND FOSSIL REMAINS SUGGEST THAT A COMPLEX CIVILIZATION ONCE EXISTED HERE.
THERE IS VERY LITTLE NATURALLY OCCURRING RADIOACTIVE MATERIAL ON THIS PLANET; THERE ARE, HOWEVER, LARGE DEPOSITS OF LEAD, IRON, MOLYBDENUM, AND BAUXITE (FROM WHICH ALUMINUM IS EXTRACTED).
THIS PLANET REVOLVES AROUND ITS SUN ONCE IN EVERY 320.5 DAYS; THAT IS, ONE PLANET-YEAR EQUALS 320.5 EARTH DAYS.

THE LARGEST SPECIES OF NATIVE ANIMAL APPEARS TO BE DOCILE, SLOW-MOVING, AND EXTREMELY STUPID.

THERE ARE SEVERAL SPECIES OF MUSHROOM-LIKE PARASITIC PLANT FORMS ON THIS PLANET; SOME OF THESE APPEAR EDIBLE, WHILE OTHERS ARE TOXIC.
THE FORCE OF GRAVITY ON THIS PLANET IS EQUAL TO 0.67 TIMES THE FORCE OF GRAVITY ON EARTH.

ONLY DURING ONE SEASON OF THE YEAR DO CLOUDS APPEAR IN ANY NUMBER.

ONE OF THE BIRDS ON THIS PLANET HAS A CALL WHICH RESEMBLES THE BARK OF A DOG.

THE ATMOSPHERE ON THIS PLANET IS OFTEN FILLED WITH VERY FINE DUST PARTICLES WHICH IMPAIR VISIBILITY AND GIVE DISTANT OBJECTS A HAZY QUALITY.
THERE IS ALMOST NEVER ANY WIND OF SUFFICIENT MAGNITUDE TO CAUSE EXTENSIVE DAMAGE ON THIS PLANET.

ROUGHLY TWO-THIRDS OF THE PLANETARY SURFACE IS COVERED WITH WATER.

PLANT GROWTH IS CONTROLLED BY CROSS-FERTILIZATION CARRIED OUT BY BIRDS AND INSECTS; THE GROWTH PERIOD EXTENDS OVER 2.5 PLANET YEARS, BUT AT ANY MOMENT IN THAT PERIOD, SOME GROWTH IS READY FOR HARVESTING.
THE POLAR ICE-PACK ON THIS PLANET IS PERMANENT AND CHANGES VERY LITTLE FROM YEAR TO YEAR; THERE ARE VERY FEW ICE-BERGS.

THIS PLANET IS SLIGHTLY LARGER THAN THE EARTH.

THIS PLANET HAS NO MOON BUT IS ORBITED BY A RING OF ROCKS AND DUST NOT UNLIKE THE ASTEROID BELT OF EARTH'S SOLAR SYSTEM.

THE NATURAL VEGETATION ON THIS PLANET IS EDIBLE, BUT HAS NO NUTRITIONAL VALUE FOR HUMAN BEINGS.

THERE ARE NUMEROUS DEPOSITS OF COAL ON THIS PLANET; THESE COULD BE MINED EASILY AND SAFELY, AND WOULD PROVIDE AN INEXPENSIVE SOURCE OF POWER.
THERE ARE NO PURPLE OR RED OBJECTS ON THIS PLANET; THE COLOURS WHICH MAY BE SEEN RANGE FROM A DEEP ORANGE TO VIOLET.

THE PERIOD OF ROTATION OF THE PLANET (THAT IS, ONE PLANET DAY) IS EQUIVALENT TO 20 EARTH HOURS.

SOME SPECIES OF ANIMALS ON THIS PLANET APPEAR TO BE ORGANIZED INTO EXTENDED FAMILY GROUPINGS.

THERE ARE FREQUENT TREMORS FELT AT THE SURFACE OF THE PLANET, INDICATING INTENSE SEISMIC ACTIVITY.

THE SURFACE TEMPERATURE OF THE PLANET RANGES FROM $^{-}40°$ C TO 40° C.

MORE STARS ARE VISIBLE TO THE NAKED EYE FROM THIS PLANET THAN ARE VISIBLE FROM EARTH.

THERE ARE SEVERAL GEYSERS ON THE PLANET; THESE ERUPT WITH CONSIDERABLE FORCE BUT AT PREDICTABLE INTERVALS.

FROM SPACE, THIS PLANET APPEARS DEEP BLUE IN COLOUR, WITH SEVERAL AREAS OF ORANGE AND SCARLET.

BOTH TEMPERATE ZONES ARE SUBJECT TO VIOLENT ELECTRICAL STORMS, WITH AWE-INSPIRING DISPLAYS OF FORK-LIGHTNING.

THERE ARE SEVERAL TYPES OF BACTERIA AND VIRUSES FOUND ON THIS PLANET; AT LEAST ONE TYPE IS FATAL TO MAN.

THERE IS A SMALL FLOWERING SHRUB ON THIS PLANET WHOSE FLOWERS GIVE OFF A SCENT SIMILAR TO THAT OF THE ROSES OF EARTH.

THERE ARE LARGE NUMBERS OF EASILY ACCESSIBLE PRECIOUS STONES ON THE PLANET, BUT THEY ARE GENERALLY HIDDEN IN FORMATIONS SIMILAR TO THE SO-CALLED ''THUNDER EGGS'' OF EARTH.
THIS PLANET'S STAR IS A BLUE-WHITE STAR, OR TYPE F STAR; ITS TEMPERATURE IS 7000° K. (SOL, EARTH'S STAR, IS A SLIGHTLY COOLER YELLOW-WHITE OR TYPE G STAR.)

THE OXYGEN CONTENT OF THE ATMOSPHERE IS 24 PERCENT; THE REMAINDER IS CONSTITUTED BY INERT GASES. (EARTH'S ATMOSPHERE CONTAINS ROUGHLY 21 PERCENT OXYGEN.)

ONE OF THE INSECTS ON THIS PLANET PRODUCES A FINE THREAD NOT UNLIKE THAT OF A SPIDER, BUT MUCH STRONGER AND MORE DURABLE; IN LARGE QUANTITIES IT COULD BE USED TO MAKE CLOTH.

THE SURFACE OF THIS PLANET IS SOMEWHAT SPONGY.

SEVERAL SPECIES OF FELINE CREATURES ARE NATIVE TO THE PLANET; THESE APPEAR TO BE SMALL AND PLACID.

THIS PLANET HAS A WIDE BAND OF TROPICAL CLIMATE AROUND ITS EQUATOR.

THIS PLANET IS THE ONLY SATELLITE OF ITS SUN.

THE SURFACE OF THE PLANET IS MARKED BY SEVERAL YOUNG MOUNTAIN RANGES, AND OCCASIONAL DEEP CREVICES.

THE RIVER WATER MUST BE CHEMICALLY TREATED BEFORE IT IS FIT FOR HUMAN CONSUMPTION.

SOUND WAVES TRAVEL SLIGHTLY SLOWER ON THIS PLANET THAN THEY DO ON EARTH; THERE IS A SUBJECTIVE IMPRESSION OF GREATER RESONANCE.

BECAUSE THIS PLANET IS NOT TILTED ON ITS AXIS AS THE EARTH IS, THERE ARE NO CHANGES OF SEASON; ONE AREA HAS CONSTANT SUMMER, ANOTHER CONSTANT SPRING OR FALL.

THERE ARE FREQUENT METEORITE SHOWERS IN THE VICINITY OF THIS PLANET; HOWEVER, IT IS VERY RARE FOR ANY OF THE PARTICLES TO PENETRATE THE ATMOSPHERE TO THE SURFACE OF THE PLANET.

THE SOIL OF THIS PLANET CONTAINS MANY NITRATES, AND USEFUL AMOUNTS OF CALCIUM.

THE SOLE LAND MASS APPEARS TO SHIFT POSITION DURING EACH REVOLUTION OF THE PLANET AROUND ITS SUN.

IRREGULARITIES IN THE PLANET'S ORBIT ABOUT ITS SUN PRODUCE CERTAIN ECCENTRICITIES IN ELECTROMAGNETIC ACTIVITY; TO DATE, NO WAY HAS BEEN FOUND TO PREDICT WHEN THESE WILL OCCUR.

PECULIAR CONDITIONS IN THE IONOSPHERE PREVENT COMMUNICATION OUTSIDE THE SYSTEM.

THERE IS AN INSECT SPECIES ON THE PLANET WHICH APPARENTLY COMMUNICATES BY WHISTLING; EACH INDIVIDUAL INSECT CAN BE IDENTIFIED BY ITS WHISTLE.

THERE ARE SEVERAL SPECIES OF KANGAROO-LIKE ANIMALS ON THIS PLANET; ONE SUCH SPECIES APPEARS TO BE OF SUFFICIENT SIZE AND GENTLENESS THAT IT MIGHT BE USED AS A MODE OF TRANSPORTATION.

FROM SPACE, THIS PLANET APPEARS TO BE A PERFECT SPHERE.

THERE ARE A VARIETY OF LIFE-FORMS IN THE OCEAN, SOME OF WHICH LIVE AT GREAT DEPTH.

SEVERAL OF THE LARGER PLANT FORMS COULD BE USED AS BUILDING MATERIALS; THE LEAVES OF ONE SPECIES OF GROUND PLANT PROVIDE EXCELLENT ROOFING MATERIAL.

ALTHOUGH THERE IS NO EVIDENCE OF THE PRESENCE OF INTELLIGENT LIFE-FORMS ON THE PLANET AT THIS TIME, THERE APPEAR TO BE ARTIFICIAL STRUCTURES ON ITS SURFACE.

THIS PLANET IS RICH IN DEPOSITS OF IRON, COPPER, ZINC, AND TIN; THERE ARE ALSO RICH LODES OF NATURAL URANIUM.

THIS PLANET REVOLVES AROUND ITS SUN ONCE IN EVERY 1032 DAYS; THAT IS, ONE PLANET-YEAR EQUALS 1032 EARTH DAYS.

THERE IS A CARNIVOROUS FORM OF PLANT-LIFE ON THE PLANET, BUT IT DOES NOT APPEAR TO BE DANGEROUS TO HUMAN LIFE.

ONE OF THE PLANTS ON THIS PLANET BEARS FRUIT OF A VERY ATTRACTIVE COLOUR AND SMELL; UNCOOKED IT IS TOXIC, BUT COOKED IT IS EDIBLE AND TASTY.

THIS PLANET HAS A GRAVITY WHICH IS EQUIVALENT TO 1.70 TIMES THAT OF EARTH.

THIS PLANET IS COVERED BY A THICK LAYER OF CLOUD MUCH OF THE TIME.

ONE OF THE BIRDS ON THIS PLANET HAS A CALL WHICH SOUNDS LIKE A SWISS YODELER.

THE ATMOSPHERE ON THIS PLANET IS EXCEPTIONALLY DUST-FREE; VISIBILITY IS MUCH GREATER THAN ON EARTH, TO THE EXTENT THAT A NEW SENSE OF DISTANCE MAY BE NECESSARY.

AT ANY GIVEN TIME, SEVERAL VIOLENT, HURRICANE-LIKE STORMS MAY BE IN PROCESS AT VARIOUS PLACES ON THE PLANET.

APPROXIMATELY THREE-FOURTHS OF THE PLANETARY SURFACE IS COVERED WITH WATER.

PLANT GROWTH IS APPARENTLY CONTROLLED BY AN INNATE MECHANISM; PERIODS OF GROWTH ARE VARIABLE ACROSS SPECIES, AND THERE APPEARS TO BE NO RELATION BETWEEN GROWING PERIOD AND TIME OF YEAR.
THE POLAR ICE ON THIS PLANET DISAPPEARS COMPLETELY AT THE HEIGHT OF THE SUMMER, BUT RE-FORMS EACH WINTER; ICE-BERGS OCCUR OCCASIONALLY.
THIS PLANET IS SOMEWHAT SMALLER THAN THE EARTH.

THIS PLANET HAS TWO MOONS; IT IS VERY RARE TO HAVE A NIGHT ON WHICH ONE OR THE OTHER IS NOT VISIBLE.

THE NATURAL VEGETATION ON THIS PLANET IS HIGHLY TOXIC WHEN INGESTED BY HUMAN BEINGS.

THERE ARE NUMEROUS WATERFALLS ON THIS PLANET; THESE ARE GENERALLY ACCESSIBLE, AND WOULD PROVIDE AN EXCELLENT AND INEXPENSIVE SOURCE OF POWER.
THERE IS NOTHING COLOURED BLUE OR VIOLET ON THIS PLANET; VISIBLE COLOURS RANGE FROM A BLUE-GREEN SHADE TO PURPLE.

THE PERIOD OF ROTATION OF THE PLANET (THAT IS, ONE PLANET-DAY) IS EQUIVALENT TO 37 EARTH HOURS.

SOME SPECIES OF ANIMALS ON THIS PLANET APPEAR TO HAVE HIGHLY ORGANIZED SOCIAL STRUCTURES, SIMILAR TO THE ANTS AND BEES OF EARTH.
THERE IS INTENSE VOLCANIC ACTIVITY ON THIS PLANET.

NOWHERE ON THE PLANET DOES THE TEMPERATURE DROP BELOW ¯10° C OR CLIMB ABOVE 20° C.

VERY FEW STARS ARE VISIBLE FROM THIS PLANET.

IN CERTAIN AREAS OF THIS PLANET, LARGE CAVERNS ARE FOUND; IN THESE CAVES ARE A VARIETY OF INTERESTING ''GEOLOGICAL'' FORMATIONS SIMILAR TO THE STALAGMITES AND STALACTITES OF EARTH.
FROM SPACE, THIS PLANET APPEARS DEEP GREEN IN COLOUR, WITH AREAS OF BLUE AND TAN.

DURING 4 MONTHS OF THE YEAR, BRILLIANT ELECTRICAL DISPLAYS, SIMILAR TO THE NORTHERN LIGHTS OF EARTH, ARE VISIBLE FROM THE NORTHERN HEMISPHERE.
ALTHOUGH BACTERIA AND VIRUSES ABOUND IN THE NATIVE LIFE-FORMS, THEY ARE NOT INCOMPATIBLE WITH HUMAN LIFE.

ONE OF THE NATIVE FLOWERING PLANTS PRODUCES LARGE SHOWY FLOWERS IN A VARIETY OF BRILLIANT COLOURS.

THERE ARE A LARGE NUMBER OF NATURALLY OCCURRING CRYSTAL FORMATIONS ON THE PLANET; WHEN CRYSTALS OF VARIOUS COLOURS ARE FOUND TOGETHER, THEIR APPEARANCE IS QUITE BREATH-TAKING.
THIS PLANET'S STAR IS A RED DWARF, OR TYPE M STAR; ITS TEMPERATURE IS 3000° K. (SOL, EARTH'S STAR, IS A SLIGHTLY WARMER YELLOW-WHITE OR TYPE G STAR.)

APPENDIX D

FLOW CHARTS, PROGRAMS, AND SAMPLE PRINTOUTS

1. Flow Charts

(a) Program ULYSSES

Start

M = 1

N = 1

P = 1

THIS TERMINAL CONNECTS YOU WITH ME; I AM THE COMPUTER ON THE SPACE SHIP ULYSSES. PLEASE ENTER YOUR NAME AS CAPTAIN FOR THE TRIP.

Subject enters 'SUBJECT NAME'

WELCOME ABOARD, CAPTAIN 'SUBJECT NAME'. I HAVE INFORMATION REGARDING THE PLANETS A AND B IN MY MEMORY BANKS; ABOUT WHICH PLANET WOULD YOU LIKE TO RECEIVE A PIECE OF INFORMATION?

Subject enters

A or B

A: Label AMAT as A → Label BMAT as B → PATH (P) = A(3) → Print A (M) → M = M + 1

B: Label AMAT as B → Label BMAT as A → PATH (P) = B(4) → Print B (N) → N = N + 1

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

Subject enters

A or B

A: LOG (P) = A

B: LOG (P) = B

P = P + 1

Does M = 51?

YES → INFORMATION FOR PLANET A HAS BEEN EXHAUSTED.

DO YOU WISH FURTHER INFORMATION ABOUT PLANET B?(1)

- YES → PATH (P) = B
  - Print B (N)
  - N = N + 1
  - PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.
  - Subject enters A or B
    - A → LOG (P) = A
    - B → LOG (P) = B
  - P = P + 1
  - Does N = 51?
    - YES → MY MEMORY BANKS HAVE BEEN EXHAUSTED. → *
    - NO → (1)
- NO → *

NO → Does N = 51?

- YES → INFORMATION FOR PLANET B HAS BEEN EXHAUSTED.
  - DO YOU WISH FURTHER INFORMATION ABOUT PLANET A?(2)
    - YES → PATH (P) = A
      - Print A (M)
      - M = M + 1
      - PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.
      - Subject enters A or B
        - A → LOG (P) = A
        - B → LOG (P) = B
      - P = P + 1
      - Does M = 51?
        - YES → MY MEMORY BANKS HAVE BEEN EXHAUSTED . → *
        - NO → (2)
    - NO → *
- NO → DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?
  - YES
  - NO

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

Subject enters

A or B

A → (3)

B → (4)

WHICH PLANET DO YOU WISH TO COLONIZE? ENTER A OR B.*

Subject enters

A or B

A → DECISION = A

B → DECISION = B

YOUR FINAL COURSE IS SET. HAVE A PLEASANT JOURNEY.

(b) Program ODYSSEUS

Start

P = 1

THIS TERMINAL CONNECTS YOU WITH ME; I AM THE COMPUTER ON THE SPACE SHIP ULYSSES. PLEASE ENTER YOUR NAME AS CAPTAIN FOR THE TRIP.

Subject enters 'SUBJECT NAME'

WELCOME ABOARD, CAPTAIN 'SUBJECT NAME'. I HAVE INFORMATION REGARDING THE PLANETS A AND B IN MY MEMORY BANKS; ABOUT WHICH PLANET WOULD YOU LIKE TO RECEIVE A PIECE OF INFORMATION?

Subject enters

A or B

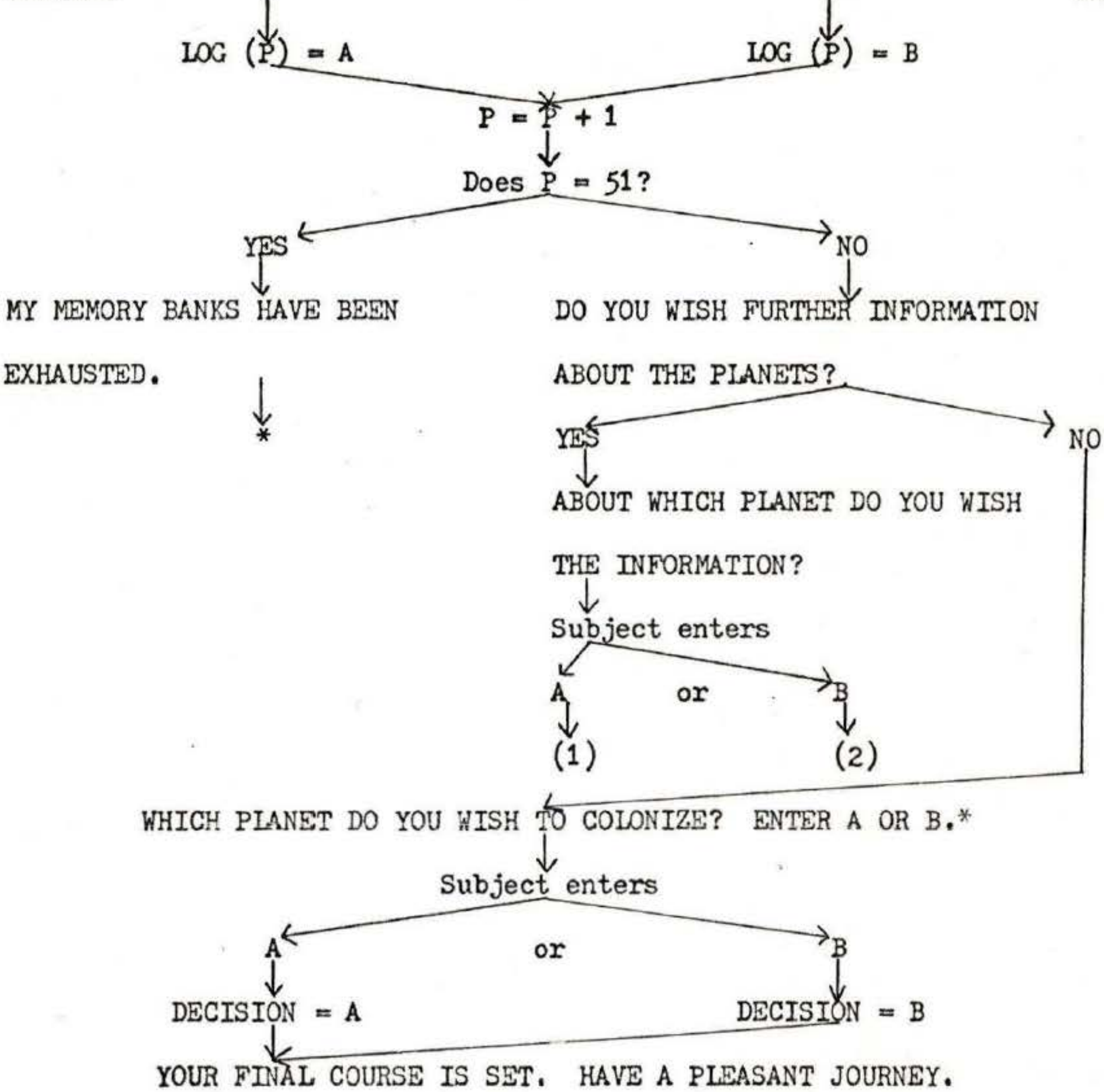
A → Label AMAT as A → Label BMAT as B → PATH (P) = A(1) → Print A (P)

B → Label AMAT as B → Label BMAT as A → PATH (P) = B(2) → Print B (P)

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

Subject enters

A or B


LOG (P) = A
LOG (P) = B
P = P + 1
Does P = 51?
YES
NO
MY MEMORY BANKS HAVE BEEN EXHAUSTED.
*
DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?
YES
NO
ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?
Subject enters
A
or
B
(1)
(2)
WHICH PLANET DO YOU WISH TO COLONIZE? ENTER A OR B.*
Subject enters
A
or
B
DECISION = A
DECISION = B
YOUR FINAL COURSE IS SET. HAVE A PLEASANT JOURNEY.

2. Programs

(a) Program ULYSSES

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∇ ULYSSES
[1] IT←IA←IB←0,LOG←PATH←⎕←⎕←⎕←''
[2] ER1←'MY MEMORY BANKS HAVE BEEN EXHAUSTED.'
[3] MESS←'YOUR FINAL COURSE IS SET.  HAVE A PLEASANT JOURNEY.'
[4] ⍎')LOAD RCALL,2596'
[5] ⍎')LOAD TEST1,2596'
[6] ⍎')LOAD AMAT,2596'
[7] ⍎')LOAD BMAT,2596'
[8] ⍎')LOAD ANSR,2596'
[9] 'THIS TERMINAL CONNECTS YOU WITH ME; I AM THE COMPUTER ON THE SPACE SHIP ULYSSES.'
[10] 'PLEASE ENTER YOUR NAME AS CAPTAIN FOR THE TRIP.'
[11] ⎕←⎕←''
[12] NAME←⍞
[13] ⎕←⎕←''
[14] 'WELCOME ABOARD, CAPTAIN ',NAME,'.'
[15] 'I HAVE INFORMATION REGARDING THE PLANETS A AND B IN MY MEMORY BANKS; ABOUT WHICH'
[16] 'PLANET WOULD YOU LIKE TO RECEIVE A PIECE OF INFORMATION?'
[17] →LA,0↑TC←'AB'[1+T='A'],0↑PATH←PATH,T←TEST1
[18] CON:'PLEASE ENTER IN THE SHIP''S LOG YOUR PRESENT HEADING.',⎕←⎕←''
[19] LOG←LOG,Y←TEST1
[20] →(((1↑⍴AMAT)>IA)∧((1↑⍴BMAT)>IB))/FI
[21] →(((1↑⍴AMAT)>IA)∧((1↑⍴BMAT)≤IB))/R1,0↑TE←TC,0↑TEC←T
[22] →(((1↑⍴BMAT)>IB)∧((1↑⍴AMAT)≤IA))/R1,0↑TE←T,0↑TEC←TC
[23] →FD,0↑⎕←ER1
[24] FI:'DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?'
[25] →(ANSR)/L1
[26] ⎕←⎕←''
[27] FD:'WHICH PLANET DO YOU WISH TO COLONIZE?  ENTER A OR B.'
[28] →0,0↑⎕←MESS,0↑FDEC←TEST1
[29] L1:'ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?',⎕←⎕←''
[30] →LB,→(T=¯1↑PATH←PATH,R←TEST1)/LA
[31] LA:→CON,0↑⎕←AMAT[(IA←IA+1);]
[32] LB:→CON,0↑⎕←BMAT[(IB←IB+1);]
[33] R1:'INFORMATION FOR PLANET ',TE,' HAS BEEN EXHAUSTED.',→(1≠IT←IT+1)/R2
[34] R2:'DO YOU WISH FURTHER INFORMATION ABOUT PLANET ',TEC,'?'
[35] ⎕←⎕←''
[36] →LB,→(T=¯1↑PATH←PATH,TEC)/LA,→(~ANSR)/FD
∇
```

(b) Program ODYSSEUS

```
∇ ODYSSEUS
 [1] IA←0,LOG←PATH←⎕←⎕←⎕←''
 [2] ER1←'MY MEMORY BANKS HAVE BEEN EXHAUSTED.'
 [3] MESS←'YOUR FINAL COURSE IS SET.  HAVE A PLEASANT JOURNEY.'
 [4] ⍎')LOAD RCALL,2596'
 [5] ⍎')LOAD TEST1,2596'
 [6] ⍎')LOAD AMAT,2596'
 [7] ⍎')LOAD BMAT,2596'
 [8] ⍎')LOAD ANSR,2596'
 [9] 'THIS TERMINAL CONNECTS YOU WITH ME; I AM THE COMPUTER ON THE SPACE SHIP ULYSSES.'
 [10] 'PLEASE ENTER YOUR NAME AS CAPTAIN FOR THE TRIP.'
 [11] ⎕←⎕←''
 [12] NAME←⍞
 [13] ⎕←⎕←''
 [14] 'WELCOME ABOARD, CAPTAIN ',NAME,'.'
 [15] 'I HAVE INFORMATION REGARDING THE PLANETS A AND B IN MY MEMORY BANKS; ABOUT WHICH'
 [16] 'PLANET WOULD YOU LIKE TO RECEIVE A PIECE OF INFORMATION?'
 [17] →LA,0↑PATH←PATH,T←TEST1
 [18] CON:'PLEASE ENTER IN THE SHIP''S LOG YOUR PRESENT HEADING.',⎕←⎕←''
 [19] LOG←LOG,Y←TEST1
 [20] →FD,0↑⎕←ER1,→(((1↑⍴AMAT)>IA)∧((1↑⍴BMAT)>IA))/FI
 [21] FI:'DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?'
 [22] →(ANSR)/L1
 [23] ⎕←⎕←''
 [24] FD:'WHICH PLANET DO YOU WISH TO COLONIZE? ENTER A OR B.'
 [25] →0,0↑⎕←MESS,0↑FDEC←TEST1
 [26] L1:'ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?',⎕←⎕←''
 [27] →LB,→(T=¯1↑PATH←PATH,R←TEST1)/LA
 [28] LA:→CON,0↑⎕←AMAT[(IA←IA+1);]
 [29] LB:→CON,0↑⎕←BMAT[(IA←IA+1);]
∇
```

(c) Subroutines

```
∇ RCALL
 [1] 'CAPTAIN: ',NAME,⎕←''
 [2] 'PATH:     ',PATH,⎕←''
 [3] 'LOG:      ',LOG,⎕←''
 [4] 'DECISION:',FDEC,⎕←''
∇
```

```
∇ R←TEST1
 [1] ERR←'YOU HAVE MADE AN INCORRECT ENTRY, PLEASE ENTER AN A OR B.'
 [2] L:→L,0↑⎕←ERR,→((R←1↑⍞)∊'AB')/END,0↑⎕←⎕←' '
 [3] END:⎕←⎕←' '
∇
```

```
∇ A←ANSR;ANS;Z
 [1] →3,0↑A←Z[1],→((+/Z←(1↑(' '≠ANS)/ANS←⍞,'C',⎕←' ')='YN')=0)/CON
 [2] CON:→1,0↑⎕←'PLEASE RETYPE YOUR ANSWER'
 [3] ⎕←⎕←''
∇
```

3. Sample Printouts

(a) Program ULYSSES

```
THIS TERMINAL CONNECTS YOU WITH ME; I AM THE COMPUTER ON THE SPACE SHIP ULYSSES.
PLEASE ENTER YOUR NAME AS CAPTAIN FOR THE TRIP.

'SUBJECT NAME'

WELCOME ABOARD, CAPTAIN 'SUBJECT NAME'.
I HAVE INFORMATION REGARDING THE PLANETS A AND B IN MY MEMORY BANKS; ABOUT WHICH
PLANET WOULD YOU LIKE TO RECEIVE A PIECE OF INFORMATION?

B

THE OXYGEN CONTENT OF THE ATMOSPHERE IS 16 PERCENT; THE REMAINDER IS MADE UP OF INERT GASES. (EARTH'S ATMOSPHERE
CONTAINS ROUGHLY 21 PERCENT OXYGEN.)

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

A

THE OXYGEN CONTENT OF THE ATMOSPHERE IS 24 PERCENT; THE REMAINDER IS CONSTITUTED BY INERT GASES. (EARTH'S ATMOSPHERE
CONTAINS ROUGHLY 21 PERCENT OXYGEN.)

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES
```

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

B

ONE OF THE BIRDS ON THIS PLANET LAYS EGGS WHICH ARE EDIBLE, RICH IN PROTEIN, AND HAVE A FLAVOUR LIKE BRUSSELS SPROUTS; THE BIRDS ARE NUMEROUS AND THEIR EGGS PLENTIFUL.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

A

ONE OF THE INSECTS ON THIS PLANET PRODUCES A FINE THREAD NOT UNLIKE THAT OF A SPIDER, BUT MUCH STRONGER AND MORE DURABLE; IN LARGE QUANTITIES IT COULD BE USED TO MAKE CLOTH.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

B

THE SURFACE OF THIS PLANET IS VERY HARD.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

A

THE SURFACE OF THIS PLANET IS SOMEWHAT SPONGY.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

B

A VARIETY OF SPECIES OF SMALL CREATURES LIVE ON THE PLANET; SOME APPEAR TO BE PREDATORY AND FEROCIOUS.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

A

SEVERAL SPECIES OF FELINE CREATURES ARE NATIVE TO THE PLANET; THESE APPEAR TO BE SMALL AND PLACID.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

NO

WHICH PLANET DO YOU WISH TO COLONIZE? ENTER A OR B.

A

YOUR FINAL COURSE IS SET. HAVE A PLEASANT JOURNEY.

```
      RCALL
CAPTAIN: 'SUBJECT NAME'
PATH:    BABABABA
LOG:     AAAAAAAA
DECISION:A
```

```
THIS TERMINAL CONNECTS YOU WITH ME; I AM THE COMPUTER ON THE SPACE SHIP ULYSSES.
PLEASE ENTER YOUR NAME AS CAPTAIN FOR THE TRIP.

'SUBJECT NAME'

WELCOME ABOARD, CAPTAIN 'SUBJECT NAME'.
I HAVE INFORMATION REGARDING THE PLANETS A AND B IN MY MEMORY BANKS; ABOUT WHICH
PLANET WOULD YOU LIKE TO RECEIVE A PIECE OF INFORMATION?

A

THE OXYGEN CONTENT OF THE ATMOSPHERE IS 16 PERCENT; THE REMAINDER IS MADE UP OF INERT GASES. (EARTH'S ATMOSPHERE
CONTAINS ROUGHLY 21 PERCENT OXYGEN.)

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

B

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

B

ONE OF THE INSECTS ON THIS PLANET PRODUCES A FINE THREAD NOT UNLIKE THAT OF A SPIDER, BUT MUCH STRONGER AND MORE
DURABLE; IN LARGE QUANTITIES IT COULD BE USED TO MAKE CLOTH.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

B

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES
```

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

B

THE SURFACE OF THIS PLANET IS SOMEWHAT SPONGY.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

B

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

B

SEVERAL SPECIES OF FELINE CREATURES ARE NATIVE TO THE PLANET; THESE APPEAR TO BE SMALL AND PLACID.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

B

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

B

THIS PLANET HAS A WIDE BAND OF TROPICAL CLIMATE AROUND ITS EQUATOR.

```
PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

B


DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?
YES


ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

B


THIS PLANET IS THE ONLY SATELLITE OF ITS SUN.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

B


DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?
YES


ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

B


THE SURFACE OF THE PLANET IS MARKED BY SEVERAL YOUNG MOUNTAIN RANGES, AND OCCASIONAL DEEP CREVICES.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

B


DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?
```

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

B

THE RIVER WATER MUST BE CHEMICALLY TREATED BEFORE IT IS FIT FOR HUMAN CONSUMPTION.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

A

SOUND WAVES TRAVEL SLIGHTLY FASTER ON THIS PLANET THAN THEY DO ON EARTH; MOST SOUNDS HAVE A SIBILANT QUALITY TO THEM.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

A

THIS PLANET HAS SEASONS LIKE EARTH'S, EXCEPT THAT AUTUMN AND SPRING ARE EXTENDED IN RELATION TO WINTER AND SUMMER.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

A

THERE IS A COMET WHICH ORBITS THIS PLANET ONCE EVERY 45 EARTH YEARS; APPROXIMATELY EVERY FIFTH ORBIT, THE COMET'S TAIL SWEEPS ACROSS THE PLANET, BUT DOES NO DAMAGE.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

A

THE SOIL OF THIS PLANET CONTAINS A GREAT DEAL OF CLAY, AND CONSIDERABLE AMOUNTS OF LIME.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

YES

ABOUT WHICH PLANET DO YOU WISH THE INFORMATION?

A

THERE ARE FOUR LARGE LAND MASSES ON THIS PLANET, AS WELL AS SCATTERED ISLAND GROUPS.

PLEASE ENTER IN THE SHIP'S LOG YOUR PRESENT HEADING.

A

DO YOU WISH FURTHER INFORMATION ABOUT THE PLANETS?

NO

WHICH PLANET DO YOU WISH TO COLONIZE? ENTER A OR B.

A

YOUR FINAL COURSE IS SET. HAVE A PLEASANT JOURNEY.

```
      RCALL
CAPTAIN: 'SUBJECT NAME'
PATH:     ABBBBBBBAAAAA ,
LOG:      BBBBBBBAAAAAA
DECISION:A
```

APPENDIX E

SCORES

#	I	S	N	PC/N	PR/N	LC/N	LR/N	#R/N	#A/#R	#C/T	T	CH	RD	AD
1	C	M	22	0.500	0.818	1.000	0.045	0.636	1.000	0.000	6	1	1.333	1.000
2	C	M	31	0.516	0.613	0.581	0.258	0.935	0.833	0.167	6	1	1.154	0.880
3	C	M	27	0.481	0.370	0.815	0.185	0.593	0.429	1.000	1	1	1.385	1.556
4	C	M	9	0.889	0.222	1.000	0.111	0.777	0.929	1.000	1	2	0.750	2.000
5	C	M	28	0.500	0.393	0.357	0.143	0.893	0.560	0.143	7	1	0.786	0.707
6	C	M	29	0.793	0.241	0.724	0.138	0.448	0.923	0.000	3	1	0.870	0.900
7	C	M	100	0.500	0.720	0.890	0.050	0.230	0.913	0.000	0	1	1.300	0.846
8	C	M	48	0.500	0.833	1.000	0.021	0.271	0.962	0.000	2	1	0.857	1.077
9	C	M	21	0.619	0.143	0.476	0.238	0.619	0.846	0.000	5	1	0.718	0.714
10	C	M	48	0.500	0.500	0.917	0.104	0.729	0.914	0.000	7	1	1.188	0.954
11	C	M	13	0.692	0.462	0.846	0.231	0.615	0.750	0.000	6	2	1.333	0.667
12	C	M	23	0.609	0.522	1.000	0.043	0.478	0.864	0.000	0	2	1.714	0.813
13	C	M	25	0.560	0.400	0.760	0.200	0.440	0.909	0.000	0	1	1.375	1.333
14	C	M	2	0.500	1.000	1.000	0.500	1.000	1.000	0.000	6	2	1.000	1.000
15	C	F	16	0.500	1.000	0.875	0.188	0.250	0.750	0.000	2	1	3.000	1.250
16	C	F	8	0.500	0.875	0.875	0.250	1.000	1.000	0.000	5	2	1.000	1.000
17	C	F	9	0.556	0.556	0.889	0.333	0.667	1.000	0.667	3	2	0.800	1.000
18	C	F	14	0.714	0.571	0.714	0.643	0.714	0.900	0.000	6	2	0.600	0.838
19	C	F	17	0.588	0.647	0.941	0.176	0.706	1.000	0.000	2	1	0.700	1.000
20	C	F	18	0.500	0.556	0.722	0.167	0.833	0.933	0.000	5	1	1.143	1.167
21	C	F	10	0.500	0.700	0.600	0.500	0.900	0.889	0.000	3	2	0.800	0.750

#	I	S	N	PC/N	PR/N	LC/N	LR/N	#R/N	#A/#R	#C/T	T	CH	RD	AD
22	C	F	8	0.500	1.000	0.625	0.500	1.000	1.000	0.000	4	2	1.000	1.000
23	C	F	26	0.500	0.769	0.500	0.231	0.731	0.658	0.000	4	2	0.900	1.204
24	C	F	14	0.500	1.000	0.857	0.214	0.857	0.833	0.000	1	1	1.000	1.000
25	C	F	7	0.571	0.857	1.000	0.143	1.000	1.000	0.200	5	2	1.000	1.000
26	C	F	42	0.762	0.167	0.667	0.071	0.190	0.375	0.000	6	1	0.521	0.300
27	C	F	38	0.500	0.895	1.000	0.026	0.474	0.889	0.000	2	1	1.250	0.800
28	C	F	20	0.450	0.350	1.000	0.050	0.800	1.000	0.000	1	1	1.222	1.000
29	N	M	24	0.583	0.583	0.042	0.083	0.542	0.615	0.500	2	2	0.833	0.857
30	N	M	25	0.760	0.240	0.560	0.080	0.520	0.885	1.000	5	2	1.053	1.425
31	N	M	18	0.389	0.444	0.944	0.167	0.556	0.600	1.000	2	1	1.048	0.300
32	N	M	47	0.553	0.277	1.000	0.021	0.511	1.000	1.000	5	1	1.131	1.000
33	N	M	17	0.706	0.176	0.176	0.235	0.706	0.917	1.000	5	1	0.833	0.875
34	N	M	45	0.778	0.378	0.733	0.044	0.511	0.826	0.000	1	1	1.357	1.123
35	N	M	13	0.538	0.308	1.000	0.077	0.615	1.000	0.000	1	1	0.857	1.000
36	N	M	8	0.625	0.750	1.000	0.125	0.500	0.500	0.000	5	2	0.600	1.000
37	N	M	33	0.970	0.061	1.000	0.030	0.606	0.900	1.000	2	2	0.594	0.895
38	N	M	4	1.000	0.250	1.000	0.250	0.750	1.000	1.000	3	1	0.750	0.500
39	N	M	50	0.360	0.400	1.000	0.020	0.380	0.974	1.000	5	1	2.444	0.955
40	N	M	28	0.393	0.500	1.000	0.036	0.643	0.778	0.625	8	1	1.382	0.694
41	N	M	50	0.420	0.460	0.400	0.220	0.320	0.813	1.000	2	2	1.381	1.167
42	N	M	23	0.609	0.261	0.435	0.174	0.652	0.933	0.800	5	2	0.964	1.200
43	N	F	16	0.500	0.563	0.750	0.270	0.688	0.909	0.154	13	2	1.750	0.857

#	I	S	N	PC/N	PR/N	LC/N	LR/N	#R/N	#A/#R	#C/T	T	CH	RD	AD
44	N	F	17	0.529	0.471	1.000	0.059	0.882	0.867	0.000	11	1	0.461	1.000
45	N	F	26	0.731	0.192	1.000	0.038	0.346	1.000	0.000	5	1	0.461	1.000
46	N	F	50	0.400	0.360	0.820	0.120	0.160	1.000	0.000	7	1	0.500	1.000
47	N	F	50	0.380	0.540	1.000	0.020	0.140	0.429	1.000	1	2	1.224	0.000
48	N	F	31	0.516	0.323	0.871	0.097	0.516	0.688	0.545	11	1	1.205	0.933
49	N	F	11	0.545	0.818	0.909	0.273	0.636	1.000	0.333	6	1	1.111	1.000
50	N	F	6	0.500	0.833	0.833	0.500	1.000	0.833	0.000	2	2	1.000	1.000
51	N	F	21	0.571	0.905	0.667	0.190	0.429	1.000	0.500	2	1	1.500	1.000
52	N	F	15	0.600	0.533	1.000	0.067	0.533	0.750	0.800	5	2	0.667	1.000
53	N	F	20	0.550	0.500	0.700	0.300	0.450	0.778	0.500	2	2	1.636	1.250
54	N	F	21	0.619	0.429	0.952	0.143	0.381	0.750	1.000	2	1	1.846	1.667
55	N	F	9	0.667	0.556	0.889	0.222	0.667	0.833	1.000	6	2	1.000	0.750
56	N	F	25	0.640	0.520	1.000	0.040	0.720	0.917	0.500	2	1	1.125	0.875

VITA

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Place of Birth: VICTORIA, B.C. | Date of Birth: JULY 9, 1951

Educational Institutions Attended, with Dates of Entering and Leaving:

UNIVERSITY OF VICTORIA, VICTORIA	1968 to 1972
VANCOUVER SCHOOL OF THEOLOGY, VANCOUVER	1972 to 1974
UNIVERSITY OF VICTORIA, VICTORIA	1974 to 1976

Degrees, Diplomas, Etc., Awarded, with Dates and Names of Institutions:

B.Sc. (Honours)	1972	University of Victoria

Honours and Awards:

B.C. Psychological Association Student Research Award, 1972

V.S.T. Auxiliary Scholarship, 1973

The Percy Jex Memorial Prize in New Testament Greek, 1973

The Korean United Church Scholarship in the Philosophy of Religion, 1973

The Dr. Gladys Storey Cunningham Bursary, 1973

The Canadian Memorial United Church Scholarship, 1974

The Frank E. Anfield Memorial Prize in Old Testament Prophets, 1974

The Sir Anthony Musgrave Memorial Prize in Early Church History, 1974

The Denny Scholarship in Practical Theology, 1974

University of Victoria Fellowship, 1974/75

Canada Council Doctoral Fellowship, 1975/76

Publications:

Bavelas, J. B., Chan, A. S., & Guthrie, J. A. Reliability and validity of traits measured by Kelly's Repertory Grid. _Canadian Journal of Behavioural Science_, 1976, _8_, 23-38.